ABSTRACT

STUDY OF EROSION PROCESSES FOR THE CONSERVATION AND UTILIZATION OF SOIL AND WATER RESOURCES IN THE TUTOVA HILLS

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Soil is the most important natural resource of humanity, the existence and evolution of human society being vitally influenced by the existence of terrestrial plants.

For the most part, terrestrial ecosystems are based on soil, which is a dynamic system, made up of organic matter, minerals, water, air and living organisms, capable of providing plants with everything necessary for their normal development, except carbon dioxide and solar radiation.

In Romania, sloping agricultural land occupies significant areas. The intensification of the exploitation of sloping agricultural land, due to food requirements, leads to the increasingly intense degradation of soil quality. This has serious consequences both for the current population and for future generations, because soil restoration is a long-term process, on the order of tens or even hundreds of years.

Soil erosion manifests itself intensely and in various forms, designating a destabilizing factor of the ecosystem where it acts.

In this context, the main purpose of this research was to study erosion processes for the conservation and valorization of soil and water resources in the Tutova Hills.

The objectives and activities of the study are represented by the knowledge of the forms of degradation of sloping agricultural land and the categories of use, determining the impact of surface erosion on soil quality in terms of the degradation of its physico-chemical properties, monitoring climatic parameters and soil water reserves in agricultural crops, monitoring the hydrological and erosional reaction through standard plots for runoff control.

The doctoral thesis is structured in two parts and includes six chapters.

In the first part, which includes 55 pages, representing chapters I, II and III, a study of the specialized literature was carried out, in order to know the current state of research describing the importance of soil erosion and the methods and works to combat soil erosion.

Chapter I presents the mechanism, extent and consequences of the soil erosion process.

Chapter II includes the current state of research on preventing and combating soil erosion. Aspects regarding the location of crop rotations, the main anti-erosion measures and works, the anti-erosion arrangement of sloping arable land and the location of agricultural exploitation roads are presented.

The natural setting of the experimental area is presented in Chapter III. The studies were carried out within the "Mircea Motoc" Research and Development Station for Combating Soil Erosion in Perieni. From a structural point of view, the territory of the Perieni Station is located in the Tutova Hills, a subunit of the Barlad Plateau, delimited to the west by the Siret Valley and to the east by the Barlad Valley. In the area where the research took place, a temperate continental climate of excessive nuance is manifested, with very hot, dry summers and less cold and dry winters. In the area of the Research and Development Station for Combating Soil Erosion "Mircea Motoc" Perieni, the average multiannual precipitation is 487 mm, and the average multiannual temperature is 9.0°C.

The soil in the study area was represented by cambic chernozem, formed on quaternary deposits, having medium texture, loess and loessoid deposits, sands and clays.

Within the perimeter of the Tutova Hills area, two vegetation zones are highlighted, namely: the forest zone and the forest-steppe zone. The forest zone is represented by the beech subzone, the oak-beech subzone, the oak-oak subzone. The forest-steppe zone includes forests of thermophilic species consisting of downy oak and pedunculate oak, but also acacia.

In Part II, which includes 64 pages, the results of research on the methods of water and soil conservation on arable land located on a slope are presented, as well as the influence of crop systems on agricultural production and agrochemical properties of the soil.

In Chapter IV, the purpose and importance of the research, the objectives and activities of the study, the research method used are presented.

In order to achieve the proposed purpose and objectives, the experience regarding standard plots for leakage control organized within the Research and Development Station for Combating Soil Erosion “Mircea Motoc” Perieni was studied.

The study activities were materialized through the losses of water, soil and fertilizing elements produced by torrential rains at standard plots for leakage control.

The leakage collection system on these plots allows the retention of the volume of water and soil in covered basins in order to avoid errors in the assessment of the volume of water leaked. Each plot is equipped with 3 collection basins of 1000 liters, 500 liters and 200 liters, the first basins being equipped with a 1:5 reduction device of the volume of water leaked. The plots are worked in a conventional system, being cultivated with: corn, wheat, sunflower, peas, perennial grasses year 4 and 5 (bromus inermis), seed mixture year 1 (golomate 30%, trefoil 25%, fescue 30%, ryegrass 15%), respecting the principle of crop rotation.

In general, the agricultural study period 2022-2024 presents an uneven evolution of precipitation compared to the reference period, this fact is noticeable both at a monthly and multi-annual level.

From the point of view of rainfall extremes, the year 2022 stands out where a deficit of -191.2 mm was recorded compared to the multi-annual average, and the year 2024 is distinguished by a surplus of precipitation of 20.1 mm compared to the average. The longest period in which no precipitation was recorded was in September, October of 2023 (28 - 29 days) and February of 2024 (27 days) and the month in which the most days with precipitation were recorded was April of 2023 (13 days).

Chapter V presents the results of research on methods of water and soil conservation on arable land located on a slope.

