ABSTRACT

Environmental degradation has been of particular interest to Greek leaders since the beginning of the sixth century BC. To prevent soil erosion on the slopes, Solon Legislator forbade their use by crops, and Pisistrate established a "gratuity" for farmers who planted protective species, such as olive, to prevent deforestation and excessive grazing.

A special interest for soil conservation existed in Romania, until the 1990s, the evidence lies in the ruins of what once were extensive works carried out for the prevention and control of soil erosion. After 1990, due to multiple factors, interest gradually decreased until it completely disappeared.

At the same time, directly proportional to the reduction of interest in soil conservation, along with technical innovations, such as genetic manipulation of crops and maintaining fertility through chemical fertilizers, the idea of sustainability has been completely forgotten, the soil undergoing intense degradation, many of them irreversible.

In Suceava County, the situation is not different from the rest of the country, there were once anti-erosion measures and works that tried to prevent and control soil degradation through erosion, which is reproduced, among other aspects, in the present work.

Thus, the doctoral thesis entitled "Research on possibilities of soil erosion control on agricultural lands from Suceava county", aimed to offer to all interested, specialists or small or large farmers, a framework regarding the situation of the agricultural land fund in slope, at the same time a situation of the lands degraded by erosion and of the anti-erosion works in Suceava county, as they are presented now. Of course, the aim is to find possibilities for remedying the negative state already mentioned.

According to the users, the thesis was divided into two parts, the current state of knowledge, respectively the part of personal contributions. The first part contains a review of the specialized literature on the possibilities of preventing and combating soil erosion on agricultural lands, as well as some general aspects regarding the natural environment in Suceava county.

In order to carry out the documentary study 114 bibliographic sources were consulted, analyzed, systematized and interpreted with authors both from the country and abroad. The basis of this study was the need to see how and to what extent the "practice" of other peoples has achieved its goal: to prevent and control soil degradation through erosion.

The first mention of soil degradation through erosion is related to Solon Legislator, a famous governor of Ancient Greece from the 6th century. It is said that he forbade the use of slopes by crops, and about Pisistrate, another ruler of that time (who incidentally was also the son of Hippocrates) that he offered a "gratuity" to farmers who planted protective species, such as olives, to prevent deforestation. and excessive grazing on the slopes.

Somewhat closer to the present time, in 1972, at the UN World Conference, environmental issues, including soil erosion, were brought to the international attention for the first time.

In Romania, the scientific approach to the erosion process was possible after 1943 in the soil erosion laboratory at the Institute of Agronomic Research, and later in the Ministry of Agriculture, the Academy of Agricultural and Forestry Sciences, agronomic universities, etc.

The scientific approaches have been especially productive, the research stations, the works (which are in ruins) are the proof of the interest that the researchers of the country had for preventing and combating soil erosion. Until 1991, with the application of Law 18 which provided for the relocation of previously cooperated or confiscated agricultural land, when the intensive agriculture practiced until then gradually transformed into a survival agriculture, where the problem of anti-erosion works and measures was not given any importance.

Water erosion is influenced, on the one hand, by atmospheric precipitation and human activity (irrational soil exploitation), both of which have a decisive character, on the other hand some elements of the natural environment (relief, soil, rock and vegetation) with a favorable role. . However, all these factors, regardless of the participation of each one in the erosion process, are in a permanent and close interdependence.

Therefore, to render the interdependence relation of all the mentioned factors, the second chapter was constituted: "General aspects regarding the study of the natural environment in Suceava county".

Suceava County is located in the north of the country and covers an area of 8555 km2 - 3.6% of the territory of Romania.

From Suceava County, only the Plateau Unit of the county will be presented briefly, as the erosion process is predominant here.

Thus, the Suceva Plateau is part of the Moldavian Plateau, being located in the northwest of it. And between the administrative boundaries of the county it covers an area of 2960 km2.

Due to the altitudinal and morphogenetic differences, it was possible to differentiate three subunits, namely Ciungi, Fălticeni and Dragomirna Plateaus.

The average altitude of the plateau is 300 m, the maximum, 629 m, is in P. Ciungi, and the minimum, 170 m, in the Siretului Meadow.

The dominant features of the relief determined the differentiation of two main types of relief, one structural and one sculptural, but representative for P. Sucevei is the structural one.

From a geological point of view, P. Sucevei is also composed of volcanic age formations, with dominant clay-marsh, gray-limestone and sand-micaceous facies, in monoclinal structure in the NV-SV direction.

The pedological study indicates the presence of a greater variety of soils in the Plateau Unit compared to the Mountain Unit.

Specifically, there are 7 soil types out of a total of ten, which belong to five classes: the luvosols and preluvosols in the luvisols class being the dominant types, the phaeosomes of the Cernisols class also occupying relatively large land areas. Smaller surfaces occupy the regosols and alluviosols in the protisols class, the hydrisols class gleisols and the anthrosols class erodosols.

The hydrographic study indicates a mean value of the density of the hydrographic network, of 0.3-0.6 km / km^2, a value that determines an average degree of land fragmentation.

