The International Journal of Engineering and Science (IJES)
|| Volume || 6 || Issue || 9 || Pages || PP 49-60 || 2017 ||
ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

The Climate Survey of Razan-Qahavand PlainThrough de-Martonne Aridity Index

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ABSTRACT
With the warmer atmosphere, more water evaporates from the oceans and land. Climate change is one of the most important global environmental challenges facing humanity with implications for food production, the supply of drinking water and health. Since the impact of this phenomenon is more severe in the developing countries including Iran, so the cognition of the drought is needful for describing the features of geographical prospect in main cities of these countries, the main objective of this paper is to survey the climate of Razan-Qahavand plain in Hamedan province through the de-Martonne aridity index. During this study, the statistical data of four synoptic station in Razan-Qahavand plain collected and analyzed. According to this fact that growing dryness of this plain due to the universal warming in association with desertification can be an actual peril for the people who live in this area, this study conducted for the prevention of worsening this situation and as a warning alarm.
Keywords: climate changes; de-Martonne, Razan-Qahavand plain, synoptic stations, desertification.

Date of Submission: 15 Aug 2017 Date of Accepted: 17 Sep 2017

I. INTRODUCTION

Human beings are at the interface of physical, geological and biological processes of the earth and any fundamental global environmental change, affecting these systems will have a drastic impact on human health in various ways. Climate parameters play an influential role as one of the abiotic factors of the environment around us. Any change in climate parameters will, therefore, impart a change directly or indirectly on human well-being. The climate is explained as an interactive intricate and multiplex system between living things which involving the rainfall, snow, and ice, and in generally atmosphere, seas, oceans and other water resources in the land surface. Climate change refers to a statistically significant change in either the mean state of the climate or in its variability (in terms of temperature, atmospheric pressure, precipitation status etc.) persisting for an extending period (typically decades or longer). Since the climatic variability and occurrence of extreme weather events are the major concerns linked to global warming, hence this paper through the de- Martonne aridity index formula has been investigated the climate situation of Razan- Qahavand plain in Hamedan province in the following. Focuses on compilation and analysis of the past three decades (1983-2013) climatic data (temperature, and rainfall) of four synoptic stations of this area has been led to understanding the climatic position of this plain. The significance of this study lies in the fact that the ground of this area is warming and there are certain variations at the regional level with respect to climatic variability in terms of temperature and precipitation pattern which in the following this issue has been investigated with details.

1.1 Background of the study

The impact of continuously changing climate is more in developing tropical countries. In developing countries, human beings are already under stress by the increasing problem of population growth, urbanization coupled with mismanagement of natural resources and unhygienic living conditions. Hardly any developing nations have directed national appraisals of the potential impacts of climate alteration on human wellbeing to comprehend the present powerlessness betterly and to assess the nation's ability to adjust to environmental change by altering the wellbeing framework or by receiving particular measures. However the national level studies do not address important inequalities within the country or cities, and so do not focus on the impacts of climate change on the most vulnerable population. It has been realized that in theory, national assessments should provide important information for the global assessments of regional and local vulnerability.

In practice, this has proved it is difficult to achieve because only a few national assessments have been undertaken. Assessments should be region-driven and reflect local environmental and health priorities. Moreover, it is noteworthy that cities dweller of the developing nations are comparatively more vulnerable to the health impacts of climate change. In an urban infrastructure, the ultimate response to climate change impacts is to strengthen the resilience of cities, which may not be achieved quickly enough to elude an increased burden of disease due to global climate change. Especially in cities of developing countries, where adaptation strategies are not prioritized, initiation of the planning process itself is a prime obligation.
Iran is one of the developing countries facing various problems on health issues. Hamedan is the fourteenth most populous city in Iran, which is stressed by the increased urbanization and population growth. In cities of developing countries like Iran, there is the lack of reliable health data to study the climate change impacts and vulnerabilities on human health. Therefore there is a need to carry out a temporally and spatially specific climate change research. There is a need for a more active input from the health sector to ensure that development and health policies contribute to a preventive approach to local and global environmental sustainability, urban population health and health equity and the need for cities to be a focus in the development of climate adaptation strategies is becoming more urgent. With constraints of available data, a detailed cadastral level research on climate change impacts and vulnerabilities on human health in Razan-Qahavand plain of Hamedan province has been investigated.

