

A Study on Current Water Consumption and Its Distribution in Bahr An-Najaf in Iraq

Asst. Prof. Dr. Hassan Ali Omran¹, Asst. Prof. Dr. Mohammed Shaker Mahmood² and Ali Abbas Kadhem³

¹ Building and Construction Eng. Department, University of Technology, Baghdad, Iraq

² Civil Engineering Department, University of Kufa, An-Najaf, Iraq

³ Civil Engineering Department, University of Kufa, An-Najaf, Iraq

ABSTRACT

The demand for water in the developing world, of which the Middle East is a part. In Iraq, the water consumptions are divided for the different fields, mainly, irrigation, industry, domestic. By using the management of water resources, we can reduce the dependence on water releases from Tigris and Euphrates that originate in Turkey. This paper focuses on current water consumption and distribution in Bahr An-Najaf area (251 km²), Najaf, Iraq in the current state. The results indicate that the consumption of agriculture of crops is the highest, then residential and industrial consumption and the lowest water consumption is livestock drinking.

Keywords— Euphrates; Najaf; Bahr An-Najaf; water resources; water resources management.

1. Introduction

Water is a pivotal to our environment, influences and shapes the landscape. The sustenance of life, economic and social developments are not possible without sufficient water of right quality.^[1]

The demand for water in the developing world, of which the Middle East is a part, has grown significantly over the past thirty years, as the result of an accelerating population growth. In the Middle East the average annual population growth is currently 3% and, as a result, scarce water resources of the region are being severely drained since water for irrigation is competing with water needed for domestic and industrial use in the rapidly growing metropolitan areas.^[2]

It is estimated that 8% of worldwide water use is for household purposes.^[3] These include drinking water, bathing, cooking, sanitation, and gardening. Basic

household water requirements have been estimated by Peter Gleick at around 50 liters per person per day, excluding water for gardens. Drinking water is water that is of sufficiently high quality so that it can be consumed or used without risk of immediate or long term harm. Such water is commonly called potable water. In most developed countries, the water supplied to households, commerce and industry is all of drinking water standard even though only a very small proportion is actually consumed or used in food preparation.^[4]

It is estimated that 70% of worldwide water use is for irrigation, with 15-35% of irrigation withdrawals being unsustainable.^[2] It takes around 2,000 - 3,000 liters of water to produce enough food to satisfy one person's daily dietary need.^[4] This is a considerable amount, when compared to that required for drinking, which is between two and five liters. To produce food for the now over 7 billion people who inhabit the planet today requires the water that would fill a canal ten meters deep, 100 meters wide and 2100 kilometers long.

It is estimated that 22% of worldwide water is used in industry.^[3] Major industrial users include hydroelectric dams, thermoelectric power plants, which use water for cooling, ore and oil refineries, which use water in chemical processes, and manufacturing plants, which use water as a solvent. Water withdrawal can be very high for certain industries, but consumption is generally much lower than that of agriculture. Water is used in renewable power generation. Hydroelectric power derives energy from the force of water flowing downhill, driving a turbine connected to a generator. This hydroelectricity is a low-cost, non-polluting, renewable energy source. Significantly, hydroelectric power can also be used for load following unlike most renewable energy sources

which are intermittent. Ultimately, the energy in a hydroelectric power plant is supplied by the sun. Heat from the sun evaporates water, which condenses as rain in higher altitudes and flows downhill. Pumped plants also exist, which use grid electricity to pump water uphill when demand is low, and use the stored water to produce electricity when demand is high.

Recreational water use is usually a very small but growing percentage of total water use. Recreational water use is mostly tied to reservoirs. If a reservoir is kept fuller than it would otherwise be for recreation, then the water retained could be categorized as recreational usage. Release of water from a few reservoirs is also timed to enhance whitewater boating, which also could be considered a recreational usage. Other examples are anglers, water skiers, nature enthusiasts and swimmers.

In Iraq, the available water demands are mainly for agriculture, domestic and industrial uses. The recent paper is focusing on presentation and discussion of these water demands in Bahr An-Najaf area in Iraq.

2. Methodology of Work

Data were collected from four main 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.

