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THE INVESTIGATION OF KHOMEYGAN RIVER DISCHARGE CHANGES IN RAZAN CITY OF HAMEDAN PROVINCE DURING A THIRTY YEARS' PERIOD

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ABSTRACT

Since, water is the main source of economic development, social security, and poverty reduction, and the surface waters due to their availability and low-cost exploitation are as one of the main sources of water supply for human requirements, hence great care should be taken in the management of these waters. Since, one of the ways to effectively use these waters is, understanding the decreasing quantity of water. Primarily, we need accurate information for each correct and exact planning. At this critical water position, meanwhile that hydrology science help to studying about water in the earth and discusses the appearance, revolution and distribution of water in nature, physiochemical characteristics of water, water reactions in the nature and its relation with living beings, hydrological research of the surface waters by collecting the information about the rivers regimes and monitoring their discharge data is useful for the flood forecast, drought control, expansion of water saving operation plans, and other relevant schematization programs. In this paper, the studies have been done on the Khomeygan River, is one of the most important surface water resources in the Razan city of Hamedan province. Then, the diagram of hydrograph, the rainfall trend on the basin of this river, and the discharge changes during the statistical period of thirty years has been surveyed. Eventually, by the geographical condition of Hamedan province of Iran, this information has been shown that the protection and keeping of this river are very significant and essential for the city of Razan due to the urbanization development and industrial growth.

KEYWORDS: Surface Water Management, Hydrological Research, Khomeygan River, Razan City & Hamedan Province.

INTRODUCTION

Since Iran possesses a very low average annual precipitation according to exposure to the arid and semi-arid area, for supply consuming water in agricultural segment, industry and drinking water, the management and preservation of surface waters plays an important role in the whole city of this country. Surface waters are one of the main sources of water supply, therefore, the knowledge about the amount, classification, and illustration of these waters will help us in making administrative decisions to the prevention of drying and destruction of them. In recent years, the use of surface waters is much more than ever due to the accessibility and the low-cost exploitation of them, hence great care should be taken in the management of these waters. One of the ways, to effectively use these waters understands the changes of water discharge relation to the hydro geological regime of them. Because for each correct and exact planning primarily, we need accurate information.

By recognition of the quantitative value of these waters in relation to other factors, we can make an appropriate use of them. The following surveys have been done about Khomeygan river regime, as one of the main rivers of the Razan city in Hamedan province, to monitor the surface water management and other hydrological factors that influence on the amount of water discharge and the discharge changes of this river, during the past three decades. Eventually, for the better optimization of the surface water resources utilization of Khomeygan River, the results have been shared with others, in the form of graphs, tables, and maps.

REVIEW OF LITERATURE

While, studying and understanding the hydrological characteristics of rivers as sources of available surface waters has great importance and special position, except one article about the investigation into the morphology of the Khomeygan river using the Rosgen classification [1], there are no valuable studies regarding the hydrological regime and quantity of water discharge changes and discharge changes of Khomeygan river.

THE OBJECTIVE OF THE STUDY

- Evaluation of the process and the average annual rate in Khomeygan synoptic station
- Evaluation of climate change – temperature and obtaining the de Martonne dryness index.
- Evaluation of the hydrography, water discharge and discharge changes of Khomeygan River.

THE STUDY OF THE AREA

Khomeygan River as one of the main rivers of Razan city has been located in the East of Hamedan Province, which is bordered by Qazvin province in the north, the Markazi province in the East, a Kabudarahang city in the west and the Hamedan city in the south.

Razan with 80 km far from the center of the province has a height of 1841 meters above the sea level and coordinates 49 (20 degrees of east longitude and 35 (23 degrees of north latitude. The next figure shows the geographical location of this city in the Hamedan province of Iran.

