Study of Groundwater Resources Condition In Plains of Bakhtegan-Maharloo Basin

Sepideh Hedayat[1], Heydar Zarei[2], Fereydoon Radmanesh[3], Amir Soltani Mohammadi[4]

[1.] MSc. Graduated, Department of Water Resources Management, Faculty of Water Sciences Engineering, Shahid Chamran University of Ahvaz, Iran.
[2.] Assistant Professor, Department of Water Resources Management, Faculty of Water Sciences Engineering, Shahid Chamran University of Ahvaz, Iran.
[3.] Associate Professor, Department of Water Resources Management, Faculty of Water Sciences Engineering, Shahid Chamran University of Ahvaz, Iran
[4.] Assistant Professor, Department of Irrigation and Drainage, Faculty of Water Sciences Engineering, Shahid Chamran University of Ahvaz, Iran.
sepideh_he@yahoo.com

Abstract: Due to the surface water resources limitations in Bakhtegan-Maharloo basin, the amount of groundwater resources discharge has been exceeded the limits and this amount has also had a significant effect on surface water resources, so that the excavation of several wells in the vicinity of Kor River has led to dry up the river. Easy access and operation of groundwater resources has led to a significant increment in discharge rate of these resources in the recent years, and in some areas, the discharge is over the potential of aquifer recharge which the continuation of this trend will cause irreversible destruction of groundwater resources. Therefore in the present study, the groundwater resources condition of the basin were studied by investigating the unit hydrographs of 19 plains of the basin which had 12 years of statistics (2002-2014). The results of aquifers unit hydrographs which is plotted based on monthly measurements of 458 observation wells indicated that Arsanjan, Kavar-Maharloo, Seidan-Faroogh, Saadat Abad and Ghare Bagh plains had the highest annual fall in groundwater levels with 2, 1.68, 1.19, 1.04, 1.02 meters drop, respectively.
[Hedayat S, Zarei H, Radmanesh F, Soltani Mohammadi A. **Study of groundwater resources condition in plains of Bakhtegan-Maharloo basin.** *World Rural Observ* 2017;9(1):1-5]. ISSN: 1944-6543 (Print); ISSN: 1944-6551 (Online). http://www.sciencepub.net/rural. 1. doi:10.7537/marswro090117.01.

Keywords: Unit hydrograph; groundwater; basin; Bakhtegan

1. Introduction

Nowadays groundwater resources have taken into more attention as a second source of fresh water in the world and Iran, due to the existing water crisis. Geographically, Iran is a country with arid and semi-arid climate with the average annual precipitation of about 240 mm which is less than one-third of the global rainfall average. Most regions of Iran except the north and some parts of the western regions are faced water resources limitations, therefore from old times groundwater resources were important for different uses such as drinking, industry and agriculture. Easy access and operation of groundwater resources has led to a significant increment in discharge rate of these resources in the recent years, and in some areas, the discharge is over the potential of aquifer recharge which the continuation of this trend will cause irreparable destruction of groundwater resources. Unlike surface water reservoirs, in case of high subsidence and water level reduction, aquifers have no way to compensate and return. Population growth and the expansion of irrigated cultivation areas in the past three decades, has increased the exploitation of water resources in worldwide, which leads the demand to overtake the global supply and water deficiency occurs in water resources [1]. According to the presented statistics, Iran is among the countries which are in an alarming condition from water viewpoint, so that considering the increasing population and available water resources, the World Food and Agriculture Organization has predicted that Iran will be in the category of countries which their water consumption per capita would be less than 1000 cubic meters until 2025. This issue will entail a serious risk to the available water resources especially aquifers, since water discharge from these sources for required water supply would be more than before [2]. Exploitation of water resources including surface and groundwater requires recognition of behavior and the amount of each resources, to impose the least damage to the environment and water reservoirs by optimization. Now, a large number of Iran's plains has become prohibited plains, and more discharge from aquifers is not possible and some aquifers are also becoming demolished [3].

In Fars province due to the lack of surface water resources in the Bakhtegan-Maharloo basin, the discharge of groundwater resources has been exceeded the limits and this amount has also had a significant effect on surface water resources. For instance, digging multiple wells in the vicinity of Kor River has led to dry up the river. Due to the dry climate of the area and lack of surface water, use of groundwater resources especially alluvial water resources has been started by digging wells and qanats from the old times in this area. In recent decades, regarding to the increasing water requirement for different uses, in addition to the alluvial water resources, use of hard formations water resources has become common, so that the drinking water of most of cities in this basin is provided from hard formations reservoirs. According to the 2009 survey in the Bakhtegan-Maharloo basin, 3 billion cubic meters of groundwater is extracted from nearly 40000 pumping wells every year, and by considering the discharge of springs and qanats this amount becomes about 4 billion cubic meters per a year [4]. However, the volume of surface reservoirs in the basin is about 1.5 billion cubic meters. Excavation of thousands wells and exceeding discharge in this basin caused an intense fall in groundwater levels and subsidence in 70 percent of the plains, which is observed in the ancient area of Persepolis [5]. By population growth and the increasing demand for water in various sections including agriculture, industry and drinking, the necessity of available water resources management of the basin is observed more than ever before.

