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**THE CHARACTERIZATION OF THE AGRICULTURAL LANDS  
ON THE EROSION–THREATENED SLOPES NEAR ALAQUEZ, ECUADOR**

**ОЦЕНКА СОСТОЯНИЯ СЕЛЬСКОХОЗЯЙСТВЕННЫХ ЗЕМЕЛЬ  
НА ЭРОЗИОННО ОПАСНЫХ СКЛОНАХ В РАЙОНЕ АЛАКЕСА, ЭКВАДОР**

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*Abstract.* The investigation is focused on the conditional characteristics of the soil on the erosion-threatened sloping lands devoted to agriculture. The studied territory is situated in the Equatorial Andes. The analyzed samples were taken from the key-sites located on the slopes with inclination angle of 10°. The comparative analysis was carried out within the borders of a key-site divided into 4 sectors with different agricultural crops: corn, oats, beans and a permanent grass pasture. It is defined that the agricultural fields used for corn cultivation are the most vulnerable to erosion. The organic matter content in the plow layer is decreasing up to 0,53 %. The process of erosion is the leading degradation factor. Observations have shown that such erosion forms as gullies are being formed. It is recommended to reduce corn cultivation in steeply inclined areas unless erosion control measures are taken.

*Аннотация:* Исследовано состояние почв на эрозионно опасных склонах используемых в сельском хозяйстве. Изученная территория расположена в экваториальных Андах. Полевые исследования земель и анализируемые образцы почв приурочены к частям склонов крутизной 10°. Сравнение проводилось в пределах ключевого участка включающего 4 сектора с различными сельскохозяйственными культурами: кукуруза, овес, фасоль, пастбища с многолетними травами. Установлено, что процессы деградации почв наиболее интенсивно развиваются на полях, где возделывается кукуруза. Наблюдается падение содержание органического вещества (до 0,53%) в пахотном слое. Основной фактор деградации, это эрозионные процессы. Также отмечено формирование эрозионных линейных форм, таких как промоины. Рекомендуется ограничение возделывания кукурузы на круто наклонных поверхностях в случае отсутствия комплекса противоэрозионных мероприятий

*Keywords:* erosion, soil, slop, agricultural lands.

*Ключевые слова:* эрозия, почва, склон, сельскохозяйственные земли.