1.2 Study of the area

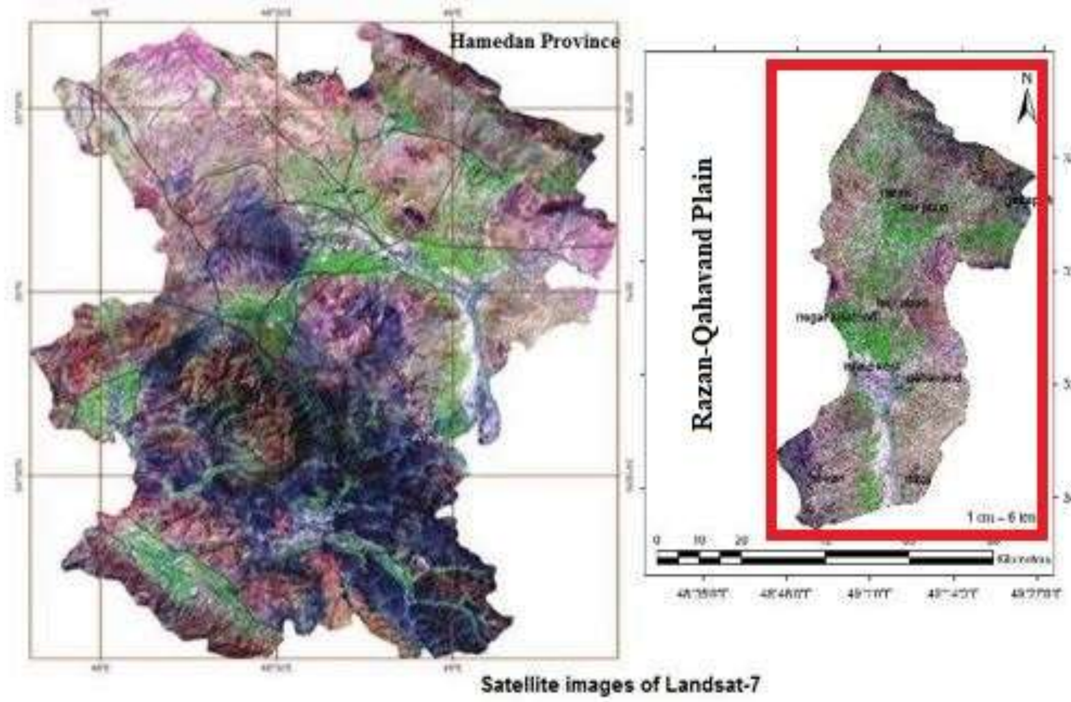

Figure 1: The location of the study area

Razan-Qhahavand basin is located in Northeast of Hamedan province and is considered as one of the plains of the Qara-Chai basin. The study area of Razan-Qahavand is imaginable in the form of a rectangle in the direction of north-south where Razan city is located on the northwest border and Qahavand in the southern part of the region. This region has an area of 3083 square kilometers in the position of 48° 40' 0" to 49° 20' 0" of the East and 35° 50' 0" to 35° 30' 0" of the North (Figure 1).

1.3 Review of literatue

Although the study on climate change compasses various disciplines viz science, social science, management, and law. With a view to these multidimensional aspects and bringing together the scientific issues and the investigation of the different subject and factual reports, despite this fact that this plain plays an important role in the lives and destiny of the people of this region, there is no significant research on climate change like this has taken place in this region till now.

1.4 Objectives of the study

- To evaluate the annual, and monthly rainfall trends basis at four meteorological subdivisions, according to the various synoptic stations of the study area.
- To look at the changes in the extreme weather events, namely, extreme temperature, evaporation and rainfalls, floods, and drought.
- To find out the climate changes and its category through the aridity index of the de-Martonne method.

In the other hand, since this study will concern to assess the trends in some important weather parameters particularly and rainfall in Razan-Qahavand plain of Hamedan province at monthly and annual scale, and thus, it will help us to know whether urbanization in this location is leading to any kind of climate change.

II. DATA AND METHOD

This study conducted on climate change of Razan-Qahavand plain of Hamedan province with the help of de-Martonne aridity index. The De Martonne index is an index which by uses the rainfall and temperature enable the appraiser possibility of the climate situation and condition of climate alterations. This study has been investigated the climate change with the statistical data which has been taken from four synoptic stations in Razan-Qahavand plain during three decades from 1983-2013.Then by using de-Martonne formula the climate of this region in accordance with the changes of rainfall trend and weather temperature has been classified into an appropriate category.

2.1 Weather Conditions

Weather is one of the most important environmental factors on the earth. Whatever the human knowledge about the weather is increased, his capability in using natural resources will be more and hence he can do better forecasting about the effects of climate changes. Weather is the set of physical, chemical and biological factors that specify the local climate and affect the habitat and behavior of living being on that region. To study about the climate of a region, long – term statistics are needed based on the accurate criteria. In the following, some climate characteristics of Hamedan province have been studied (Alizadeh, 2006).

In the northeast and east of Alvand highlands among the Mount Alvand and Mount Garin, there are lowlands and smooth plains. Vast plains of north and northeast of province are in the path of severe winds. Air masses easily affect these areas. The seating of these plains in the vicinity of the highlands and mountainous areas cause the severe winds in the province, for this reason, Hamedan province is one of the windy areas of the country and most cities of Hamedan province located in the highlands.

The average wind speed in Hamedan province has been reported 4 meters per second. Other effective factors contributing to the atmospheric conditions of this province included being far from the sea and pressurized streams of cold weathers of north and west. In general, the highlands of the province have cold and alpine weather and its southern areas – Malayer and Nahavand – have mountainous temperate weather. According to the reports of Hamedan synoptic stations, Nojeh, the absolute maximum air temperature in this province is 8.36 ˚C, and its absolute minimum is -6.29 ˚C and the average temperature is 6.9˚C.