Heretofore, many studies are done by researches in groundwater resources conditions fields using unit hydrograph and groundwater balance. Azhdari studied the groundwater balance in Tuyserkan plains. According to unit hydrograph, he estimated the drop level of 2008-2009 water year 2.52 meters and concluded that the aquifer of the studied area is faced groundwater level fall which is caused mostly by discharge for agriculture, to the extent that this plain should be considered as forbidden plain to compensate deficit reservoir volume[6]. In another study Hojjati and Boostani by using groundwater balance in sustainable management of the Khir-Estahban plain aquifer concluded that in the statistical period of 10 years the groundwater level has fallen 7.08 meters. Also according to the alluvial aquifer balance, changes in the volume of groundwater in the aquifer of Khir plain is -10.93 million cubic meters which indicates the reduction of the groundwater level and excessive discharge from the groundwater[7]. Zarei and Akhoond Ali by comparing the classic statistical methods and the geostatistical methods in estimating groundwater unit hydrograph in the main plains of Khuzestan concluded that, the Thiessen method in drawing groundwater unit hydrograph can be used only on the condition that the observation wells have an appropriate distribution and the groundwater level has a slight hydraulic gradient. They also concluded that the observation wells distribution condition is the main factor of error in groundwater levels interpolation and drawing unit hydrograph[8].

In this study, the groundwater resources condition of the Bakhtegan-Maharloo basin was investigated to achieve a general aspect of the basin. To this purpose, unit hydrograph of the plains of Bakhtegan-Maharloo basin and the annual changes of the groundwater level were determined and plains with the highest and the lowest drop in groundwater levels, have been identified.

2. Material and Methods

The studied area is Bakhtegan-Maharloo basin which is located in southwest of Iran and in north, central and southeastern of Fars province. The total area of this basin is 31511 square kilometer, which includes 16630 square kilometers of mountains and 14881 square kilometers of plains and lakes. The most important river in Bakhtegan-Maharloo basin is Kor River. Figure (1) shows the location of the studied area in the country, Fars province and also the position of the observation wells in the basin and the studied area.

This basin has 28 study areas containing alluvial aquifers. Aquifers unit hydrographs are drawn based on the results of monthly measurements from 458 observation wells in 19 plains of the basin for 2002-2014 water years. Other plains of the basin were omitted from the calculations due to not having data of the 12 years (2002-2014).

3. Results

The variations of groundwater level resulting from the unit hydrograph is calculated as the total fall in the statistical period (2002-2014) and the average annual fall (Table 1). According to the calculations, the level of groundwater has fallen in 90 percent of the plains which have the possibility of drawing the unit hydrograph (Figure 2). The most annual falling in the groundwater level belongs to the Arsanjan plain and is equal to 2 meters (Figure 3). Also the Kavar-Maharloo, Seidan-Faroogh, Saadat Abad and Ghare Bagh plains have more than 1 meter annual fall of the groundwater level.

The unit hydrograph form represents the minimum groundwater level in September and October (due to the considerable decrease in rainfall and discharge for agriculture) and the maximum groundwater level in April and May (due to the precipitation or melting snow). In other words, the amount of rainfall and discharge are the most important factors of variation and fluctuation of groundwater level in aquifers of the plains. Kharameh and Shiraz plains are encountered to an annual increase of 0.09 and 0.04 of groundwater level, respectively. The results show that the critical plains in terms of fall of groundwater level have more pumping wells. At this moment, many plains of this basin have become forbidden. The first prohibition was started in Neyriz plain in 1984. Although the plains have become forbidden for several years, still the increasing trend of groundwater level falling in their unit hydrograph is observed and the reservoir capacity is reduced every year. Meanwhile, Kharameh and Shiraz plains were encountered to groundwater level increment after the prohibition which can be considered that the vicinity of most of observation wells to the city and effect of city sewer system in the form of absorption wells caused the aquifer to feed. While the areas with no observation wells far from the city, have a steep fall in groundwater level. In Kharameh plain, due to the reduction of ground water quality, qualitative prohibition is applied.

