Quantity And Distribution Of The Current Surface And Ground Water Resources In Bahr An-Najaf In Iraq

Hassan Ali Omran, Mohammed Shaker Mahmood and Ali Abbas

Abstract— The hydrologic cycle describes the continuous movement of water above, on, and below the surface of the Earth. The issue of water is one of the most important matter due to a lack of water resources with hot and dry climate. Iraq is vulnerable because of its reliance degree up to 90 % on the water of the Tigris and Euphrates that originate from Turkey. This paper focuses on current and distribution of the surface and ground water resources in Bahr An-Najaf basin in Najaf, Iraq. The results indicate that the total volume of water quantity is about 180 Mm^3 with monthly variation. Surface water is about 77% of the total water volume and the groundwater is about 21%.

Index Terms— Euphrates; Najaf; Bahr An-Najaf; water resources; water resources management.

1 INTRODUCTION

THE water resources are sources of water that are useful or potentially useful. Uses of water in clude agricultural, industrial, household, recreational and environmental activities. The majority of human uses require fresh water. 97 percent of the water on the Earth is salt water and only three percent is fresh water; slightly over two thirds of this is frozen in glaciers and polar ice caps.[1]

The remaining unfrozen freshwater is found mainly as groundwater, with only a small fraction present above ground or in the air.[2]

Surface water is water in a river, lake or fresh water wetland. Surface water is naturally replenished by precipitation and naturally lost through discharge to the oceans, evaporation, evapotranspiration and sub-surface seepage. Although the only natural input to any surface water system is precipitation within its watershed, the total quantity of water in that system at any given time is also dependent on many other factors. These factors include storage capacity in lakes, wetlands and artificial reservoirs, the permeability of the soil beneath these storage bodies, the runoff characteristics of the land in the watershed, the timing of the precipitation and local evaporation rates. [3]

All of these factors also affect the proportions of water loss. Human activities can have a large and sometimes devastating impact on these factors. Humans often increase storage capacity by constructing reservoirs and decrease it by draining wetlands. Humans often increase runoff quantities and velocities by paving areas and channelizing stream flow.[4]

Sub-surface water, or groundwater, is fresh water located in the pore space of soil and rocks. It is also water that is flowing within aquifers below the water table. Sometimes it is useful to make a distinction between sub-surface water that is closely associated with surface water and deep sub-surface water in an aquifer (sometimes called "fossil water"). Sub-surface water can be thought of in the same terms as surface water: inputs, outputs and storage. The critical difference is that due to its slow rate of turnover, sub-surface water storage is generally much larger compared to inputs than it is for surface water. This difference makes it easy for humans to use sub-surface water unsustainably for a long time without severe consequences. Nevertheless, over the long term the average rate of seepage above a sub-surface water source is the upper bound for average consumption of water from that source. The natural input to sub-surface water is seepage from surface water. The natural outputs from sub-surface water are springs and seepage to the oceans.[5]

The total quantity of water available at any given time is an important consideration. Some human water users have an intermittent need for water. For example, many farms require large quantities of water in the spring, and no water at all in the winter. To supply such a farm with water, a surface water system may require a large storage capacity to collect water throughout the year and release it in a short period of time. Other users have a continuous need for water, such as a power plant that requires water for cooling. To supply such a power plant with water, a surface water system only needs enough storage capacity to fill in when average stream flow is below the power plant's need.[3]

There are several types of water resources in the Bahr An-Najaf area such as surface water represented by three canals, groundwater and surface runoff resulting from rainfall through the valleys in Bahr An-Najaf basin. The recent paper presents and discusses these different water resources.

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2 DATA RESOURCES & WORK METHODOLOGY

Data were collected from four maim sources are different Directorates of An Najaf governate, researches, laboratory tests and on-site visits. Data covered the information related to geology, topography, geomorphology, soil, meteorological, water resources, water consumptions, water quality and future estimated consumptions. The recent paper focuses on the presentation and discussion of the current ground and surface water in Bahr An Najaf in Iraq.

