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The Erosion Yield Potention of Lithology Unite in Komroud Drainage Basin (North Semnan, Iran) Using MPSIAC Method

Ahmad Adib[1+], Davood Jahani[2], Masomeh Zareh [3]

[1]Faculty of Engineering, Islamic Azad University, South Tehran Branch, Tehran, Iran
[2, 3] Geology department, Islamic Azad University, North Tehran Branch, Tehran, Iran

Abstract. Komroud basin with area of 32 km^2 is located at North of Semnan Provence. Kahar formation with the age of infracamberian is the oldest available stones in this basin. Stone units in infracamberian and Cambrian formation cover more than 50% area of total range. This region is generally consisting of sediment stones. 6 main factors including geology, climate, tectonic, slope, plant cover and weathering are influence on level of erosion of rock units. In this research effective factors on erosion will be studied. And by using Arc GIS software the level of sediment yield map and investigation of formations to erosion at Komroud basin was specified. Most important factors on erosion at this region include geology, tectonic and slope. Then based on MPSIAC the related tables, maps will be prepared and finally the level of sediment at Komroud basin will be achieved. Results of tests and studies, certified that stone units of Komroud basin are classified within 5 erosion groups in which Quaternary unite had very high erosion and Lalun & Mila formation had very low sediment. Factors including Surface geology were effective on Komroud basin.

Keywords: Komroud Drainage Basin, Erosion, Alluvium, Erosion Sensitive

1. Introduction

Sedimentation measure can be estimated by different methods. Sedimentation amounts affected mutually by erosion factors, erodible extent of geologic units, ground dip and land use. Erodible of geologic units depended on petrologic properties, geologic structure and morphology of the area (S, Feyznia., 2007). Sediment assessment methods don't determine the real sediment amount and for this reason one should use field surveys and the related methods. Mechanical damage of Alborz south range results in making large mechanical products, mostly rock exposure and debris fans on the range. Active valleys are the important part of topography, and rivers excavate the basements more. In this part of Alborz, all the rivers origin from the high regions (Alborz middle wall), because of that erosion of the runout is the most important factor of the erosion, although this part have more drier air than the north range. The common range processes in this area are: washing, creeping, falling, sliding, solifluxion and snow slide (A, Aghanabati., 2004). In the region, mechanical and fine deposits are prepared for range and sedimentation activities due to physiographic (long length and steep slope of the ranges) and climatic (high temperature difference and nearly heavy raining) properties.

The watershed of Komroud village is located in Chashm rural district, Mehdishahr district, the north of Semnan province, and at coordinate 53°9′ longitude and 35°9′ with height 2200m. Fig. 1 shows the location of this area. The village is located in the middle of area and is limited to the villages Bandbon from the north, Gadouk from the west, paghale from the east and ghadamgah from the south. The study watershed includes 4 hydrological unites: A-INT, A1-INT, A1-1, and A1-2.

+ Corresponding author. Tel.: +989123459083 ; fax: +982166593929
E-mail: adib@azad.ac.ir & geo.adib@yahoo.com

2. The study methods

In this study, we assessed sensitivity of rock units to erosion and sedimentation amount basis on MPSIAC model by using library study, field survey and numerical calculations combined to data. The model alculates the sediment amount of Komroud basin straightly by considering more factors than the others. Modelling soil erosion is the process of mathematically describing soil particle detachment, transport and deposition on land surfaces (Wijeskera et al. 2002). In watershed management studies, knowledge on the erodibility of the soil, the state and intensity of erosion, and the expected effect of conservation measures control are of paramount importance in the understanding of erosion. These are especially critical in areas without any gauging station (Noman and Tahir 2002). Empirical methods are commonly used as a means of expressing existing (actual), expected (forecasted or predicted) and possible (potential) erosion (Ghadiri 1990). There are few methods that were generally used for soil erosion studies such as Food and Agriculture Organization (FAO), Water Erosion Prediction Project (WEPP), Universal Soil Loss Equation Method (USLE), Erosion Potential Method (EPM), and Pacific South West Inter Agency Committee Method (PSIAC) (Jalalian et al. 1997). The suitability of each method depends on climate and area, type of research and availability of data. In this study, Modified PSIAC (MPSIAC) method which is specially design for arid and semi-arid area in the United States was assessed for its applicability to the Iranian watershed environment.