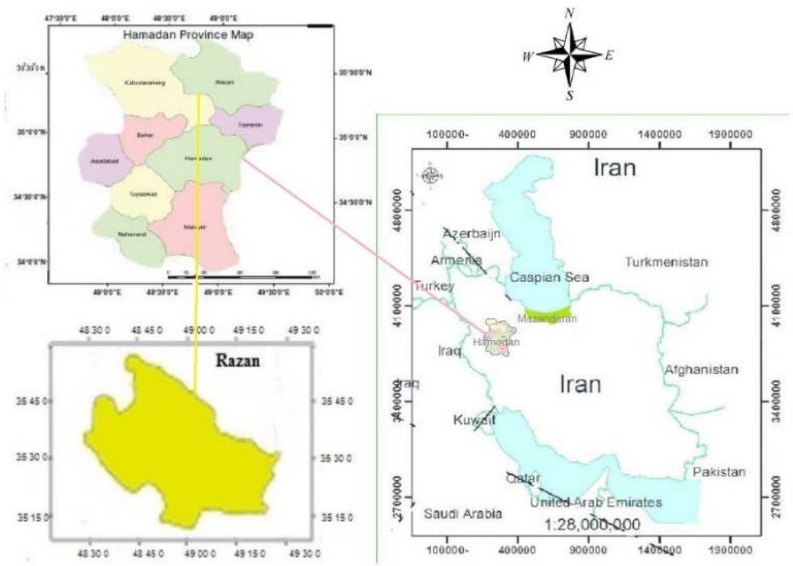

Figure 1: The Geographical Location of Razan city in Hamedan Province

Also, Khomeygan river is located in the northern area of the Khomeygan village within 2 kilometers in the south of Razan city. The next figure has been shown the synoptic station of this village from Razan.

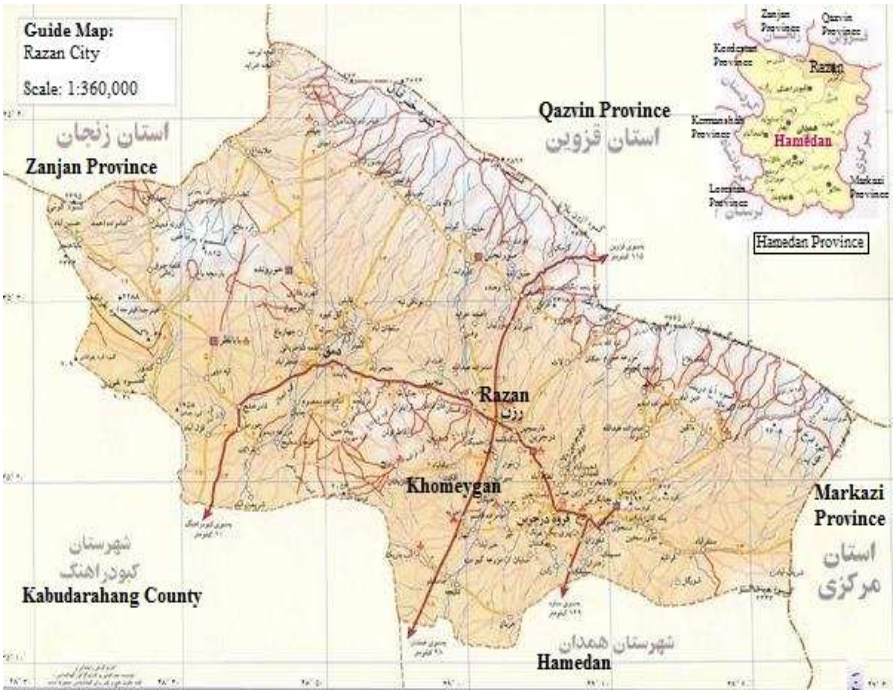

Figure 2: Geographical Location Khomeygan Station in the Study Area

MATERIAKS AND METHODS

The Hydrological Situation of the Study Area

Hydrology is the science of water study and related to the effective factors on forecasting of rainfall, surface water and climate of a region. So, hydrology involves analysis of factors affecting rainfall, droughts, surface floods and fluctuations in surface water. In hydrological studies that include measuring and recording data, data analysis and apply the results in solving various problems, different assumptions are appeared which the final results may not exactly be conformed to the reality, therefore it is not considered as the exact and accurate sciences and only provides an estimate of the truth. Of course, it should be noted that, here, inaccurate means physical – mathematical concept and does not mean that the answers are inconsistent with the truth.

Weather Conditions

Since the weather is one of the most important environmental factors, hence the human knowledge about the weather temperature and climate changes, increasing his abilities about the effects of Influential factors on natural resources and especially water reservoirs. In this paper, the area of study on Khomeygan, due to the large plains in north and northeast of Hamedan province has been situated in the path of severe winds. Air masses easily affect this village.