2.1 The Study Area

Bahr An-Najaf area is located in the south-west direction from the center of An-Najaf city on the right side of the main road between of An-Najaf city and the Al-Hirra city. [6]

Bahr An-Najaf area is located between longitudes 44° 11′ 34″ to 44° 22′ 37″ and latitudes 31° 47′ 11″ to 32° 04′ 08″ with area of 251 Km². It includes a lake with area of 48 Km² approximately, increase area in the rainy season and decrease in the summer period. [6 & 8]

The study area represents a natural extension of the alluvial plain in the form of the tongue extends across the western plateau from the south to the north side of the Al-Manathira city. [7]

Average ground level is about 25 m above sea level and the study area descends gradually from the west and south-west to the north and north-east. Figure (1) shows the location of study area in An-Najaf Al-Ashraf province and in Iraq.

2.2 Current Water Resources

Water resources include three canals, artesian and shallow groundwater wells, springs, reservoir and run-off in the catchment. These canals are Al-Sadeer, Abojedhoe'o and Al-Bederiya. There are 24 shallow wells and 34 artesian wells distributed on the study area. There are six springs distributed within the study area. In addition to rainfall.

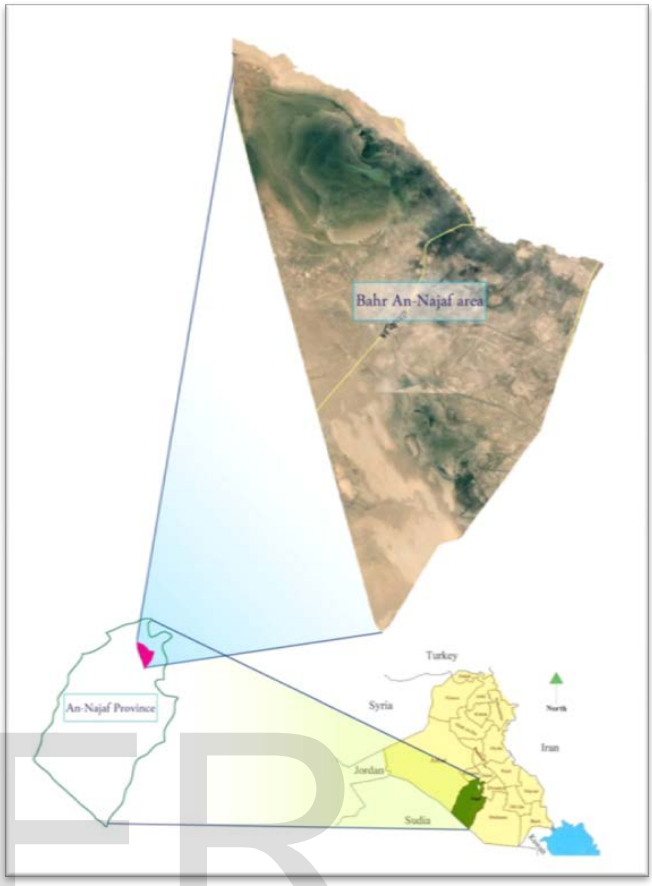

FIG. (1): The Location of Study Area in An-Najaf Province and in Iraq. [6]

3 RESULTS AND DISCUSSION

3.1 Rainfall

The rain on selected area is low and non-uniformly distributed along the year. [10] Precipitation occurs during fall, winter and spring seasons. The maximum monthly precipitation recorded was (17.6 mm) in November while four months from June to September in which rainfall zero as shown in Table (4-1). The Average annual summation of rainfall was (100.2 mm) during the period of (1981-2013). [11]

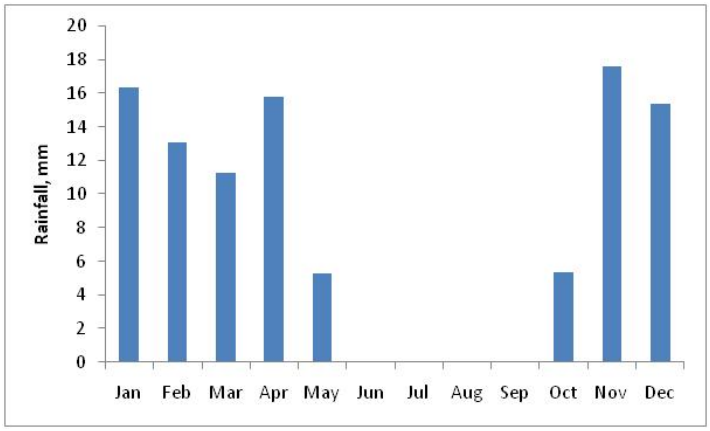

Figure (3): Average Rainfall in mm.