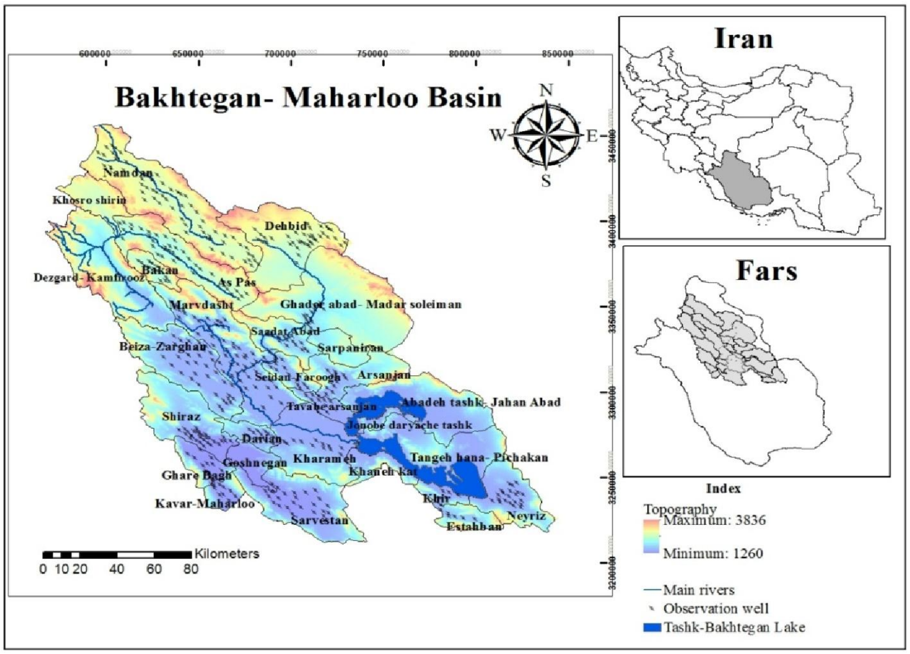

Figure 1. General view of the Bakhtegan- Maharlu basin and the location of observation wells

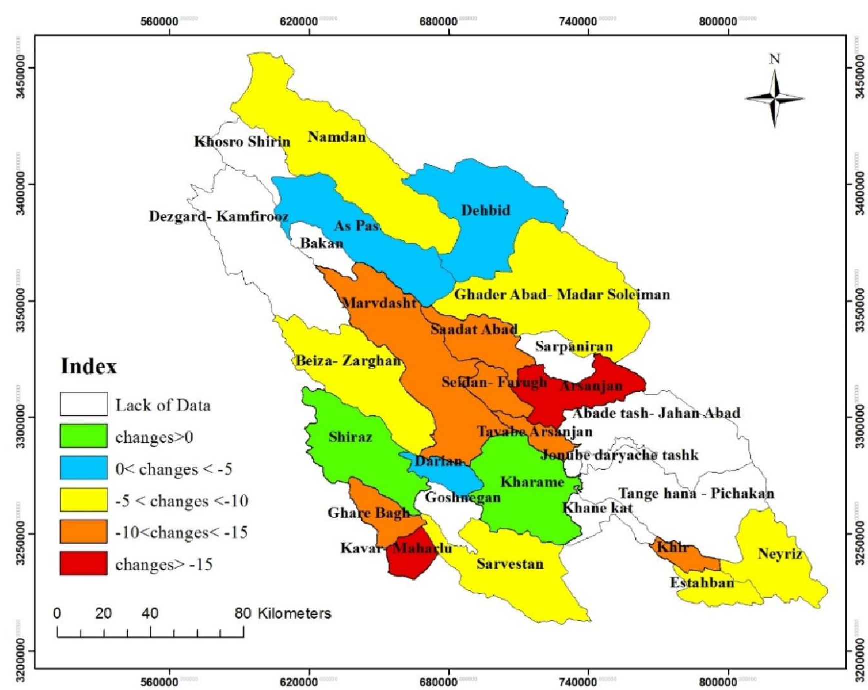

Figure 2. The groundwater level changes in 12 years in the plains of Bakhtegan Maharloo basin (m)