Other effective factors contributing to the climate conditions of this village included being far from the sea and pressurized streams of north and west cold weathers. According to the reports of the Khomeygan synoptic station, which is located in the village of Khomeygan in the northern area within 2 kilometers in the south of Razan, the absolute maximum air temperature in this village is 36/4, and its absolute minimum is 29/8 and the average temperature is 9/8˚C. Figure 3. Shows the position of Khomeygan synoptic station in the city of Razan.

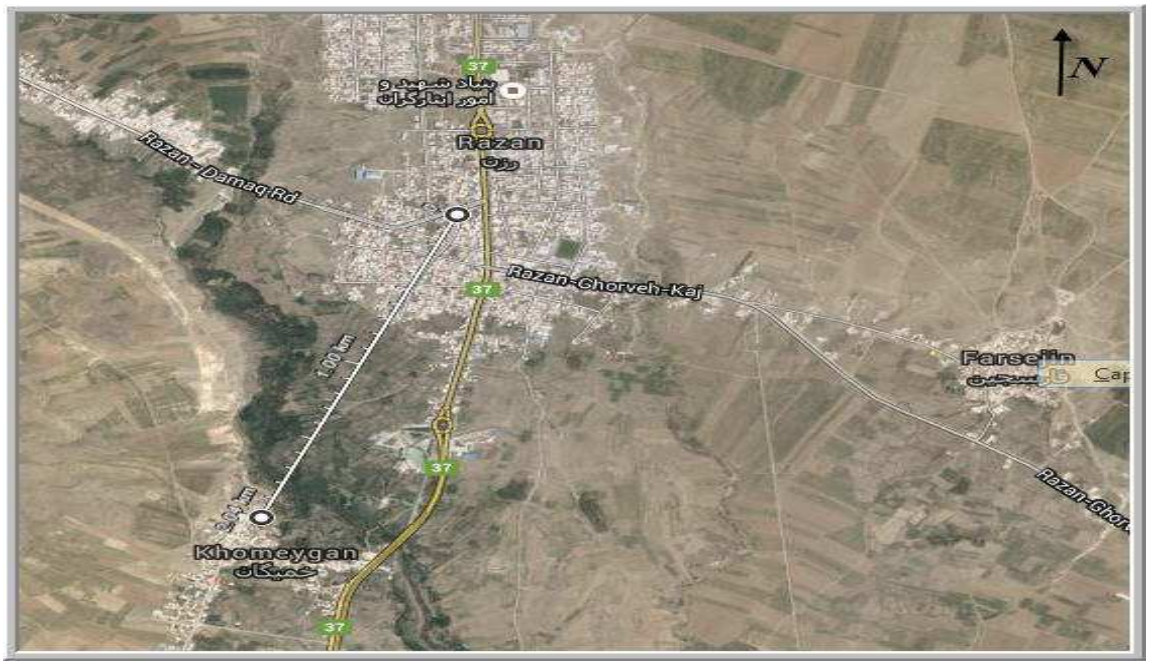

Figure 3: Geographical Location of the Khomeygan Synoptic Station in the City of Razan

Precipitation

Precipitation can be considered as the most important factor which directly involved in the hydrological cycle. When a drop of rain formed in the air, until it reaches the ground level, it's considered as the most key element in the hydrological cycle. However, humidity in the air in terms of quantity compared with the total water in the world is not high, but is the most vital resource for mankind in terms of renewable water supply, because rainfall is actually condensation liquefaction of little particles of water vapor in the air that reach to the ground in the form of rain, snow and so on [2].

According to the available data by Khomeygan synoptic station, the average monthly rainfall (per month) has been prepared during the thirty years' statistical period (1983-2013) in Table 1. To better understand the data, data were analyzed using statistical formulas and Microsoft Excel Software. Then for a further understanding, results demonstrated in the diagram (figure 4).

