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Investigation of Flood Distribution and Feeding Performance of Artificial RED Garden in Shahr-E-Reza on Quantity and Quality of Groundwater Table, Isfahan, Iran

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ABSTRACT

Increasing water consumption has increased using of synthetic nutritional methods for enriching groundwater resources. Artificial feeding is a method that can save excess water for using in low level water time in underground. The purpose of this study is to evaluate the performance of the flood dispersal and artificial feeding system in the Red Garden of Shahr-e-Daghshan and improving, saving quality of the groundwater table in the area. In order to investigate the performance of these plans, an area of 1570 km2 was considered in the Southern of Shah-Reza. The statistics data from 5 years before the design of the plans (1986-2002) related to flood control fluctuations in 20 observation wells and many indicator Qanat were surveyed in this area. The annual fluctuations in the level of the station show a rise in the level of the station after the depletion of the plan. Dewatering of the first and second turns, with an increase of more than one meter above groundwater level, has had the highest impact on the level of groundwater table in the region. Reduced permeability at sediment levels, wasted flood through evaporation and wasteful exploitation of groundwater resources, cause to loss of the impact on the increase in the level and quality of groundwater in the area, especially in the dry, drought season and recent high droughts.

***Keywords*:** Artificial Nutrition; Flood Spreading; Aquifer Surface; Water Quality; Groundwater Quality

1. Introduction

Groundwater resources have always been considered as a valuable reserve for the development of countries. In this regard, efforts have been made to identify the capabilities of these resources as well as their consumption. According to Vkili's report (1996), an estimated 130 billion cubic meters of water available from Iran's underground water is 45 billion cubic meters. Wolfe (1968) quoted from Kahairti (2001) that extensive use of groundwater resources for various uses in areas with high potential for exploitation has caused problems, most notably water pollution, while in areas with a limited capacity, the problem the major decline is the stock. According to Behnia's report (1988), one of the most useful ways in water supply of different parts, especially in dry and dry areas, is to deal with crises caused by a single year, contributing to the increase of groundwater reserves and preventing the khanates from flooding and artificial feeding of aquifers. Hamill & Bell (1986) reported that artificial nutrition may be carried out using a variety of methods. These methods include ponds and feeding chains. Gullies are used in large areas of India to feed artificial groundwater aquifers. Kurdvani (1994) Karami (1996) and Samiami (1991), the nutrition of groundwater aquifers through the creation of disadvantaged flood spreading networks is as follows:

-Inhibiting floods and reducing water erosion

-Prevent land from excessive groundwater resources

-In order to increase drainage and wells, storage underground water

-Reduced soil sensitivity to wind erosion

-Improving groundwater quality

So far, many artificial insemination projects and flood spreading networks have been implemented and put into operation in many parts of Iran. Tavakoli (1983) reported that most of the plans were constructed in the southern areas of the southern regions of Alborz and the Eastern Zagros, quoted by Kiaheirati (2001). This kind of plans are for two periods. The first period of the projects that has been in existence since 1986 in the large and advanced plots of irrigation and in the form of a basin, including plans of Varamin Garmsar and Qazvin Plain. Plans for the second phase have been carried out following water shortages in the central areas along rivers that there are one or more floods in the year to feed them. These plans are: Nutrition barrier in the Golrobar Dam of Semnan, Flood spreading plans such as Tang-Eram Borazjan, Mahdi Abad Fasa and Khezr Abad Yazd.

The evaluation of artificial nutrition plans is relatively complex. In many settings, the feeding time is very limited and depend on one or more floods a year. According to Rahmanian (1986), one of the most important problems is to assess the lack of statistics and information on the period of operation (lack of statistical data and information, lack of a study according characteristics of the watershed and climatic conditions on the other hand, trajectory to achieve the objectives of study and design). Tarhami (1997) reported that for measuring the returns of the plans, examining criteria such as the accuracy of the studies for choosing the location and the artificial feeding system, the amount of blindness of artificial feeding systems in the current state of volume of water entered into the table is due to artificial nutrition and changes in water level and water. In this paper, the quantity and quality of groundwater below the ground floor of the implementation of flood spreading and artificial nutrition plans of the Red garden of Shah-Reza is investigated before and after performance.

