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Estimating Flood Potential Emphasizing on Geomorphologic Characteristics in Tarikn Basin Using the SCS Method

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ABSTRACT

Flood is a phenomenon which causes large damages annually and it has been always considered by hydrologists. Factors such as physiography, geomorphology and human factors that can cause acceleration of this phenomenon in the basins; since the exploitation of water resources projects, flood control, dam construction, operation, and most areas of Watershed Hydrology, flood flow is important. The degree of accuracy and safety studies, facility design and construction of water, depends heavily on the research method. In the present study the potential of Tarik flood basin has been studied using the SCS. Hydrograph of the basin according to rainfall amounts of 24-hour, time of concentration, curve number, rainfall excess, time to peak and peak, respectively, then the flood hydrograph for the basin in the Tarik periods of 2, 5, 10, 25, 50 and 100 years were calculated. The results showed that in terms of form , Tarik basin flood rise can not be because the basin is considered to be stretched, but this basin, the basin is a narrow, short channel length and minor runoffs of rainfall in a short time to reach the main drainage fill and drainage work. The area, part of the basin is considered to be small, so its reaction to short-term rainfall into flood will be greater.

Keywords: Hydrograph, SCS, the regional analysis, curve number (CN), time to peak, peak discharge, Tarik River.

INTRODUCTION

Flood studies and flood control is one of the issues in the watershed management plans. The current floods in a basin area of a direct effect on agriculture and its economic and social situation there; one method to estimate the flood hydrograph method no later called the Soil Conservation Organization of the SCS (Soil Conservation Services). In this method the coordinates of the dimensionless unit hydrograph in which the relative amounts of time (t / t_p) vs. flow rate (q / q_p) has been obtained.

To obtain the coordinates of points on the hydrograph (t / t_p) and (q / q_p) is required to be computed values of TP and QP [] (Heydari Zadeh, 2010). SCS flood estimation methods commonly used for the basin that are no hydrometric stations. In this regard, many researches have been conducted inside and outside the country. Geetha, et al (2008), Yahta, et al (2010) and Resma, et al (2010) Flood estimation in Indian country, the SCS method on some of the studied basins and flood damages has been studied. Heydari Zadeh (2010) developed a method for estimating peak flood SCS with the concept of logical methods for their study area (Halilan) has done. Behzad et al (2011) estimated potential flood in the river basin Zilki and Firehrud and compared with the SCS method Firehrud basin physiography and morphology and the ability to flood the basin above basin Flattering Zilki. Sefidrud watershed of SefidRud Dam in Manjil in its estuary receives up to 10 main basins. Most of these basins are of very high yield.

Therefore, identification of physiographic characteristics and flood Flattering this basins before any construction development in these sectors is recommended. Physiographic conditions at the margin because of the Tarik river, fertile land for agriculture has occurred. Significant area of flood plain sediments and its suitability for agriculture, has led in this area of the river, the rice should be there too. Hydrometric stations are no rivers or rain this assessment, based on information that suggests there is a history of flooding in this basin Flattering. However, in recent years the exploitation of forest trees in the area of the basin caused the runoffs increased rainfall in this part. Member changes, development of roads and residential areas will increase the production of runoff and flood risk [9]. Due to the fertile land on the riverside, there are Tarik dam on the river crosses the river with Sefidrud in place and prevent a possible disaster, in this paper and watershed physiographic characteristics of the Tarik has been studied using the SCS.

Study area

Tarik basin in Gilan province is located in Rudbar city. Flowing rivers in this basin in the lake of Tarik dam and enter by western part of the into bed of Sefidrud. Tarik river originates in Hezarmarz heights located in 18 kilometers North East of Rostam Abad city and springs are now in this section. The following table is presented according to geographical location and basin characteristics.