3.2 Canals

Euphrates river represents the main source of surface water in An-Najaf province and it is divided south Al-Kifl city (about 1 km) into two branches, first, Kufa river in the west and second, Abbasia river in the east. When Kufa river flows through Abosskhir city (16 km north Kufa city) is called Mashkhab river. Mashkhab river branched from right side, Juhat canal which, also, branched into three canals, Al-Sadeer, Abojedhoe'o and Al-Bederiya. These three canals are the surface water resource in Bahr An Najaf. [12]

All three canals are unlined and branched from the right side of Juhat toward northwest. There is A regulator of two gates on each canal to regulate the water flow. Through 2013, the average discharge of Al-Sadeer canal is 1.68 m3/sec while the average discharge of Abojedhoe'o canal is 1.33 m3/sec and the average discharge of Al-Bederiya canal is 1.4 m3/sec, as in

Table (1). Figure (4) shows canals of study area with its monthly discharge depending on collected data. The maximum discharge is within the summer time corresponding to agriculture activities. Plate(1) presents the rivers of Al-Sadeer and Al-Bederiya. Figure (5) show the path of the three canals. [12]

Table (1): Monthly Discharges of Study Area Canals

Month	Discharge of Canals (m^3/sec)		
	Al-Sadeer	Abojedhoe'o	Al-Bederiya
Jan	1.05	0.89	0.87
Feb	1.49	1.04	1.16
Mar	1.32	0.95	1.08
Apr	1.3	1.03	1.07
May	1.2	0.82	1.2
Jun	2.29	1.71	1.82
Jul	2.6	2.06	2.06
Aug	2.21	1.86	1.87
Sep	2.11	1.71	1.69
Oct	1.74	1.56	1.48
Nov	1.63	1.41	1.5
Dec	1.22	0.87	0.95

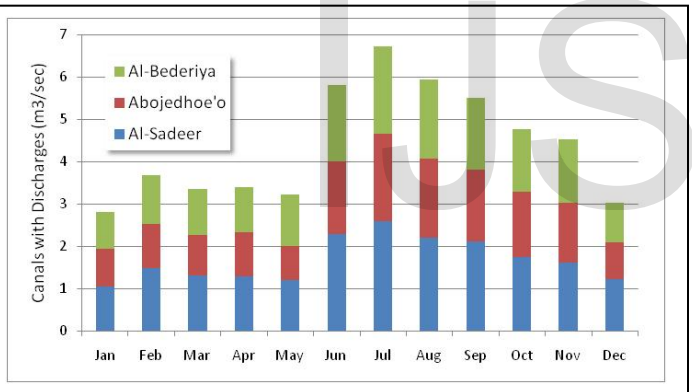

FIG. (4) : Monthly Discharges of Study Area Canals.

3.3 Wells

The study area contains number of wells and are considered the main source of water recourses especially toward west of the study area and are into two types, first, artesian and the second, shallow. These data were collected from the Directorate of wells and groundwater of An-Najaf province. Table (2) illustrates the type and discharge of the wells.

Artesian wells have relatively large discharge not less than 30 (l/sec) and shallow wells have low discharge not more than 10 (l/sec), generally the discharge of wells in the study area classified within (600-3600) (l / min) discharge zone [13] and sum of discharge of wells of the study area reach to 1.244 (m3/sec). [14]

3.4 Springs

The other type of underground water resources is springs, which due to the existence of cracks and faults in aquifers appears naturally on the surface. There are six springs within study area as shown in Table (3) and sum of discharge of this springs reach to 0.05 m3/sec. [15]

