The Estimated Annual Runoff in the Ivar Sub Watershed

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Abstract: Runoff is a component of the hydrologic cycle. That occurs after precipitation phenomena, stem flow, potholes, evapotranspiration and infiltration. Predict the amount of runoff and flood the structural design is often done on the watershed of these parameters. It is difficult and high risk in arid and semi-arid areas. In this study, were used the empirical method for estimating runoff from Justin point and Regional, Chataigne and India Agricultural Research Forum. Based on the results obtained under I08 sub watershed was the highest runoff volume in all methods. The amount of runoff in the watershed for methods Justin point, Regional, Chataigne and India Agricultural Research Forum, are respectively, 0.282, 1.147, 0.698 and 0.942. Due to climatic conditions, topography, slope, vegetation cover and land use Chataigne method is recommended with most appropriate method for estimating runoff.
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1. Introduction

Excess rain said rain that no to stays on the surface and not on the whole earth So that the watershed began move and exit from the watershed of direct runoff (2). Excess rainfall is the main component relationship between rainfall and runoff. The difference between total rainfall and excess rainfall is called kept or loss hydrology (4). Ratio between direct runoff to the average rainfall in a specified time interval is runoff coefficient (5). In general, in the event of rainfall, when increases rainfall intensity ratio to intensity soil permeability, surface runoff and flows through the hydrographic network to the output watershed. Runoff is a component of the hydrologic cycle that created after precipitation phenomena, Stem flow, potholes, evapotranspiration and infiltration (3). Predict the amount of runoff and flood structures based on these parameters, is difficult for designers that often in arid and semi-arid areas. And the risk is high.

2. Materials and methods

Ivar watershed with an area of about 5,500 hectares, located in North Khorasan province, Jajarm city and with longitude 56 degrees 8 minutes and 58 seconds to 56 degrees, 15 minutes, 53 seconds width and longitude 36 degrees 58 minutes and 3 seconds up to 37 degrees and 4 minutes and 26 seconds. The climate classification will be assessed Domarten climate arid regions. Minimum and maximum altitude of 1031 and 1603 meters, the annual average rainfall of 168 mm. The average annual temperature 14.1, the average annual minimum temperature 7.8, 22.1 average annual maximum temperature, absolute annual minimum -8.1 and the absolute maximum annual 40.1 ° C. Prevailing wind are east winds and the amount of 17.3 of the total.

2.1 Justin Method

Justin, to estimate annual runoff, using three parameters: precipitation, temperature, slope watershed has the following formula:

(1)

$$R = K \times S^{0.155} \frac{P^2}{1.8T + 32}$$

(2)

$$S = \frac{H_{max} - H_{min}}{\sqrt{A}}$$

R: The annual runoff height (cm), P: annual rainfall height (cm), S: slope watershed (mm-1), T: mean annual temperature (° C), A: area (sq km), Hmax: maximum height of watershed (km), Hmin: minimum height of watershed (km) K: coefficient Justin. Accuracy in estimating runoff is dependent on the accuracy of the K coefficient. Usually, at first in the region to a watershed with water and measure statistics, And has selected the profile of the area, the maximum and minimum height, annual discharge, average annual precipitation and mean annual temperature is known, and determine the amount of K. These can then be used in relationship calibrated to the watershed of study.

2.2 Point methods

In this method, is used long-term data from Darband-Sankhast station to determine the Justin coefficient. The value of K for the watershed of Darband-Sankhast station has been determined 0.125.

2.3 Regional method

In this way, the data were collected runoff for all hydrological stations in this area. Then the multiple correlation were established between area, annual precipitation and mean annual temperature with height runoff regional stations (Table 2). The value of K in area is determined 0.49155 with correlation coefficient 0.95.

2.4 ICAR method

Indian Agriculture Research Council for estimating annual runoff of small watershed is provided formula as follows:

(3) $$R = \frac{1.115 \times P^{1/44}}{T^{1.34} \times A^{0/0613}}$$

In this case, the parameters are defined as follows:

R: Annual runoff height (cm), P: Mean annual rainfall (cm), T: mean annual temperature (°C), A: area (square kilometers).

2.5 Chataigne method

According to this technique is based on the deficit (D). This amount is obtained on the following equation.

(4) $$D = P - \lambda P^2$$

(5) $$\lambda = \frac{1}{0.8 + 0.14T}$$

(6) $$R = P - D$$

P: annual rainfall area (m), T: average temperature areas (°C), D: lack of annual flow (m), R: runoff (m).

