

## POPULATION GROWTH IN ERBIL GOVERNORATE AND WATER CONSUMPTION. A CASE STUDY

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### ABSTRACT

Erbil Governorate is one of four governorates in the Kurdistan Region of Iraq, it is the capital of the region. Different data about the population and water consumption in Erbil Governorate and those of Erbil City were reviewed to write the current article. The coverage area of the governorate is 14,872 km<sup>2</sup>, whereas that of Erbil City is 1131.44 km<sup>2</sup>. The population in the governorate is 1,763,351, whereas in Erbil City is 897,000, and the growth rate from the last year is 2.16%. The water consumption in Erbil Governorate is 425,708,200 l/ day, whereas that of Erbil City is 253,800,000 l/ day. Different sources; however, reported different data about the population and water consumption. Some of the reported data showed large differences in the population and water consumption leading to large discrepancies. All those discrepancies are discussed and relevant results are presented.

**KEYWORDS:** Erbil; coverage area; population; water consumption; water scarcity.

### 1. INTRODUCTION

Erbil Governorate is bounded by two rivers, the Greater (Upper) Zab from the west and partly by the Lesser (Lower) Zab from the east. Moreover, there are many other perennial streams like Shamdinan, Rawanduz, Shaqlawa, Hiran, Bastoora, and many intermittent streams like Shewa Sur, Fatmah Khan, Ainkawa, Peer Rash, Shalgha ...etc (Fig. 1). The majority of these rivers and streams drain to the Greater Zab River feeding the river with large amounts of fresh water. Therefore, the Ministry of Agriculture and Water in the Kurdistan Regional Government (KRG) has planned to construct many dams of different sizes and purposes to utilize the saved water in the reservoirs during the drought months.

The data used in the compilation of the Hydrogeological maps of Iraq belongs to 2012

(Al-Basrawi and Al-Jiburi, 2015). It is worth mentioning that the groundwater level is the most changed data, especially in Erbil Plain. The groundwater level is lowered to a range of (20 – 50) m, and locally more. This is attributed to the over-pumping of water from drilled water wells for agricultural activities and a decrease in the rainfall amount. Other hydrogeological parameters are almost the same as presented on the map. Table (1) is a summary of the hydrogeological parameters of Erbil Governorate.

The current research aims to elucidate the increase in population at Erbil Governorate and Erbil City, and accordingly, the increase in water consumption during the last few years. Moreover, it shows the percentage of the consumed water supplied by Ifraz water treatment plants and the drilled water wells. Besides, indicating the consumed amounts of water by tourists.

**Table( 1):-**Main hydrogeological parameters of Erbil Governorate (From Al-Basrawi and Al-Jiburi, 2025)

No.	Area	Aquifer Rock Types	Groundwater Depth (m)	Transmissivity (m <sup>2</sup> / day)	Salinity of Groundwater (mg/l)	T.D.S. (mg/l)
1	Highly Mountainous	Mainly Sedimentary rocks with igneous and metamorphic rocks	10 - 40	18.3 - 209	Freshwater (< 500)	64 - 307
2	Flat	Clay, sand, and gravel	40 - 60	49 - 276	Freshwater (Less than 1000)	164 - 260
3	Upper	Clay, sand, and gravel with secondary gypsum	60 -100	58 - 442	Slightly Brackish Water (1000 -3000)	1030 - 2980
	Lower	Limestone, marl, and gypsum	60 - 100	46 - 442	Brackish Water (3000-10000)	4540 - 9980

## 2. MATERIALS AND METHODS

The current article is conducted based on different data, which mainly are acquired from the internet, postgraduate theses, and published articles. The acquired data are sorted and arranged in different tables based on different sources. It is noted that different sources have reported different data about the same aspect, for example, the number of inhabitants living in Erbil Governorate and Erbil City, and accordingly, the consumed water amounts during different years. Such ambiguities remained unsolved because all used data are officially published and/ or reported; therefore, it is

difficult to ascertain which data is more accurate.

## 3. POPULATION OF ERBIL GOVERNORATE AND ERBIL CITY

Data about the population of the Erbil Governorate and that of Erbil City are quoted from the Internet. For the governorate, the population was 1,713,461 in 2009 and for Erbil city was 792,981 (Internet data, 2023 a, Table 2). However, in 2020, the population of the Erbil Governorate was 2,932,800 (Table 3) (Krs Net, 2020). According to another source (Internet data, 2023, b), the population in Erbil Governorate was 1,763,351 (Table 3).

