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THE COMPARATIVE CHARACTERISTIC OF THE ERODED SOILS IN THE GUAYLLABAMBA RIVER VALLEY (EQUATORIAL ANDES) ON THE SLOPES WITH THE EXPOSURE TO THE SOUTH AND NORTH

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СРАВНИТЕЛЬНАЯ ХАРАКТЕРИСТИКА ЭРОДИРОВАННЫХ ПОЧВ НА СКЛОНАХ СЕВЕРНОЙ И ЮЖНОЙ ЭКСПОЗИЦИИ В ДОЛИНЕ РЕКИ ГУАЙАБАМБА (GUAYLLABAMBA) В ЭКВАТОРИАЛЬНЫХ АНДАХ

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Abstract. The paper presents the results of the investigation of the soils on the slopes with the exposure to the south and north in the valley of the Guayllabamba river, the South America, Equatorial Andes. The analisys proved that the soils on the slope with the exposure to the north are characterized with small amount of organic matter (0.10–0.21%). The organic matter content in the soils of the slope with the exposure to the south vary from 0.44 to 1.92%. The maximum organic matter amount on the slope with the exposure to the south reveals in the parts with the slope angle of 19°, the minimum amount charachterises the slope with the angle of 14° The upper part of the south–exposure slope, characterized as more fertile, differs in the most parameters. The slopes of Equatorial Andes are characterized by great microclimate diversity that creates a range of local ecosystems.

Аннотация. Исследованы почвы на склонах северной и южной экспозиции в долине реки Гуайабамба (Guayllabamba) в Южной Америке, в экваториальных Андах. Установлено, что склон северной экспозиции характеризуется почвами с очень низким содержанием органического вещества 0,10–0,21%. В почвах склона южной экспозиции содержание органического вещества варьирует в пределах 0,44–1,92%. Максимальное содержание органического вещества на склоне южной экспозиции отмечается при угле наклона поверхности 19°, тогда как минимальное содержание органического вещества установлено при меньшем угле наклона, в 14°. Верхняя часть склона южной экспозиции отличается по большинству параметров и характеризуется большим потенциальным плодородием. Склоны в экваториальных Андах характеризуются очень большим разнообразием микроклиматических условий, что выступает как фактор формирования множества локальных экосистем.

Keywords: erosion, soil, slop, exposure.

Ключевые слова: эрозия, почва, склон, экспозиция.

The investigation was carried out in Equatorial Andes. The key-site is located in the Pichincha Province (Republic of Ecuador) in the valley of the Guayllabamba river almost at the equator line (78°23′ N, 00°03′ W), 10–60 meters above sea level.

The slopes are covered mostly by the modern soft erodible sediments. According to the data of Instituto Nacional de Meteorología e Hidrología del Ecuador the mean temperature is 15 °C, slightly varying through the months. Liquid forms of precipitation prevail with a considerable proportion of rainfall. The average annual precipitation for the region does not exceed 700 mm with the highest precipitation rates in April. The humid period lasts from January to the mid-summer. The monthly average rate from January to April is 300 mm. The dry season falls on the period of August–December. The forms of linear erosion are prevailing in the investigated area. The key site is not agriculturally cultivated.

The authors have carried out the investigation in 2018. The research work was focused on the comparative analisys of the soils taken from the slopes with different exposure. In particular, the mid-latitudes show the distinct difference between the south–exposure and north–exposure slopes caused by insolation intensity. A number of previous research papers have dealt with the problem of the erosion on the slopes with different exposition in the tropical and equatorial zones of Latin America [1–4] and others. Nevertheless, the difference between the south and north–exposure slopes in the equatorial area of the mountine part of South America.

The Guayllabamba river valley in the investigation zone does not show well-defined terraces. The valley has steep slopes grading into the flood plain. The investigation was held on the south–exposure slopes with the length of 280 m and on the north–exposure slopes with the length of 150 m; the soil samples were taken to be analyzed at the laboratory of Agrocalidad, Quito. Three sectors within the slopes were investigated: upper, middle and low parts (Tables 1–2).