3. Results

Table 1. Estimating runoff and runoff coefficient use Justin point model

Sub watershed	Area (Km^2)	P (mm)	H(max)	H(min)	T (°C)	S	R(mm)	The volume of runoff (MM^3)	Run off Coeficient (%)
I1	2.068	179	1214	1129	14.3	0.059	4.5	0.009	2.5
I2	7.799	186	1440	1134	14.0	0.110	5	0.042	2.9
I3	2.946	188	1480	1134	13.9	0.202	6	0.018	3.2
I4	5.139	192	1480	1130	13.8	0.154	6	0.031	3.2
I5	5.357	204	1500	1123	13.3	0.163	7	0.037	3.4
I6	1.904	180	1203	1119	14.2	0.061	5	0.009	2.5
I7	5.358	187	1460	1109	13.9	0.152	5.7	0.030	3.0
I8	1.751	180	1193	1107	14.2	0.065	4.6	0.008	2.6
I9	2.990	195	1490	1102	13.6	0.224	6.7	0.020	3.4
I10	4.584	213	1603	1233	13.0	0.173	7.8	0.036	3.7
I11	1.854	172	1130	1059	14.5	0.052	4.0	0.007	2.3
I01	10.843	187	1480	1130	14.0	0.106	5.4	0.059	2.9
I02	19.765	187	1480	1125	14.0	0.080	5.1	0.102	2.8
I03	26.229	190	1500	1119	13.9	0.074	5.3	0.139	2.8
I04	29.187	189	1500	1109	14.0	0.072	5.2	0.151	2.7
I05	34.573	188	1500	1108	14.0	0.067	5.1	0.176	2.7
I06	36.692	188	1500	1103	14.0	0.066	5.1	0.185	2.7
I07	40.736	187	1500	1086	14.0	0.065	5.0	0.204	2.7
I08	51.534	189	1603	1084	14.0	0.072	5.2	0.267	2.7
watershed	55.000	188	1603	1059	14.1	0.073	5.1	0.282	2.7

Table 2. Physiographic parameters and meteorological stations in the region

Station Name	Minimum height	Average height	Maximum height	Area (square kilometers)	Rain	Temperature
Tabarrok Abad	1470	1896	2800	560.0	353	8.1
HeiHei	1350	1876	2800	900.0	349	7.6
Ghalee Bar Bar	770	1509	2490	1586.9	282	10.9
Barezoo	1440	1915	2903	496.7	297	8.1
Baba Aman	1010	1605	2890	1232.6	306	9.2
Qatlesh	960	1525	2490	1355.2	312	7.3
Darkesh	1040	1817	2455	114.5	450	9.1
Shir Abad	580	1785	2470	183.5	324	9.5
DarbandSalmaghan	680	1306	2680	1087.0	252	11.9
Aghmazar	560	1481	2903	12004.0	278	11.1
Ayarghayeh	530	1044	1655	883.7	253	10.6
GhareGhanloo	840	1315	2233	1033.7	284	10.6
Yangcheh	1670	1860	2145	95.2	346	10.5
BidvazSfaraien	1300	2100	3100	519.9	371	8.0
RooinAraqi	1430	1993	2700	201.0	349	8.9
Radkan	1230	1949	2800	245.0	370	9.9
MoushangFarizi	1420	2160	3143	277.0	400	9.2
Golmakan	1550	2599	3340	49.0	479	7.2
Dolat Abad	1580	2735	3100	40.0	504	6.5
Ardak	1400	2089	3029	497.0	421	9.4
SarasiabShandiz	1300	2068	3249	203.0	384	9.9
Golestan	1260	1971	2960	76.0	428	10.6
Karnian	1220	1560	2625	140.0	302	10.0
Kardeh	1300	2080	2930	431.4	408	8.7
Sang Divar	670	1714	3023	228.0	410	9.7
Hatamghale	500	1946	3000	1238.7	308	6.0
Kikan	1450	2085	2720	81.0	305	5.4
MohammadtaghiBeik	1030	1989	2903	945.0	346	6.5

Table 3. Runoff establish and runoff coefficient use of regional Justin model

Sub watershed	Area (Km^2)	P (mm)	H(max)	H(min)	T (°C)	S	R(mm)	The volume of runoff (MM^3)	Run off Coeficient (%)
I1	2.068	179	1214	1129	14.3	0.06	18.3	0.038	10.2
I2	7.799	186	1440	1134	14.0	0.11	21.8	0.170	11.7
I3	2.946	188	1480	1134	13.9	0.20	24.8	0.073	13.1
I4	5.139	192	1480	1130	13.8	0.15	24.6	0.127	12.9
I5	5.357	204	1500	1123	13.3	0.16	28.5	0.153	14.0
I6	1.904	180	1203	1119	14.2	0.06	18.5	0.035	10.3
I7	5.358	187	1460	1109	13.9	0.15	23.2	0.124	12.4
I8	1.751	180	1193	1107	14.2	0.06	18.8	0.033	10.4
I9	2.990	195	1490	1102	13.6	0.22	27.3	0.082	14.0
I10	4.584	213	1603	1233	13.0	0.17	31.7	0.145	14.9
I11	1.854	172	1130	1059	14.5	0.05	16.4	0.030	9.5
I01	10.843	187	1480	1130	14.0	0.11	22.0	0.238	11.8
I02	19.765	187	1480	1125	14.0	0.08	21.0	0.414	11.2
I03	26.229	190	1500	1119	13.9	0.07	21.5	0.564	11.3
I04	29.187	189	1500	1109	14.0	0.07	21.1	0.617	11.2
I05	34.573	188	1500	1108	14.0	0.07	20.8	0.719	11.0
I06	36.692	188	1500	1103	14.0	0.07	20.6	0.755	11.0
I07	40.736	187	1500	1086	14.0	0.06	20.4	0.832	10.9
I08	51.534	189	1603	1084	14.0	0.07	21.1	1.088	11.2
watershed	55.000	188	1603	1059	14.1	0.07	20.9	1.147	11.1