**Table( 2):-** The population of Erbil Governorate in 2009 (Internet Data, 2023a)

No.	District	Population	No.	District	Population
1	Erbil	792,981	6	Koya	95,246
2	Dashti Hewler	186,346	7	Khabat	93,442
3	Makhmour	173,801	8	Mergasur	44,661
4	Soran	154,945	9	Choman	23,730
5	Shaqlawā	124,628	10	Rawanduz	21,280
Total		1,711,070			

It can be noted from the data presented in Table (3) that there is a big difference in the presented population data by different sources,

especially in the year 2020. For Erbil City, the population during 2020 – 2023 is presented in Table (4).

**Table( 3):-** Number of people living in urban and rural areas in the Erbil Governorate

No.	Source	Year	Population	Urban (76%)	Rural (24%)
1	EGP (2023)	2023	2,432,324	1,848,566	583,758
2	Kasro Net (2023)	2020	2,932,800	2,228,928	703,872
3	Internet data (2023a)	2009	1,711,070	1,300,413	410,657

**Table( 4):-** Population in Erbil city during the last four years (Internet data, 2023 c)

No.	Year	Population	Increase (%)
1	2020	846000	1.56
2	2021	861000	1.77
3	2022	878000	1.97
4	2023	897000	2.16

### 3. WATER CONSUMPTION

The consumption of drinking water in the Kurdistan Region of Iraq (KRI) exceeds international standards (Kurdistan 24, 2023). The per capita quantity of drinking water consumed in the KRI exceeds international standards (Ministry of Municipalities and Tourism). According to international standards, only 250 liters of drinking water per day is needed for one person. While the KRI, the daily production of drinking water per person is 300 liters to 350 liters (Kurdistan 24, 2023).

#### 4.1. Erbil Governorate

We have considered the data mentioned by Kurdistan 24 (2023) to estimate the consumed drinking water based on the mentioned populations by different sources (Table 3). However, we have assumed that the per capita water consumption is lower in rural areas. Therefore, we have considered 200 liters/ day/ person in rural areas, whereas, for urban areas, we considered 300 liters/ day/ person. The results are shown in Table (5). However, it is believed that these numbers are exaggerated.

**Table (5):-**Total consumed water in urban and rural areas at the Erbil Governorate (For the sources of the population, refer to Table 3)

No.	Year	Population	Urban (76%) (300 l/day)	Total consumed water (l/ day)	Rural (24%) (200 l/day)	Total consumed water (l/ day)	Total consumed water	
							l/ day	m3 /year
1	2023	2,432,324	1,848,566	554,569,800	583,758	116,751,600	671,321,400	245,032,311
2	2022	2,055, 448	1,562,141	468,642,300	493,307	98,662,400	567,304,700	207,066,216
3	2020	2,932,800	2,228,928	6,879,840,000	703,872	140,774,400	7,020,614,400	2,562,524,000
4	2009	1,711,070	1,300,413	390,123,900	410,657	82,131,400	472,255,300	172,373,000

#### 4.2. Erbil City

The estimated population of Erbil City is also problematic. Different sources have estimated different populations at different years. The found data based on the Internet (2023 d) are

presented in Tables (6 and 7). It was assumed 300 l/day/capita for water consumption in Erbil City (Kurdistan 24, 2023), accordingly, the total consumed water per day per year is presented in Table (7).

**Table (6):-** Population in Erbil City during the last four years (Internet data, 2023 c)

No.	Year	Population	Increase (%)
1	2020	846000	1.56
2	2021	861000	1.77
3	2022	878000	1.97
4	2023	897000	2.16

**Table( 7):-** Number of people living in Erbil City and consumed water quantities

No.	Source	Year	Population	Water Consumption	
				l/ day	m3/ year
1	Internet data (2023d)	2023	1,612,700	483,810,000	176,590,650
2	Macrotrends (2023)	2023	897,000	269,100,000	98,221,500
3		2022	878,000	263,400,000	96,141,000
4		2021	861,000	258,300,000	94,279,500
5		2020	846,000	253,800,000	92,637,000

Mahmood and Omer (2019) estimated the consumed water in Erbil City from 2014 – 2018 with different data, which are presented in Table

(8). We assumed the daily water consumption of 300 l/day per capita and found the population in Erbil City as presented in Table (8).

**Table (8) :-**Water Consumption and population data in Erbil City (2014 – 2018) (From Mahmood and Omer, 2019)

No.	Year	Total consumed water		Estimated Population
		m3 / year	l/ day	
1	2014	139,036,720	380,922,521	1,269,742
2	2015	143,472,095	393,074,233	1,310,247
3	2016	158,069,446	433,066,975	1,443,557
4	2017	164,331,177	450,222,403	1,500,741
5	2018	172,252,910	471,925,781	1,573,086

### 4.3 Tourism

Tourists pay a visit to Erbil Governorate usually as tourist groups arriving from different cities and towns of Iraq and rarely from abroad. Although there are no sound data about the visits, we have found relevant data on the Internet.