The torrential downpours that caused leaks during the study period were analyzed at the standard plots for leak control at the "Mircea Motoc" Research and Development Station for Combating Soil Erosion in Perieni and a retrospective was made as follows: 6 downpours were below 20 mm, 7 downpours were between 20-40 mm, 1 downpour between 40-50 mm and 1 downpour over 50 mm. The smallest torrential downpour was 7.5 mm in July 2024, and the largest was 98.0 mm in September also in 2024. The year 2023 was atypical with only 1 downpour of 38.4 mm in August, which caused leaks in almost all agricultural crops studied.

In the study years 2022-2024, the largest amounts of eroded soil were recorded in the field (land ready for sowing) of 10.484 t/ha at a downpour of 49.0 mm in 2024 on 13.06.2024+14.06.2024, because the field is the most vulnerable to the erosion process.

Determinations were made on the loss of humus from the soil under the main agricultural crops in three sections of each cultivated plot. In section A-upstream plot, the soil humus content had the highest values in the corn crop between 3.80-3.96% indicating an average soil humus supply state, and the lowest amounts of humus were recorded in the pea crop of 1.93-1.97% presenting a poor soil supply state. In section B-middle plot, the

highest soil humus content was recorded in the sunflower crop with values between 3.51% and 3.82% indicating an average soil humus supply state, and at the opposite pole with a low content is the permanent black field with values between 2.10% and 2.14% also representing an average soil humus supply state. In the case of section C-downstream plot, the highest soil humus content was recorded in the seed mixture year 1 (golomate 30%, trefoil 25%, fescue 30%, ryegrass 15%), with values between 3.72% and 3.94% indicating an average state of soil supply with humus, and the lowest content is in the permanent black field with values between 1.87% and 2.05% also representing an average state of soil supply with humus.

In order to establish the changes that erosion produces on the chemical properties of the soil in agricultural crops in the area of the Research and Development Station for Combating Soil Erosion "Mircea Motoc" Perieni, analyses were carried out on the nitrogen content in the soil in the agricultural crops studied.

The dynamics of nitrogen content in the soil showed that in plots sown with peas and seed mixture year 1 (golomate 30%, trefoil 25%, fescue 30%, ryegrass 15%), there is an increase in the amount of nitrogen in the soil in the upstream-downstream direction due to the displacement of fertile soil from upstream to downstream under the influence of liquid and solid runoff. In plots sown with wheat, sunflower, corn, peas (area of 150 sq m), unfertilized wheat and unfertilized corn, a significant decrease in nitrogen content in the soil was observed starting from the upstream section, followed by a stabilization of the nitrogen content around 0.183%, followed by a decrease in nitrogen content towards the downstream of the plot of 0.145%.

In Chapter VI, the results of research on the influence of cropping systems on agricultural production and soil agrochemical properties are presented. The soil moisture regime was monitored at each stage of vegetation (sowing, emergence, flowering, harvesting) of the crops at a depth of 0-30 cm, 0-70 cm and 0-100 cm on a cambic chernozem soil. In all the crops analyzed (peas, wheat, sunflower, corn, seed mixture, unfertilized wheat and unfertilized corn), a progressive decrease in soil moisture is observed as the plants progress from emergence to flowering and harvest. The highest soil moisture values are recorded at the emergence stage, and the lowest values are observed at harvest. The differences are more pronounced at a depth of 0-30 cm, where evaporation and water consumption by the roots are more intense.

Differences were made regarding soil moisture between fertilized and unfertilized crops, and it was found that unfertilized wheat and corn have lower soil moisture compared to their fertilized versions, which suggests that fertilization improves root development and increases water use efficiency. In the case of unfertilized wheat, the difference is less pronounced, but in unfertilized corn the decrease in soil moisture is faster.

Also, comparisons of soil moisture between depths were made and the following were noted: the superficial layer (0-30 cm) loses water the fastest, which confirms that evaporation and water consumption by the roots are more intense in this area, the depth of 0-70 cm reflects a more balanced consumption, and the differences between crops become more visible at this depth, the layer of 0-100 cm maintains the largest water reserves, and the decrease in humidity is slower, which indicates that the roots progressively extract water from the depth.

The evolution of the content of soil fertilizing elements (humus, nitrogen) was studied after a long period of 24 years, on three sections (upstream, middle, downstream) at two depths 0-10 cm and 10-20 cm for wheat, corn and permanent black field. For this purpose, comparisons were made between the values obtained in 2024 with the values obtained from the research carried out by Filiche E. in 2000. In the upstream section, on the two depths (0-10 cm and 10-20 cm), negative differences were observed between 2000 and 2024 for wheat, corn and black field. The differences in humus and nitrogen content in the soil were due to surface liquid runoff that brings with them significant quantities of fertilizing elements. In the downstream section, the humus content of the soil had positive differences between the values in 2000 and 2024 for all crops but also for permanent black field. These positive differences are explained by the fact that part of the humus moves downstream of the plot with the sediments and accumulates in areas with a lower slope.

The doctoral thesis concludes with the conclusions resulting from the studies carried out, but also with the recommendations considered necessary regarding the existing situation, regarding the conservation of soil and water resources.