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Qaleh - Jouq Watershed Park Executive Meteorological Phase Studies, Kermanshah Province, Iran

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ABSTRACT

In various achieves of provincial organizations' primary scrutiny, in addition to a mere case, no studies in the field of meteorology have been obtained. Moreover, the only report relates to the study of Hardin watershed (the northern region), which was done by Jahan watershed management in Kermanshah Province in 1993.

Therefore, it is commonly used to compile the following report. Qaleh Jouq watershed district with an area of 5639 hectares (39.66 km²) is located in 50 km east of Kermanshah and 5 km north of Harsin. It is possible to access this watershed through Kermanshah-Harsin asphalt road. In addition, access to it is possible from another by-way.

INTRODUCTION

No atmospheric meteorological stations have been installed in the area up to now, however in Hardin that is located 5km in south of the area. There is a typical rain gauge station. This station belongs to the meteorological organization that was installed in 1964 and is still active. In spite of the facilities, during the statistical period of the station, there is a statistical deficit in some years and months. As a result, in order to study and formulate a meteorological report in the region, a wider area containing more than one of the stations of evaporation gauge, storage and synoptic should be taken into account. The area is located between the geographical longitudes of 45'-05' and 48'-07' and the latitudes of 34'-00' to 34'-40', with an area of approximately 704,000 hectares equals 7040 km². Within the designated area, there are 44 weather stations belonging to Meteorological Organization of the country and Ministry of Energy. The number of stations belonging to the Meteorological Organization is 23 and stations relating to the Ministry of Energy are 21 in total. Among the stations belong to Meteorological Organization, 2 of them are synoptic, 2 climatologic and 19 ordinary rain gauges. One of the rain gauge stations is closed and the rest are active.

Among the stations of the ministry of energy, there are three evaporation gauges, nine ordinary rain gauges, and nine other rain gauges in storage. Three rain gauge stations that are in Abshar Sahneh, Milan Rahan, and Taqe Boston are closed. And two storage stations in Sarfiroozabad and Sormesar have been considered and turned into rain gauges.

Stations Inspections

The following results were obtained from inspecting several stations belonging to the Meteorological Organization and Ministry of Energy.

1. The validity and reliability of statistics at the stations of Meteorological Organization is more than those in the stations of the Ministry of Energy.

2. Alignment and evaluation changes at the stations of the Ministry of Energy are more than the stations of the Meteorological Organization.

3. The location of the rain gauge stations is appropriate. Some of them are located on buildings and a number of others are placed in unobstructed places

Proposition for Stablishing New Stations

According to the world meteorological organization, the density of rain gauge station in mountainous areas should be as follows.

Minimum Number of Rain Gauge Stations	Minimum Number of Rain Gauge Stations
1 station	Up to 75 km^2
2 Stations	75-150 km2
3 Stations	150-300 km^2
4 Stations	300-550 km^2
5 Stations	550-800 km^2
6 Stations	800-1300 km^2

According to the above chart and considered area of 56.39 km2, the area required a rain gauge station, which is recommended to be a constant type.

Validity and Reliability of Data for Analysis

Test of Data Adequacy for Analysis

Before using the hydrological data, the length of available statistics should be considered to ensure that they are sufficient. To this end, using Maxus equation is proposed.

$Y= (4.3t \log R)^2 + 6$

In the above mentioned equation,

Y= the least acceptable amount of numerical data for analysis

R= ratio of the amount of change in the return period of 100 years to its value in the return period of 2 years.

The data of four stations (synoptic of Kermanshah, synoptic of Kangavar, rain gauge of Abshar Sahneh and the one in Arat) which are respectively 46, 22, 17 and 22 years old, were tested. The results are as follows.

Synoptic Station in Kermanshah

R= 100- year rainfall ratio/ 2-year rainfall = 811.4/459.4= 1.77

Y= (4.3t logR)2+6

Y=11

Y= (4.3+2.015+0.248)2+6=10.6

At the synoptic station of Kermanshah, y=11. However, the resulted value at this station is 11 years.

Synoptic Station in Kangavar

R= 100- year rainfall ratio/ 2-year rainfall =726.9/409.6=1.77

Y=11

Y= (4.3+2.015+0.248)2+6=10.6

The minimum required value is 10.6 years.

