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Assess the Impact of Drought on Quantity of the Resources Groundwater Abhar Plain

[1]Homayoon Moghimi, [2]Shokat Moghimi and [3]Omosalameh Babaee Fine

[1]*Assistant Professor, Department of Geology, Payam Noor University, Tehran, Iran.*
[2]*Assistant Professor, Department of Geography, Islamic Azad University Tehran Central branch.*
[3]*Assistant Professor, Department of Geography, Payam Noor University, Tehran, Iran.*

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ABSTRACT

Abhar plain of the biggest agricultural of Zanjan province and agricultural pole considered. The growing population in recent decades, the social and economic development, Agricultural boom in the region and also, Small and Medium Industry Development in Abhar plain, Increased use of underground water resources in the region. Therefore, the aim of this research was to evaluate Reaction of groundwater droughts in different periods according to the characteristics of severity and duration of dry periods. In this research climate data, hydrometer and Statistics, 39 observation wells in the basin plain Abhar during the period 1992 to 2008 are used. The period of occurrence, duration and severity of drought in the basin was calculated using the SPI. Furthermore, changes Groundwater in relation to periods Reviews drought and unit hydrograph was drawn. Results showed an average decline the water level is one meter per year. Drawing unit hydrograph and Thiessen Network shows that the decline Groundwater, In addition to the intensity and duration of drought, human factors such as population growth, increasing the level of development of agro-industries has had a large role in the decline quantity of groundwater.

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INTRODUCTION

The occurrence of frequent and prolonged droughts climate is one of the main causes of water shortages, particularly surface water resources that enter the double pressure on groundwater resources. Meteorological drought is associated with a delay in one place leads to hydrological drought that this time delay increases in groundwater hydrology [5]. Drought is a slow phenomenon, crawlers, complicated by the wide range that influenced greatly the lives of plants, animals and humans, which is why it is important to consider natural hazards. Its effects are not limited to arid and semi-arid areas, but also occur in moist areas and are causing water shortages [23,10,13]. Drought is the exact meaning of the reduced precipitation in a range of specific climate zones specified on a long-term average rainfall over the same area at the same interval [6]. In fact, drought occurs when water will greatly reduce the time and place [12]. Drought is natural hazard events that are very harmful effects on ecological environment into it. The scientific study of the natural hazard planning is one of the basic needs of agriculture and water resources in arid and semi-arid climates [9]. Wallen [21] concluded with a review of climatic, hydrological and farming drought in Australia and its relationship with the Middle East agriculture that water balance study is realistic to assess the drought. Rouault and Richard [20] by using SPI spatial extension and severity of drought in southern Africa during the periods of 3, 6 and 12-month investigate and found that this index is a useful tool for monitoring spatial extension and severity of drought in southern Africa. Lucas *et al* [14] were calculated and compared using data from 28 stations during the 40 years that included drought indices: SPI, Z and precipitation anomalies. Machlica *et al* [15] obtained hydrological droughts in river nitrate (Nitra) of Slovakia during the period 1976-2003 by dividing the mean annual flow during the period and concluded that from the 1990s to the present catchment upstream sector still remains in the dry state. Other examples can be associated with drought and groundwater resources like [19,22,16]. Aziz [4] in a study examining the relationship between recent drought and groundwater in the plain of Qazvin and concluded that underground water resources of the region has affected the circulation and precipitation regimes in terms of attitude and the annual turnover that indicating the two-month delay, This means that the maximum

Corresponding Author: Homayoon Moghimi, Assistant Professor, Department of Geology, Payam Noor University, Tehran, Iran.