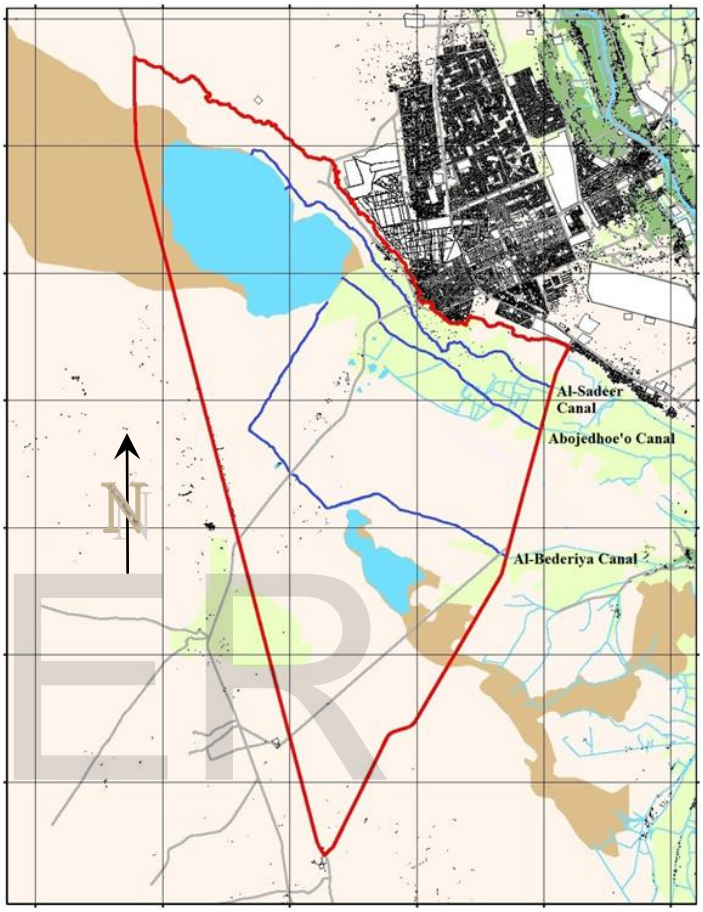

Figure (5): Three Canals of Study Area and Its Path.

Al-Sadeer Canal. Al-Bederiya Canal.

Plate (1): Al-Sadeer & Al-Bederiya Canal in Study Area.

Table (2): Wells of Study Area with its discharges and types.

Well No.	Q (m^3/sec)	Well type	Well No.	Q (m^3/sec)	Well type
1	0.007	Shallow	30	0.033	Artesian
2	0.006	Shallow	31	0.03	Artesian
3	0.007	Shallow	32	0.033	Artesian
4	0.005	Shallow	33	0.015	Artesian
5	0.007	Shallow	34	0.033	Artesian
6	0.004	Shallow	35	0.035	Artesian
7	0.007	Shallow	36	0.033	Artesian
8	0.009	Shallow	37	0.033	Artesian
9	0.009	Shallow	38	0.033	Artesian
10	0.007	Shallow	39	0.033	Artesian
11	0.01	Shallow	40	0.033	Artesian
12	0.007	Shallow	41	0.033	Artesian
13	0.009	Shallow	42	0.02	Artesian
14	0.007	Shallow	43	0.033	Artesian
15	0.008	Shallow	44	0.033	Artesian
16	0.008	Shallow	45	0.03	Artesian
17	0.005	Shallow	46	0.033	Artesian
18	0.005	Shallow	47	0.033	Artesian
19	0.007	Shallow	48	0.033	Artesian
20	0.007	Shallow	49	0.035	Artesian
21	0.004	Shallow	50	0.03	Artesian
22	0.01	Shallow	51	0.03	Artesian
23	0.009	Shallow	52	0.033	Artesian
24	0.008	Shallow	53	0.035	Artesian
25	0.03	Artesian	54	0.03	Artesian
26	0.033	Artesian	55	0.033	Artesian
27	0.03	Artesian	56	0.033	Artesian
28	0.03	Artesian	57	0.033	Artesian
29	0.035	Artesian	58	0.03	Artesian

Table (3): Springs of Study Area with its Discharge. [15]

Spring name	Q (lit/sec)	Spring name	Q (lit/sec)
Al-Ghariba	6	Ghal'et muslim	14.1
Al-Rohban	12.6	Hezbaneh	6.3
Said sa'id	8	Al-Jarthamy	3.1

4 DISTRIBUTION OF THE CURRENT WATER RESOURCES

Figure (1) illustrates the distribution of the current water resources, surface and ground. One can notice that the most of water resources are exist in the southern east of the basin. This situation helps to establish some producted farms and settlements.

For future development in the residential and agriculture fields, there is a need to manage these resources and finding additional new resources.

