

Future Water Demand of Gaziantep Province Using Population Forecasting Method

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ABSTRACT

Population projections are necessary to estimate the future population by following the trend (increase) line. Population projections are significant for managing and planning the research area. This study aims to examine the water need and water consumption of Gaziantep province. In order to determine the future population of Gaziantep city, İlbank method was utilized in the calculations. Düzbağ Dam which is considered to supply drinking water to Gaziantep is not sufficient for close future and in order to supply water to city it is estimated that there will be need for new water resources. Therefore, state corporation should take required precautions.

Keywords: Gaziantep, water need, population, İlbank method

I. INTRODUCTION

One of the fundamental requirements of economic development depends on clean and sufficient water supply. Even if “75% of the Earth’s surface is covered with water”, this statement is misleading about water abundance in the world, only 1% of it is drinkable[1]. The reasons such as the rapid increase in world population, the overdevelopment of industry and technology and also not embracing or expanding environmental consciousness decently, cause to gradual decrease in drinking water quantity in the world [2]. Although Turkey is surrounded by water on three sides, it is located in an insufficient region in terms of drinkingwater resources. Besides, within climate change, groundwater resources and

surface water resources have been decreasing [3]. In order to determine the situation of water system and zoning, the study has started to conduct by Gaziantep Water and Sewerage Administration (GASKİ) and Gaziantep Province Zoning Report has been prepared [4]. Gaziantep province has meet water need from Kartalkaya Dam, Mizmilli waterwells and twenty deep-wellsin different location of the city.

II. MATERIAL AND METHOD

Material

In Figure 1, Şehitkâmil, Şahinbey and Oğuzeli districts under the responsibility of Gaziantep General Directorate of Water and Sewerage Administration (GASKI) has shown [5].



Figure 1. Districts of Gaziantep Province

In Figure 1, population results of three districts of Gaziantep province showed. Şahinbey, Oğuzeli, Şehitkamil are the main towns of Gaziantep province which are also responsibility area of GASKI(General Directorate of Water and Sewerage Administration).

Table 2. Population Census Results of Gaziantep city center

Year	Population
1965	187756
1970	253981
1975	327104
1980	402743
1985	509047
1990	636842

2000	893617
2007	1175042
2008	1235815
2009	1278676
2010	1324520
2011	1386052
2012	1522359
2013	1607885
2014	1702912
2015	1842368

According to records of GASKİ (2011-2015), water accrual values, water loss and water consumption rate have been shown in Table 4. These values were given in two groups as household and public.

Table 4. Water consumption of subscribers and values of water supply to city(2011-2015)

	2011	2012	2013	2014	2015
Water consumption of consumer (m ³)	29,908.787	32,198.304	34,540.124	37,630.857	42,550.220
Total amount of water consumption (m ³)	44,994.815	48,821.905	52,408.230	59,780.985	70,070.540
Total amount of water supply (m ³)	90,993.582	95,601.294	99,003.815	110,398.552	123,184.090
Water Loss (%)	49.4	51.06	52.9	54.1	56.8

III. METHOD

In order to determine household and drink water need of Gaziantep province, population census results of the city were compiled at first and then population projections belongs to target years in future were showed, then water need has been estimated [6]. By means of these population census results and methods of population estimation as shown below, population growth rate coefficients and population projections for target years in the future were estimated. İlbank method was utilized in the calculations.

□İlbank Method

$$\zeta = \left(a \sqrt{\frac{N_y}{N_e}} - 1 \right) 100 \quad (1)$$

In this formula, ζ symbolizes population growth rate (growth/increase) coefficient; a, period between two population year; N_y , population of

city in current population year and N_e , population of the city in previous population year.

$$N_g = N_y \left(1 + \frac{\zeta}{100} \right)^x \quad (2)$$

In this formula, N_g is population of the province in the future; x is period from last year in 2014 to the target year. And also, calculations have been made in accordance with arithmetic interest rate and compound interest rate methods.

Population of Gaziantep According to □İlbank Method

When the datas were calculated in accordance with İlbank method, the values were derived from calculations as shown in Table 7. R² was calculated as 0.9834; value of RMSE was found 41.169 people.

Table 7. Population forecasting according to Ilbank method

Year	TURKSTAT Population	In reference to 1960, (Ç) values	(Ç)max	Population in accordance with □ Ilbank method
1960	124097	-	-	-
1965	160012	5.21	3	-
1970	227652	6.25	3	206270
1975	300882	6.08	3	308259
1980	374290	5.67	3	404210
1985	473635	5.50	3	493253
1990	689848	5.88	3	619127
1995	832703	5.59	3	917958
2000	949559	5.21	3	1092959
2007	1190963	4.93	3	1355751
2008	1256384	4.94	3	1249668
2009	1299143	4.90	3	1318461
2010	1370598	4.92	3	1362922
2011	1397313	4.86	3	1438046
2012	1442059	4.83	3	1465250
2013	1501556	4.81	3	1511708
2014	1556381	4.79	3	1573879
2015	1626985	4.79	3	1631006

Population Projection and Water Need of Gaziantep city center

For population forecasting, it has seen that the most appropriate method for population forecasting is Ilbank method and population forecasting for the future has been made via this method. In calculations for Gaziantep province in 2015, it has seen that water consumption per person

is 105 lt/capi/day (70.070.540(total water consumption) /1.842.368 (population of city center) /365(days) =105 lt/capi/day). It has been utilized in calculations 225 liters water which is the daily water consumption value per person according to Ilbank estimation and population forecasting and water need until 2050 have shown in Table 9.