rainfall were during the months of March and April and maximum level of ground water in the area occurs during April and May. Haghani has been studied the effects of drought on groundwater quality and quantity reductions and has concluded that quantitative effects of drought on groundwater aquifers, endangering and destroys the health of water or water continuous, cause to reduce the underground water storage in open aquifers to beneath the floor. Mohammadi & Shamsi Pour [5] dealt with the effects of drought on water resources in Hamadan plains using multivariate statistical analysis and GIS. In this study, we examined the plains north of Hamadan as varied climate and surface water hydrology as independent variables to determine the correlation between the static level plains (the dependent variable) on monthly basis over the 17 years from 1984 to 2000, Results 42% correlation between independent climatic variables with the intensity drops has shown that spring Plains area has the steepest drop in the region along the junction of the Highlands has had the least amount of loss. Hosseini Zare and colleagues [1] examined the effects of drought in Blue 87-1386 on the quantity and quality of water resources in Khuzestan province and have concluded that water quality has declined due to water scarcity and drought and increased salinity and mineral water and the amount of water soluble salts has increased from upstream to downstream, so that it is 1.5 to 3.5 in comparison to previous years. Mousavi and colleagues [7] examined the effects of drought on aquifer Ramhormoz and have concluded that water table fell 81 centimeters in September 1387 compared to the year 86. Dodangeh *et al* [3] investigated times to determine the minimum and maximum exploitation of groundwater Plains Zanjan and have concluded that Zanjan Plain was in critical condition because discharge rate was lower than the feed rate of the Plains and the water level went down about three meters, the greatest loss was in the spring and lowest was in winter and this trend will continue in the future with the subsidence area. Nakhayi and Mahdi Lou have investigated the Abhar's groundwater level fluctuations during the period 2006-2010. The research that has been done with the help of GMS Software and Data Processing performs the interpolation points and the corresponding maps show that From 1996 to 2010, groundwater levels dropped as a descending process that greatest decline was seen in the border area. In this research, the present study attempted to assess the impact of drought on groundwater quality in the area Abhar and Its main purpose is to change the zoning of the location of groundwater quantity associated with droughts occurred. For this purpose, we use the Standardized Precipitation Index (SPI), were identified droughts and sustain, then a groundwater were drawn in by the continuing drought and the unit hydrograph Tysen network map.

The study area:

Abhar area located with a geographical east longitude of 48 50 to 49 25 and 35 54 to 36 30 north latitude in the province. Salt Lake Basin is one of the major rivers Abharrud that part of it, is located in the study area (figure 1).

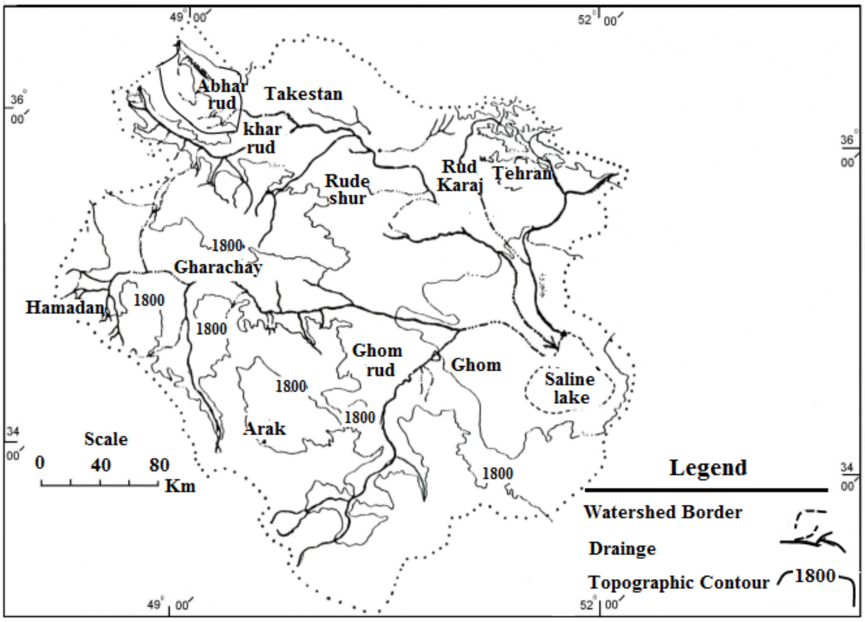

Fig. 1: Scope of Abharrud catchment area.

Data and Methods:

This study used data from 39 observation wells and annual precipitation 5 meteorological stations during 1992-2008 (tables 1, 2 and figure 2). Methods used are including library research, documentation studies and laboratory and field work.

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Table 2: Profile of rain-gauge stations of plain Abhar.