The two most important arteries that cross the plateau are Suceava and Siretul. Suceava being the main artery draining the plateau, and Sireto the only collector of both Suceava and other tributaries. Suceava springs from the Lucina Massif, has a length of 172.3 km and a basin area of 2625 km^2.

The stream springs from the Carpathian Forest, has a length of 706 km and a surface area of 44,835 km^2.

For the study of the climatic regime, the data from the weather stations Rădăuți and Suceava for 2015 were taken into account.

Thus the average temperature of January has values between -4.3ºC in Rădăuți and -4.1 ºC in Suceava, and the average temperature of July, the hottest month of the year, has values between 19.2 ºC in Suceava and 18.7 ºC in Rădăuți.

The annual maximum was 32.7 ºC in Rădăuți and 32.8 ºC in Suceava, maximums recorded in July, and the minimum was -22 ºC in Rădăuți and -18.2 ºC in Suceava, minimums recorded in January.

The average annual amount of atmospheric precipitation in the Sucevei Plateau is 593 mm / year, with quantitative differences depending on the altitude, the areas with higher altitudes benefiting from a higher precipitation contribution, being higher in the west (564 mm in Rădăuți) than in the east (508 mm in Suceava).

In the warm season, respectively in May and June, the most significant amounts of precipitation fall. In almost all cases the summer precipitation is in the form of showers, accompanied by orange phenomena, which explains the large quantities of water recorded in a short time.

The maximum amount of precipitation dropped in 24 hours at the Rădăuți weather station was 29 mm, in May, and in the same year, the maximum amount of precipitation recorded at Suceava weather station was 31 mm in September.

During the year the potential evapotranspiration values increase continuously from April to July, when they reach maximum values throughout the region (128 mm in Suceava and 125 mm in Rădăuţi), after which its values gradually decrease until November.

As noted in the table, the water consumption by evapotranspiration in 2015 was higher than the amount of precipitation dropped, thus there is a likelihood of water shortage for plants.

Regarding the dynamics of air masses, the wind rose from Suceava weather station indicates the dominance of the NV-SE winds, with a frequency of 27.6% and 10.3%.

The highest multiannual average speeds have the northwest winds, estimated at 4.7 m / s, and the lowest east winds, with 2.7 m / s.

Regarding the spontaneous and cultivated vegetation, once the forests covered almost the entire extent of the plateau, now the forest occupies relatively small areas, especially on the higher places near Obcine. However, they are also spread on the lower hills, on the unpaved areas in the culture of the eastern Ciungi Plateau and in the Falticeni and Dragomirna Platforms. These belong to the undergrowth of gorunets and oaks and being brighter forests allow the growth of many species of shrubs such as: walnut, walnut, hawthorn, horn, etc.

It is very important to note that in the county there are still three forest reserves: the one near Mitocul Dragomirnei, which in Zamostea and Pădurea Crujana in Patrauti.

Also, pastures and meadows occupy relatively large areas in areas of torrential hydrographic basins, with poorly productive land (Ilisasca, Horaitei, Hatnutei, etc.) or on the slope surfaces affected by denudation processes, which accompany the Suceva, Siret and Moldovan valleys. They are made up of associations of meadow, field grass, goat's wool, filth etc. Likewise, fortunately, within the county there are three botanical reserves, such as the secular Fănețele Calafindești, Frumoasa and Ponoare.

Although they occupied a relatively small area, the orchards of apple, hair, plum and cherry, located on lands with a slope of more than 5% (in Radaseni, Falticeni, Vulturești, Bunești, Preutesti, Horodnic, Ilisesti), also suffered a decrease drastic in the period 1990-2019. The area of orchards was reduced by 1200 ha, from 2600 ha in 1990 to 1400 ha in 2019.

Also, SCDP Fălticeni, established in 1939, with a rich research and production activity, in 1990 used an area of 870 ha, but so far the area has been reduced to 160, 3 ha.

The second part, the personal contribution, consists of 6 chapters each aiming to present certain aspects relevant to the topic of the thesis.

About 31,500 ha agricultural land is in a state of degradation through erosion from weak to excessive, and about half of this erosion manifests with a strong, very strong and excessive intensity. Therefore, from a pedological and agrochemical point of view, these areas constitute lands that are below the limits of the possibilities of supporting productive crops. Regarding the state of degradation by deep erosion, the surface of 1364 ha affected streams and 2205 ha of oases of different shapes and sizes suggest the extension of the surface erosion process and the advance to the erosion phase in depth (ravines), where 542 are already affected. Ha. These, but also other aspects relevant for the study of the evolution of the lands degraded by erosion, are presented in detail in chapter 5.

Chapter 6 presents the evolution of the cultivation systems on the sloping agricultural land during 1998-2019, as well as the situation of soil erosion prevention and control facilities located in the Moldova, Siret and Suceava river basins.

The evolution in 1998-2019 of the cultivation systems on the sloping agricultural lands indicates a growth rate or decrease of the areas relatively consistent with the one started after 1990. Thus, the arable land area that is currently working in its valley direction increased compared to 1998 with 73.9%.