Table 1.

SOIL CHARACTERISTICS OF THE SOUTH–EXPOSURE SLOPE

Parameters		*Upper part of the slope (slope angle 19°)*	*Middle part of the slope (slope angle 14°)*	*Lower part of the slope (slope angle 34°)*
Organic matter (%)		1.92	0.44	0.56
Nitrogen (%)		0.10	0.02	0.03
Phosphorus (mg/kg)		15.0	4.7	5.4
Potassium (cmol/kg)		0.63	0.19	0.23
Calcium (cmol/kg)		7.59	16.25	9.32
Magnesium(cmol/kg)		1.98	2.23	1.96
Iron (mg/kg)		133.3	29.2	38.2
Manganese (mg/kg)		7.95	0.15	0.83
Copper(mg/kg)		6.56	4.90	5.12
Zinc (mg/kg)		<1.60	<1.60	<1.60
pH		6.60	8.90	8.23
Textures of the soil	Sand (%)	56	70	72
	Silt (%)	32	18	18
	Clay (%)	12	12	10

Table 2.

SOIL CHARACTERISTICS OF THE NORTH–EXPOSURE SLOPE

Parameters		*Upper part of the slope (slope angle 45°)*	*Middle part of the slope (slope angle 25°)*	*Lower part of the slope (slope angle 25°)*
Organic matter (%)		0.10	0.21	0.21
Nitrogen (%)		—	0.01	0.01
Phosphorus (mg/kg)		4.6	4.4	5.6
Potassium (cmol/kg)		0.46	0.71	0.57
Calcium (cmol/kg)		5.74	18.26	19.43
Magnesium(cmol/kg)		1.06	2.49	2.01
Iron (mg/kg)		38.6	30.3	32.6
Manganese (mg/kg)		<0.40	<0.40	<0.40
Copper(mg/kg)		3.89	3.49	3.06
Zinc (mg/kg)		<1.60	<1.60	<1.60
pH		9.30	9.03	9.05
Textures of the soil	Sand (%)	56	70	74
	Silt (%)	30	18	16
	Clay (%)	14	12	10

A general view of the study area is presented in the Figure.

Figure. Study area. Slopes in the Guayllabamba river valley.

The percentage difference in the amount of the organic matter in the soils dependable on the slope exposure provokes a particular interest. The north–exposure slope is characterized by the soils with the low amount of the organic matter (0.10–0.21%.). The organic matter parameters

of the south–exposure slope vary from 0.44 to 1.92%. It should be mentioned that the maximum amount of the soil organic content is revealed at the high angle of the surface inclination (19°), the minimal organic content was found in the soil samples taken from the slope with the inclination angle of 14°. It appears that the location of the site with the maximal parameter (1.92%) in the upper part of the slope at the divide with low amount of the flowing surface water that has not yet become powerful enough to cause the linier erosion is the key factor for saving the soil organic content.

The both of the slopes are characterized by a very low Nitrogen parameter. Comparing Phosphorus parameters, it could be noted that according to Agencia Ecuatoriana de Aseguramiento de Calidad Agro the mounted area of the Andes the low amount is characterized by the low Phosphorus amount. It is only the upper part of the slope with the exposure to the south reveals the mid-Phosphorus content. All the soil samples show the high amount of Calcium. According to the interpretation presented above, the analysis revealed the mid-Iron content. And again, the higher indicators are characterizing the upper part of the south–exposure slope. Manganese–content parameters shows the same tendency. The soils are strong alkaline except for the slope with the exposure to the south.

On this basis we conclude that the slopes with the different exposure reveal the great difference in such deteminal parameter as the soil organic content: the northern slope shows the lower indicators.

Meanwhile, in the previously published paper [4] devoted to the investigation of the geographically close area, located on an upper elevation level, did not reveal the determing difference between the eroded soils of north and south exposure. It is obvious that the slopes of the Equatorial Andes are characterized by a great diversity of microclimate circumstances that stands as a formation factor for a multiple of local ecosystems.

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