The hottest months of the year are June and July with a maximum temperature of 35˚C and the coldest months of the year are in December and January with the average temperature of - 4.25˚C (Regional water of Hamedan province, 2015). According to this report, the annual rainfall is more than 300 mm which is changeable in different months of the year, so that in March is up to 95 mm, in April 82 mm, in May 81 mm and in other months is changeable proportional to the season. Hamedan province with 143 days of frost in a year is one of the coldest regions in Iran. The coldest months of the year are December, January, February, and sometimes March. Blowing wind in the province continues almost in all months of the year. Different types of blowing winds in this province included:

- North and northwest winds that blow in spring and winter seasons and often are wet and pluvial.
- West – east winds mostly blow in the autumn season.
- Local winds, which arise due to the pressure difference between the highlands and plains, such as one local mild wind (Kur Wind) in the area of Asad Abad (Regional water of Hamedan province, 2015).

2.2 Precipitation

Precipitation can be considered as the most important factor that is directly involved in the hydrological cycle. When a drop of rain formed in the air, until it reaches the ground level, it considered as the most important 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 a lot 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 (Alizadeh, 2006).

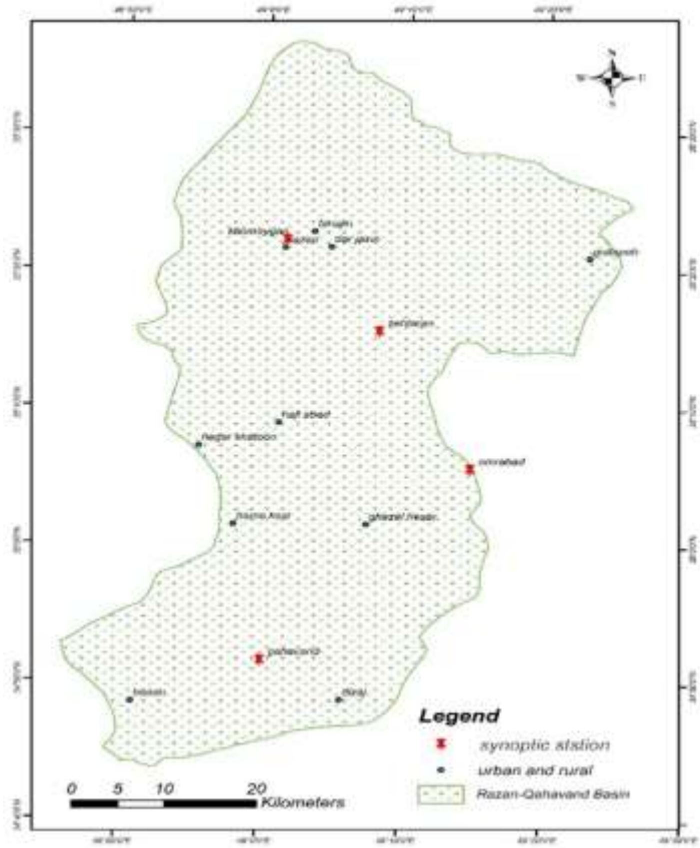

Figure 2: The position of synoptic stations in the study area.

Precipitation is one of the most important factors that which is effective directly or indirectly on the groundwater potential of apt and prepared formations to save water. The amount and type of atmospheric precipitation vary depending on climate and highlands of the region. Whatever, the amount and volume of rainfall in the area are more (taking into account the other conditions being equal), the amount of penetrated water into the groundwater table increase and thus discharge from this table and aquifer increase, too. The type of precipitation and its amount is effective on the rate of infiltration. In this way, the torrential and sudden rainfall produce large volumes of runoffs that compared to gradual precipitation or snowfall which have more opportunity for penetration, have less runoffs. There are four rain gauge stations in the study area of Razan – Qahavand plain included Khomeygan, Zehtaran, Qahavand and OmrAbad. Figure (2) shows the position of synoptic stations in the study area. In the following, statistics and characteristics of each station is presented.

2.2.1 Khomeygan station

Khomeygan station is in the northern area with 2 kilometers distance from south of Razan city and is located in the village of Khomeygan. The statistics of precipitation in this station during a period of 30 years (1983-2013), were collected from the Regional Water in Hamedan province.

To better understand the available data, data were analyzed using statistical formulas and Microsoft Excel Software. According to available data, the average monthly rainfall (per month) prepared during the statistical period (table 1). For a better understanding, results demonstrated in a 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**		

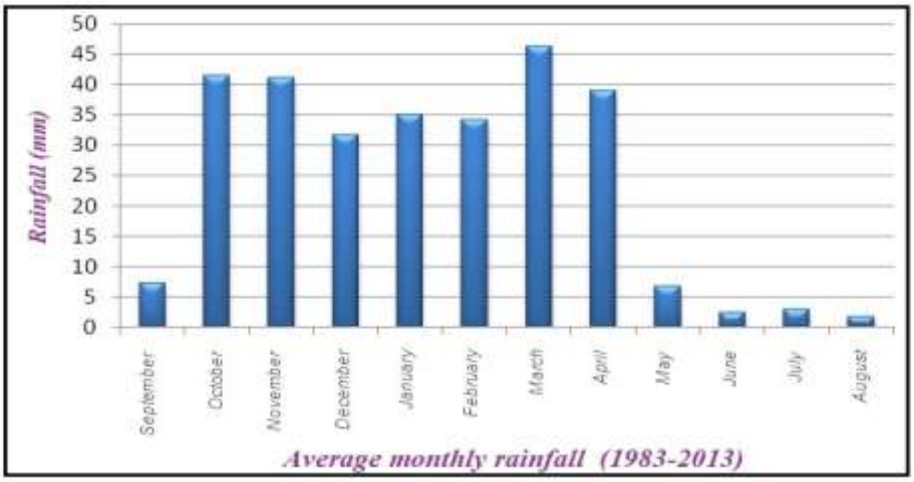

Figure4: The average monthly rainfall in Khomeygan station

These results indicate that the highest rainfall in March and the lowest rainfall occurred in August in Khomeygan station. In this station, the rainfall period during the year is usually from twentieth of October to twentieth of May. The average rainfall in this seven months' period (twentieth of October to twentieth of May) is equal to 38.4 mm per month.