Station name	River's name	Geographical weight	Geographical longitude	height
Gharveh-Abharrud	Abharrud	36.06	49.38	1430
Arhan	Abharrud	36.31	48.91	2086
Kineh varas	Abharrud	36.17	49.06	1730
Zia Abad	Abharrud	35.99	49.45	1430
Sayin Ghale	Abharrud	36.31	49.07	1693

Source: Department of Energy

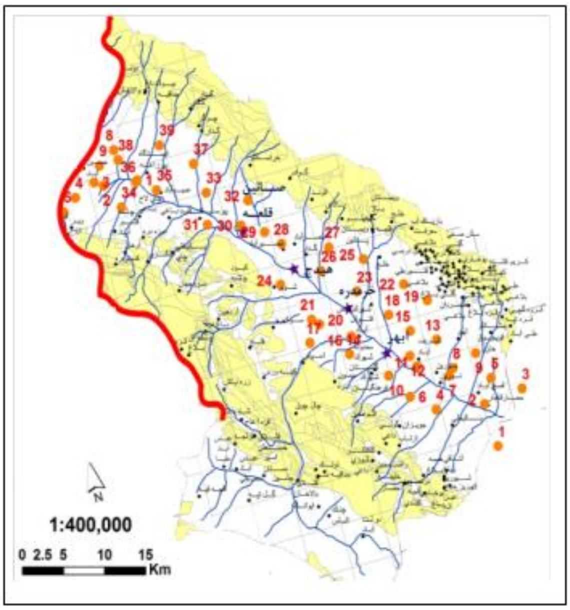


Fig. 2: The location of the observation wells in the area of plain Abhar.

Research Findings:

The study area is rich in groundwater, Plain Abhar sediments are relatively good in terms of Hydrodynamic properties (hydraulic conductivity, storage coefficient and hydraulic conductivity) and effective porosity. Precipitation and flowing water will easily penetrate the aquifer.

In the study area, a total of 189 spring bays that mainly originate from Karaj Formation (North-East Prairie Heights) and all of them are located in the mountains of North and South Abharrud. The minimum instantaneous discharge springs, is variable between .9 to 30 liters per second. These springs have an annual discharge of 5.744 million cubic.

Alluvium were divided into two groups in terms of permeability, Permeable alluvium northern slopes which cause great texture absorb considerable water and comprise Groundwater reservoirs, Rocks are weathering on the southern slopes and have made a hilly plain with a large area that due to the low thickness often their wells are semi-deep Due to the low thickness, often semi-deep wells that are and their water are placed.

Much of groundwater extracted and used in the deep and half deep wells. Aqueducts and fountains have a little role in this aspect.

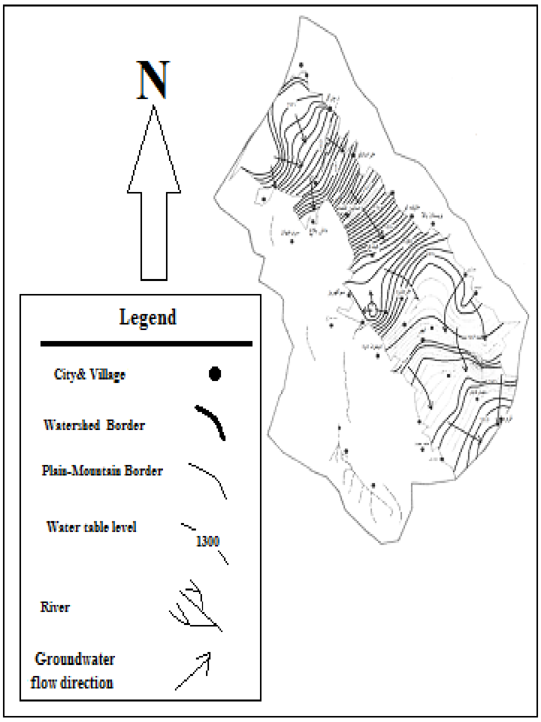
To determine the hydrodynamic properties of the aquifer (S, T, and K) is used from Isopiz maps, geophysical data and exploration wells. Hydraulic conductivity (T) of the Northeast and West Plains (of power) changes between 1400 and 1600 and between 1200 to 800 in the middle and (discharge) less than 500 square meters on the day at the end. Storage coefficient (S) Plain varies from 2 to 15% that has considered with an average of 6% for the whole. The electrical conductivity in the power are changing from 15 to 20, the middle 8 to 15, the output (drain) 9 from 2 to 8 m on day shift. Accordingly, the thickness of the aquifer in the power range is between 70 to 80 in the middle, 80 to 100 at the end of section between 50 and 60 meters.