2. Material & method

The city of Shahreza is located 85 km South of Isfahan, due to the type of low density precipitation in the in winter and autumn in the major part of the year, there are water scarcity problems. There are severe and short time rains that occur in a few days a year that cause flood and wasted water and also occasionally causes damage as a seasonal flood. According to the Office of Watershed Management Studies and Designation of Isfahan Province (1988), the studied projects are located 25 km South of Shah-Reza and 5 km distance to South-West of the Red-e-Sadr River in the west of the Esfarjan River from the Gavkhoni marsh with the geographical coordinates of the Eastern 52 .00' longitude and Northern 31 .49' latitude and 2000 meters above sea level and at the highest point of the Ghannat Garden Red. The water catchment area of these plans is about 323 square kilometers. The most important organization in the basin is Falmaneh Stone and Ahkras. In the middle of basin is permanent river there is a permanent river that drainage the basin. The estimated annual flood of the river is 32.9 cubic meters per second. There is suspended sediments in the low rain period. The maximum observed amount of sediment is 32.5 tons per day. The annual amount of annual precipitation in the Esfarjan River is 10.4 thousand cubic meters. In general, the site of the project has a heavy to medium texture (silty loamy-silty clay) and light sandy sandy loam (sandy-loamy sand). Lime content 15 to 35 percent. Average alkaline earth reaction. Average electrical conductivity less than 3 dS / m. Carbon Organic is very low (less than 4%), the total amount of nitrogen is less (less than 0.5%), the average absorbed potassium (150-150 mg / kg). Based on the permeability experiments performed by Mr. Rezaei (1998), the soil surface permeability (depth of 20 cm) has a moderate limit (permeability of 7.7 cm / h) and deep soils (depth greater than 120 cm) very fast (over From 25 cm / h). These soils are located in the hydrologic group BC. The artificial feeding plan of Shahreza has been designed by the Jihad-e-Agriculture Organization of Isfahan Province in 1988. The project consists of 6 ponds with dimensions of 150 * 50 and 3 meters high, which has been completely dewatered at least four times in years 91-92, 97-98, 98-99, `2000-2002. In addition to this project, in order to take advantage of the flood of the Asfarjan River, the design of the Red Sands Flood was designed in 1993-94 by Vajra. The plan consists of 10 strips of 105 hectares and is fully dewatered in the years 97-98, 98-99, 2001-2002.

3. Collect basic information

3.1 Collection of rainfall data in the study area

In order to obtain information about the monthly rainfall during the years 1986 to 2002, three climates stations were selected such as Izad-khsat, Mahyar and Saghsoud-Beig and rainfall statistics were extracted from the statistical periodicals of the Meteorological Organization of Isfahan province. **Table (1)** shows the specifications of the stations.

Name of Station	Establish Year	Elevation (m)	latitude	longitude	Type of Station
Ezad khast	1974	2150	31°32'	52° 08'	Evaporation
Magsoud Baig	1966	1980	31 50'	51 59'	Evaporation
Mahyar	1967	1650	32 16'	51 48'	Climatology

3.2 To collect information of the groundwater level of wells in the study area

Alluvial aquifer of this area is formed in the main area of the South Shah-Reza Plain. The aquifer type is the plain one. There is a pressure aquifer in low underground water has been reported as a barrel width in the western plain of the plain, which in the past was well-equipped, and drilled wells were discharged in their own right. The range studied in this study is about 1570 square kilometers and is located in the center of this plain (**Figure 1**). This range actually includes 20 observation wells measured by the watershed of Isfahan. Monthly data related to the absolute altitude of the water surface (the absolute difference between the point of the well with the water level at the point of the sign) was extracted from the Water Organization of the province during the October 1999 to October 2002 period (**Table 3**). In **Table (2)** shows the specification of the observed wells. Also, the statistics related were provided to the monthly flow of five fields of the Qanat index of the area, called Wolndan, Maghsoudbaig, Sharif Abad, Allah Abad-Meysineh.