2.1 The Selected 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. ^[5]

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. ^[5]

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. ^[6]

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. ^[6]

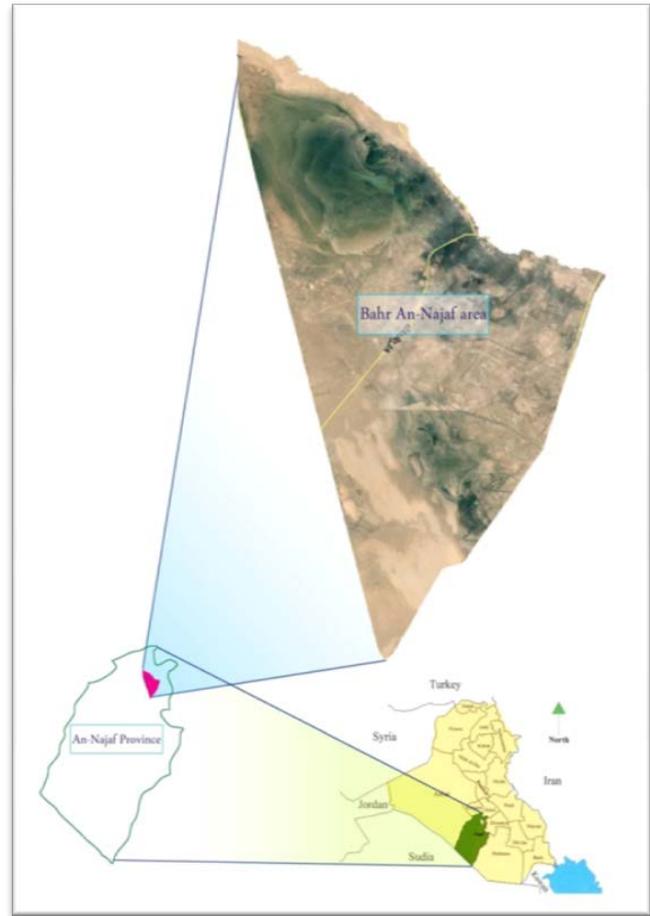


Figure (1): The Location of Study Area in An-Najaf Province and in Iraq. ^[6]

2.2 Land Cover Types

Using computer software ArcGIS (9.3) there are several types of cover of the earth's surface in the study area, including cultivated farmland or not, land covered with natural plants, barren land, buildings like houses or factories, a lake and temporary watershed. Table (1) presents the percentage of different land cover types.

2.3 Current Water Consumptions

Current demands represent kinds of consumptions for the current study area took from archive data of relevant directorates, its estimation or survey for year of study, 2013. There are three main types of water consumptions, agricultural, residential and industrial.

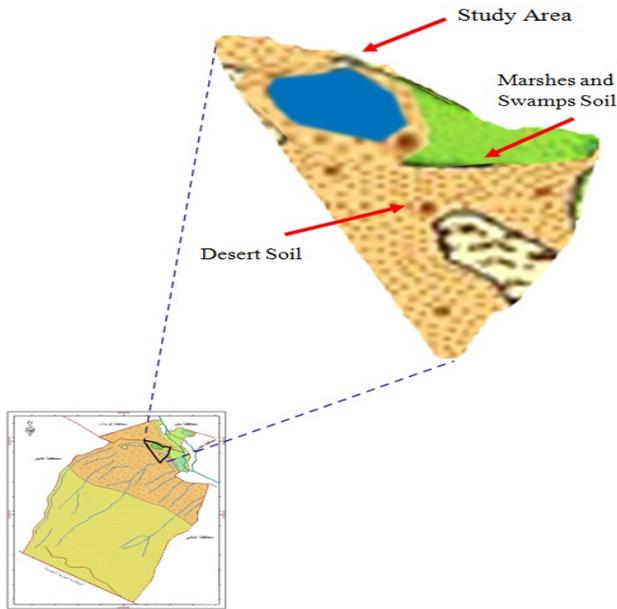


Figure (2): Type of Study area Soils and its Location. [7]

Table (1): Percentage of Different Land Cover Types.