The aquifer status:

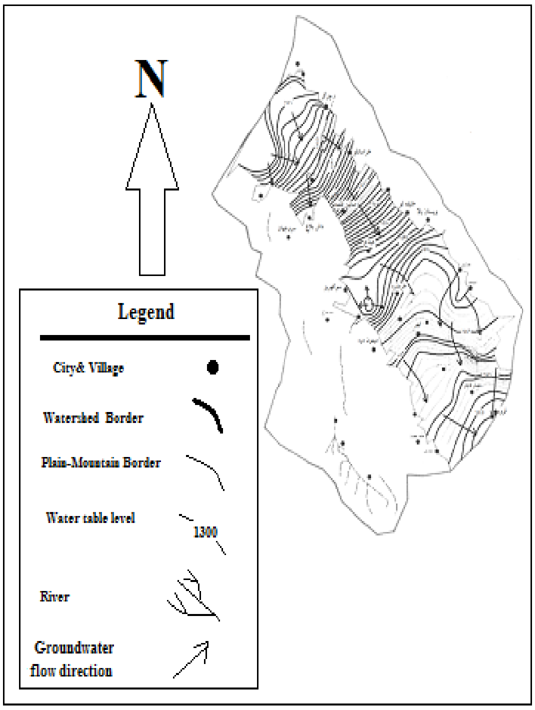
According to the wells piezometers, geometrical properties of the aquifer can be argued that sediments forming of abhar Plain probably include present alluvium in and around the Abhrrvd River trusts Terraces related to the Quaternary.

As previously mentioned, the data of water level from 39 observational wells in the area Abhar precipitation for mapping water table level, rain-gauge precipitation data for five stations is used for drawing unit hydrograph.

To evaluate the impact of groundwater plotted in water depths of 1992-2008 map of shallow groundwater level maximum (April) Abhar. This map shows the maximum depth of groundwater has seen in northeastern mountain range, towards Plain Abhar and Khat-ol-ghar reduced the depth middle and near the Abhar River reach to less than 20 meters. The minimum water level in the southeastern plains arrive to about Abhar to less than 10 meters from Qorveh in which some areas as effluent are removed from the bottom of the river. The depth of water table elevations from the edges toward the center and north-western plains to the south-east it decreases using the piezometric wells, The minimum and maximum groundwater elevation maps Abhar plotted in watery years of 1992- 2008 (figure 3 a, b).



(B) the balance sheets of plain abhar water table (minimum depth to groundwater, April, 1992-2008)



A contour map of the water table within the area abhar (maximum water table, April, 1992-2008)

Fig. 3: Map of water table elevation prairie region Abhar.

According to the contour plots, the direction of underground water is from the North West to the South East Prairie Abhar and is consistent with steep topography plain. Finally we can get the maximum level that Abharrud River, ground water feeds into the North Western Plains; and its reason is the drop in the water table due to pumping wells and the hydraulic gradient of the aquifer.

With stop pumping the minimum level occurs in autumn on the map**,** groundwater flow direction goes towards Abharrud. The most important part of drainage water has done by the river in the central plains and the north-east of the river Abharrud. (Figure 3 a, b). The average hydraulic gradient within the aquifer is estimated at about 6.2 per thousand Abhar.

By measuring annual changes in the water table, it has plotted the unit hydrograph abhar plains (Figure 4). As shown in this figure, from 1997-1998 to 2007-2008 descending to the plains of the unit hydrograph. The study of drought in the region using the Standardized Precipitation Index (SPI) in the range of 12 and 24 months was found that the entire study period 1971-2007, the maximum duration is from the drought period (1996-2007). The result of these droughts is decline in groundwater levels in the area of Abharrud Plains (Quality Paper).