This amount compared to average rainfall in other months of the year (twentieth of May to twentieth of 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 (2.4 mm per months). It suggests that there is not rainfall balance in this station and the highest rainfall occurs in the autumn, winter and spring seasons and the lowest rainfall is 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 rainfall during one water year were calculated for the separate and distinct years. Then, the total amounts of rainfall per year were shown in a diagram as a figure (5).

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

$$y = 1.927x + 259 \quad \text{Equation (1)}$$

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. The most amounts of precipitation in the water year of 2009-2010 reported equal to 464.5 mm and the lowest amount of rainfall in the water year of 1998-1999 reported equal to 157.3 mm in this station.

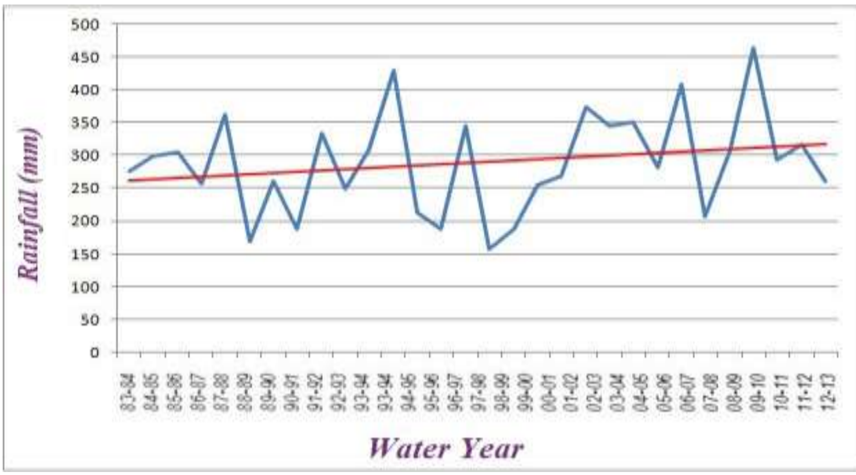

Figure 5: The precipitation process in water years 62-92 Khomeygan station

2.2.2 Qahavand station

This synoptic station is in Qahavand city within 40 kilometers distance from east of Hamedan and located in the south of Razan – Qahavand plain.Precipitation statistics in this station during a period of 30 years (1983-2013) were collected from Regional Water of Hamedan province. To search for hydrological features in this area (Qahavand), data were analyzed using Microsoft Excel Software and statistical formulas. Average monthly rainfalls (per month) were obtained during 30 years' statistical period (table 2). To show detailed data, we put them in a graph as figure (6).

Table 2: Monthly and annual rainfall statistics in Qahavand station

Water Year (1983 - 2013)			
Time (month)	**Average**	**Time (month)**	**Average**
September	**6.5**	**April**	**33**
October	**37.3**	**May**	**6.1**
November	**32.7**	**June**	**2.7**
December	**24**	**July**	**1.7**
January	**27.6**	**August**	**1.7**
February	**31.1**	**Total/ Annual**	**244.3**
March	**39.9**		

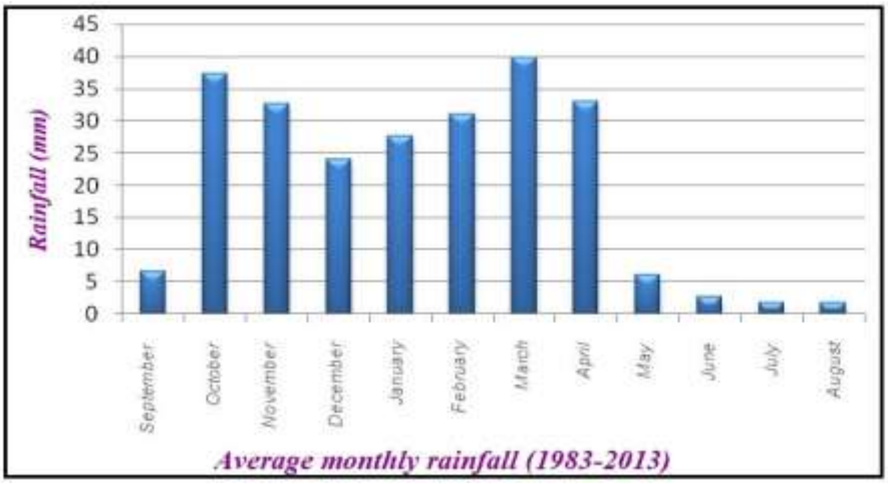

Figure 6: The average monthly rainfall in Qahavand station

This graph shows that the highest precipitation occurred in March and the lowest occurred in August and September in Qahavand station. The average amount of rainfall during this statistical period in this station is 244.3 mm per year. In this station, precipitation period started from twentieth of October and will continue until the twentieth of May. This period in accordance with the fully rainy period of the water year. Low precipitation period includes the months of twentieth of May to twentieth of October.