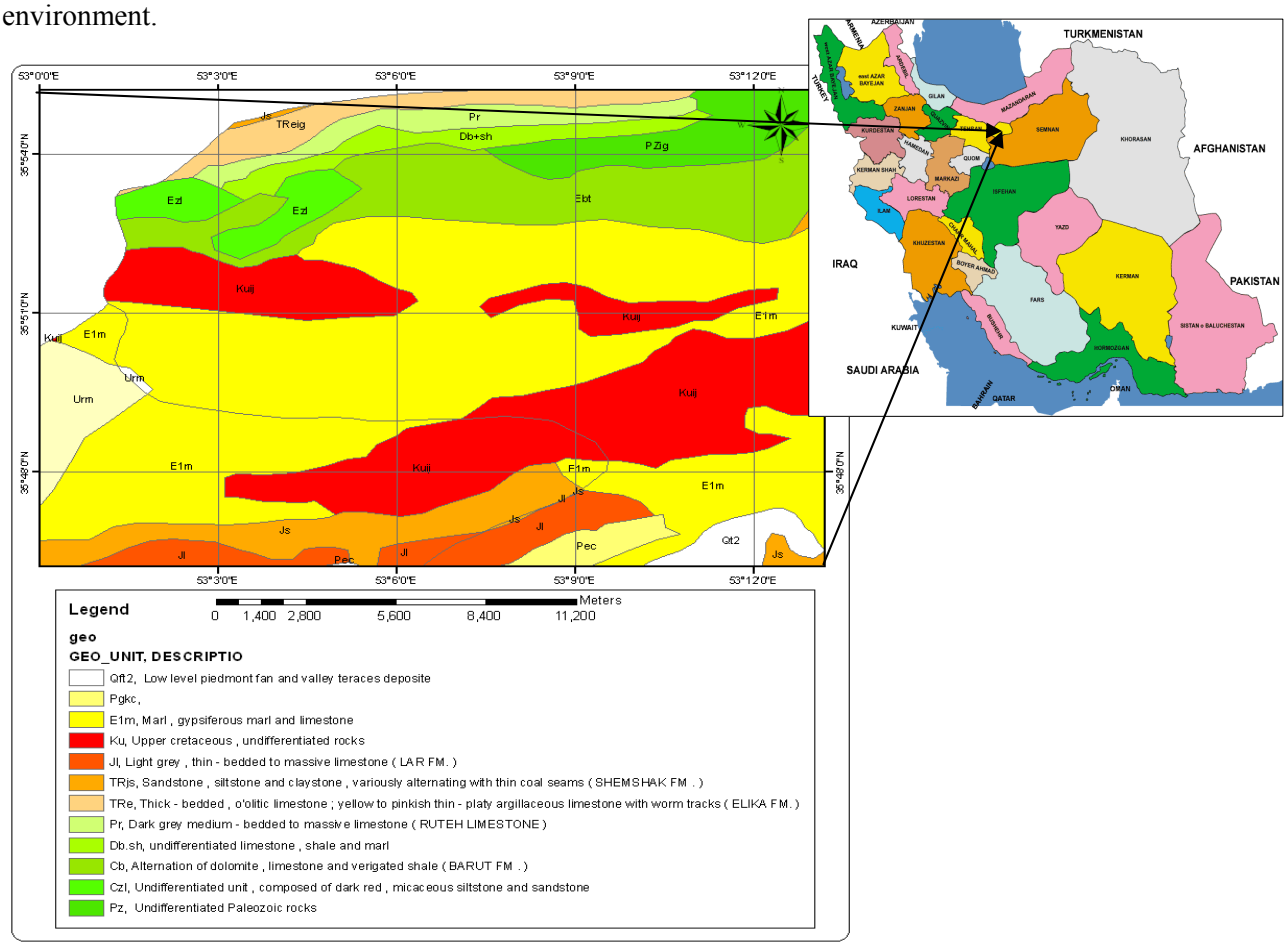

Fig. 1: Geology map and Location of the watershed Komroud village, northern Semnan province.