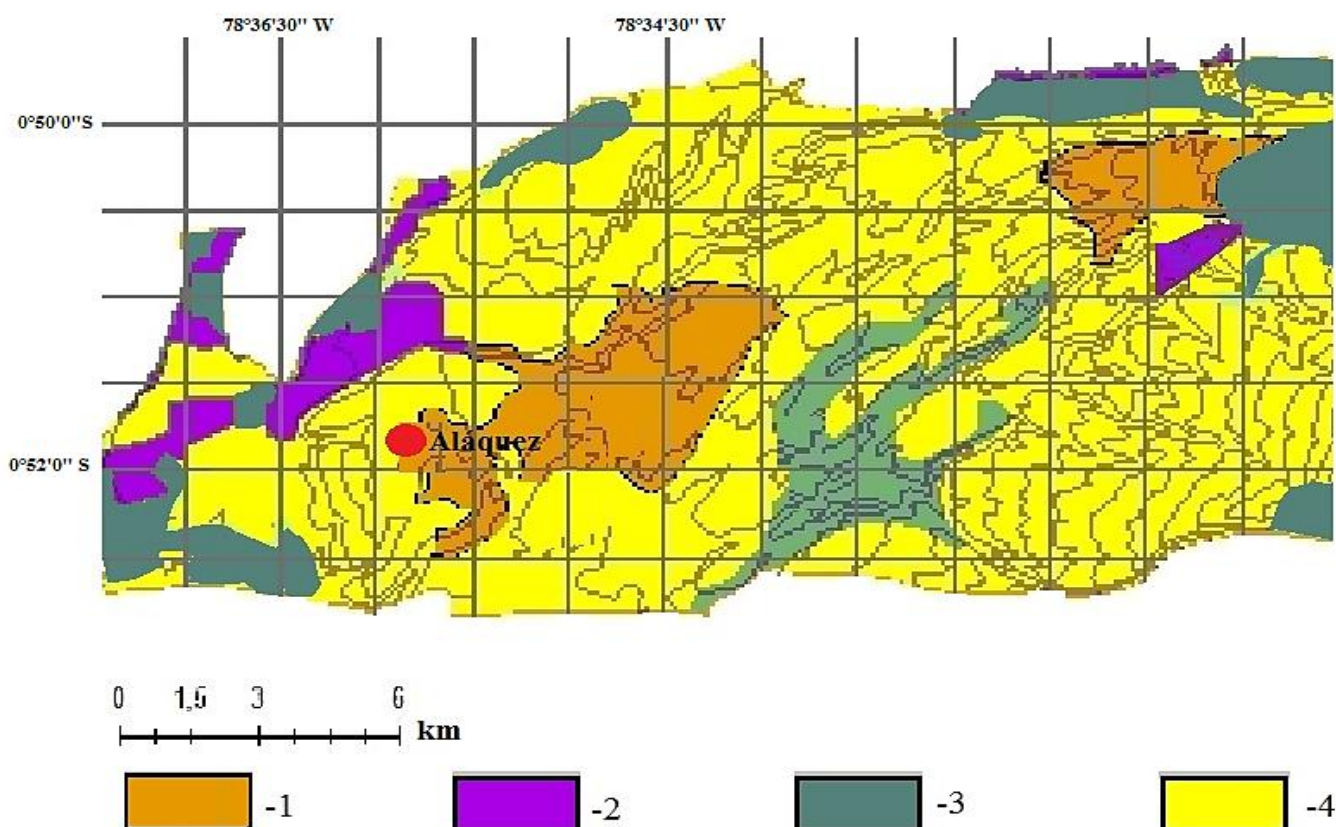
Comparative characterization of erosion–threatened areas used for agricultural crops cultivation is one of the topical issues of agriculture and the theory of erosion. The collection of soil erosion data according to various provoking factors leads to some applied recommendations. It

becomes more important for the region under the investigation for the more than 40% of the population is occupied in agriculture activity.

The territory has not been thoroughly studied as far as field investigations are concerned. The developed and earlier approved mathematical models of soil erosion loss appear not to be effective for the Equatorial Andes zone [1]. Therefore, the comparative analysis of the impact that the natural conditions and agricultural crops have on the soil erosion and the degradation of slop lands carried out in the framework of field investigation process becomes particular important. A number of previous research papers have dealt with the problem of the soil degradation process in Ecuador caused by agricultural activity [2–4] and others.

The authors carried out the investigation in the province of Cotopaxi, canton Latacunga, Ecuador in 2016. The key–site is located near Aláquez, 2700–3000 meters above sea level. The location in the equatorial part of the Andes determine the main climat characteristics of the territory. The mean temperature is 12 °C, slightly varying through the months. The average annual precipitation for the region is 500–700 mm. Liquid forms of precipitation prevail. The materials for the investigation were provided by map data sources, land using data; meteorological data of The National Institute of Meteorology and Hydrology, Ecuador. ArcGIS software was applied. Field investigations were carried out. The soil sampling analysis was carried out at the laboratory of *Agrocalidad*, Quito.

Within the key–site (Figure 1) there are some sectors used for various agricultural crops cultivation (corn, permanent grass pastures, cereals, annual plants). The analysis proved the soil to be loam.



Within each sector there were selected parts on slopes with inclination angle of 10 °. Such

areas are considered to be erosion-threatened ones: the processes of linear erosion alongside with sheet wash have been observed in the area. As for the agricultural crops on the investigated slopes, the prevailing ones are oats and beans as annual plants.

The results of the organic matter content analysis in the soils of the sectors with different agricultural crops are presented on Figure 2.