The Station in Abshar Sahneh

Y=7

Y= (4.3+2.015+0.248)2+6=6.6

The minimum required value is almost 7 years.

The Rain Gauge Station in Aran- Kangavar

Y=10

Y= (4.3+2.015+0.248)2+6=9.8

Atmospheric Falls: Source of Falls

The main source of rainfalls in the study area and the surrounding areas, as in all parts of west of the country, is the rain-fed systems that enter the country from the western part, and they cause rain in plateau of Iran.

The humidity of these systems is fed and supplied from the Atlantic Ocean, the Mediterranean, and the black sea, and their activity is usually reported between August and May.

Iran's synoptic meteorological surveys have shown that, over a period of five years, an average of 40 systems with active rain-fed core have entered Iran from the western and north western parts of the country annually.

The bembchmarking method without dimension:

The division of rainy year and ungainly year was determined with utilization of the annual statistics of selected stations in the index period from the following equation.

xi – x = ks

In the above mentioned equation

X=the average rainfall of the station in the index period in millimeters

S=standard deviation

Xi= yearly amount of rain in which 'I' is in millimeters.

Rainfall gradient considering altitude:

Gradient means x amount of rainfall increase per y amount of altitude increase. This formula aims to calculate the height of fall at various altitude levels. However, the increase in falls is somewhat clear, especially due to high calculation of clouds causing rainfalls. Moreover, in higher altitude, no rainfalls have been observed. Therefore, the gradient is zero.

In establishing the relation in the equation, we tried to select stations at different heights in order to achieve a high correlation coefficient. And more over, cover high and low altitudes of the area.

The obtained result is based on average 27 years of the index period and its correlation coefficient is 0.774%, which is significant at 1% level. The general form of the obtained equation is as follows.

P= a+b*h

P=220. +0.46*h

R=0.744

Estimating the monthly and annual rainfall of the considered area and each of the sub-domains:

Using the gradient relation and the mean height of the main area and each of the domains, the average monthly precipitation and their annual sum were obtained. Thus, at first, the nearest station in the study area, which is Harsin rain gauge, was selected and the confident was calculated by considering the annual rainfall ratio of the area and sub-areas. The monthly precipitation values of the sub areas and the main area are estimated by adjusting the aforementioned coefficient in the precipitation of Harasin station.

Measuring Short-Term Rainfall In The Area: It Is Possible To Study Short-Term Precipitation In Two Ways:

1. Having statistics relating to constant rainfall gauges and extracting information about short-0term cloudbursts

2. Using experimental methods such as Pol, Qahreman Vaziri and etc.

In the study area, there are only two synoptic stations, one in Kermanshah, and the other in Kangavar, which have rain gauges that record short-term rainfalls. Although the sshort-term rainfalls were recorded, accessing the statistics was not possible. Therefore, experimental methods especially Qahreman was used.

This formula is presented for Iran's weather conditions at a period of 15 minutes to 20 hours. Short-term storms of the stations within 24-hour rainfall data were calculated through putting this formula into practice. The overall form of Qahreman formula is as follows.

P'_{t10}= (0.45+0.2471 In(T-0.6000)) (0.371+0.6184$_t$0.4484) p^{60}_{10}

In the mentioned formula

T= time in minutes

T= year back period

In= Basic logarithm

P^{60}_{10}= the ten-year hourly-back precipitation. It is required to mention that the values are from 15 to 360 minutes.

Snowfall Survey in the Region:

The rate of such coefficient can be calculated by direct measurement or at times, it can be achieved by total annual rain fall or by empirical formulas thorough considering the amount of rainfall in days when the temperature is below zero. Since no snow measurements are carried out in the area under study, the second method requires cost and time. Therefore, experimental methods were used in this study. One of these methods was proposed by Sat Chandra, an Idian Hydrologist in 1984, whose equation is as follows.

$S_n= P_1(1-P_r)$

In the above mentioned equation:

S_n= water from melting in millimeters

P_t= Average monthly rainfall in millimeters

P_r= the ratio of rainfall to the sum of precipitation obtained from the following equation.

$P_r = (T_{max}-Bs)/ (T_{max}-T_{min})$

T_{max}=the maximum absolute temperature in a month

T_{min}=the minimum absolute temperature in a month

Bs= the temperature at which the raindrops are solid.