The average rainfall in rainy months is equal to 32.2 mm per month and the average rainfall in low precipitation months is equal to 3.7 mm per month. Therefore, the average rainfall in high precipitation period is 8.7 times more than average rainfall in low precipitation period. So, the rainy period is in autumn, winter and early spring seasons and low rainfall period is in the summer season. Rainfall trend during the statistical period for Qahavand station obtained using the total precipitation in each water year. Then, the amount of annual rainfall toward water year in this station demonstrated in a graph (figure 7). The precipitation trend line in this statistical period is as follows:

$y = 3.150x + 195.4$ Equation (2)

This equation shows that precipitation trend in Qahavand station during 30 water years with the slope of 3.15 has an upward trend. The upward trend of precipitation in this station can be due to the high rainfall in this period or high accuracy in measuring rainfall with using the more accurate rain gauge. Of course, increasing rainfall in this period (30 years) does not have an acceptable reason because average rainfall in a region is usually steady so accuracy in station measurements can be an important factor in the upward trend shown above. Most amount of precipitation in Qahavand station during the statistical period, in the water year of 1994-1995 is 434.5 mm and the lowest amount of precipitation in water years of 1988-1989 and 2007-2008 is 119 mm.

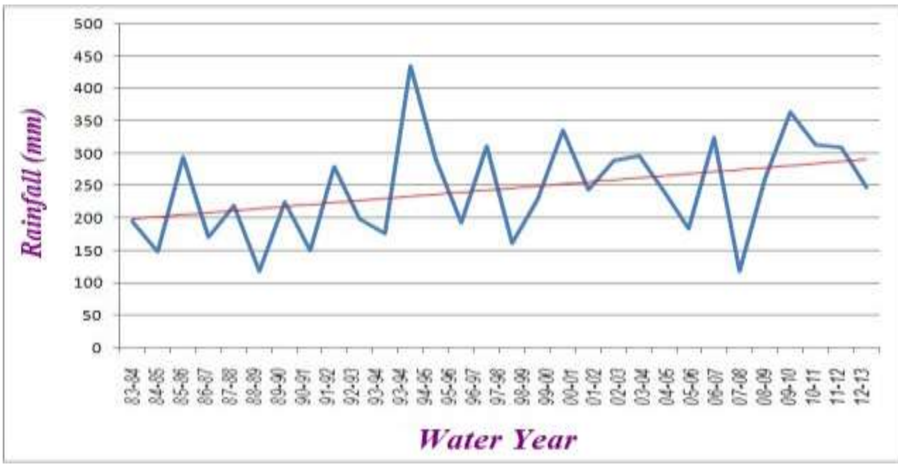

Figure 7: The precipitation process in water years 1983-2013 Qahavand station

2.2.3Omrabad station

This station located at a distance of 33 km of northeast of Qahavand and also in 37 km of southeast of Razan city in Omrabad village near the eastern border of the study area. The rainfall statistics in this station during a 30 years' period (1983-2013) was taken from Regional Water of Hamedan province (table 3). To investigate the characteristics of the region, data were analyzed using Microsoft Excel Software and statistical formulas.

Table 3: Monthly and annual rainfall Statistics in Omarabad station

Water Year (1983 - 2013)			
Time (month)	**Average**	**Time (month)**	**Average**
September	**6.7**	**April**	**34.4**
October	**36.2**	**May**	**6.9**
November	**30.6**	**June**	**3.9**
December	**29.1**	**July**	**1.7**
January	**32.4**	**August**	**1.4**
February	**30.6**	**Total/ Annual**	**255**
March	**39.8**		

The average monthly rainfall during 30 years' statistical period in Omarabad station was prepared (graph 8). According to this graph, the most amount of precipitation occurred in March and the lowest precipitation occurred in July and August. Also, the average rainfall during this statistical period in this station is 255 mm per year.The rainy period in this station started from twentieth of October and will continue until the twentieth of May. The average rainfall in rainy period is equal to 33.3 mm per month. Low precipitation period continues from twentieth of May to twentieth of October in which the average rainfall is equal to 4.12 mm per month. The average rainfall during rainy period is 8 times more than average rainfall in low precipitation period. Rainy period in this station are in autumn, winter, and early spring and low rainfall is in the summer season.