Table 1. Geographic location of Tarik basin

Longitude	Latitude	Altitude maximum	Altitude minimum	Altitude average	Length of river
49 29 58 – 49 34 49	36 59 46 – 37 03 10	740	80	410	11.66

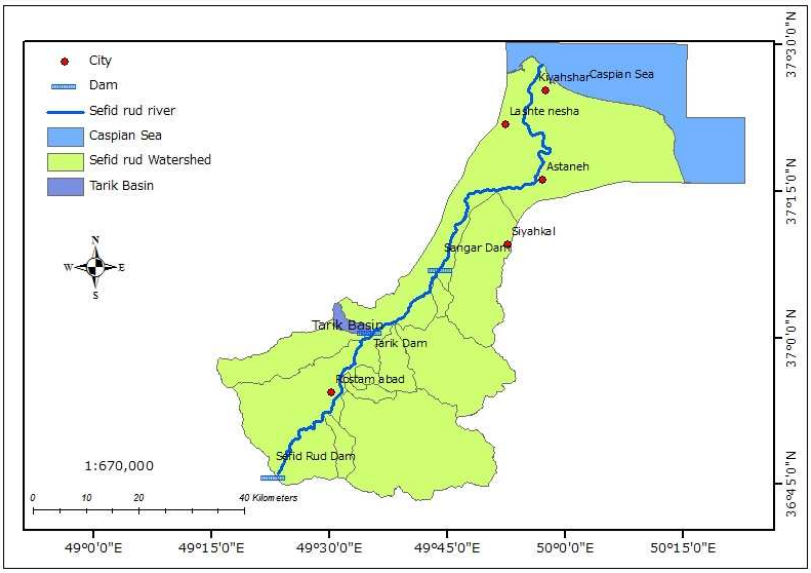

Figure 1. Location Map of Tarik basin

MATERIALS AND METHODS

This research has been provided based on field observations and library research - analysis using 50 000 topographic maps: one of the armed forces of geographical, geological maps 1: 100000 Geological Survey, 1:250000 geological maps, soil and vegetation of Forest and rangelands, water resources and meteorological data Meteorological Organization and the Center of Studies is the hydrometric station discharge. The Tarik watershed area using Arc GIS software on 1: 50 000 topographic maps distinct physiographic basin characteristic such as software in this area, form and height levels were determined. Physiographic of the basin is such that the output of the foothills and the other part that it is in the nature of the plain. We therefore measured evaporation and rainfall climatology of this basin and five stations were measured. For estimation of basin climate stations Bijar city, Shah Shahidan, Spili, Pir Kuh and Astaneh were used in the period 1987-2009 for precipitation and temperature gradient equation was proposed for the basin as follows:

Table 2. Correlation coefficients of temperature and precipitation for the Tarik basin 1987-2009

Month	Correlation Coefficients of Precipitation	R^2	Correlation Coefficients of Temperature	R^2
Jan	P = -0.04H + 105.17	-0.89	T_{mean} = -0.004 H + 8.33	-1
Feb.	P = -0.02 H + 102.26	-0.55	T_{mean} = -0.003 H + 7.43	-1
Mar	P = -0.04 H + 105.37	-0.98	T_{mean} = -0.003 H + 9.15	-0.99
Apr	P = -0.01 H + 96.23	-0.61	T_{mean} = -0.003 H + 13.19	-1
May	P = -0.01 H + 76.30	-0.79	T_{mean} = - 0.003 H + 17.67	-0.99
June	P = -0.01 H +56.93	-0.46	T_{mean} = -0.004 H + 22.42	-0.99
Jul	P = -0.03 H + 89.01	-0.96	T_{mean} = - 0.005 H + 24.77	-0.99
Aug	P = -0.04 H + 78.30	-1	T_{mean} = -0.004 H + 25.96	-0.99
Sep	P = -0.09 H + 179.37	-1	T_{mean} =- 0.003 H + 23.65	-1
Oct	P = -0.07 H + 158.05	-1	T_{mean} = -0.002 H + 18.94	-0.89
Nov	P = -0.04 H + 144.87	-0.98	T_{mean} = -0.004 H + 15.23	-1
Dec	P = -0.03 H + 135.25	-0.86	T_{mean} = -0.004 H + 10.60	-1
Annual	P = -0.45 H + 1335.65	-0.99	T_{mean} = - 0.003 H + 16.46	-0.99

River discharge was too Tarik. Hydrometric station is Tarik River no.