3. Discussion

Different factors affect erosion and sedimentation including geology, climate, slope, vegetation, weathering and tectonic situations (W, Summer at al 1996) and (J, Venden Berghe., 2003).In this region, the most effective factors on erosion are geology, slope and tectonic. Layer thickness, mineral properties and exfoliation are effective factors on rock erosion (H, Ahmadi., 1999). Drainage density of the basin shows status of surface and underlying soil layers resistance to erosion (A, Alizadeh., 2000). Possibility of erosion

in the south part is more than the others because its rock unites are less resistant to erosion (S, Feyznia., 2007). Geological and lithological properties of the region indicated in table 1 and fig 1.

Table 1: Formation and rock unit lithology of Norh semnan (GSI., 1987)

Lithology	Symbol	Formation	Era/Era ton
Younger Alluvium	Qal		Quaternary
Older Alluvium	Qt		
Marl, Marlstone, Limestone and tuff Intercalation	E_m		Eocene
Dolomite, Sandstone, Limestone, shale	C_m	Mila	Cambrian
Sandston, Arkose, shale	C_l	Lalun	
Shale, Sandy Shale, Red Micaceous	Pc_z	Zagun	
Shale , Dolomite, Limestone, Siltstone, Gypsum Lens	$Pc_{bt,gm}$	Barut	Infracambrian-lower Paleozoic
Slaty Siltston, Shale	Pc_k	Kahar	

3.1. Slope

Slope has main role on runout extent, flood penetration and intensity. By increasing slope, displacement of the debris particles, and then their abrasion ability are increased.

3.2. Sensitivity of rock unites to erosion

Rock behavior against weathering and erosion is depended to rock nature and relative factors of the surrounding environment (S, Feyznia., 2007). The rocks of the basin have classified to 4 group basis on mineral, grain size, structure and texture properties and using geomorphologic indexes, erosion features, field survey and rock resistance study (table 2, 3).

Table 2: Rock and sediment classification according to the hardness and erodible (S, Feyznia., 2007 from Diakonov)

Erosion ability	Order	Hardness	Lithology	Symbol	Formation
Very high	1	1	Younger Alluvium	Qal	Quaternary
High	2	1.5	Older Alluvium	Qt	
Medium	4	3	Marl, Marlstone, Limestone and tuff Intercalation	E_m	Eocene
low	3	6	Dolomite, Sandstone, Limestone, shale	C_m	Mila
Low	3	7	Sandston, Arkose, shale	C_l	Lalun
Medium to low	4	4	Shale, Sandy Shale, Red Micaceous	Pc_z	Zagun
Medium to low	3	2.5	Shale , Dolomite, Limestone, Siltstone, Gypsum Lens	$Pc_{bt,gm}$	Barut
Medium	4	5	Slaty Siltston, Shale	Pc_k	Kahar

In this survey, units of the basin compared nearly to each other. In the following, we describe these 5 groups.

-Very high erosion ability: discontinuous quaternary deposits (Qal), seen in the drainage basement

-High erosion ability: this group includes quaternary deposits (Qt) with low cohesion.

-Medium erosion ability: shale, mudstone and siltstone have medium erosion ability. Erosion of these rocks depend on their porosity, compression, cementation and hardening, exfoliation and crushing.

-Low erosion ability: this group involves rather resistant rocks such as sandstones of Lalun and Kahar formation and limestone and dolomite of Mila formation.

4. The Results

4.1. Surface geology

The watershed is composed of thick sanstone, limestone, dolomite, shale, gypsum and alluvial deposites. MPSIAC model has different grades for rock resistance (H, Refahi., 1996) . Table 3 showes how to rating geological factor to basin sedimentation and sesitivity.

Table 3: grades of geological factor, described by sub basins

grade	Sensitive to erosion	Erosion group	Lithology	Hydrological unit
1.5	Low	Low	Younger Alluvium	A-int
1.5	Low	Low	Older Alluvium	
1.5	Low	Low	Marl, Marlstone, Limestone and tuff Intercalation	
5	Very sensitive	Very high	Dolomite, Sandstone, Limestone, shale	A1-1
5	Very sensitive	Very high	Sandston, Arkose, shale	
4	sensitive	High	Shale, Sandy Shale, Red Micaceous	A1-2
3	sensitive	Medium	Shale , Dolomite, Limestone, Gypsum Lens Siltstone	
2.5	Medium	Medium	Slaty Siltston, Shale	A1-int

4.2. Soil

By MPSIAC method one can determines K factor, according to the percent of silt and very soft gravel, gravel and organic material of soil, in addition to soil structure and texture (H, Refahi., 1996), (table 4 , 5).