Table 1: Monthly and annual rainfall statistics in Khomeygan station

Water Year (1983 - 2013)			
Time (Month)	**Average**	**Time (Month)**	**Average**
September	**7.2**	**April**	**39.1**
October	**41.4**	**May**	**6.8**
November	**41.4**	**June**	**2.4**
December	**31.6**	**July**	**2.9**
January	**35**	**August**	**1.7**
February	**34.2**	**Total/ Annual**	**288.9**
March	**46.3**		

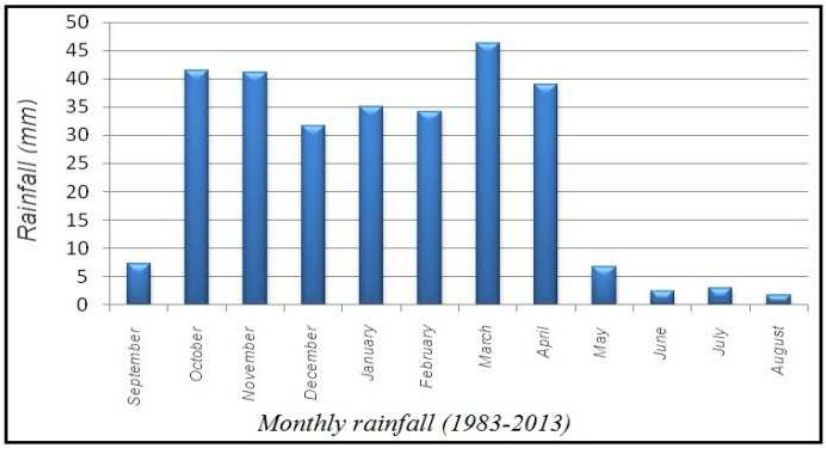

Figure 4: The Average Monthly Rainfall in Khomeygan Station

These results indicate that, the highest rainfall in March and the lowest rainfall occurred, in August, in Khomeygan station. At this station, the precipitation period during the year is usually from twentieth of October to twentieth of May. The average rainfall in this seven month period (October to May) is 38.4 mm per month. This amount compared to average rainfall in other months of the year (20 May to 20 October) which is 4/2 mm per month, is very different. In these times, there is not any significant rainfall at this station. Therefore, the length of a water year based on the amount of rainfall can be divided into two parts included high rainfall months and low rainfall months.

In this station, the average precipitation in high rainfall months (38.4 mm per month) is about 9 times higher than the average precipitation in low rainfall months (4.2 mm per months). It suggests that there is not rainfall balance in this station and the highest rainfall occurs in autumn, winter, and spring and the lowest rainfall are related to the hot season of summer. Also, the average amount of rainfall during this statistical period in Khomeygan station is 288.9 mm per year. To determine the rainfall trend, during the statistical period for Khomeygan station, the total amount of precipitation, during a water year was calculated for the separate and distinct years. Then, the total amounts of rainfall per year were shown in a diagram, as figure 5.

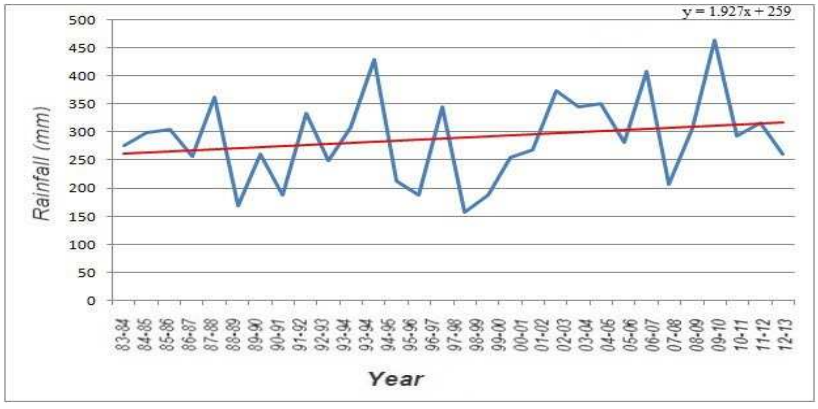

Figure 5: The Precipitation Process in Water Years 1983-2013 Khomeygan Station

For more accurate examination, the line trend of rainfall during 30 year statistical period determined in which the trend line equation is as follows:

$$Y = 1.927x + 259 \qquad \text{Equation (1)}$$

This equation shows that the rainfall trend during this statistical period with the slope of 1.9 has an upward slope. This can be due to increased rainfall in this period or accurate measure of rainfall in Khomeygan station has been increased in recent years. In Khomeygan, the most precipitation in water year of 2009-2010 reported equal 464.5 mm and the lowest amount of precipitation in the water year of 1998-1999 equal 157.3 mm in the synoptic station.