Simultaneously with the extension of the worked lands in the direction of the highest slope the cultivated area along the level curves was reduced by 98.1%, the crops in the strips were reduced by 90%, the cultivation system with grass strips is practiced on surfaces smaller by 50%, and the agroteras on the arable decreased by 66.7%.

For orchards, the situation indicates a reduction of the surface of the classical plantations in the land understood by about 23.1%, and of the intensive plantations on the land not cleared by 40%. Regarding the plantations arranged on terraces continue their area is reduced by 96.7%.

After 1998, the area of pastures exploited improperly increased by 12.3%, and the area of pastures improved and arranged for rational grazing reduced by 95%. Also, the area of grassland equipped with waves or level channels was reduced by 37%.

On the territory of Suceava county there are 26 land erosion control arrangements, which are under the administration of the National Agency for Land Improvements, Suceava County Branch, which covers an area of 85189 ha.

The specific conditions of relief, climate, hydrography, geology and pedology have determined the execution of the arrangements for combating surface soil erosion in complex with those against deep soil erosion. At the same time, they are in the complex, close to or complemented by drying facilities, sometimes with drainage works.

The most soil erosion control arrangements, 18 arrangements, were made and put into operation in the 1980s, in the 1970s 7 layouts were put into operation and after 1990 a single arrangement, the one from Slobozia-Dornești in year 1993.

The facilities in the hydrographic sub-basins of the Moldova River, with a total area of 4155 ha, are located in the area of Ioneasa, Boura and Broșteni.

The fittings consist of canals, openings, roads, marginal channels, bridges, falls, springs, absorbent drains and fireplaces.

Within the hydrographic sub-basins of the Siret river, on the territory of Suceava county, the anti-erosion arrangements have been systematically implemented from 1972 to 1989.

The 13 arrangements, located relatively uniformly in the Plateau Unit of the county, total an area of 50597 ha, the arrangement of the Șomuzul Mare being noted by the largest area, which measures approximately 25,500 ha.

Also, the main hydro-ameliorative works consisted of: canals, outlets, roads, marginal canals, bridges, falls, source catchments, absorbent drains, collecting drains and fireplaces.

Simultaneously with the works carried out in the hydrographic sub-basins of the Siret and Moldova rivers, during the same period, in the 1970s-'80s, works with an anti-erosion character and in the hydrographic sub-basins of the Suceava river were executed. Thus, the first works began in 1976, in the Lucina sub-basin, and the last works, in the Dornești-Frătăuții Noi-Siret and Slobozia-Dornești sub-basins, in 1989.

In the period 1976-1989, a number of 10 layouts were designed and put into operation in the County Platform Unit, totaling an area of 30417 ha.

Similar to the other facilities, these were composed of: canals, outlets, roads, marginal channels, bridges, falls, water sources, absorbent drains, sewers and fireplaces.

The main depth CES works carried out in the hydrographic sub-basins of the Siret, Suceava and Moldova rivers were: 49 km of valleys-ravines, 330 dams, 227 thresholds, 1216 sleepers, 656 spiers, 17 cleionages, 79 rafts, 436 ha forest protection plantations. .

Chapter 7 addresses issues related to the technical efficiency of the slope erosion works, such as the support walls of gabions, the technological roads, the marginal channels of roads, etc., but also to

the technical efficiency of the transverse concrete constructions (collector drains and absorbent drains, coastal channels, outlets provided with falls, sleepers, dams, thresholds, etc.). The current situation signals: the degradation of 40% of the section of the outlets, main and marginal channels along their entire length; 35% degradation of the length of the drainage network; degradation of 30% of the number of visiting homes from the drainage network, respectively of 30% of the number of evacuation holes; degradation of the entire length of the erosion roads; degradation of the hydrotechnical constructions within the layout (sleepers - 30%, falls - 15%, bridges - 25%, dams - 30%).

There are also situations in which certain works have reached their technical efficiency and have also been maintained being in a good state of conservation.

Ultimately, as long as they were maintained and they were in an optimal state of operation, the anti-erosion works carried out under all the arrangements achieved their prescribed technical efficiency. But since they were no longer maintained and with the intensification of the degradation process on one side of the land, on the other side of the constructions, they could no longer fulfill the purpose for which they were built.

The last chapter develops several proposals for the rehabilitation and extension of the anti-erosion arrangements. Among the first relatively simple but effective measures that can be taken to rehabilitate the anti-erosion arrangements are: channel decommissioning, maintaining the location of grass strips, removing vegetation from the sections of the channels, consolidating the banks, restricting etc.

At the same time, in 26 communes of Suceava county where the erosion process manifests with different degrees of intensity, it is absolutely necessary to rehabilitate and extend the anti-erosion works. For example, Vatra Moldoviței, Preutești, Forăști, Mălini, Stulpicani, where the surfaces affected by surface erosion exceed 10,000 ha.

Finally, the thesis concludes with a chapter of conclusions and recommendations that aim to indicate how weak links should be strengthened or replaced by missing ones, in real sustainable agriculture.