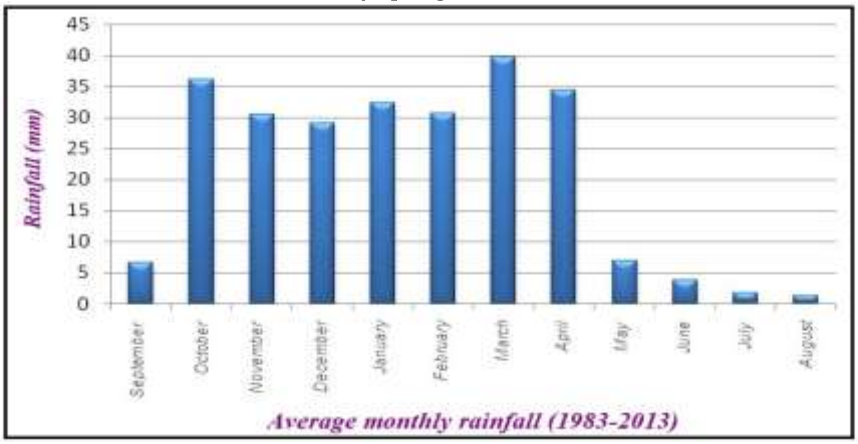

Figure 8: The average monthly rainfall in Omarabad station

To determine rainfall trend in Omrabad station during the statistical period, total precipitation in each water year were obtained. The total precipitation in each year toward the statistical water year period demonstrated in a graph (9). Rainfall trend line in this station determined as follows:

$y = 2.255x + 221.1$ Equation (3)

This equation shows that rainfall trend in this station during 30 years' statistical period, with the slope of 2.25 is upward. This upward trend can be due to the increase of rainfall during 30 years' period and the main reason this can be included the increased accuracy in rainfall measurement, using accurate rain gauge in this station or using experienced experts. The most amount of precipitation in Omrabad station in years of 1998-1999 is equal to 120.5 mm per year.

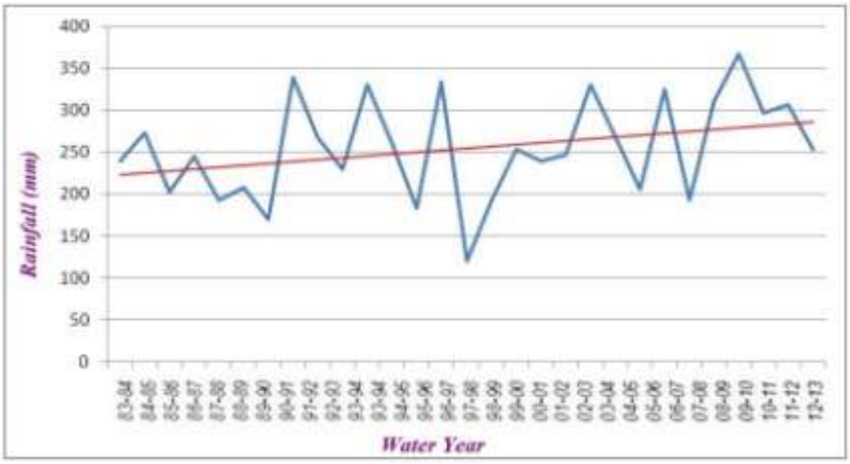

Figure 9: Rainfall process in water years of 1983-2013 in Omarabad station.

2.2.4 Zehtaran station

This station located at a distance of 17 km in southeast of Razan city and near Zehtaran village in study area. The rainfall statistics in this station during 30 years' period (1983-2013) taken from the Regional Water in Hamedan province. Data were analyzed using Microsoft Excel Software and statistical formulas (table 4).

Table 4: The monthly and annual rainfall data in Zehtaran station

Water Year (1983 - 2013)			
Time (month)	**Average**	**Time (month)**	**Average**
September	**9.3**	**April**	**3.37**
October	**3.37**	**May**	**8.5**
November	**6.33**	**June**	**7.3**
December	**27**	**July**	**9.1**
January	**5.34**	**August**	**6.0**
February	**2.37**	**Total/ Annual**	**266**
March	**4.47**		

The diagram in figure (10) shows the average monthly rainfall in Zehtaran station during 30 years' statistical period. This graph shows that the most precipitation occurred in March and the lowest precipitation occurred in August in Zehtaran station. Also, the average rainfall during this statistical period in Zehtaran station is 266 mm per year. In this station, the rainy period started from twentieth of October and will continue until twentieth of May which the average rainfall in this period is equal to 36.3 mm per month.

The low rainfall period started from twentieth of May and will continue until twentieth of October which the average rainfall in this period is equal to 3.18 mm per month. The average rainfall in rainy period is 11.4 times more than average rainfall in low precipitation period. Rainy period is in autumn, winter and early spring and low rainfall period is in the summer season.

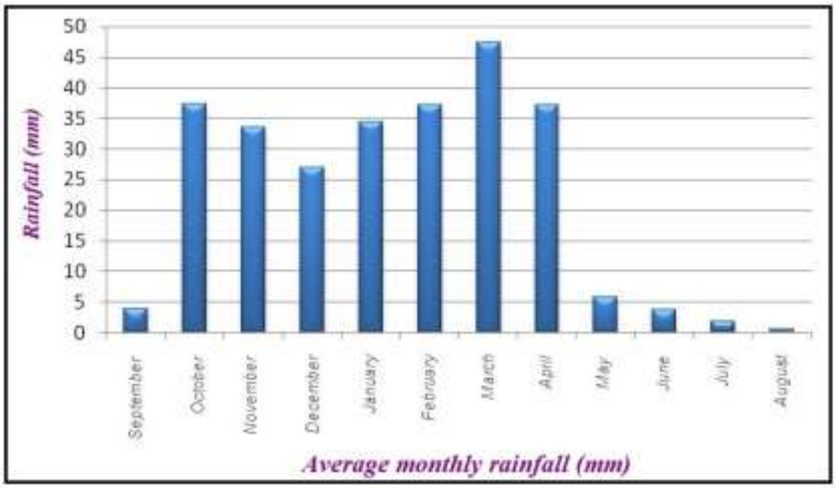

Figure 10: The average monthly rainfall in Zehtaran station

To determine rainfall trend in Zehtaran station during 30 years' statistical period, the total precipitation in each water year were obtained cumulatively. The total precipitation in each year toward statistical period water year demonstrated in a graph (figure 11).