The regional analysis was used to estimate river discharge and the discharge relationships - level, and use of statistics for the City of hydrometer stations Bijar, Totkabon, Pole Sazeman, Lavashan and Gilvan and the following relations were obtained:

Table 3. Monthly Discharge Correlation Equations of Tarik Basin (m3 / s) Period 1987-2009

Month	Correlation Coefficients of Discharge	R^2
Jan	Q = 0.002 A + 4.43	0.95
Feb.	Q = 0.002 A + 5.54	0.95
Mar	Q = 0.005 A + 6.44	0.98
Apr	Q = 0.012 A + 5.31	1
May	Q = 0.015 A + 2.31	1
June	Q = 0.008 A + 1.64	0.99
Jul	Q = 0.003 A + 2.36	0.98
Aug	Q = 0.001 A + 1.97	0.95
Sep	Q = 0.0001 A + 4.53	0.37
Oct	Q = 0.00042 A + 6.34	0.31
Nov	Q = 0.001 A + 7.10	0.72
Dec	Q = 0.002 A + 5.98	0.91
Annual	Q = 0.004 A + 4.36	0.98

With the physiographic features, climates, Tarik basin discharge, hydrograph dimensions of this basin was calculated using SCS. Hydrographs based on the method of calculation was presented as follows:

• In this section, using a 24-hour rainfall and average rainfall stations Lahijan climatology basin, rainfall in 1 hour with 10-year return period (P_{10}^{60}) and then calculated using 24-hour rainfall RIMAC 1.0 software basin with return periods were different.

• Time of concentration: Karpich basin method respectively [1].

• Curve number: The following parameters are necessary to determine CN in the basin:

- Type of land use
- Field operations
- Hydrological condition
- Hydrologic soil groups

The physiographic conditions, vegetation and soil conditions, the basin was obtained CN values.

• To obtain the value S (initial stored soil moisture deficit) on the curve number

S = (1000 / CN) - 10

• Effective rainfall in the basin, according to the following relationships were obtained: [17]

Q = (P - 0.2 S) 2 / (P + 0.8 S)

CN = curve number

S = lack of soil moisture storage (mm or inches)

Q = amount of excess rainfall (mm or inches)

P = 24-hour rainfall (mm)

• **Time to Peak**: The following relationship was obtained. (Mahdavi, M., 2010: 210)

$t_p = 0.6\ T_c + T_c\ 0.5$

t_p = time to peak

T_c = time of concentration

This parameter is used to obtain time-base.

• **Peak Discharge** (maximum instantaneous flow rate) was obtained from the following equation: [17]
$q_p = 2.083\ A\ Q\ /\ t_p$
q_p = peak flow in cubic meters per second
A = watershed area to square kilometers
Q = direct runoff or rainfall excess height in centimeters
T_p = Time to peak