Temperature

In general, temperature reviews in each zone concentrated on the five temperature parameters included the average of maximums, absolute maximum, the daily average temperature, absolute minimum and the average of minimums. Since in investigating thermal regime, due to greater stability of temperature of precipitation, the average monthly changes from one year to another is inconsiderable, in this section, the data analysis has been done by using the annual average of 30 years' statistical period. At the current survey, the average annual temperature of the Khomeygan station, during a thirty years' statistical period has been obtained equal to being 12.3°C.

Evaporation

In hydrology, engineering, evaporation is important from two aspects, firstly, since evaporation from rivers, lakes, and reservoirs cause water losses, it is essential to calculate the amount of it, secondly, evaporation and transpiration from the soil surface and herbal coverage (vegetation) within the watershed basins is considered as one of the components of the water cycle. According to the information which obtained from the regional water in Razan city, the average annual evaporation is estimated equal to 1972.6 mm in the Khomeygan station.

Climate

The climate in Persian pronounced as /eqlim/ is an Arabic word which is called "weather (atmospheric conditions)" in Persian. The word climate originates from a Greek word "clima" meaning tendency, which refers to the tendency of the sun. But in hydrology, meteorological factors investigated and what is important is to put basin or area of the study into one suitable climatic group in order to use them to interpret hydrological calculation results and to ensure the achievement of more reliable results (Alizadeh, 2009).

Thus, the climate is atmospheric parameters determining a region's weather conditions, regardless of the time of their occurrence. There are different ways to determine the climate, but in this study, the method of the motion has been used which is described below.

De Martonne Aridity Index

In de Martonne classification, aridity index I, have a direct ratio with rainfall and an inverse ratio with the average annual temperature. So, increased I, indicates the high humidity and decreased I, indicates the drought in the region. This classification is based on the average annual temperature. The de Martonne aridity index is calculated by the equation 2.

$$I = \frac{P}{T+10}$$

Equation (2)

Where, P is the average of rainfall and T the average of temperature in Centigrade. According to de Martonne formula, there are six kinds of weather classification which came in Table (2).

Table 2: Different Types of Climate Based on De Martonne Classification

De Martonne Aridity Index Range	Climate Type
10<	Dry/arid
9/19 to 10	Semiarid
9/23 to 20	Mediterranean
9/27 to 24	Sub-humid/Semi humid
9/34 to 28	Humid
35>	Too humid

According to the information given above, the average rainfall of Khomeygan is 288.9 mm per year, and the average temperature of weather is 12.3˚C. Based on de Martonne formula, I is equal to 12.9, which shows the semiarid climate for this region.

The Hydrological Situation of Khomeygan River

According to the geographical position of Khomeygan, that has been located in the semiarid climate, the surface water flow of this river is seasonal. This river originates from the northern highlands of Ozun Bolagh, Khalaj, Dolat Abad and Vafas, and flows to the southward and in the southern part passes near the villages of Saravak, Negar Khatun, and Jahan Abad villages and finally sheds to the Qara Chai River. Figure 6, shows a view of Khomeygan River in Vafas Region.

For further study about the Khomeygan River, the statistical data of discharge of this river has been collected during a period of 30 years. Then these statical data analyzed in Microsoft Excel software that for examining the obtained results of formulas, these statistics is presented in Table 3.

Figure 6: A view of Khomeygan River (picture direction to the south)

Table 3: Statistical discharge of Khomeygan River in Khomeygan hydrometric station.

Water Year (1983-2013)	The Average Discharge(m^3/s)			
	Annual		Monthly	
	September	0.015	Average	0.192
	October	0.072		
	November	0.158	Maximum	2.985
	December	0.165		
	January	0.183	Minimum	0.005
	February	0.401		
	March	0.866	Million cubic meter	6.301
	April	0.358		
	May	0.045		
	June	0.016	Momentary water discharge	7.767
	July	0.026		
	August	0.009		

For this purpose, the total flowing discharge in each month of water year specified then, the average flowing discharge of each month (for example the average flowing discharge of March in the years of 1983 to 2013) calculated in the total statistical period. The average discharge of this river during the statistical period is 0.192 cube meter per second (6.301 million cubic meters in the year).