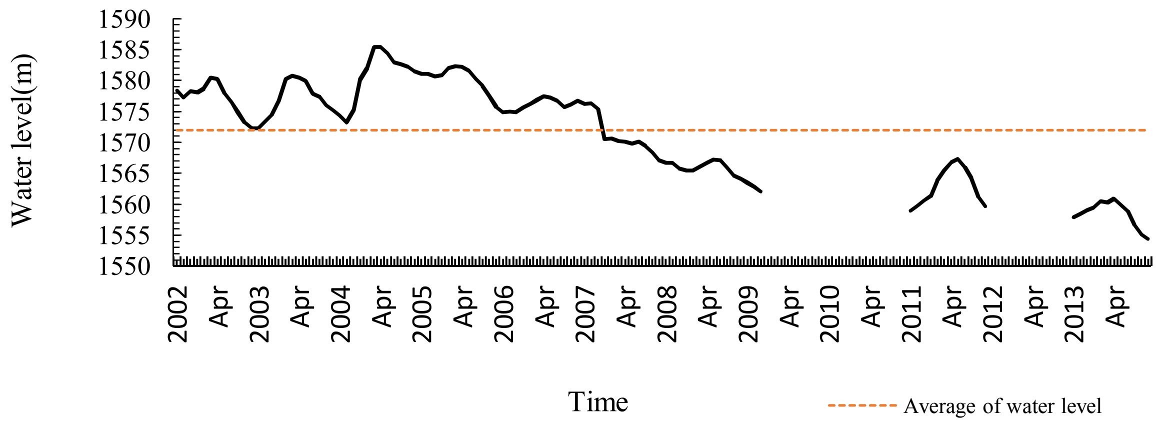

Figure 3. Unit Hydrograph of Arsanjan plain

Table 1 - Changes in groundwater level from the plain aquifer unit hydrograph of the Bakhtegan Maharloo basin

Plains	Area (Km^2)	Number of Pumping wells	Ratio of the wells number to the area	Groundwater level changes in 12 years(m)	Annual changes in groundwater level(m)
Arsanjan	789	669	0/76	-23/97	-2/00
Kavar- maharloo	323	854	2/64	-20/13	-1/68
Seidan- faroogh	369	1826	4/95	-14/24	-1/19
Saadat Abad	723	799	1/11	-12/50	-1/04
Ghare Bagh	453	2815	6/21	-12/19	-1/02
Tavabe Arsanjan	275	1894	6/89	-11/27	-0/94
Marvdasht	2367	8435	3/56	-10/32	-0/86
Khir	229	291	1/27	-10/21	-0/85
Ghader Abad-Madar Soleiman	2908	654	0/22	-9/35	-0/78
Estahban	417	38	0/09	-8/96	-0/75
Namdan	2803	2589	0/92	-8/16	-0/68
Beiza- Zarghan	1738	5570	3/20	-6/93	-0/58
Sarvestan	1641	1116	0/68	-6/57	-0/55
Neyriz	1019	421	0/41	-6/33	-0/53
As Pas	1623	1512	0/93	-4/97	-0/41
Darian	334	795	2/38	-4/05	-0/34
Dehbid	1890	390	0/21	-3/03	-0/25
Shiraz	1428	2758	1/93	+0/44	+0/04
Kharame	1584	1134	0/72	+1/03	+0/09

4. Discussions

The variations of groundwater level of aquifers unit hydrograph in 19 plains of Bakhtegan-Maharloo basin were investigated for 2002-2014 water year. The results showed that most plains of the basin are confronted with a sharp drop in groundwater level. Planning and management for correct use of groundwater resources is necessary, in order to solve these problems. Implementing methods of balancing can support the aquifer storage. By considering that the most of groundwater resources in the basin are used as waterlogging for agriculture, changing irrigation systems can compensate the drop in the aquifer to a high degree.

Corresponding Author:
Sepideh Hedayat
Department of Water Resources Management
Faculty of Water Sciences Engineering, Shahid Chamran University of Ahvaz
Ahvaz, Iran
Telephone: 098-9372978720
E-mail: sepideh_he@yahoo.com

References

1. Hellegers P. Treating water in irrigated agriculture as an economic good. Presented on the conference of Irrigation Water Policies, 2002; Agadir, Morocco.
2. Banzhad, H, Seyfi A. Underground water level control by changing cropping patterns in Hamadan-Bahar plain. National Conference on Management of irrigation and drainage network 2006, Shahid Chamran University, Department of Water Science Engineering.
3. Al Sheikh A, Hamrah, M, Helali, H, Fatehi A. Application of GIS in groundwater resources balance in Talesh plain. Journal of Geographical Sciences 2004;(3): 99-118.
4. Ghafarijoo N, Zarei H. Balance analysis in plains of Bakhtegan-Tashk-Maharloo basin. National Congress of irrigation and drainage, 2014.
5. Mirasi S, Rahnama H. A comprehensive review of the subsidence situation with regard to the injury and its factors and provide appropriate solutions (Case study: Fars and Chaharmahal Bakhtiari Provinces). Bana- Journal of Civil Engineering Association of Iran 2013, (55).
6. Azhdari Z, Maleki Nezhad H, Fath Zadeh A, Hosseini S. Evaluate and determine groundwater balance of Tuyserkan plain. National Conference on sustainable development of renewable natural resources, Hamadan, 2014.
7. Hojjati S, Boostani F, (2009). Sustainable management of Khir- Estahban plains aquifer by using the groundwater balance. Natural Geography Quarterly, Second year,2009 (6).
8. Zarei H, Akhoondali A. Comparing the classic statistical methods and the geostatistical methods in estimating groundwater unit hydrograph in the main plains of Khuzestan. The second National Conference on Management of irrigation and drainage networks, 2008.

1/13/2017