Researches by various scientists indicate that the boundary temperature between snow and rain varies between 1.66 to 2.20 oC.

Temperatures

Temperature variation in ground level and altitudes were much lower than rainfall. Consequently, stations that measure temperature are much less than rain gauge stations. Such a situation is also true about the area of the study. It means that the number of temperature measuring stations is much less than rain gauge stations. The number of former stations is 4 which are in Kangavar, Firoozabad, Polchehr and Kermanshah. Therefore, considering and studying temperature and thermal gradients of the area with emphasis on statistics of the 4 stations did not provide acceptable results. To the aim, the system of environmental stations outside the study area has been used in this section.

Regarding the maximum and minimum absolute values, it should be noted that there is no statistical remark in this regard.

Frosty Days

Forestry days are the days when the temperature is set to below zerooC. In the study area, the only two stations in Kermanshah and Kangavar provide statistics of frosty days. Therefore, to determine the number of frosty days in the area and the altitudes of different areas, the environmental stations of the area determine the frosty days of the upper levels. Among them, the highest amount belongs to Kangavar station with 104.6 days, and the lowest relates to Sar Pol Zahab's station.

Relative Humidity

Relative humidity is of the meteorological parameters that has a significant impact on climate, vegetation and other phenomena. By the definition, relative humidity is the ratio of the available water vapor pressure to the standard vapor pressure at the same temperature as expressed in percentage.

This regional element is measured at various stations at 6:30, 12:30, and 18:30 local times. The maximum relative humidity is usually at 6:30 and the minimum humidity is at 12:30. The mean of these two values shows the average daily humidity content.

This parameter is measured at synoptic climatology and evapo transpiration stations. Here, the statistics of Kangavar synoptic satiation are considered as the reagent of humidity.

Wind

Wind is a current of air moving across the earth's surface. Since the vertical component of the air motion is less than 1/100 of the horizontal component, so in the meteorology, the horizontal motion of air is called wind. Direction, speed, and frequency of wind are measured at synoptic, climatology and evapo transpiration stations. Moreover, wind direction is determined at synoptic stations. The height of velometer and air cock of the stations is 10 meters above the earth level according to the international standard. The nearest station measuring the wind parameter is Kangavar synoptic station. The data relating to the eight-year period from 1989 to 1996 of the station is available. The station represents the wind area of Qaleh Jouq.

Evaporation

The process of converting liquid water to vapor is called evaporation. Evaporation may occur on free surface of water, in moist soil or through transpiration from the surface of plants. Study of the area evaporations based on using the station statistics within the range.

Evaporation Pan Surface Evaporation

Evaporation from surface of the evaporation pan is an A class, which has a higher value than evaporation from the free surface of water. As it is shown in the table, the highest annual evaporation with 2355.1 millimeters relates to the evaporation station of Panjpol Cher and the smallest amount with 1440.73 millimeters is in relation with the station in ToutShami. Considering months of a year, the highest amount of evaporation relates to July and August.

Evaporation from the sea level surface:

By measuring the evaporation rate from the evaporation pan, the amount of evaporation from the sea level surface can be calculated using the equation given below.

$E= K_1EA$

In the mentioned equation,

E= Sea level surface evaporation in millimeter

K_1= It is a coefficient that is considered to be 0.7 for hot months, 0.8 for clod months and 0.75 for warm months according to the application of professional preferences.

EA= the evaporation pan surface evaporation in which

E= 2083.6-0.455*H

r= -0.803

E= Annual evaporation of sea level water in millimeter

H= with respect to the average evaporation of Qale Jouq area and the above equation, the mean annual evaporation of the 880.9 mm range has been met.

Real Evapotranspiration

The real evapotranspiration of the domain is calculated using the following methods.

1. Turek (Turkish) formula
2. Coutine formula

Potential Evapotranspiration

The maximum evapotranspiration of the atmosphere is called potential evapotranspiration. This evapotranspiration is the maximum amount of water that can be return to the atmosphere in a region through plant evaporation and transpiration, which depends on the climate of that area. In contrast with potential evaporation, the amount of water that turns to the atmosphere collectively through volatile and transpiration vegetation is called real evapotranspiration.