Land Cover Types	Percent of Total Area (%)
Cultivated farmland	3.68
Farmland not Cultivated	13.05
Lands covered with natural plants	55.18
Buildings	0.19
Barren land	6.78
Lake	19.1
Temporary watershed	2

3. RESULTS AND DISCUSSION

3.1 Agriculture Irrigation Consumption

Agricultural sector represents the largest consumer of water in the study area due to the proportion of farmland in addition to the type of irrigation, which is a primitive and type of crop like rice or vegetables plantings, which consume large amounts of water and also due to the lack of rain and increasing the temperatures cause high evaporation.

Knowledge of water consumption for agricultural crops, the main pillar of the process of the administration of water resources in the field of agriculture, which is the biggest consumer of water.

Area of agricultural land in the study area are (16800) donem and cultivated them is (3700) donem, representing

22% of the land can be cultivated is actually exploited in agriculture Agricultural crops cultivated in the study area are wheat, barley, rice, palm and vegetables. [8]

It is worth mentioning that the rate of water consumption for irrigation influenced by several factors, including the growth stage of the crop will be like at the stage of maturity or weeding in addition to the effect of temperature, evaporation and rain. The quantity of agricultural irrigation consumption will discuss in Table (2) and Table (3).

Table (2): List of farmland planted in the study area. [8]

Crop	Cultivated area	Unit
Wheat	950	Donem
Barley	200	Donem
Rice(Cultivated after wheat and barley in the same farm)	1150	Donem
Palm	80000	Head
Vegetables	2150	Donem

Table (3): Monthly water consumption of crops in the study area per donem during the planting season. [9] [10]

Month	Wheat and Barley (m ³ /donem)	Rice (m ³ /donem)	Palm (m ³ /head)	Vegetables(m ³ /donem)
Jan	152.1	--	3.1	25
Feb	150.3	--	2.9	100
Mar	146.1	--	1.55	112.5
Apr	117	--	4.5	117.5
May	--	786	4.65	62.5
Jun	--	939	4.5	100
Jul	--	1127.8	3.1	125
Aug	--	964.2	3.1	87.5
Sep	--	575.33	3	50
Oct	180.6	225.75	3.1	25
Nov	199.8	--	1.5	365
Dec	183	--	1.55	200
Sum.	1129	4618.0	36.6	1370

3.2 Livestock Drinking Consumption

There are several kinds of Livestock in the study area, which consume water, represent in table (4), which was prepared from veterinary unit of Bahr An-Najaf and the quantity of livestock drinking consumption will discuss in same table.

Table (4): Livestock Kinds with its count and water consumption. [11][12]

Livestock	Head ^[11]	Average Daily Consumption(l/Day) ^[12]
Lactating Cattle	800	80
Beef Cattle	1300	80
Buffalo	2000	137
Camel	450	13
Sheep	7000	15
Goat	3000	5
Donkey	250	27
Horse	20	29



Plate (2): Livestock in the Study Area.



(A): Cultivated Farmland



(B): Not cultivated Farmland

Plate (1): Farmland of Study Area (A and B).

3.3 Domestic Water Consumption

Residents of the study area is currently about 3,000 families and the average number of family members is 7 people and distributed population of three major groupings are the first farm area adjacent to the channels of the three by the alignment of the river Al-Sadeer 1400 family and the alignment of the river Abojedhoe'o 400 families and alignment River Al-Bederiya 200 families and then secondly the Madhloom village with 700 families and Third factories of bricks and sand and gravel zone has 300 families

The average consumption of water per capita per year in of An-Najaf province is (93.588 m³) and shown in monthly variation in table (5).^[13]

Table (5): The average consumption of water per person per month during the year 2013 in An-Najaf province.^[13]

Month	Consumption (l/person/day)
Jan	108
Feb	121
Mar	189
Apr	276
May	339
Jun	377
Jul	399
Aug	372
Sep	316
Oct	253
Nov	188
Dec	130

3.4 Industrial Water Consumption

There are two types of industries that consume water with to the fact that the study area contains the raw materials for these industries with is the brick factory with the number of 10 in the study area in addition to the 5 factory

for the production of sand with gravel and Factories almost similar in the method of working and the amount of water consumption and production the same product.