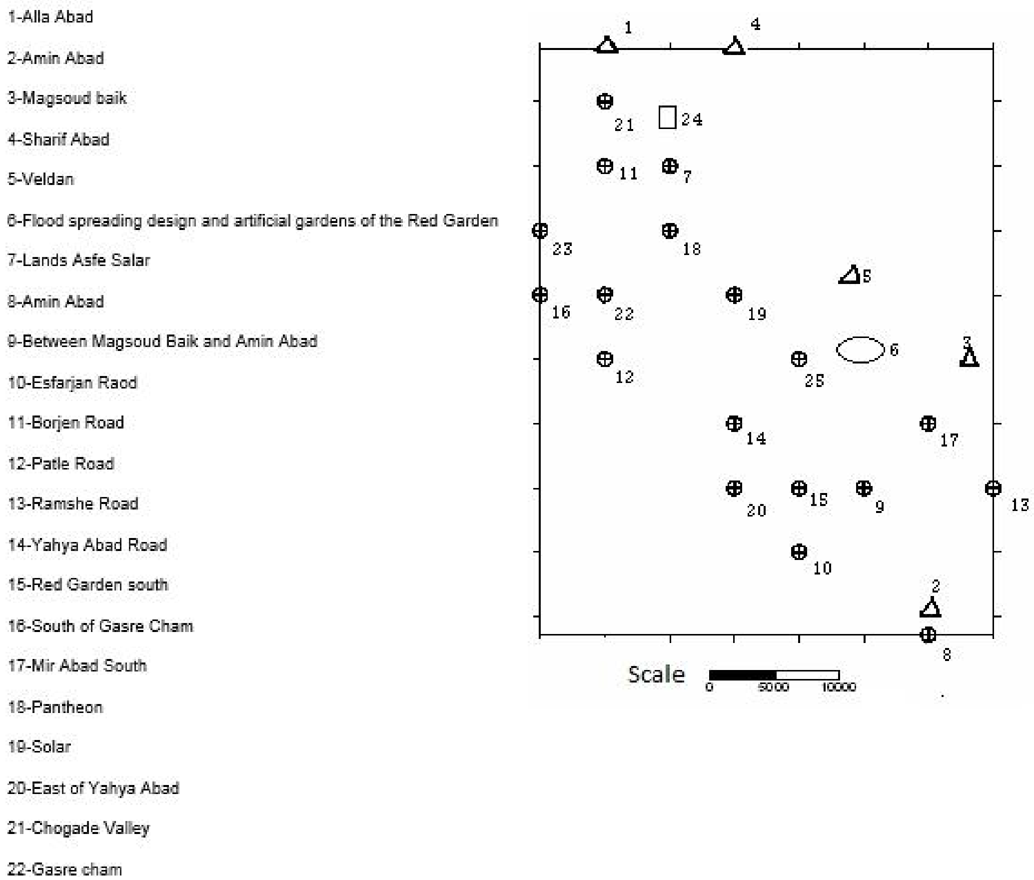

Figure 1; Study area.