The hydrography diagram of figure 7, shows the changes of average monthly discharge of Khomeygan River, during the statistical period of thirty years. The maximum discharge of the river is in March, with 0.866 cube meters per second, and minimum discharge is in August with 0.009 cube meters per second. The highest amount of discharge in this river is in accordance with the most precipitation around this station. The average discharge of this river is 6.301 million cube meters in the year. Over-hydration period started from twentieth in November, and continues until the twentieth of May. The average discharge of the river during over-hydration is 0.355 cube meters per second. The dehydration period started from twentieth in May, and continues until the twentieth of November.

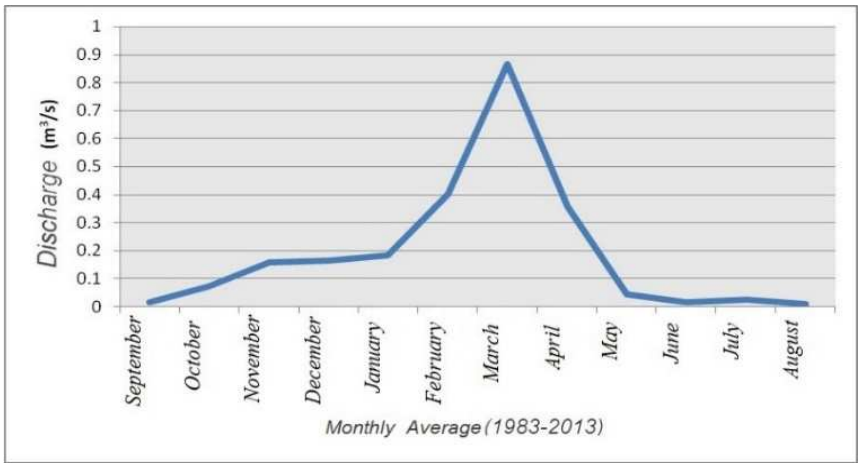

Figure 7: The Hydrograph of Khomeygan River (Monthly Average of Water Year 1983-2013)

The period of this river is in accordance with the low precipitation around this station. Typically, during the dehydration period, base discharge flows in Khomeygan River. The average discharge of the river in dehydration period is equal to 0.0305 cube meters per second. The average discharge in over-hydration period is 11.6 times more than the average discharge in dehydration period. The over-hydration period is in accordance with the seasons of autumn, winter, and early spring and dehydration period is accordance with the summer season. To view the trend of the discharge changes in the Khomeygan River, during the statistical period, the amount of discharging of them per water year determined in the three parameters of maximums, medium, and minimum, which the trend of discharge changes has been demonstrated in figure 8.

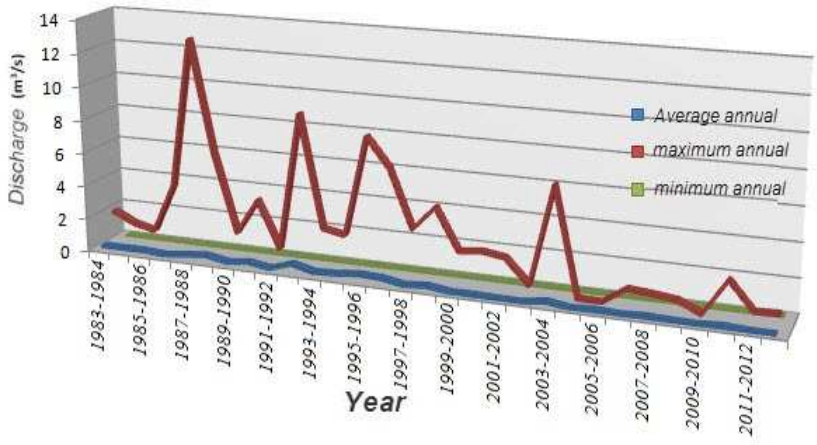

Figure 8: Discharge Changes of Khomeygan River (The Yearly Average, Maximum and Minimum)

