UDC 551.435
AGRIS P36
http://doi.org/10.5281/zenodo.2256971

THE CORRELATION OF GULLIES WITH VARIOUS LENGTH IN THE SECTOR OF ZABALA, PICHINCHA PROVINCE, ECUADOR

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СООТНОШЕНИЕ ОВРАГОВ РАЗЛИЧНОЙ ДЛИНЫ В СЕКТОРЕ ЗАВАЛА (ZABALA), ПРОВИНЦИИ ПИЧИНЧА, ЭКВАДОР

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Abstract. The investigation of linear erosion forms was carried out at the city of Quito (Equatorial Andes). The study was aimed to define the correlation between rill forms with different length parameters in the key-site area located nearby Zabala. It is stated that the rill forms with the length up to 50 m (58%) prevail. The gullies with the length of more than 200 m make 9% of all rill forms. Nevertheless, these gullies, as a rule, create main channels that provoke the formation of multiple side forms in the process of regressive erosion. The further development of the linear erosion causes the dissection of the investigated area that increases the risk for landslide developments.

Аннотация. Исследования линейных эрозионных форм проводились близ города Кито на территории экваториальных Анд. Целью работы было определение соотношения овражных форм различной длины на ключевом участке близ населенного пункта Завала. Установлено, что преобладают овражные формы длиной до 50 м, составляющие 58%. Овраги длиной свыше 200 м составляют 9% от всех эрозионных форм. Однако именно эти овраги, как правило, выступают в качестве основного ствола от которого идет формирование в результате регрессивной эрозии множества боковых форм. Расчленение территории исследуемого участка на отдельные фрагменты в результате дальнейшего развития линейных форм эрозии, способствует увеличению риска развития оползневых процессов.

Keywords: gully, erosion, slope, regressive erosion.

Ключевые слова: овраг, эрозия, склон, регрессивная эрозия.

The main conditions for the linear erosion are formed by such factors as relief — mainly characterized by the availability of steep slopes, humid climate, erodible soils and rocks.

The territory under study shows the combination of these factors and as a result the area is affected by sheet and linear erosion. The positional relation of the linear erosion forms, the estimation criterion for the erosion activity and the comparative analysis of varying territories form an important question to investigate.

The research was carried out in the key-site located 2500–2800 meters above sea level at the settlement of Zabala in the northern outskirt of Quito, Pichincha Province, and Equatorial Andes. The slope length varies from 150 to 550 meters. The inclination angle varies from 5–10° at the divide and on the undercut slopes to 25–35° in the mid and low parts of the slopes.

The slopes are covered by the modern residual, erodible deposits. According to Instituto Nacional de Meteorología e Hidrología del Ecuador, the mean temperature is 14 °C, slightly varying through the months. Liquid forms of precipitation prevail with a considerable proportion of rainfall. The average annual precipitation for the region is 600–700 mm. A number of research papers deal with erosion and accumulative formation processes in the territory [1–4]

The gullies on the key-site (Figure 1) were counted. ArcGIS 10.3 software was used to analyze the orthophotos provided by “Instituto Geográfico Militar” и “La Administración Zonal de Calderón” to see the distribution of the linear erosion forms on the key-site. The morphometric parameters of the gullies were refined and proved by the further field investigation. The results are shown in Table 1: the sequential number and the scheme number given in brackets for each gully and the gully length are presented.

Figure 1. The scheme of the studied gullies location.

The area is covered with isolated gullies as well as gullies developed in spreading system of erosive forms. As for the paper, the parameter of the length of erosive forms is considered as decisive. In this case the side–gullies are studied as separate forms. This fact is considered important for denoting a general criterion for other territories that may be involved in comparative analysis.

A number of the longest gullies in the process of regressive erosion came up close to the dividing crest. Thus, the correlation between the headwall and the watershed area has formed. These erosive forms have exhausted the possibilities for the gully–head erosion but many of the side–gullies erode further. Figure 2 shows the side–gully with rill erosion in its bottom.

Table 1.