Table 4: K amount according to the texture and Percentage of soil Organic

No	Percentage of soil			Soil texture
	4	2	0.5	
1	0.22	0.31	0.36	Fine sand
2	0.18	0.22	0.27	sandy clay
3	0.42	0.53	0.57	clay silty sand
4	0.74	0.94	1.07	silty clay

Table 5: Land Properties of Komroud sub basins

K(Soil factor grade)	X-1-1	M-5-1	M-4-1	M-2-2	M-2-1	M-1-1	CL-1-1	Hydrological unit
0.4		2	235		27	175		A1-1
0.39		215		7. 9		180		A1-2
0.46		75	210	530				A1-int
0.44	9	295	1125	540	28		105	A-int

4.3. Climate

In the study area, according to the climate studies (T, Report. 2007) 6 hours rain falling occurred in every sub basins. Climate grades of them are shown in table 6.

Table 6: 6 hours falling with 2 years recurrent period and climate grade of the sub basins

Grade of climate factor	6 hours falling in 2 years	Height (m)	Hydrological unit
6.5	35.5	2640	A1-1
5.5	31.3	2404	A1-2
4.5	25	1920	A1-int
5.2	29	2250	A-int

4.4. Runout

Properties such as water Debbie, soil, watershed structure, morphology, drainage density and falling rate are effective on runouts. In this basin, we determined the runout factor by using hydrological data of all sub basins (T, Report. 2007) and MPSIAC method (table 7).

Table 7: Runout factor of the sub basins

Runout factor	Annual water $M^3/s_{/km^2}$	Runout Height (Cm)	Hydrologic unite
4	0.38	36	S_{1-1}
11	3.4	32	S_{1-2}
4.1	0.2	33	S_1
2.7	0.05	31	S

4.5. Erosion of the watershed surface

Due to determination of erosion effect on sedimentation, we surveyed rainy, sheet, groove and ditch erosion. To determine current erosion factor by MPSIAC method, soil surface factor (SSF) at first, and then current erosion factor of any geological and hydrological units components was calculated (H, Refahi., 1996),(table 8).

Table 8: ground cover and land use grade of the sub basins

Land use grade	Ground cover grade	Vegetation %	Bare soil %	Area (Ht)	Hydrological unit
50	33	50	30	1400	A1-1
35	55	33	50	400	A1-2
33	53	30	52	900	A1-int
32	51	32	51	800	A-int

4.6. drainage erosion and sediment transfer

Average slope of river basement, rocks of the river and potential flood power are some of the effective factors on river erosion and sediment place. River erosion grades of every sub basins were calculated by MPSIAC method and have presented in table 8. After determination of the 7 factors, special sediment was calculated by following equation of all Komroud sub basins (table 9).

Table 9: Grade of current erosion season and river erosion factor

Grade of river erosion	Grade of current erosion situation	Hydrological unit
10	45	A1-1
8	50	A1-2
7	44	A1-int
15	48	A-int

5. Conclusion

- Effective factors on erosion of study area are geology, slope and tectonic situation.

- The Rock units are in 5 erosion ability groups, the quaternary deposits are in the group very high and Soltanieh formation is in very low group.

- Surface geology and slope are the most important and effective factors between the 9 factors of MPSIAC method.

- A1-2 basin has the most annual deposit.

Table 9: Special sediment of the hydrological units by MPSIAC method in Komroud basin.

Grade sum	River erosion	Surfac erosion	Land use	Ground cover	slope	rounout	Climate	Soil	Geology	ydrological unit
182.5	10	45	50	33	20	4	6.5	4	10	A1-1
185.4	8	50	35	55	20	11	5.5	3.9	7	A1-2

172.7	7	44	33	53	20	4.1	4.5	4.6	2.5	A1-int
182.8	15	48	32	51	20	2.7	5.2	4.4	4.5	A-int

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