Anthropogenic changes of the agricultural production features of river valley-escarpment soils in Martuni region, Sevan basin, RA

Samvel Kroyan*¹, Suren Tovmasyan¹ and Anush Margaryan¹
¹National University of Architecture and Construction of Armenia, Yerevan, Armenia

Abstract. The article discusses the agro-production features of the river valley-escarpment soils of the Republic of Armenia, the negative changes occurring in the soils due to the impact of climate change and the anthropogenic factor, as well as a number of issues related to the ways of increasing soil fertility. According to the Research results, river valley-escarpment soils are in general, characterized by high natural fertility and are widely used in agricultural production as high-quality arable land. Meantime, significant changes in the agro-productive features of soils are observed as well. In order to efficiently use the land, increase and maintain the fertility, it is recommended that scientifically based complex agrotechnical measures in compliance with local conditions are applied.

1 Introduction

In modern age, in conditions of global climate change, one of the priority issues facing society is the effective use of land resources, their improvement and preservation. Detailed studies of the genetic and agro-productive features of soils are of great importance for our land poor countries. Clarification of these and other similar issues is of special importance for the republic, especially concerning river valley-escarpment soils, because although these soils occupy relatively small areas, they are characterized by having high indicators of agro-production features and fertility.

2 Materials and methods

The research material is river valley-escarpment soils of the Republic of Armenia, the negative changes that occur in them, as a result of natural factors and unplanned human economic activity

The object of the research is the river valley-escarpment soils in the territory of Nerkin Getashen community of Lake Sevan basin.

Research was carried out by the method of comparison of cultivated and non-cultivated (idle) lands.

* Corresponding author: kroyan.samvel@mail.ru
Field work was carried out using soil extraction method, laboratory research was carried out using the modern methods in the sphere of soil science [1-2].

Geological studies were carried out in three stages: preparatory work, field work and laboratory research.

During the preparatory work, the object of study was selected, the scale of the soil output, the volume of field and office work and the dates of execution were determined, then topographic maps were obtained. Materials on soil science, agrochemical, geological, botanical, hydrogeological, saline, man-made pollution of the investigated area were studied and prepared.

A preliminary soil map was created with soil science materials on a topographical basis prepared for field work, on which the soil type was distinguished.

Field works were carried out in the following order:

- Placing and description of land sections, definition of land designation.
- Soil samples were taken according to genetic horizons, a selection of soil samples intended for laboratory analyzes was made, the soil samples were dried in an air-dry state and broken into small pieces, passing through a 1 mm sieve.
- Groundwater samples were taken.

During the field works, the morphological characteristics of soils, the degree of stoniness and erosion, water-physical properties were studied, the original name of the soil was given and ways of their effective use were indicated.

The depth of soil sections varies from 81cm to 101cm.

Soil samples were taken according to genetic horizons, with a total weight of 300-400g. (Figure 1)

![Soil sections](image)

Fig. 1. The location of soil sections.

Laboratory analyzes were carried out with the following methods:

Research was carried out by the method of comparison of cultivated and non-cultivated (idle) lands in areas with homogeneous terrain. The laboratory researches were carried out in laboratories of the branch of Armenian National Agrarian University(ANAU) H. Petrosyan Scientific Center of Soil Science, Melioration and Agrochemistry.
Hygroscopic moisture content of the soil was determined by the Nikolaev method, humus content by the Turin method.

Organic carbon and total nitrogen was determined by calculation method, calcium and magnesium by Gedroits and Ivanov methods.

3 Results and Discussion

The river valley-escarpment soils of RA Martuni region of the Sevan basin are spread in the low-lying escarpments of Argich river lower current. Soil-forming rocks are in a form of alluvial sediments (outwashes). The groundwater level is quite high and often reaches the soil surface. The total area of these lands is around 16 thousand. Ha [3-8]. The upper horizons of river valley-escarpment soils are characterized by the presence of (have) a well-defined turf horizon, where the content of minor dispersed silt fractions is significant. This horizon contains hardly any skeletal particles, but is abundant in the amount of the dust fraction. The thickness of the peat horizon sometimes reaches 50 cm. One of major morphological features of the soils is that they do not contain carbonates and hydrated lime, the lower horizons are glaciated, and the upper horizons mostly have a gray-brown coloration.

The peat horizon of river valley-escarpment soils is unstructured, in some cases it is merely granular, yet the lower horizons are characterized by a well-defined clod-granular structure.

In terms of mechanical composition, the soils have a well-defined mottled layered structure.

It is slightly sandy-loamy in the vegetable layer, medium sandy-loamy in the middle, and slightly sandy-loamy in the lower layers of the profile. The physico-chemical composition data of the of river valley-escarpment soils are presented in the figures below (Figures 2-5).