THE LENGTH OF THE LINEAR EROSION FORMS ON THE KEY-SITE

Number gully (number of the gully on the scheme)	*The length of the gully (m)*	*Number gully (number of the gully on the scheme)*	*The length of the gully (m)*	*Number gully (number of the gully on the scheme)*	*The length of the gully (m)*
1 (1)	43	27 (20)	29	53 (33)	169
2 (2)	170	28 (21)	43	54 (35)	16
3 (3)	62	29 (22)	14	55 (34A)	7
4 (4)	163	30 (23)	64	56 (34)	67
5 (4A)	40	31 (23A)	49	57 (36)	273
6 (5)	25	32 (23A1)	16	58 (36A1)	28
7 (6)	160	33 (24)	53	59 (36B)	38
8 (7)	37	34 (25)	41	60 (36A)	82
9 (7A)	16	35 (26)	42	61 (37)	278
10 (8)	201	36 (27)	158	62 (37A)	24
11 (9)	11	37 (27A)	124	63 (37B)	42
12 (10)	197	38 (27A1)	30	64 (37C)	36
13 (10A)	40	39 (28)	270	65 (37D)	33
14 (11)	12	40 (28A)	27	66 (37E)	32
15 (12)	22	41 (29)	236	67 (37F)	85
16 (10B)	62	42 (29A)	23	68 (37G)	27
17 (13)	30	43 (29B)	54	69 (37H)	30
18 (13A)	19	44 (29B1)	24	70 (37I)	19
19 (13B)	13	45 (30)	234	71 (37J)	186
20 (14)	15	46 (30A)	44	72 (38)	103
21 (15)	22	47 (31)	198	73 (38A)	53
22 (16)	61	48 (32)	61	74 (38A1)	29
23 (16A)	22	49 (33A)	99	75 (39)	130
24 (17B)	16	50(33A1)	11	76 (39A)	215
25 (18)	21	51 (33A2)	15	77 (40)	182
26 (19)	63	52 (33A3)	15	78 (41A)	137

Table 2.

THE CORRELATION OF THE GULLIES OF DIFFERENT LENGTHS ON THE KEY-SITE

The length of the gully (m)		*Number of gullies*	*Percent gullies of varying length*
0	50	45	58
50	100	13	17
100	150	4	5
150	200	9	12
200	250	4	5
250	300	3	4
Over 300		0	0
In all		78	100

We would like to underline that 75% of the gullies do not exceed the length of 100 m. While 58% of all the explored erosive forms are less than 50 m in length. Only 9% of the gullies exceed the length of 200 m. The linear erosive forms of more than 150 in length make 21% of all the amount. Though these gullies create main channels that provoke the formation of multiple side forms in the process of regressive erosion.

Figure 2. The side–gully with rill erosion in its bottom.

The further development of the linear erosion causes the dissection of the studied area that increases the risk for landslide developments. The loss of soil stability may cause landslides heavy enough to provoke rockfalls to block the Pan–American Highway, an important traffic artery in the region.

Among the well–known factors of linear erosion, a questionable aspect remains: why some slopes are covered with a wide spread gully network while only few gullies are formed on the surface of other slopes with coincident parameters. This phenomenon is revealed in coincidence of all the circumstances of erosion development. It does not seem convincing to find the explanation for the specifics in the anthropogenic influence. Thus, in Ecuador well–spread gully networks are discovered even in forest ecosystems minimally affected by anthropogenic activities. The studied slopes with dense gully networks presented in the research paper are not used in agricultural activity and have hardly ever been before.

The authors find it an advanced research direction to investigate various territories within Equatorial Andes area using uniform research methods. Therefore, the analysis of the correlation of length parameters of erosion forms is considered to be one of important comparative parameters.

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Работа поступила в редакцию 17.11.2018 г.

Принята к публикации 21.11.2018 г.

Cite as (APA):

Kravchenko, R., Pareja, E., & Flores, Y. G. (2018). The correlation of gullies with various length in the sector of Zabala, Pichincha Province, Ecuador. *Bulletin of Science and Practice, 4*(12), 215-219.

Ссылка для цитирования:

Kravchenko R., Pareja E., Flores Y. G. The correlation of gullies with various length in the sector of Zabala, Pichincha Province, Ecuador // Бюллетень науки и практики. 2018. Т. 4. №12. С. 215-219. Режим доступа: http://www.bulletennauki.com/12-33 (дата обращения 15.12.2018).