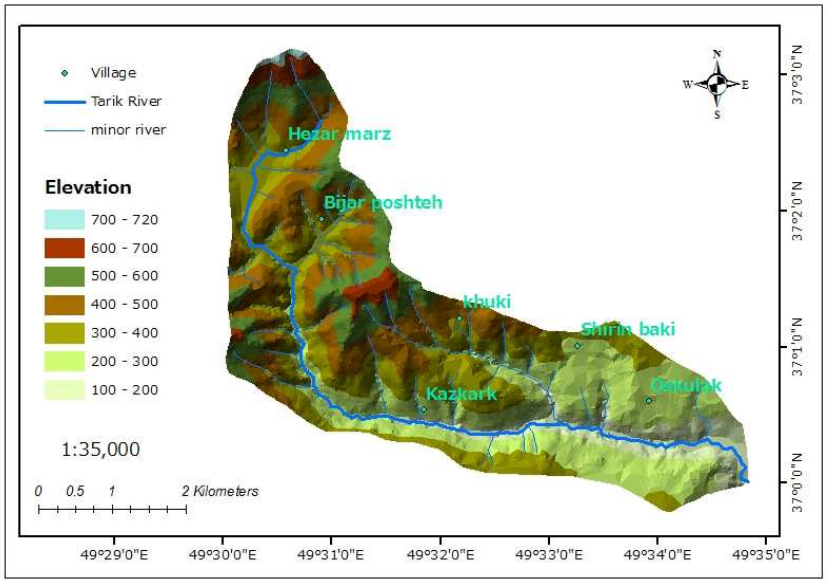

Figure 2. Elevation Map of Tarik basin

RESULTS

Climate: The rainfall coefficient obtained - height and temperature - altitude, rainfall and temperature in the Tarik basin is presented in accordance with the following table.

Table 4. Values, Rainfall and Temperature in the Tarik Basin - Period 1987-2009

Month	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Precipitation	90.7	96	89.3	92.8	70.6	52.4	77.3	62.6	144.1	130.6	129.9	122.2	1152.2
Temperature	6.86	6.19	8.06	12.08	16.31	20.88	22.81	24.42	22.39	18.03	13.74	8.98	15.13

In Tarik Basin the precipitation rate is more than 50 mm throughout the year . Total annual precipitation in the Basin 1152.2 mm has been estimated, maximum and minimum rainfall in June is the month of September. The average annual temperature in the basin, 15.13 ° C is estimated that the maximum and minimum temperature in August.
Discharge: the discharge of the river basin area in accordance with the coefficients obtained from the analysis were the following table:

Table 5. Tarik River Discharge (m3 / s) - Period 1987-2009

Month	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Discharge	4.47	5.59	6.53	5.54	2.59	1.80	2.53	1.99	4.54	6.35	7.13	6.05	4.58

The average annual river discharge 4.58 cubic meters per second. River discharge shows that starting from the month of September rainfall, river flow has increased, so that precipitation occurred in November to reach its peak, Also has the highest amounts of precipitation and river discharge decrease from May, it also decreases the amount of discharge.

Flood Estimation Methods SCS: to get the hydrograph of the basin basin of Tarik 24-hour rainfall amounts were calculated according to the following table.

Table 6. 24-Hour Rainfall Basin with Different Return Periods

24-hour rainfall with different return periods						P_{10}^{60}	Base station	24-hour rainfall	Average precipitation basin
2	5	10	25	50	100				
36.52	55.82	68.62	84.69	96.58	108.4	23.18	Lahijan	26.6	96.54

- In the Tarik SCS watershed time of concentration using the Karpich method and 0.27 was obtained.
- The surface area of soil conditions, vegetation, and how land use and soil moisture, or curve number CN of the basin was estimated to number 45.
- Lack of soil moisture storage or S for basin 31 mm respectively.
- High amount of rainfall surplus in hand basins were obtained for CN and S according to the following table.

Table 7. Values CN, S, and Effective Rainfall

CN	S	Effective rainfall (mm)					
	mm	2	5	10	25	50	100
45	31	15	30.5	41.7	56.2	67.3	78.3

- The amount of focus time, time to peak for the Tarik area 0.69 respectively, meaning that the peak flood flow in the rivers Tarik 0.69 hours.
- With an area of concentration, excess rainfall and time to peak, peak (maximum instantaneous flow rate) with different return periods were calculated according to following table for a Tarik basin.

Table 8. Maximum Discharge Tarik Basin Moment with a Different Return Periods

Area basin (km^2)	T_c	t_p	Maximum discharge (m^3 / s)					
			2	5	10	25	50	100
19.12	0.27	0.69	86.48	176.23	240.70	324.76	388.45	452.43

Given the above and having in hand t_p (time to peak) q_p (a maximum flow rate) of basin unit hydrographs in different return periods were calculated and presented.