Table 9. For Gaziantep city center, population projection and estimated water need according to population of Gaziantep city center

Year	Estimated population according to Ilbank method	Estimated water need (m ³)
2016	1.326.775	108.961.437
2017	1.384.240	113.680.744
2018	1.444.194	118.604.453
2019	1.506.744	123.741.416
2020	1.572.004	129.100.869
2021	1.640.090	134.692.450
2022	1.711.125	140.526.212
2023	1.785.237	146.612.644
2024	1.862.559	152.962.690
2025	1.943.230	159.587.767
2026	2.027.394	166.499.788
2027	2.115.204	173.711.180
2028	2.206.817	181.234.910
2029	2.302.398	189.084.505
2030	2.402.119	197.274.081
2031	2.506.159	205.818.360
2032	2.614.705	214.732.708
2033	2.727.953	224.033.150
2034	2.846.105	233.736.412
2035	2.969.375	243.859.938
2036	3.097.983	254.421.931
2037	3.232.162	265.441.382

2038	3.372.153	276.938.105
2039	3.518.207	288.932.771
2040	3.670.586	301.446.946
2041	3.829.566	314.503.132
2042	3.995.431	328.124.804
2043	4.168.480	342.336.453
2044	4.349.024	357.163.634
2045	4.537.388	372.633.005
2046	4.733.910	388.772.382
2047	4.938.944	405.610.782
2048	5.152.858	423.178.483
2049	5.376.037	441.507.071
2050	5.608.882	460.629.501

Düzba □ Dam Water Capacity

It has planned that the Düzbağ Dam, which is considered to meet drinking and utility water needs of the city center of Gaziantep for the long term, is located 4 km away from the Kahramanmaraş - Helete (Düzbağ) town, on the Göksu River which is the tributary of the Euphrates River by DSİ. Estimated water need according to population forecasting has been taken into account in order to determine the water quantity which will be taken from the dam.

Even if the current total water supply flow rate is 6 m³/s(189 million m³), the actual water need of the city is 125 million m³. Pumping efficiency and working times have been adjusted in accordance with this efficiency. The water loss is also another important parameter for water demand

projection. It has been accepted that water loss rate is approximately 55 % in the current situation, until 2050 it will be reduced to about 30 %, thanks to improvements and zoning in the system. The 30% as water loss rate will be a significant standard in international norms for Gaziantep province.

When Kartalkaya Dam's flow rate which equals to 4 m³/s is considered, the flow rate of water conveyance is on the safe side. When the Düzbağ dam is started to using, the flow rate of water flow is 7.50 m³/sand 245.520.00 m³ water will be able to supply per year. The amount of water considered to be taken from the dam is given in Table 12. When Table 11 is examined, according to the current situation, it is necessary to operate the dam in 2020 and the dam will be sufficient until 2044.

Table 11. The water quantity from Düzbağ Dam according to population forecasting

Year	Estimated Water Need (m ³)	Water quantity from current water resources (m ³)	Estimated water quantity from dam (m ³)
2016	108.961.437	125.000.000	-
2017	113.680.744	125.000.000	-
2018	118.604.453	125.000.000	-
2019	123.741.416	125.000.000	-
2020	129.100.869	125.000.000	4.100.869
2021	134.692.450	125.000.000	9.692.450
2022	140.526.212	125.000.000	15.526.212
2023	146.612.644	125.000.000	21.612.644
2024	152.962.690	125.000.000	27.962.690
2025	159.587.767	125.000.000	34.587.767
2026	166.499.788	125.000.000	41.499.788
2027	173.711.180	125.000.000	48.711.180
2028	181.234.910	125.000.000	56.234.910
2029	189.084.505	125.000.000	64.084.505
2030	197.274.081	125.000.000	72.274.081
2031	205.818.360	125.000.000	80.818.360
2032	214.732.708	125.000.000	89.732.708
2033	224.033.150	125.000.000	99.033.150
2034	233.736.412	125.000.000	108.736.412
2035	243.859.938	125.000.000	118.859.938
2036	254.421.931	125.000.000	129.421.931

2037	265.441.382	125.000.000	140.441.382
2038	276.938.105	125.000.000	151.938.105
2039	288.932.771	125.000.000	163.932.771
2040	301.446.946	125.000.000	176.446.946
2041	314.503.132	125.000.000	189.503.132
2042	328.124.804	125.000.000	203.124.804
2043	342.336.453	125.000.000	217.336.453
2044	357.163.634	125.000.000	232.163.634
2045	372.633.005	125.000.000	247.633.005
2046	388.772.382	125.000.000	263.772.382
2047	405.610.782	125.000.000	280.610.782
2048	423.178.483	125.000.000	298.178.483
2049	441.507.071	125.000.000	316.507.071
2050	460.629.501	125.000.000	335.629.501

IV. CONCLUSION

For Gaziantep province, the method in which the trend of population is best observed was investigated and Ilbank method has been applied, and this analysis method has been used in the population estimation. Estimated water demand in the target year of projection has been calculated as 460.629.501 m³ according to the population of 2050 and the water consumption per capita of Ilbank (225lt / person). The water loss in distribution line rate 30% was added to water consumption which has been calculated for the upcoming years and the consumption-based water need has been calculated. The water need of Gaziantep has been met from Kartalkaya Dam, Mizmilli water-wells and water-wells in inner city and approximately 125.000.000 m³ water has been supplied to city from these resources per year. It can be said that the current resources and Düzbağ Dam will be insufficient in long term. The Düzbağ dam, which will be built in Helete town of Çağlayancerit district in Kahramanmaraş province, makes it possible to supply water with gravity flow and zero energy cost makes this project positive. But, this water supply will no longer meet the growing population need in the future. It will be inevitable that as a safe recourse will be considered to meet water need and similar needs of increasing population. This situation should be examined by notably by companies related to development of city sources.

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