Row	Place	Coordinates on the map	Absolute Altitude Point (m)	Date of commencement	UTM	
					Y	X
1	Asfe Salar Lands	35M4-43D	1835/24	60-61	3535000	580000
2	Amin Abad	39T4-2D	2061/93	60-61	3500000	600000
3	Between Amin Abad &Magsoud Baig	38R4-2D	2033/53	59-60	3510000	595000
4	Near Esfar jan	37S4-1S	2116/40	62-63	3503000	590000
5	Borojen road	34M4-14D	1853/28	62-62	3535000	575000
6	First of Patleh Road	34PA-1D	1953/21	60-61	3520000	575000
7	Rameshe Road	40R4-1D	1999/55	60-61	3510000	605000
8	Yahya Abad Road	38R41D	1981.57	60-61	3515000	585000
9	South of Red Garden	37R4-1D	2025.78	60-61	3510000	590000
10	South of Gasre cham	33O4-1D	1999.20	60-61	3525000	570000
11	South of Mir Abad	39Q4-1D	1979.16	62-63	3515000	600000
12	Chogare Valley	34L4-1D	1813.29	62-63	3540000	575000
13	Pantheon	35N4-2D	1862.97	62-63	3530000	580000
14	Solar	34O4-2D	1899.85	60-61	3525000	585000
15	East of Yahya Abad	36R4-1D	2102.85	60-61	3510000	585000
16	Gasre Cham	34O4-3D	1932.07	62-63	3535000	575000
17	West of Shareza Road	34L4-29D	1831.54	60-61	3540000	575000
18	Mousa Abad	33N4-12D	1961.41	60-61	3530000	570000
19	Emam Square	35L4-22D	1818.02	64-65	3540000	580000
20	Veshareh	37P4-4S	1951.38	60-61	3520000	590000

4. To collect data on the quality of Qanat's water in the study area

In order to evaluate the performance of the water quality of the region, the results of chemical analysis of water from several riparian aqueducts in the region during the years 1986-2002 were prepared by the Water Organization of Isfahan (**Table 4**).

5. The method of assessing the impact of the groundwater aquifer plan

This section of the research is two part. In the first section, fluctuations in water level of observation wells in the study area were carried out during drainage and months after dewatering. In the second part, in order to examine the process of fluctuations in the level of the station in the whole range, with the aid of the area for which the area was used, using the absolute height of the water level of the wells and the Tissan equation, the mean absolute height of the water surface was calculated and calculated from the year 1986 to September 2002. Tysen's formula has been displaced below:

$$\overline{H} = \frac{\sum_{i=1}^{n} a_i H_i}{\sum a_i}$$

where in:

H=Average absolute height of the monthly water level in the study area in meters

H_i=monthly absolute height of the groundwater level in the i m in meters per meter

ai=Area of each polygon in well im per km/s

i= Well number

n=The number of wells is from 1 to 20 in this article.

6. Result & discussion

6.1 Effect of flood spreading and artificial nutrition on surface water table fluctuations

Amount of water has been added to the groundwater table in each time of the drainage in the plans. In the year 1997-1998, which lasted from 1997/2/19 to 1998/3/17, the volume of water extracted in this facility is about 9.7 million cubic meters, if it exceeds the capacity of the facility, which is about 110 hectares, only 1 centimeter per second. This value is due to the amount of evaporation that can be very effective in increasing groundwater levels.

Table (3) shows the water surface fluctuations of the study area. **Figure (2&5)** shows a sample of water of the wells in Mousa Abad, Esfarjan Road, Solar Junction of South of Red Garden from 1986 to 2002 and **Figure (6)** shows whole of the area in. Also, the water level display of the station level is plotted in the entire study area by using the data obtained from equation (1). The survey of these water shows the effect of the design of the rising water level. This effect has not been the same in all wells. In the wells of Esfarjan, Solar and south of the Red Garden, water level has been increased in the month after water harvesting, especially during the periods 1990-1992 and 1948-1997, has been considerably high (more than 5 meters). This is due to the decrease in the level of 89% in Mousa Abad in those periods. This difference may arise from several factors such as the soil texture of the discharge area and the site from the site of the implementation of the project, which seems to be the most significant distance from the site of the project. The overall surface water level of the whole area shows a high level of stagnation in the month after each watering. Noteworthy, in Figures (2 & 6) and Table 3, the reduction of the effect of plan dewatering in the years 1998-1999 and 2001-2002. This decrease may be due to increased drainage of groundwater, droughts, and the reduction of plan performance during a multiplication process and an impact on the implementation site.