The number of tourists in 2022 in Erbil Governorate was 2,752,000 tourists (KRG, 2023), with a 35 % increase from the year 2021. Among them, 671,146 tourists visited in the first four months of 2022 (Rudaw, 2023). Whereas in 2021 the number was 1,971,522 tourists (BaseNews, 2021). It is worth mentioning that on the 2023 New Year occasion, 61,658 tourists visited Erbil Governorate (Iraq Business News, 2023).

Tourists who visit Erbil Governorate are

mainly located in hotels, motels, and other Sumer resorts at the main touristic locations, therefore, the consumed water amounts are related to where they have been located. It was assumed that the water consumption per capita is not 300 liters per day (Kurdistan 24, 2023), but 200 l/ day per capita. This is attributed to the fact that the tourists spend their visits out of hotels and other touristic accommodations; therefore, they use less water amounts than the people living in Erbil City. However, it was estimated the water consumption by the tourists assuming different durations; since there is no sound data for the spent duration by the tourists. The results are presented in Table (9). The majority of them spent 4 – 7 days, and occasionally they travel out of Erbil Governorate to neighboring Sulaymaniyah and Duhok governorates.

**Table( 9):-** Estimated amount of consumed water by tourists during 2021 and 2022

Assumed Duration (Days)	Year/ Source	Number of tourists	Water Consumption (l/day)	Total water consumption (m3/ year)
4	2022/ KRG (2023)	2,752,000	200	2,201,600
7				3,852,800
10				5,504,000
4	2021/ Basnews (2021)	1,971,522	200	1,577,218
7				2,760,131
10				3,943,044

### 5. Supplied Water to Erbil Governorate and Erbil City

The sources of the supplied water to Erbil

City are: 1) Ifraz water treatment plants (Ifrac 1, 2, and 3), and 2) Groundwater wells. The amounts of pumped water from Ifraz water

treatment plants are presented in Table (10) based on Aziz and Mustafa (2022). Whereas,

other cities and towns within the governorate have their water treatment plants.

**Table (10):-** Amounts of pumped water in three water plants in 2020 (From Aziz, and Mustafa, 2022)

No	Water Plant	Constructed year	Discharge (m <sup>3</sup> / day)	Discharge (m <sup>3</sup> / year)
1	Ifraz 1	1968	34,000	12,410,000
2	Ifraz 2	1983	44,000	16,060,000
3	Ifraz 3	2007	216,000	78,840,000
Total			294,000	107,310,000

According to Aziz and Mustafa (2022), groundwater is one of the main sources of water in Erbil City. There are 1100 water wells in Erbil City (General Directorate of Water and Sewerage in Kurdistan Region-Iraq, 2020 in Aziz and Mustafa, 2022). The water wells data are:

- The estimated rate of good drainage for each well = 25 m<sup>3</sup>/hr.
- The average number of operating hours for each well = 15 hours
- The produced water from wells = 412,500 m<sup>3</sup>/day.

When we add the amount of pumped water from Ifraz water plants (Table 10), then the total amount of water available in Erbil City in 2020 will be 706,500 m<sup>3</sup>/day. The rate of losses is about (15 %) (General Directorate of Water and

Sewerage in Kurdistan Region-Iraq, 2020, in Aziz and Mustafa, 2022). Thus, the remaining net quantity (85 %) is 600,525 m<sup>3</sup>/day.

The average daily water consumption in Erbil City is nearly 380 liters/person/day (General Directorate of Water and Sewerage in Kurdistan Region-Iraq, 2020 in Aziz and Mustafa, 2022).

The percentage of domestic wells represents 40 % of the water supply system in Erbil City. Mostly, Erbil City uses groundwater for irrigation, industrial, and other daily activities (Wali and Alwan, 2016).

When considering the estimated percentage of water usage from domestic wells as 40 % (Wali and Alwan, 2016), then the total amount of required water for the population of Erbil City will be enormous (Table 11), and again we believe these data are highly exaggerated.

