ABSTRACT

Key words: erosion, soil, amelioration works

Degradation of agricultural land by slope processes such as erosion and landslides is one of the main concerns of those exploiting natural soil resources, due to the particular impact on agricultural production, conservation and environmental protection. Many researchers in the field consider the continued degradation of soil resources through erosion and landslides to be one of the most serious long-term threats to humankind.

Although soil erosion processes are physical processes, they have numerous consequences on different economic sectors that affect people's daily lives. As a result of these processes, soil is depleted of humus and non-renewable nutrient resources. Under these conditions, restrictions on cultivated agricultural crops are increased and yields are considerably reduced in quantity and quality.

Complex erosion processes lead to significant changes in the morphological, physical, chemical and biological properties of the soil, resulting in a substantial decrease in fertility for crop plants and, consequently, a decrease in agricultural production. Erosion also pollutes other environmental resources such as groundwater and water courses. Degraded agricultural land is difficult to farm because of the need to adapt crop cultivation technologies to the new conditions resulting from repeated slope processes.

According to https://www.worldometers.info, soil erosion and other forms of land degradation deprive mankind of 5-7 million hectares of agricultural land every year.

In Romania, before 1990, only 2.1 million ha of agricultural land at risk of erosion (6.4 million ha) were properly managed with erosion control practices. However, very important have been the changes in the way agricultural land has been exploited since 1990, due to its deficient exploitation in the form of small plots, its orientation towards hill-valley and the extensive fragmentation in about 48 million plots, resulting in a doubling of the number of plots compared to the pre-war period.

In order to carry out the documentation study, 159 bibliographical sources were consulted, systematized, analyzed and interpreted, with authors from both the country and abroad.

The aim of this work was to highlight how the restoration and rehabilitation of slopes through soil erosion control works contributed to the prevention of soil degradation and modification of soil properties.

One of the earliest mentions of soil degradation due to anthropogenic influence through erosion is linked to Solon the Lawgiver, a famous 6th century governor of ancient Greece. He is said to have banned the cultivation of hillsides, and another ruler of the time, Pisistrates, is said to have offered a 'bonus' to farmers who planted protective species, such as olive trees, to prevent deforestation and overgrazing on hillsides.

Wind erosion devastated millions of acres of farmland in the United States in the 1930s, and as a result, the government, in order to provide farmers with knowledge about soil conservation, created an agricultural extension service where they were trained to seed along level courves, plant trees, hedges and grass around cultivated plots. Crop rotation was also introduced to give the soil a chance to recover its nutrients, and within a few years land productivity was restored.

In Romania, Ion Ionescu de la Brad (1869), in his paper Monografia Județului Putna, points out the threats caused by the loss of fertile soil layer, and later, provides the first data on soil degradation by erosion.

Research in the field has subsequently expanded within the Romanian Institute of Agricultural Research and the Academy of Agricultural and Forestry Sciences, with a particular role for the Central Research Station for Combating Soil Erosion Perieni, land improvement faculties and agricultural universities.

The current state of soil evolution is influenced both by the factors that determine its formation and by anthropogenic activities. It is often difficult to separate the impact of anthropogenic activities from that of soil-forming factors, as they are also strongly influenced by human activities.

Soils are formed over a long period of time through complex pedogenetic processes, but their degradation takes place over a short period of time, which is why knowledge of the influence of each factor on soil degradation and therefore on water and wind erosion is particularly important in order to develop measures to reduce their intensity, to prevent degradation and even to improve already degraded soils.

For soils with slopes between 5 and 12%, strip cropping is recommended.

Thus, the doctoral thesis entitled The cumulative effect of some soil working systems on the quality status of agricultural lands from Ezăreni Farm, aimed to provide all those interested, specialists, small or large farmers, with a framework on the conditions of evolution of macromorphological properties, the hydro-physical and chemical conditions of the soils on the northern slope of the farm, which has been levelled by levelling and shaping works on the stabilised former landslides and was regraded in 2011, compared to the reference soils on the Ezăreni plateau.