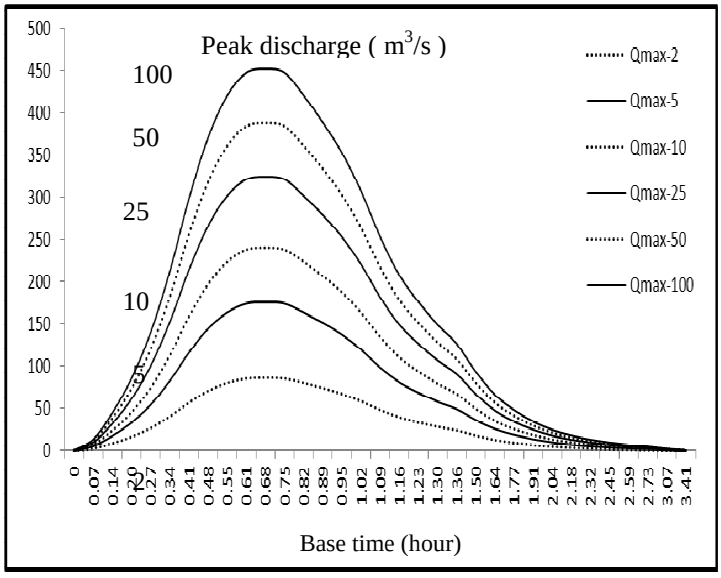

Figure 3. Hydrograph Chart of Tarik River Flood

Table 9. Hydrograph Dimensions of Tarik Basin at Different Return Periods

t/t_p	T	q/q_p	Qmax-2	Qmax-5	Qmax-10	Qmax-25	Qmax-50	Qmax-100
0	0	0	0	0	0	0	0	0
0,1	0,07	0,03	2,59	5,29	7,22	9,74	11,65	13,57
0,2	0,14	0,1	8,65	17,62	24,07	32,48	38,85	45,24
0,3	0,20	0,19	16,43	33,48	45,73	61,71	73,81	85,96
0,4	0,27	0,31	26,81	54,63	74,62	100,68	120,42	140,25
0,5	0,34	0,47	40,64	82,83	113,13	152,64	182,57	212,64
0,6	0,41	0,66	57,08	116,31	158,86	214,34	256,38	298,60
0,7	0,48	0,82	70,91	144,51	197,37	266,31	318,53	370,99
0,8	0,55	0,93	80,42	163,89	223,85	302,03	361,26	420,76
0,9	0,61	0,99	85,61	174,47	238,29	321,52	384,57	447,90
1	0,68	1	86,48	176,23	240,70	324,76	388,45	452,43
1,1	0,75	0,99	85,61	174,47	238,29	321,52	384,57	447,90
1,2	0,82	0,93	80,42	163,89	223,85	302,03	361,26	420,76
1,3	0,89	0,86	74,37	151,56	207,00	279,30	334,07	389,09
1,4	0,95	0,78	67,45	137,46	187,74	253,32	302,99	352,89
1,5	1,02	0,68	58,80	119,84	163,67	220,84	264,15	307,65
1,6	1,09	0,56	48,43	98,69	134,79	181,87	217,53	253,36
1,7	1,16	0,46	39,78	81,07	110,72	149,39	178,69	208,12
1,8	1,23	0,39	33,73	68,73	93,87	126,66	151,50	176,45
1,9	1,30	0,33	28,54	58,16	79,43	107,17	128,19	149,30
2	1,36	0,28	24,21	49,34	67,40	90,93	108,77	126,68
2,2	1,50	0,207	17,90	36,48	49,82	67,23	80,41	93,65
2,4	1,64	0,147	12,71	25,91	35,38	47,74	57,10	66,51
2,6	1,77	0,107	9,25	18,86	25,75	34,75	41,56	48,41
2,8	1,91	0,077	6,66	13,57	18,53	25,01	29,91	34,84
3	2,04	0,055	4,76	9,69	13,24	17,86	21,36	24,88
3,2	2,18	0,04	3,46	7,05	9,63	12,99	15,54	18,10
3,4	2,32	0,029	2,51	5,11	6,98	9,42	11,27	13,12
3,6	2,45	0,021	1,82	3,70	5,05	6,82	8,16	9,50
3,8	2,59	0,015	1,30	2,64	3,61	4,87	5,83	6,79
4	2,73	0,011	0,95	1,94	2,65	3,57	4,27	4,98
4,5	3,07	0,005	0,43	0,88	1,20	1,62	1,94	2,26
5	3,41	0	0	0	0	0	0	0