**Table( 11):-** Total quantities of required water for the population of Erbil City

No.	Source	Year	Water Consumption (m <sup>3</sup> / year)		
			From Ifraz plants	From wells	Total
			60 %	40 %	
1	Internet data (2023 e)	2023	176,590,650	70,636,260	247,226,910
2	Macrotrends (2023)	2023	98,221,500	39,288,600	137,510,100
3		2022	96,141,000	38,456,400	134,597,400
4		2021	94,279,500	37,711,800	131,991,300
5		2020	92,637,000	37,054,800	129,691,800

The estimated consumed water in the Erbil Governorate is obscure because no relevant data was found; hitherto. However, it was used the

population data to estimate the consumed water in 2022 in the governorate. It was considered 300 l/ day/ person in Erbil City (Kurdistan 24,

2023), 200 l/day/person in rural areas, and 200 l/day/ per tourist. The total amount of consumed water is presented in Table (12).

**Table (12):-** Total estimated consumed water at the Erbil Governorate

No.	Year	Population of Erbil Governorate	Consumed Water (m <sup>3</sup> / year)	Consumed water by tourists (m <sup>3</sup> /year)	Total consumed water (m <sup>3</sup> /year)
1	2023	2,432,324	245,032,311	1,600,000*	246,632,311
2	2022	2,055, 448	207,066,216	3,852,800	210,649,016
2	2020	2,932,800	2,562,524,000	2,760,131	256,5284,131

\* For the First three months only

## 5. DISCUSSION

The presented data about the population in Erbil Governorate and Erbil City and the consumed amount of water during many years showed that different sources reported different data. Therefore, it is not easy to estimate the consumed amounts of water in the Erbil Governorate and/ or in the city. Tables (2-7, 11, and 12) show such data, which are not unified. For example, in 2023, the population of Erbil City is reported to be 1,612,700 and 897,000 (ESTA, 2023, KasroNet, 2023, respectively). Such data will lead to misleading amounts of consumed water not only in Erbil Citu but in Erbil Governorate. It is worth mentioning that even in the whole Kurdistan Region of Iraq such data are not unified.

Such not unified data is not concerned only with the population that leads to strange amounts of consumed water but it deals with the percentage of the supplied amounts of the groundwater and those pumped from Ifraz water treatment plants. According to Wali and Alwan (2016), the percentage of the used groundwater in Erbil city is 40%, whereas according to BaseNews (2023), the amount is 65%. Unfortunately, no data is available about the amounts of the pumped groundwater. However, according to Aziz and Mustafa (2022), there

were 1,100 water wells in Erbic City in 2020 and the amount of pumped water was estimated to be 412,500 m<sup>3</sup>/ day. If we consider that the number of water wells is increased by 15%, then the number of water wells will be 1,265 wells. Accordingly, the amount of pumped water from the water wells will be 474,375 m<sup>3</sup>/ day and 173,146,875 m<sup>3</sup>/ year. And when we add the amount of supplied water by Ifraz water plants in 2020 (107,310, 000 m<sup>3</sup>/year, Table 10) to those supplied by water wells, then the total amount of supplied water to Erbil city will be 280, 456,875 m<sup>3</sup>/ year. This is almost the double amount of the estimated supplied water to Erbil City, which is 129,691,800 m<sup>3</sup>/ year (Table 11). It is worth mentioning that the annual discharge of the Greater Zab River in 2018 was 12,700,000,000 m<sup>3</sup> (Al-Ansari et al., 2018).

Another ambiguity is the consumed water per capita per day. According to Kurdistan 24 (2023), the daily consumption is 300 liters to 350 liters. However, according to the General Directorate of Water and Sewerage in Kurdistan Region-Iraq, 2020 (in Aziz and Mustafa, 2022) is nearly 380 liters/person/day. These numbers are more than the international standards. In Europe, it is about 100 l/ day, in Germany, ranges between (100 – 220) l/ day, in the USA, it is more than 500 l/day (Visionwater, 2023).

## 6. CONCLUSIONS

The population of Erbil Governorate and Erbil City in 2022 was 2,055, 448, and 878,000, respectively, whereas the consumed water amounts were 210,649,016 m<sup>3</sup>/ year and 134,597,400 m<sup>3</sup>/ year, respectively. However, different sources have reported different data. The percentage of people living in urban and rural areas in Erbil Governorate is 76% and 24%, respectively. The sources of consumed water amount in Erbil City are Ifraz water treatment plants and drilled water wells (groundwater) with percentages of 60% and 40%, respectively. The produced water amounts from 1100 drilled water wells in 2022 in Erbil City was 412,500 m<sup>3</sup>/day, with 15 hours of pumping time for each well, which yields 375 m<sup>3</sup>/ hr. The average water consumption in Erbil City ranges between (300-350) l/ day/ person, whereas in rural areas it is 200 l/ day/person. The daily loss in the supplied water amounts from Ifraz water treatment plants is about 15%.

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