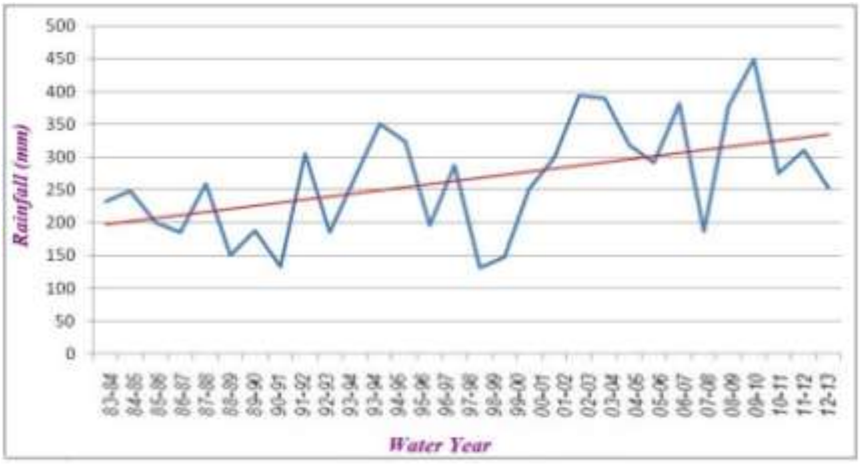

Figure 11: Rainfall process in water years of 1983-2013 in Zehtaran station.

The rainfall trend line in this station determined as follows:

$y = 4.777x + 191.9$ Equation (4)

This equation shows that rainfall trend around this station with the slope of 4.7, during this 30 years' statistical period has an upward trend. This trend is due to the increased rainfall in this area or more accuracy in rainfall measurement in this station. To investigate the correctness of this subject, the discharge data of flowing rivers in this area during mentioned statistical period can be checked. This operation discussed and analyzed in the other parts of this chapter. The most precipitation in Zehtaran station in the water year of 2009-2010 occurred 448.5 mm and the lowest precipitation in the water year of 1998-1999 occurred 132 mm.

III. TEMPERATURE

All exploration results demonstrate that the energy of the radiation received to the earth will advance all earth's physical and biological processes. Inequality radiation reaching the earth surface causes temperature differences and the resulting pressure differences which cause the motion creating in the atmosphere and finally creates the atmospheric position which leads to the climate existence in a long-term series.The factors that determine the thermal state of one region includes a mix of wet temperature, dry temperature, dew point, soil surface temperature, water temperature, thermal amplitude changes of the heat and cold units. The above mentioned thermal factors depend on the geodetic latitude, height from sea level, distribution of land and sea, ground roughness's and topography of the land, oceanic currents, motion modes of other systems especially dynamic motion of air masses and so on (Alizadeh, 2006).Generally, investigating temperature in each zone concentrated on the five temperature parameters included the average of maximums, absolute maximum, daily average temperature, absolute minimum and the average of minimums. Since in investigating thermal regime, due to the more stability of temperature to precipitation, the average monthly changes from one year to another year is least so, in this part, the annual average (during 30 years' statistical period) has been used. Table (5) shows the average annual temperature in region stations.

Table 5: The average annual temperature in study area stations

Station	Average Temperature (C^{o})
Khomeygan	**12.3**
Qahavand	**13.1**
Omrabad	**11.8**
Zehtaran	**12.1**

3.1 Evaporation

The process of converting water to steam called evaporation. Evaporation may occur from free levels of water, moist levels of soil and through the transpiration process from the surface of plants. Evaporation measurement among different phenomena of the hydrological cycle is the most difficult of them. In hydrological engineering, evaporation is important from two aspects, firstly, since evaporation from the dams' reservoirs and surface of rivers and lakes cause water losses it is essential to calculate the amount of it, secondly, evaporation and transpiration from the soil surface and vegetation (herbal coverage) within the watershed basin is considered as one of the components of the water cycle.The amount of evaporation depends on different factors such as sunlight radiation, temperature, relative humidity, wind speed, also geography and topography of the region, geodetic latitude and the distance from the production resource of humidity (Alizadeh, 2006). The amount of annual evaporation from the basin of class A in hydrometric stations in the region during 30 years' statistical period was examined which the table (6) shows the average annual evaporation during this statistical period in each station.

Table 6: The average annual evaporation in study area stations

Station	Average Evaporation(mm)
Khomeygan	**1972.6**
Qahavand	**1682.9**
Omrabad	**2468.6**
Zehtaran	**2214.7**

IV. CLIMATE

Climate in Persian pronounced as /eqlim/ is an Arabic word which means "clime changes of territory due to atmospheric conditions" in Persian. The word climate originates from a Greek word "clima" meaning tendency which refers to the tendency of the sun. Climate is the result of simultaneous effects of meteorology phenomena and demonstrates the average air condition at an arbitrary point. Therefore, when we discuss about the climate of a region, we don't consider the temporary moments or don't propose the interim time.