DISCUSSION

Hydrograph of the basin according to rainfall amounts of 24-hour, time of concentration, curve number, rainfall excess, time to peak and peak, respectively, the flood hydrograph for the basin in the Tarik periods of 2, 5, 10, 25, 50 and 100 years respectively. In addition to these parameters, physiographic and geomorphologic factors also rise in the flood basin will be effective in the Tarik. Geomorphological and hydrological watershed reaction function of the dynamic parameters of flow rate is constant: 1419). Rodriguez-Iturbi, 1979) and there is a direct relationship between geomorphology of a basin and its hydrological response [5]. The geomorphologic units, Tarik basin is such that it is part of the foot and another part which is in its output, nature is so plain between the minimum and maximum height is 80 to 740 m. Studies show that Tarik basin physiographic of the basin basin is small area so that the 19.12 square kilometers and its form, is drawn close to the basin. Area and form of the basin that is mentioned on the flood hydrograph Flattering basin and it has a direct effect. Hydrograph form in large basins, drawn and beveled (sleeping), while in small basins that show backlash against showers Hydrograph is sharp and immediate and short-term flood to occur. The almost circular form of the basins with the same hydrographic network of concentration time, the waters reach the exit point, Flood flow and short-term rate is especially high in the hydrograph to be sharp, whereas in elongated basins, water discharge and hydrograph gradually drawn by the state [16]. The coefficients obtained from Gravelius methods, Horton, Miller and a rectangular, Tarik basin is elongated in form, almost. Tarik basin, the basin is considered to be asymmetric. This basin contains the whole North West - South East, so the main channel in the northern part of the process itself - the South and in other parts of the West - East has taken. The position is such that the volume of drainage basin elevation basin in its northern half and eastern half of South and West, the minor streams in the northern half and eastern half longer than the minor streams are the South and West. Thus runoffs resulted from precipitation in less time than the southern half and western slopes into the main drains are Tarik. According to the chart in this basin, most of penile meters altitude in the range 300 to 600 meters, also most of the steep grades 30 – 60 and 0 - 2 respectively, with frequency 18.83 and 16.74 percent are located.

Table 9. Slope Distribution Respect to Area in Tarik River Basin

Slope class	0-2	2-5	5-8	8-12	12-20	20-30	30-60	> 60
Area (km2)	3.2	1.2	1.9	1.72	2	2.5	3.6	3
slope distribution (%)	16.74	6.28	9.94	9	10.46	13.08	18.83	15.69

The Tarik river margins in the range 80 to 300 m altitude, fertile lands have been developed that is currently land for rice cultivation are considered. The slope of the land where the river has been reduced in past periods of erosion have formed. The watershed of the indicators (population density) and agriculture-based economy, the region is prone to develop agriculture and tourism. Terrace of the river (good soil) with the major surface water resources, agricultural inputs, it is considered that the annual river discharge and precipitation regimes and the threat is extremely serious []. (Rahimi, 1388: 89). Tarik River main channel slope 2.75 percent is estimated. Studies indicate that the basin of the river bed slope of the Tarik valleys are shallow. Most morphological changes in the main channel of river floods can be seen and continue to exit the basin. These changes include deepening and widening the main river bed and flood plain is severely degraded [11]. Flooding in while giving, more extensive exploration of landscapes is landscapes compression; Compressions of the flood scenes mainly coarse rock material are included. Density of coarse sediment in the bed is the main channel [11]. Tarik river bed at the beginning of the bed load is coarse, but where the bed slope decreases, Organic and Sandy River bed [18]. It shows the dynamics of coarse river-bed intensive pothole and once in the last period. Hypsometric curve (relationship between height and horizontal cross drainage), the river showed that the aging process to take over the Tarik river.