Study of evaporation and transpira tion of the area was carried out in three ways.

Blaney Crible's Method

In this method, evapotranspiration is calculated using the following formula.

ETP = a + b[P(0/46T+8.13)]

In which:

EPT= the average evapotranspiration of reference plant (grass) per month in millimeter

T= the average daily temperature in the considered month in Celsius

P= the percentage of light hours in each of the days of the month in question relative to the total lighting hours of the year. This parameter only depends on latitude.

a, b= they are climate coefficients which are obtained from the following formulas.

a= 0.0043(RH min) – n/N – 41.1

b= 082-0.0041 (RH min) +1.07(n/N) +0.066(u day)-0.66(RH min) n/N – 0.0006(RH min) (u day)

RH_{min}= Minimum relative humidity

N= Maximum Sunny hours

N= the actual number of hours of the sun presence

(U day) = wind speed during the day at 2 meters above the ground level in meter per second

Trond White's Method

This method is based on the average monthly temperature. Evapotranspiration is calculated using the formula given below.

Im= [Tm/5]151

Im=the annual thermal index is the sum of the monthly thermal indicators

Tm=the average monthly temperature in Celsius

Evapotranspiration is calculated monthly by the following formula.

ETO= 16Nm [10Tm/I] a

In which:

ETO= Evapotranspiration per millimeter

Tm= the average temperature in the desired month to Celsius

I= Annual heat index

Nm= correction factor extracted from the special table.

a= it is a coefficient that depends on the annual thermal indicators. Its value is calculated from the formula below.

a= (675*10-9) *I3-(771*10-7) *I2-(1792*10-4) *I+0.492

PANMAN'S MODIFIED METHOD:

Similar to what Griddle has been told about, based on the comparison of the result of the original Penman method and the lysimetric results, protectdeveloped a change in Penman equation, which is known as penman's modified method. Penman correctional formula FAQ is as follows:

ETO=CZ[WRn+(1-W) F(u)(ea-ed)]

In which:

EPO= Evapotranspiration potential (millimeters/month)

W=The weighting factor depending on the temperature and altitude of the station from the sea level

F(u)=wind speed function

Ea.=Air vapor pressure at the average monthly temperature (mill bar)

The Penman correctional FAQ is as follows, for a specific graph of the C coefficient that can be estimated for 7 different weather conditions. However, others have done research on the C coefficient, which ultimately resulted in the following formula in 1988.

C=0.68+0.0028(RH max) + 0.018(RS)-0.068(U2day) +0.013

[U day/ u night] + 0.0097(U2 day) [U day/ u night] +0.43*10-4(RH max) (RS) (U2 day)

In which:

RH max= is the maximum relative humidity (in percent)

RS= Solar radiation in millimeter per day

(U2day) = Average wind speed at a height of two meters throughout the day

[U day/u night] = the ratio of the wind speed per day to wind speed at night

Z= Number of days of the month

The calculation of each of the coefficients is detailed in the hydrologic books.

Climate:

Using two methods, Ambarjeh, DE martin, and modified DE martin have been used to identify climate type of Qaleh Jouq watershed.

AMBARJEH METHOD

In this method, the climate of different areas surrounding the study area is determined using the following formula.

Q=200P/(M2-m2)

In which:

Q= Amberjeh Humidity coefficient

P= Average annual precipitation to millimeters

Q= 2000*670.5/ (305.42-264.32) = 57.3

M=average of maximum temperature in the warmest month of the year

M=average of minimum temperature in the coldest month of the year

In this formula, M and m are both in Kelvin and its value is 273.16. The climatic location of several areas in Qaleh Jouq watershed is known in Ambarjah climatic formula. Based on Amberjeh method, the climate of the region is the climatic type of altitude.

DE MARTIN'S METHOD:

DE martin calculates the climatic factor of the regions using the following formula and introduces the type of climate in different region based on the six climatic types that it presents.

T= P/T+10= 670.5/18.8=35.7

In which:

I= the climate variable is a factor that changes from 10 to 55

P= Average annual rainfall

T=Average annual temperature

Using the formula, the climate factor of Qaleh Jouq area and its station were calculated. Their position is determined based on DE martin climate profile. As a result, the climate in this area is a very amid type.

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