Table 4. Runoff establish and runoff coefficient use of ICAR model

Sub watershed	Area(Km^2)	P(mm)	T (°C)	R(mm)	The volume of runoff (MM^3)	Run off Coeficient (%)
I1	2.068	179	14.3	19.3	0.040	10.8
I2	7.799	186	14.0	19.2	0.150	10.4
I3	2.946	188	13.9	21.1	0.062	11.2
I4	5.139	192	13.8	21.1	0.108	11.0
I5	5.357	204	13.3	24.1	0.129	11.8
I6	1.904	180	14.2	19.6	0.037	10.9
I7	5.358	187	13.9	19.9	0.107	10.7
I8	1.751	180	14.2	19.8	0.035	11.0
I9	2.990	195	13.6	22.8	0.068	11.7
I10	4.584	213	13.0	26.7	0.122	12.6
I11	1.854	172	14.5	18.0	0.033	10.4
I01	10.843	187	14.0	19.1	0.207	10.2
I02	19.765	187	14.0	18.3	0.361	9.8
I03	26.229	190	13.9	18.6	0.488	9.8
I04	29.187	189	14.0	18.2	0.531	9.6
I05	34.573	188	14.0	17.9	0.620	9.5
I06	36.692	188	14.0	17.7	0.651	9.4
I07	40.736	187	14.0	17.6	0.715	9.4
I08	51.534	189	14.0	17.5	0.901	9.3
watershed	55.000	188	14.1	17.1	0.942	9.1

Table 5. Estimated annual runoff by Chataigne method

Sub watershed	Area(Km^2)	P(mm)	T (°C)	R(mm)	The volume of runoff (MM^3)	Run off Coeficient (%)
I1	2.068	179	14.26	11.5	0.024	6.4
I2	7.799	186	14.00	12.5	0.098	6.7
I3	2.946	188	13.88	12.9	0.038	6.9
I4	5.139	192	13.76	13.5	0.069	7.0
I5	5.357	204	13.29	15.6	0.083	7.7
I6	1.904	180	14.21	11.6	0.022	6.4
I7	5.358	187	13.94	12.6	0.068	6.8
I8	1.751	180	14.20	11.6	0.020	6.5
I9	2.990	195	13.60	14.1	0.042	7.2
I10	4.584	213	12.98	17.3	0.079	8.1
I11	1.854	172	14.49	10.5	0.019	6.1
I01	10.843	187	13.98	12.7	0.137	6.8
I02	19.765	187	14.01	12.6	0.249	6.8
I03	26.229	190	13.89	13.1	0.344	6.9
I04	29.187	189	13.97	12.9	0.377	6.8
I05	34.573	188	13.99	12.9	0.445	6.8
I06	36.692	188	14.03	12.8	0.469	6.8
I07	40.736	187	14.02	12.7	0.517	6.8
I08	51.534	189	14.04	12.9	0.665	6.8
watershed	55.000	188	14.12	12.7	0.698	6.8

4. Conclusion

Experimental methods for estimating runoff is based on empirical formulas. Among these methods, Justin methods, Indian Society of Agricultural Research (ICAR) and Chataigne are the most common methods. It should be noted that because the majority of these coefficients in the region, therefore their use should be of particular interest. Because they use the same coefficients can cause significant errors. Sub-watershed runoff and region hydrological units establish of the different methods. Different values respectively for runoff parameter from any method. The results are different of different methods. In this study, for estimating runoff was used the empirical method such as regional Justin and point Justin, India Association of Agricultural Research and Chataigne method. Based on the results obtained the I08 sub watershed was highest runoff volume in all methods. The amount of runoff in the watershed respectively for methods of point Justin and Regional, India Agricultural Research Forum, Chataigne are 0.282, 1.147, 0.698 and 0.942. Due to climatic conditions, topography, slope, vegetation cover and land use is recommended Chataigne method by most appropriate method for estimating runoff.

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