Fig. 2. Humus, organic carbon and nitrogen concentration in non-cultivated soils.
The analysis of the data from the figures shows that the humus horizons of the soils contain a large amount of organic substance. The humus percentage in the upper horizons of the non-cultivated soils is 19.88%. The percentage of organic carbon and total nitrogen is 11.69 and 0.99%, respectively (Figure 2). The hygroscopic moisture index in uncultivated soils is low (5.84-5.92%) [8-12]. In the upper horizons of the river valley-escarpment soils, the lightly base reaction of the soil solution becomes lightly acide in the middle and lower horizons.

The table data shows that calcium ion dominates in the absorption complex of river valley-escarpment soils. In the horizon of non-cultivated soils, it ranges from 42.55-45.14 mgEq in 100g of soil. The amount of absorbed magnesium in the above-mentioned horizon is 4.72-5.44 mgEq in 100 g of soil (Figure 3) [12-15].
In terms of agricultural use, river valley-escarpment soils are of major interest, because, as we have already mentioned, they are characterized by rather high fertility. In the last few decades, as a result of global climate changes and uncoordinated human economic activities, cultivated parts of river valley-escarpment soils, among a number of soil types of the republic have also been significantly affected.

Thus, the comparison of the table figures reveals that there is a significant reduction of humus, organic carbon and total nitrogen reserves in cultivated soils. When comparing the respective indicators of the upper horizons of non-cultivated and cultivated lands, it becomes clear that the humus content in the upper horizons of arable lands decreases amounting to 14.57%. The content of both organic carbon and total nitrogen significantly reduces simultaneously with the decrease of humus concentration (Figure 4).

The high content of humus in river valley-escarpment soils and the significant amount of soft silt fractions in the mechanical composition determined the large volume of absorption of these soils. In the upper horizons of uncultivated soils, this figure is 50.58 mgEq per 100g, and the calcium ion predominates. Magnesium content barely exceeds 5.44 mgEq in 100g of soil. A certain decrease of mentioned indicators is observed in cultivated lands (Figure 5) [15-18].

The decrease in the reserves of above-mentioned nutrients is primarily due to both long-term uncoordinated use of arable land and global climate changes.

4 Conclusion

To sum up, research shows that among the characteristic features of the river valley-escarpment soils of RA are:

- Existence of a well-defined peat (turf) layer in the upper horizons.
- The peat horizon is unstructured.
- Soil solution reaction is almost neutral.
- The content of humus, organic carbon, nitrogen, absorbed calcium and magnesium is relatively high.
- Long-term uncoordinated agricultural use and global climate change led to significant changes in a number of agro-productive features of soils.
The results of the study of river valley-escarpment soils, the characteristics of the genetic and productive characteristics of the soils, as well as the possibilities of territorial organization provide a basis for recommending a number of agromelioration measures, which are aimed at increasing the productivity of the mentioned soils.

The measures of primary importance are:

- Laying of water collection streams in the direction of the slopes’ horizontal, strictly take into account the gradient of the slope and the amount of precipitations while determining the distance of the streams.
- In highly eroded soils, in the case of steep slopes, it is necessary to build stair-shaped escarp(ment)s, having a soil layer of 30-40 cm.
- The escarp(ment)s can sometimes be replaced by deep furrows, placing the inter-furrow spaces under cereal, butterfly-flowered perennial herbs, and planting fruit trees on the escarp(ment)s.
- Fertilize the soil with organic and mineral fertilizers, especially matured manure.
- It is recommended to cultivate sainfoin and perennial grass mixtures, which will restore the decayed structure, increase the reserves of organic matter, and improve the agrophysical features of the soil.
- To withstand dry and hot winds, as well as to reduce evaporation and loss of organic carbon, plant protective forest strips at the border of the plots, make mulching, if possible apply no till, or minimal cultivation.

References

6. E.N. Badalyan, R.A. Edilyan, Comparative characteristics of organic matter of the main types of soils in the ArmSSR, Biolog.zh, Armenia, 7, 695-703 (1979)
7. L.A. Grishina, D.S. Orlova, System of Indices of Soils Humus State. In the book: Theses of Reports of the V Delegate Congress of the All-Union Community of Soil Scientists, Minsk, 2, 3-7 (1978)


14. Samvel Kroyan, Suren Tovmasyan, Paruyr Efendyan, Anush Margaryan, Change of water-physical properties of mountainous meadow-chernozem soils of the republic of Armenia under the influence of anthropogenic factor, E3S Web of Conferences, 420, 03003, 1-7 (2023) https://doi.org/10.1051/e3sconf/202342003003