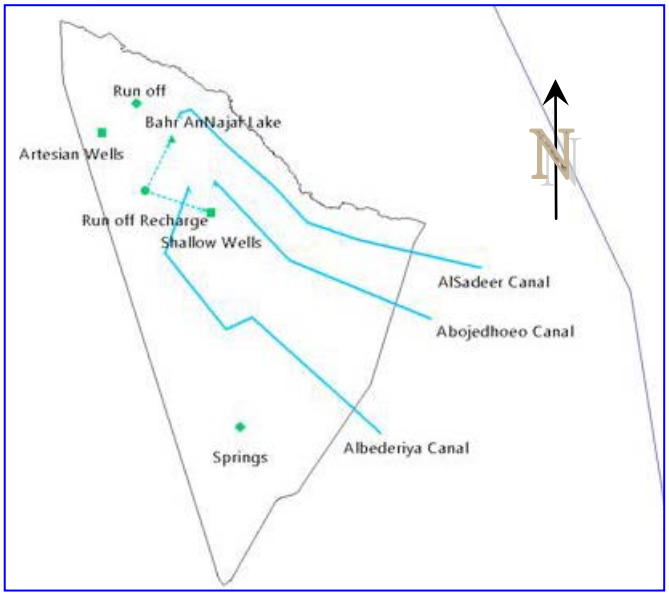

Figure (1): The Distribution of The Current Water Resources.

5 CONCLUSION

Currently there are two major types of water resources, first, usable water resource represented by water of canals, wells and the springs with total annual water quantity equal to 179.659 Mm3 and second unusable water resources that represented by runoff due to rainfall with total annual water quantity equal to 64.47 Mm3 and is considered unusable because of out of lack and irregular distribution over year where can't withdrawal water from quantity from it at needing time.

Three canals are considered the main and usable water resource currently in the study area that are Al-Sadeer, Abojedhoe'o and Al-Bederiya, the total annual amount of their water estimated 138.852 Mm3 and accounted for 77% of the total annual water recourses.

There are fifty eight wells in the study area and the total annual amount of their water estimated to will be 39.23 Mm3 (20%).

There are six springs in the study area and the total annual amount of their water estimated to will be 1.577 Mm3 (0.8%).

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REFERNCES

[1] Jam. S.K., and Singh. V.P., "Water Resources Systems Planning and Management" Developments in Water Science Elsevier Science London 2003, PP.766-789 Vol.51, First Edition

[2] Alfarra. A., "Modeling Water Resource Management in Lake Naivasha", Research released 2004, International Institute Geo-Information Science and Earth observation, Enscheda ,Netherlands,

PP14-49
[3] Kliot. N., "Water Resources and Conflict in the Middle East", Published in the Taylor & Francis e-Library London and New York, 2005.
[4] "Iraq water management assistance programme report", (2011), Water Policy and Management Commission, EU Union.
[5] Integrated management of water resources report", the World Summit on Sustainable Development, the United Nations, Johannesburg, 26 August - 4 September 2002 / (in Arabic)
[6] Al- Musawee A. S. T. (2003), Natural characteristics of the Bahr An-Najaf low, current reality and prospects of development. Journal of Najafi's Studies / Third Issue / Najaf / Iraq (in Arabic)
[7] Al- Musawee A. S. T. (2002) Optimal exploitation of water and agricultural land in the Bahr An-Najaf. Journal of the Geographical Society of the Iraqi / Issue 51/ Basrah /Iraq (in Arabic)
[8] Buringh P., (1960) "SOILS AND SOIL CONDITIONS IN IRAQ". Directorates General of Agricultural Research and Projects, Ministry of Agriculture, Iraq.
[9] General Commission of Survey / Baghdad / Iraq
[10] Al-Waely, M.F.A. (2004). "Climatic Water Budget In AL-Najaf Governorate Study In Applied Climatology". M.Sc. Thesis College of Arts, University Of Kufa
[11] General Authority for Iraqi Meteorology/ Baghdad / Iraq
[12] Directorate of Water Resources of An-Najaf Al-Ashraf province.
[13] Al-Chalabi M.K.O.(2002) "The special variations for water –resources characteristic in Najaf governorate" M.Sc. Thesis The College Of Arts University Of Kufa.(in Arabic)
[14] Directorate of Wells and Groundwater of An-Najaf Al-Ashraf province.
[15] AL-Zamily, A. J. H. (2007) "The Landforms Of Dissected Edges Of The Western Plateau Between The Two Lakes Razzaza And Sawa And Their Effects On Human Activities". Dissertation Doctor Of Philosophy In Geography Submitted To The College Of Arts University of Baghdad.
[16] Directorate of Sewages of An-Najaf Al-Ashraf province
[17] The Technical Report for the Planning and Urban Design for the New City of Najaf, March 2008, Republic of Iraq, Investment Commission