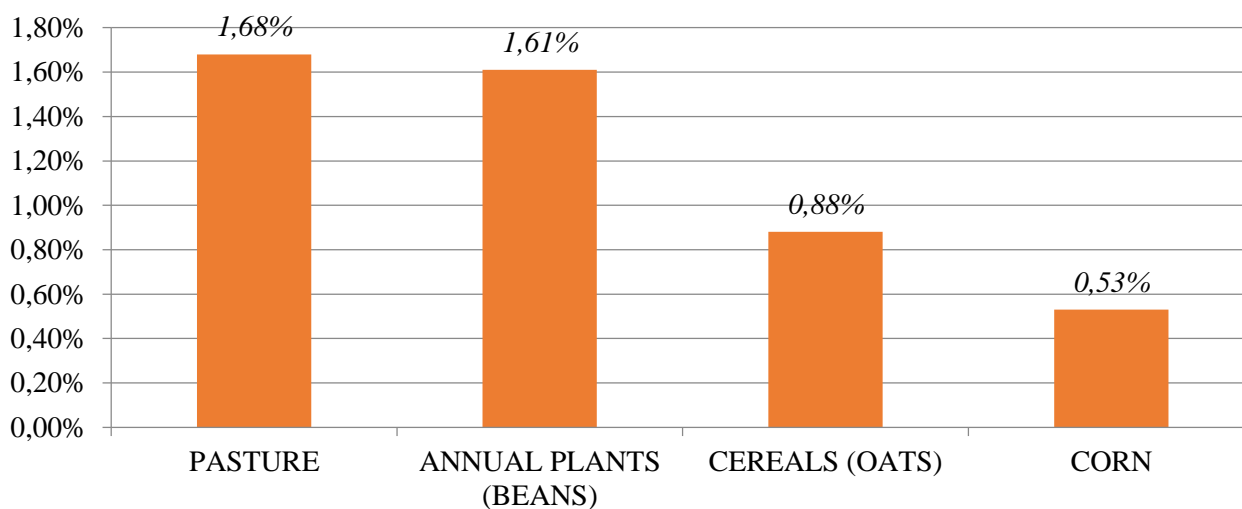


Figure 2. Organic matter content (%) in the slope soils of the key-site with inclination angle of 10 °.

The growing areas with oats are characterized by low rates of organic content. However, the amount of organic matter loss is the greatest in the soils of the corn fields. Cultivating corn on the slopes with inclination angle of 10 ° leads to a fast soil fertility decline. The organic matter content range of 0,53% in the plow layer reveals the soil degradation mostly caused by water erosion process. Prolong corn cultivation in the steeply inclined areas of the Equatorial Andes make them lost for agriculture. The field investigation has shown the formation of gullies and rills in the territory. The conditions are favorable for active linear erosion processes that are likely to cause the complete loss of the lands for agricultural activity.

On the contrary, the beans fields and pasture in the key-site are characterized by medium organic matter content of 1,61% и 1,68%. It should be mentioned that such low percentage is typical for the mountain soils of the territory. The organic matter index of more than 2% is considered to be a high one in accordance with the standards acceptable to the environmental conditions.

Table illustrates the analysis results presenting other meaningful indications of the soils in the key sectors.

Table.

THE SOIL PARAMETERS OF THE KEY-SITE SLOPES WITH INCLINATION ANGLE OF 10 °

Cultivation	pH	Nitrogen, %	Phosphorus, ppm	Potassium, cmol/kg	Organic matter, %
Pasture	6.91	0.08	52.4	0.71	1.68
Cereals (Oats)	7.16	0.04	96.6	0.21	0.88
Annual plants (Beans)	7.18	0.08	64.8	0.76	1.61
Corn	6.80	0.03	11.2	0.36	0.53

The analysis reveals that nitrogen content is low in the soils of all the sectors. According to the standards acceptable to Ecuador, the soils of the mountain zone are characterized by high phosphorus content in case they are used for the cultivation of cereals or beans and pastures. The medium phosphorus content is general for corn fields. The high index of potassium was defined in the soils of the sectors used for beans cultivation and permanent grass growing. The corn and cereals fields are characterized by the medium potassium index.

Prolong corn cultivation on the slopes with inclination angle of 10° leads to the considerable degradation of the soils in the mountain areas of Ecuador. The actions should be taken to change the policy of agricultural land use in the region; to turn to crop rotation is one of such measures.

It is recommended to reduce corn cultivation in steeply inclined areas unless erosion control measures are taken.

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