As can be seen in Figure 4, in 2008 the overall inventory in accordance with the instructions has inventory of all water resources including groundwater and surface that according to the report in the Abhar area stated wells numbers 1445 Circles with 265.65 million cubic meters of discharge and fields numbers 82 field with discharge 19.1 million cubic, and spring numbers 189 line with 5.75 million cubic discharge in a year that groundwater depletion has been equal to the sum of 272.580 million cubic meters per year.

It should be noted that according to the latest statistics in 2008, Agriculture alone accounted for 71 percent of water wells, 76 percent water and 58 percent water aqueducts that is approximately 241 million cubic meters, it means % 88.5 of the groundwater is in agricultural consumption and the rest is for domestic consumption (7.3 percent), industry (3.1 percent) and other applications as well. However, according to the Department of Water Affairs Qazvin, plain water Abhar in 1997 has been in terms of agricultural use of 247.42 MCM from 16.67 million cubic meters of potable in terms of 5.14 million cubic meters of industrial applications. This means that 92% of underground water resources are devoted to agricultural use and the rest of drinking (6%), industry (2%) and other uses as well.

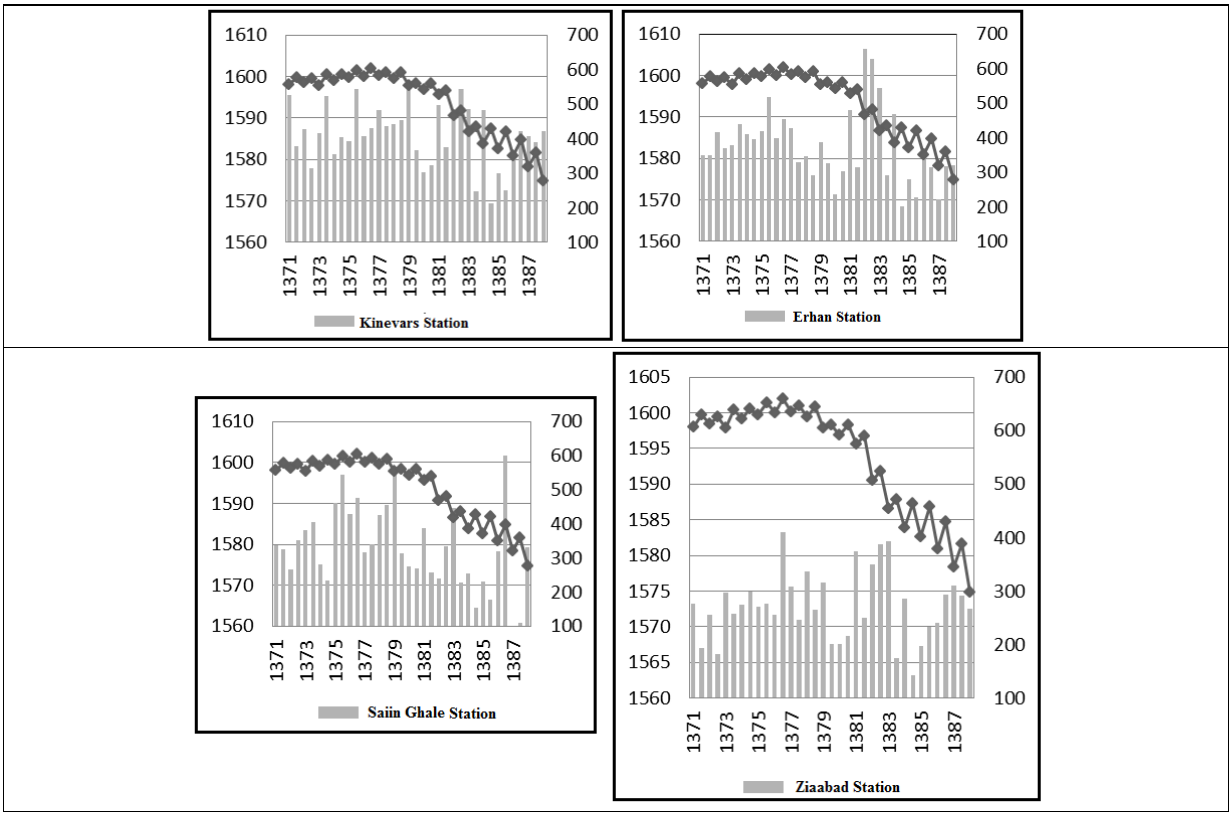


Fig. 4: Hydrograph of groundwater Abhar range of plain water during the month of September, 1992-2008.