Month after watering	Water Level changes	Month before watering	Month of watering	Month after watering	waterLevel changes	Month before watering	Month of watering	Month after watering	Water Level changes	Month before watering	Month of watering	Month after watering	Water Level changes
1959.	+0.03	1959.71	1959.7	1959.71	*	1959.61	1959.61	1966.66	+0.05	1958.59	1958.56	1958.54	-0/02
2108.	+4.11	2102.52	2102.89	2107.94	+5.05	2103.69	2104.74	2104.49	+2.75	2102.89	210.59	21007.19	+4.3
1808.7	+1.9	1810.99	1811.67	1812.38	+1.39	1809.33	1809.63	1810.23	+.09	1805.13	1805.38	18004.83	-0.3

1878.8	+3.55	1878.4	1878.31	1880	+1.6	1877.5	1877.85	1878.1	+0.6	1873.95	1873.9	1873.75	-.2
1931.7	+1.45	1932.18	1932.52	1932.38	+0.2	1932.33	1932.5	1932.68	+0.35	1929.78	1930.28	1930.33	+.55
2038.0	+1.95	2036.66	2036.4	2036.21	-0.45	2038.66	2038.93	2038.08	_0.58	2034.28	2034.23	2033.83	-.045
1844.9	+3.85	1842.36	1842.61	1845.01	+2.65	1842.21	1842.71	1842.96	+0.75	1840.06	1840.01	1840.71	+0.65
1998.2	+4.93	1993.42	1993.4	1993.42	*	1992.47	1992.49	1993.42	+0.95	1991.47	1991.57	1991.61	+0.14
1911.4	+0.07	1914.26	1914.11	1913.76	-0.5	1914.21	1913.56	1913.56	-0.3	1910.39	1910.36	1911.21	+0.82
1999.6	-0.5	2002.53	2002.45	2001.96	-0.57	2000.73	2000.65	2000.85	+0.12	19998.78	1998.83	1998.88	+0.1
1973.6	+0.22	1978.14	1978.22	1978.79	+0.65	1978.36	1978.34	1979.09	+0.36	1977.04	1977.14	1977.84	+0.8
*	*	1700.72	1700.99	1701.19	+0.47	1700.78	1701.3	1700.92	+0.05	1696.97	1696.72	1696.22	-0.75
1936.9	+0.4	1937.24	1937.34	1937.3	+0.06	1937.19	1937.22	1937.18	-0.01	1936.72	1936.77	1936.67	-0.05
2068.2	-0.07	2069.24	20.69.14	20.69.9	-0.13	2068.74	2067.94	2068.74	*	2068.39	2068.44	2068.39	0
*	*	1782.73	1782.65	1782.63	-0.1	1782.75	1783.13	1782.78	+0.03	**	**	**	**
1913.9	-0.35	1913.97	1913.77	1914.62	+0.65	1913.67	1913.67	1913.72	+0.05	1913.37	1913.37	1913.17	-0.2
1794.7	+2.18	1796.17	796.7	1798.28	+2.11	1796.22	1797.02	+0.8	1790.57	1790.57	1791.52	1791.47	+0.9
1818.9	-0.02	1819.9	1819.9	1819.87	-0.03	1819.87	1819.82	1819.87	*	1817.62	1817.57	1818.42	+0.8
1913.9	-0.65	1913.15	1912.7	1912.26	-0.89	1913.15	1912.7	1912.26	-0.89	1911.5	1911.5	1911.75	+0.25

											5		
1807	+1.5	1806.6	1806.6	1807.07	+1.07	1806.5	1806.5	1806.86	+0.36	1804.7	1805.03	1805.02	+0.17

6.2 The effect of artificial feed water flow system on groundwater quality

According to Alizadeh (1995), groundwater quality is the same as atmospheric water quality, which is altered during the passage of the rocks, and its changes depend on factors such as minerals that are in contact with water, heat, pressure conditions, and the time when the water vapors are in contact with it.

One of the sources of flood spreading and artificial nutrition is the effect of this plan on the quality of groundwater. This phenomenon occurs when the water supplied is not of good quality or the underlying formations of gypsum or salt, in which case the passage through these formations will reduce the amount of water lost and the quality of groundwater.

In order to study the effect of synthetic nutrition on groundwater quality in the studied area, the results of water decomposition of the five aqueducts in the province of Isfahan province were presented in Table (4).