The diagram represents the maximum discharge of river per water year, which this period conformed to over-hydration of each water year. The lowest amount of river discharge also happened in a drought period that even the base flow reached zero. According to the annual maximum discharging graph, it can be realized that during the statistical period, river discharge has the subtractive trend. The maximum and minimum discharges of the river are useful for analyzing short-term periods such as torrential and drought periods, so for accurate determination of trend changes of river discharge the average annual discharge is used. Figure 9, shows the average annual discharge changes of the Khomeygan River, during the statistical period. The trend of river discharge changes is according to the following equation:

$$Y = -0.010x + 0.348 \qquad \text{Equation (3)}$$

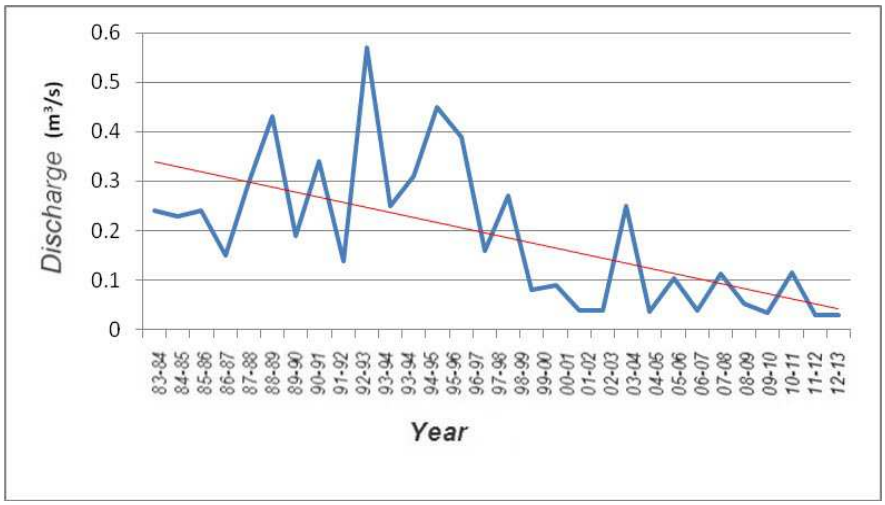

Figure 9: The Process of Discharge Changes in Khomeygan River During the Statistical Period

This equation shows that, the river discharge changes, during the statistical period are with the slope of 0.01 is descending. This suggests that, whether precipitation has a descending trend in this period, or the use of river water for agricultural and industrial consumptions increased in this period. Interestingly, the highest discharge rate in the year of 1991-1992 was about 0.57 cube meters per second, and the low discharge rate in the year of 2010 to 2012 was about 0.03 cube meters per second, respectively.

RESULTS

According to the statistical data during the thirty years' period (1983-2013) it's clearly obvious that although the precipitation during this period has increased a little more, the use of river water for agricultural and industrial consumptions has also increased far more during this thirty years' period.

CONCLUSIONS

Iran possesses a very low average annual precipitation due to exposure to the arid and semi-arid area, hence the surface waters play an essential role in supplying consuming water in agriculture, industry and sometimes drinking water. Urban growth, the increase of industrial activities and indiscriminate use of chemical fertilizers in agriculture caused surface water decrease and contamination of them which are harmful for human health, animals, and plants. Nowadays, in most of developing countries and the third world (underdeveloped countries), the most attention is concentrated on finding the most suitable groundwater aquifers to supply water for drinking, agriculture, and industry while less attention is paid to the resources of surface waters. Water shortage in Iran is considered as one of the main limiting factors for the development of economic activity in the coming decades.

Achieving a relative balance of supply and demand of water is an essential and necessary principle which is not possible without creating a comprehensive system of water management. In the new global attitude, water is an economist-social goods and a basic human need. Although water is a renewable resource, its amount is limited. Since due to the population growth, industrial development, and increasing levels of health and welfare, renewable resources per capita is declining, protection and care more than ever about the quantity and quality of surface water resources should be taken into consideration in the needs of the related authority's duties, and the greatest care must be taken in the management of these waters according to the scarcity and level reduction of these resources in near future years.

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