Table 10. Tarik River Main Waterway Slope

Altitude	Altitude average	Length of river in each unite (m)	Average of slope in each unite (%)	main water way slope (%)
80-100	90	85.62	23.36	2.75
100-200	150	6103.12	1.64	
200-300	250	3344.52	2.99	
300-400	350	2123.28	4.71	

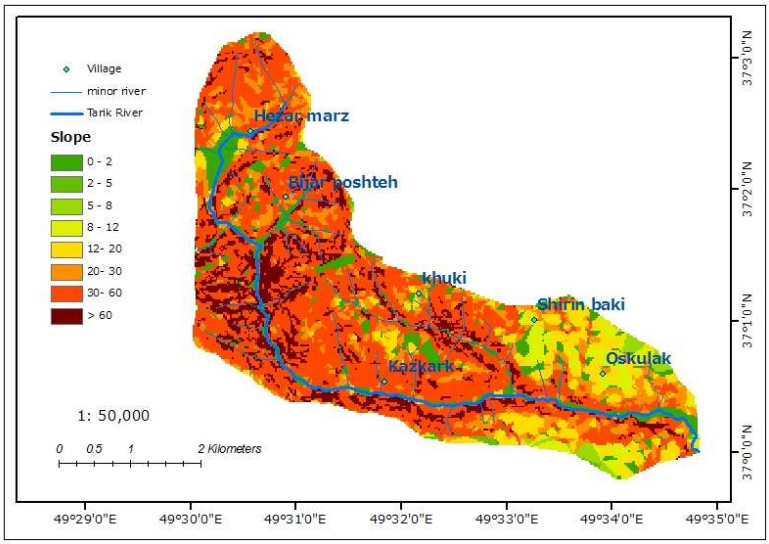

Figure 4. Tarik Basin Slope Map

CONCLUSION

Tarik basin is one of the unknown and small basins of Sefidrud watershed, which its main drainage enters into Sefidrud river before Tarik dam. The mountainous state basin and its land are covered with forests, but in recent years due to deforestation in the basin, where precipitation has increased the amount of runoff. Geomorphologic investigations, physiographic and climatic basin shows Tarik, the form, size and slope of river bed and 24-hour rainfall in this basin are considered an important factor in its Flattering flood. Basin form Tarik basin is one of the relatively long basins. The focus of the basin and the flood has affected Flattering. The basin is more elongated, its concentration decreases with time, resulting in peak time, peak flow rate decreases. But the Tarik basin, the basin is a narrow, short channel length and minor runoffs of rainfall in a short time to reach the main drainage fill and drainage work. The area, part of the basin basin is considered to be small, so its reaction to short-term rainfall into

runoff will be greater. Obtained 24-hour rainfall for the basin with different return periods, indicating increased rainfall in this watershed is Tarik. Flooding occurs when the soil and plants can not absorb rainfall and runoff in the channel throughput of natural stretch of river is not created. On average, approximately 30% of rainfall becomes runoff, which increases the rate of melting snow []. (Rahimi, 2009: 86). Studies indicate that the volume of topographic elevations in the northern half of the basin and its tributary waterways and further east and west is longer than the southern half, thus the runoffs of rainfall in less time than the southern half and western slopes into the main drains are Tarik. Tarik River of time for 3.41 hours is obtained which indicates the low basin area is Tarik. River hydrograph shows that the peak time for the Tarik river, 0.69 hours, meaning that the river discharge in less than 0.69 hours, reaches its peak. Hydrograph form suggests that the low basin area, the concentration decreased so that the basin has increased flooding. Flood zones in this basin range from 80 to 300 m elevation (topographic map) are located on the riverside, in the slope area between 0 – 2 percent. Many of the rivers are Tarik potholes that are connected by the shallow river bed. However, once the bed of the river bed is large for some part of its expansion that reduces sealing process that is flattering.

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