SAR(meq/lit)						**EC(ds/m)**					**C1(meq/lit)**					**$SO4^{-2}$(meq/lit)**				
Year	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
91	5.27	3.07	2.3	4.7	6.1	2.33	0.99	0.89	0.78	4.4	1.11	2.2	2.4	2.2	31.6	11.2	6.3	4	3.4	11.6
92	4.48	4.46	1.99	4.13	6.21	2.46	11.4	1.03	0.86	4.3	11.2	2.2	3.2	1.9	28.8	10.7	6.5	5.8	4.2	11.9
93	4.45	3.88	1.87	2.93	6.22	2.84	13	1.02	0.94	4.5	12	7.4	3.5	2.3	26	14.1	8.5	4.9	4	17.1
94	4.38	3.41	1.93	2.88	6.57	2.82	12.8	0.98	0.9	4.3	12.4	2.3	2.62	2	26.8	12.5	8.1	4.1	5	13.9
95	4.41	1.67	1.72	3.26	6.52	2.56	12	0.94	0.95	4.1	13.2	2.8	2.3	2.1	27.5	10.8	7.2	4	4.2	15.2
96	4.49	1.85	2.13	3.51	13.5	2.5	11.9	1	0.93	4.5	12.5	2.7	3.1	2.3	33	11	7.33	3.1	4	13.9
97	4.98	4.84	1.4	2.63	5.43	2.46	14.4	0.97	0.88	4.6	12.7	6.4	3.1	2.3	31.1	12	5.84	5	2.9	15.5
98	-	-	-	-	-	2.5	15.9	1.05	0.95	4.5	13.6	7.2	3.1	2.2	28	-	-	-	-	-
99	4.59	3.16	2.55	3.62	6.58	2.72	15.8	1	0.87	4.5	13.6	7.4	5.4	2	-	12.5	7.6	3.3	4.6	23.1
2000	-	2.63	1.96	3.49	5.48	2.59	16.6	1.34	0.92	4.4	12.8	6.21	3	2	12.8	13.8	6.21	11.7	4.2	13.3

Since sufficient information on the quality of water in Qanats in the years before and after watering in two drainage periods as well as flood quality is not available in the Red Square, it is not possible to judge its positive or negative effects on the groundwater quality in the area, but according to the existing statistics and the comparison of the years of 1992 And in the year 1999, when the water was digested in the beginning, it seems the plan has been not positive or negative effects on water quality in rest of the years. While, Kiaharati (2001) in the study of plain flood spreading project in the Moghar Adarestan got results that the system has not been effected in improving the quality and quantity of groundwater in the area. He explained the reasons for the failure of this project to be inadequate that flood spreading from high permeability is high water stress, water erosion combined with frequent runoff, entry and accumulation of fine grained deposits with a high water content in the lava, reduced permeability of the deposited sediment strips due to the presence of capillaries and flood leakage in a thin layer.

7. Results & suggestion

The results of this study indicate that the implementation of the flood and artificial feeding project of the Red Garden Shah Reza has had an impressive effect (over one meter) on the increase in groundwater level in the area. Extending and improving the effectiveness of these plans will increase the volume of water extracted. Rezaei (1998) investigated the phenomenon of blockage in the penetrating system, concluding that removing a 10 cm layer of substrate would be sufficient to effectively retrieve the effect. By sampling the water fed and chemical extraction, sampling of the wells in the sub-area of the project can be used to study the effects of the implementation of the project on the quality of groundwater.

1-Alla Abad
2-Amin Abad
3-Magsoud baik
4-Sharif Abad
5-Veldan
6-Flood spreading design and artificial gardens of the Red Garden
7-Lands Asfe Salar
8-Amin Abad
9-Between Magsoud Baik and Amin Abad
10-Esfarjan Raod
11-Borjen Road
12-Patle Road
13-Ramshe Road
14-Yahya Abad Road
15-Red Garden south
16-South of Gasre Cham
17-Mir Abad South
18-Pantheon
19-Solar
20-East of Yahya Abad
21-Chogade Valley
22-Gasre cham

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