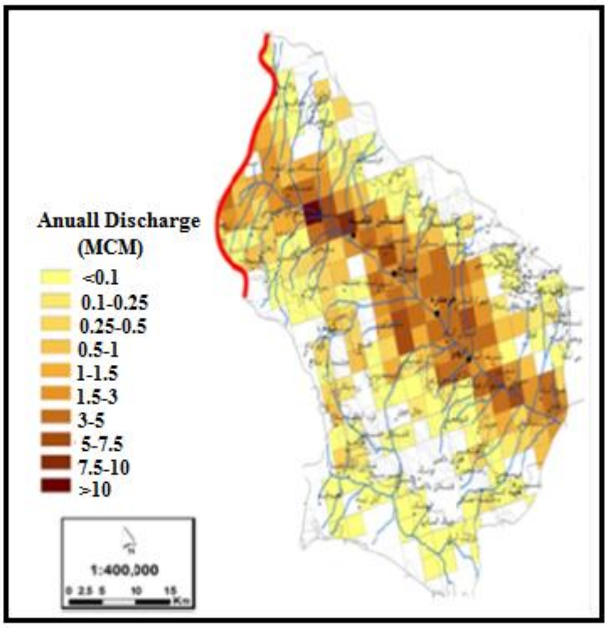


Fig. 5: The annual discharge of groundwater plain Abhar.

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The total area of 989.1 square km area obtained to prepare a groundwater balance Abhar and to determine the input and output sides of the Plains with Network Thiessen Mapping and according to the network, the hydrograph of unit Plains is drawn. Plain water inlet and outlet sides to provide balance for the year is determined by drawing maps Isopize 2007-2008 (Figure 6).

Table 3: Summary data of water sources (wells, aqueducts and fountains) in the study area.

sum	Total withdrawal of groundwater			Number of Springs	Total number of fields	The total number of wells	Plains Area	The total area of the region	Statistic year
	Aqueduct	spring	well						
288.84	7.7	11.9	269.24	70 Geometry	44 Course	973 circle	$Km^2$1300	$Km^2$1916	1997
272.580	1.19	5.75	265.65	201 Geometry	82 Course	1445 circle	$Km^2$1300	$Km^2$19166	2008

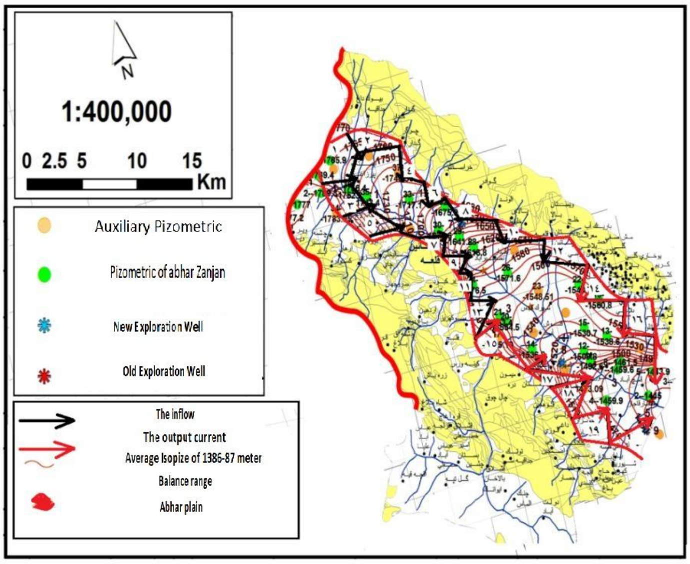

Fig. 6: Map of balance and Isopize aqueous medium in the range 2007-2008 of Plain Abhar.