3.4.1 Brick factory consumption

Has reached the amount of water consumption of the plant is one of the bricks up to 10 m³/day and equip this amount of wells completely and there are ten plants in the study area. Daily consumption of the warm months of March to October to turn after a month of November to February at a rate of one day of work every three days because of increased rainfall.

3.4.2 Sand and gravel factory consumption

Estimated has been the amount of water consumption up to 360 m³/day and develop this amount of wells in the form of fully collect the required amount of water within the basins along the day to consume during morning working hours. Daily consumption of the warm months from March to October to turn after a month of November to February at a rate of one day of work every five days because of the decrease of temperature and rainfall increase.

Total industrial water consumption during 2013 will be calculated in table (6).

Table (6): Industrial sector water consumptions of the study area during 2013.

Month	Total monthly consumption for brick Factories (m ³)	Total monthly consumption for Sand and Gravel Factories (m ³)
Jan	1,000	10,800
Feb	1,000	10,800
Mar	3,100	55,800
Apr	3,000	54,000
May	3,100	55,800
Jun	3,000	54,000
Jul	3,100	55,800
Aug	3,100	55,800
Sep	3,000	54,000
Oct	3,100	55,800
Nov	1,000	10,800
Dec	1,000	10,800
Sum.	28,500	484,200

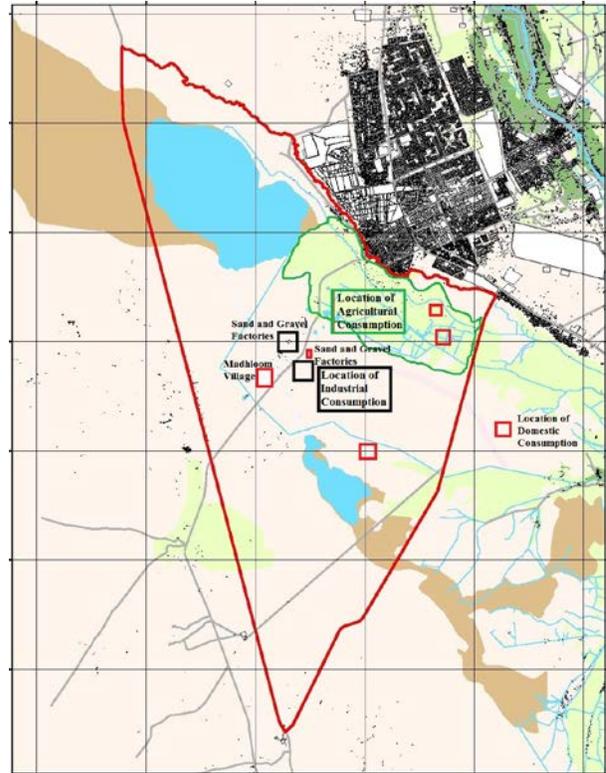


Fig (3): Location of Current Water Consumption.

4. CONCLUSION

The consumption of agriculture of crops is the highest (82%), then the residential (13%), then industrial consumption (4%) and the lowest water consumption is livestock drinking (1%), each sector water consumption percentage shown in fig.(4). The agriculture and domestic demands can increase within few years.

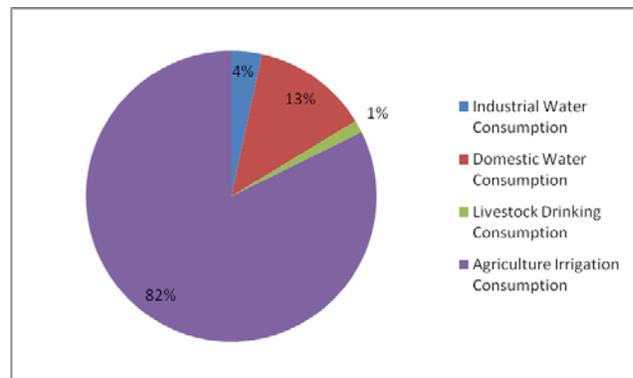


Figure (4): Percentage of Total Consumption for each Water Consumer Sector in the Study Area during 2013.

5. Recommendations

One can notice that there are need for water resources management to balance the water resources and demands for two states, current and future.

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