For example, when we say that one region is tropical, it refers to the general climate of that region and it is possible that the weather be very cold in a particular year of that region. Of course, the climate has a broader meaning and not confined only to meteorological parameters but involves physical, chemical, environmental and cultural factors.But in hydrology, meteorological factors investigated and what is important is to place basin or area of the study into one suitable climate classification in order to use them to interpret the hydrological calculation results and to ensure the achieving of more reliable results (Alizadeh, 2006). Thus, the climate means atmospheric parameters determining a region's weather conditions regardless of the time of their occurrence. There are different ways to determine the climate that the method of de-Martonne has been used in this study which is described below.

4.1 de Martonne aridity index

In de Martonne classification, aridity index I has a direct ratio with rainfall and has an inverse ratio with the average annual temperature. So, increased I shows the high humidity and decreased I shows the aridity (dryness) of the region. This classification is based on the average annual temperature. De-Martonne aridity index is calculated by the next equation (5).

$$I = \frac{P}{T+10} \quad \text{Equation (5)}$$

In this equation, P is the average rainfall and T is the average of temperature in terms of Celsius degree. According to de-Martonne formula, seven kinds of weather can be defined and classified as the table (7).

Table 7: Different types of climate based on de-Martonne classification

de-Martonne Aridity Index Values (IDM)	Climate Classification
$I < 10$	**Dry/Arid**
$15 \leq I \leq 24$	**Semi-Arid**
$24 \leq I \leq 30$	**Mediterranean**
$30 \leq I \leq 35$	**Slightly-Humid**
$40 \leq I \leq 50$	**Humid**
$50 \leq I \leq 60$	**Very-Humid**
$60 \leq I \leq 187$	**Excessively-Humid**

The average rainfall in this region is 263.55 mm per year and the average temperature is 12.325˚C. Based on de-Martonne formula, I is equal to 11.8 and the region's climate is semiarid.

V. THE IMPACT OF CLIMATE ALTERATIONS IN THE STUDY OF AREA

The climate alteration is a function of the nature and magnitude of the changes in the environment of this region and has been impacted on the health and vulnerability of individual or population of the study area involved. The climate changes have been also impacted on the biological systems and many other aspects of the physical environment in this area. These effects include changes in the incidence of infectious diseases like water-borne diseases, vector-borne diseases and malnutrition caused by excessive drought and famine.

VI. RESULTS

This investigation shows that climate of this plain despite being in cold weather has the semiarid climate. Since convincing evidence of climate changes of this region shows that this problem is advancing rapidly as a great risk with impacts far beyond just the environment. This issue, therefore, receives an unprecedented attention of the industrialists and ordinary citizens.

VII. CONCLUSIONS

Climate change is one of the most important global environmental challenges facing humanity with implications for food production, natural ecosystems, freshwater supply, health, etc. Also, the increase in the global temperature is expected to leave several impacts on the global hydrological system, sea level, crop production and related processes.The climate change in the Razan-Qahavand plain is basically resulting owing to the uncontrolled emissions of the greenhouse gases due to industrialization, deforestation, burning of the fossil fuels, and many natural causes like death, and decomposition of organic matter etc. So the factors can be put under two categories: (1) natural causes; and (2) anthropogenic causes.

Natural Causes

Microbes, plants, animals and humans and in fact all living forms contribute naturally to the warming of this region. They contribute to CO_2 emissions by respiration and through their death and decomposition. Also, the plants on defoliation cannot absorb the available CO_2 and contribute to CO_2 emissions from the respiring branches help to this phenomenon. A significant part of this area's climate variability is also caused by changes in the solar radiations.

Various causes that govern climatic variability at different time-scale have been identified, which can be mainly grouped into internal and external causes. Internal causes involve; i) oscillations in the atmospheric system (e.g. Thermohaline circulation changes that redistribute heat between the regions of this area), ii) water vapor and low altitude clouds that form important feedback mechanisms and iii) the topography cover and vegetation extent. The external causes include i) variations in the incoming solar radiation due to change in the sun-earth geometry and ii) variation in the incoming solar irradiance at various wavelengths due to changes in the solar activity. Also, the future temperature change is dependent on levels of atmospheric greenhouse gases, in particular CO_2, and to a lesser extent methane and other greenhouse gases.

Anthropogenic causes

The human activities resulting the climate change of this area include industrialization, deforestation, transportation, urbanization, agricultural practices, energy supply and waste.

In addition, the climate change is likely the most significant determinative of the type of vegetation cover of this region and has the important impact on the ecology, structure, and distribution of forests (Ghafoori Kasbi, M. 2010). Several climate–vegetation studies have shown that certain climatic regimes are associated with particular plant communities or functional types. Therefore, it is also rational to know that climate changes

would modify the configuration state of an ecosystem. The various impacts of climate change on plants of this region may be included the following events;
Shift in vegetation towards a higher altitude, the spread of invasive species, changes in the phenological behavior, increasing forest fires, increase in the pest attacks, and extinction.

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