On land with a slope of 12-18%, a strip cropping system is recommended. The width of the strips is set differently and varies from 200 m to less than 50 m, the largest width being 150-200 m, which can be used on land with a slope of 12-14%. Strip widths are reduced to less than 50 m when the slope is greater than 18%.

From a geomorphological point of view, the area where the Ezăreni farm is located is marked by the Iași Coast, on the Strunga-Voinești-Mogoșești-Ciurea-Tomești alignment, flanked to the west and south by the contact with the Central Moldavian Plateau, and to the east by the Moldavian Plain, respectively the Jijia Bahlui Plain.

The Ezăreni farm exploits the lands located on the interfluve delimited to the north by the Ursului Valley stream (Ezăreni), to the west by the Cornești stream, to the south by the Boaghia stream, and to the west by the La Podiș plateau. The minimum altitude is 58 m at the confluence of the Ursului Valley stream and the Cornești stream, and the maximum is 132 m on the La Podiș hill.

Interfluvial slopes are affected by landslides in waves at different stages of evolution. On the Boaghia Valley there are active and semi-active landslides favoured by the fairly frequent presence of coastal springs, while on the western slope of the Cornești Valley landslides have been stabilised by spring catchments and anti-erosion structures. The southern slope of the Bear Valley stream is affected by semi-active landslides with areas of coastal springs and in places stabilized landslides.

According to custom, the thesis was structured in two parts, the current state of knowledge and the personal contributions part.

The first part contains a review of the literature on options for preventing and managing soil erosion on agricultural land through agri-environmental works, as well as some general aspects of the natural conditions of the land on which the research was carried out.

In order to carry out the research and achieve the proposed objectives, several steps were taken, such as the preliminary ones, for the documentation and study of the soil layer of the farm, as well as the actual ones, for the selection of the portion of land within the rehabilitated slope on which the research will be carried out, for the location of the soil profiles to be carried out, their execution, the sampling of soil in the undisturbed (natural) and modified state, their preparation for laboratory analysis, the method and methodology of execution and interpretation of the results, the equipment used in the laboratory etc.

Thus, in order to generate a preliminary map of the soil types and subtypes found on the farm, soil cores were taken from representative areas according to landform and degree of land complexity, using a set of cores that was inserted vertically into the soil using an ATLAS COPCO COBRA jackhammer.

On the basis of these preliminary observations, we were able to get an idea of the state of evolution of soils used for forestry or arable purposes, as well as the influence of agri-environmental works on the improvement of their macromorphological, hydro-physical and chemical properties.

Between 2012 and 2013, this perimeter was restored by levelling and relocating the strips and the grassed strips, resulting in a number of five strips with a minimum width of 22.8 m and a maximum width of 64.2 m, while the number of grassed strips remained at five, with a width between 3.83 and 6.23 m.

These data were obtained from a topographic survey, scale 1:2000, carried out on the slope with soil erosion control works covering an area of about 15 ha.

For the preparation of the topographic plan, 447 topographic points were surveyed in the field using Stonex S7 GPS with an accuracy of 0.5 m. Field data processing was performed with AutoCad software, resulting in a site plan with a contour equidistance of 2.5 m.

In order to highlight the effect of the anti-erosion measures carried out and the cultivation technologies used on the rehabilitated slope, two control or reference profiles were taken from the Ezăreni plateau, one with forest use and one with arable use, and eight other profiles located on the anti-erosion and rehabilitated slope, which were divided into four groups according to macromorphological, textural, compactness and compaction, hydro-physical and chemical properties.

As a result of the high heterogeneity of the soil cover on the slope developed by the rehabilitation works, four soil groups were identified as follows: the group of soils representative of the Ezăreni plateau (1), the group of soils not or slightly modified by the rehabilitation works (2), the group of soils strongly anthropogenically modified (3) and the group of cumulic, clogged and covered soils (4).

The analysis of the above mentioned properties aimed to determine the degree of influence of tillage and cultivation technologies on soil quality, fertility and production capacity under conventional land use conditions.

The thesis concludes with a chapter of conclusions and recommendations aimed at indicating how tillage and land use technologies developed and redeveloped by anti-erosion tillage should be applied to improve soil quality properties in truly sustainable agriculture.