It has been use from Trent White to determine the elements of balance (Table 4). By this method, the annual actual evapotranspiration is 235.5 mm, which is equal to 77% of the total. 11% of the total precipitation in the form of intrusion inter to the groundwater. The remaining 12% is in the form of runoff in the current study. Rainfall in the area is 233 million cubic meters as evaporation, 33.28 million cubic meters as infiltration, and 36.3 million cubic meters per year of seasonal and permanent rivers flow (Table 4).

Table 4: Abhar water balance by Trent White Plains method (in blue 2007- 2008).

Total	September	August	July	Jun	May	April	March	February	January	December	November	October	month / description
	19.9	25.5	25	21.6	15.2	11.7	4.9	0.1	-0.2	7.3	11	18.7	t(°C)
62.51	8.05	11.7	11.36	9.11	5.35	3.61	0.96	0.002	0	1.77	3.28	7.32	I_m
	1.03	1.16	1.23	1.21	1.21	1.09	1.03	0.85	0.87	0.85	0.86	0.97	°weight (35
686.97	88.28	127.27	123.61	99.63	59.33	40.33	11.17	0.034	0	20.1	36.8	80.42	Etp
765.11	90.92	147.63	152.04	120.55	71.78	43.95	11.5	0.028	0	17.08	31.64	78	Etpc
305.9	18.7	3.1	2	3.1	70.6	33.4	30.3	29.8	0.66	20.8	24.2	3.9	P
237.6	18.7	3.1	2	41.37	71.78	43.95	11.5	0.028	0	17.08	24.2	3.9	Etr
68.29	0	0	0	0	0	0	18.8	29.77	19.72	0	0	0	Additional water
527.52	72.22	144.53	150.04	79.18	0	0	0	0	0	0	7.44	74.1	Water shortage
	0	0	0	0	38.27	39.45	50	50	50	3.72	0	0	Soil wetness requirements
34.14	0	0	0	0	0	0	9.4	14.88	9.86	0	0	0	Surface flow penetration

Conclusion:

Rainfall is the most important parameter that can be directly involved in groundwater issues. Evaporation compromise 77% of precipitation, infiltration in the soil 11% precipitation and water runoff compromise other 12%. As a result, 233 million cubic meters of precipitation returns to the atmosphere as evaporation. It has penetrated 33.28 million cubic meters and 36.3 million cubic meters of runoff is flowing.

The study area is rich in groundwater, because the situation of Abhar plain sediments is relatively good in terms of hydrodynamic properties (hydraulic conductivity, storage coefficient and hydraulic conductivity) and the effective porosity. As a result, precipitation and after that flowing water will easily penetrate the aquifer. In this study, we sought to examine the relationship between drought and groundwater levels; therefore, we have chosen SPI method between the different methods of determining drought to cause a bit of simplicity that most long drought is since 1996 to 2007 respectively with SPI classes obtained by examining the results of the entire study period. In the most severe droughts in the study area Zyaabad station of, Kine vers of, Sayin Castle of, Arhan and Qorveh is related to. The survey showed that hydrograph of groundwater unit declined and shows 4 meter drop. The decline in this area has several causes that their most notably is drought and we can note from the humanitarian to population growth, increasing the number of factories increased cultivation area.

That its consequence is the change of the quality of groundwater plain Abharrud and it has predicted that this process has increased continuously. It is proposed to improve ground water level reduction that done a comprehensive compilation of standard and quantitative status of groundwater and surface water. Aquifer is told to drill a number of exploratory wells to determine the hydrodynamic properties. Regular measurements of water table and increase the number of piezometric wells to cover the whole range of studies had recommended from 25 to 15 kilometers to 10 kilometers per piezometric wells. Re-Census of wells tapping and a new data set is done to control the volume of water extracted from wells and use of groundwater resources, if you need to install water meters. Department of Energy with collaboration with the Ministry of Agriculture and the Department of Environment use from modern methods of agriculture and a variety of agricultural products due to climatic conditions in the study area. Department of Energy has examined Catchment areas, Due to geological conditions (in terms of diversity of geology and mines), climatic conditions and groundwater and surface water. Where dams are designed for long-term environmental damage can cause irreparable. Clouds and rivers along which they are traveling is very difficult to create new hydrometric stations automatically. Since there isn't accurate measurement of discharge in these places and is calculated only through discharge estimate.

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