ABSTRACT

Keywords: Slope land, runoff, soil erosion, organic carbon, nutrient losses, cropping systems, yield, soil fertility.

In Moldavian Plain, the relief has got a hill aspect, fragmented on large valleys with long versants and the slope higher than 5 %, the pluvial regime during the vegetation period has got an acute torrential character, and the lithologic facies are predominantly clayey-marly. In this natural environment favorable to the development of ample slope processes, the human inadequate intervention in the natural environment triggers intensification of soil erosion processes and land sloping. The direct consequence of this state is actually the insidious decrease of soil fertility and also the derangement of the hydrological equilibrium of the hydrographic network and the affectation of geographic landscape quality in the area.

Of the total surface of almost 8000 km^2 of this physical-geographic unit the agricultural lands represent 75 % of which, 365,000 ha (61 %) are situated on slopes higher than 5 % being exposed to the land erosion process.

Amongst uses, the arable holds the balance with 71.2%, followed by pasture and meadow lands with 24,7%, vine and tree plantations with 2.3% only and 1.8% respectively. The large arable area on sloping lands is of higher importance for soil erosion as the repeated mobilization of the superficial layer through the agro-technical works favors the soil and nutritive elements losses, especially when these works are performed on hill-valley direction.

In order to prevent the accentuation of the soil degradation on some versants from Moldavian Plateau it is needed to identify the modalities to decrease the water erosion through water at feasible values that contribute to stabilizing the land massifs on the surfaces with potential sloping conditions.

Wanting to satisfy the wish to rationally use the land fund in slope, by responsibly administering the natural resources and the environment protection, this essay contains the results of the researches made between 2009 - 2011 regarding the erosion risk evaluation on the versants of Moldavian Plain and improvement of the ways to prevent and combat the soil erosion on arable lands, for the protection and improvement of soil resources.

The Thesis includes a volume of 181 pages and is structured in two parts and six chapters.

Part I, representing 26% of the thesis, contains general considerations upon the soil erosion process, updated X-ray of the study issues addressed both nationally and internationally as well as the natural environment of the reference area.

Chapter I represent approximately 9% of the essay volume and contain appreciations upon the soil erosion process. Based on the bibliographic documentation, some considerations regarding the soil degradation through water erosion are presented and it is insisted upon the quantitative and qualitative consequences of erosion upon soil characteristics and quality of the environment.

Chapter II, representing 10% of the thesis extension, refers to studies and research - made in Romania and other countries - regarding the theoretical and applicative aspects of soil erosion, with special reference upon the anti-erosion concerns on the studied area lands.

Chapter III includes, in approximately 6% of the thesis, the analytical presentation of the natural environment components of Moldavian Plain, with determining or favorable role in the erosion process and land sloping.

In the second part of the thesis, representing 61% of the thesis, the personal contributions in the study field addressed are presented.

Chapter IV, representing 11% of the thesis, highlights the study objects and the methods used to perform the observations and the measuring regarding the water and soil conservation methods for the superior development of the arable versants of the water sub-basins area where the scientific investigations have been performed.

In order to identify the areas with vulnerability elevated risk to erosion and to fill in the data basis necessary for the land studies, the existing land book data from the territorial town halls and from the Directorate for Agriculture and Rural Development Iaşi were used. Furthermore, the information provided by the agronomic engineers from the agricultural chambers, referring to the evolution of the agricultural land and anti-erosion works, were used, as well as the topographical maps of the area made at scales 1:25,000 and 1:50,000.

These have been filled with data obtained after the trips made to the field.

The typical Chernosem cambic, on which the experiments were carried, has evolved on loessoid deposits, is average beaten and presents a clay-argyle texture. The soil has a weak alkaline reaction on the depth of 0-20 cm, an average content in humus and nitrogen and an average provision in mobile phosphorous and a very good one in mobile potassium.

The control of soil erosion was performed with the help of parcels for controlling the leakage located on an agricultural terraced versant with the platform slope of 11%. The experiments were located on the same versant, according to block method, in four repetitions.

Determination of total nitrogen, nitrates, phosphorous and potassium content on drained water samples and beaten soil of different rotations has allowed estimating the losses of nutrient elements.

The anti-erosion and economic efficiency of the measures, methods and solid and water conservation technologies have been verified in production conditions.

Chapter V, with the biggest content (19% in work economy), presents the results of the investigations to identify the water and soil conservation methods on the arable lands situated on slopes.

In order to identify the areas with vulnerability elevated rate through erosion, digital simulation has been used (relief quantitative analysis), a very important application in geomorphology, hydrology, pedology etc., which has allowed the cartographic representation of the pedo-geographical parameters. Thus, the maps containing the general characteristics of the relief (hypsometry, declivities, exposition), soils and of the land usage in the Bahluieț water basin have been drawn.

Where the atmospheric precipitations represent the determining factor of the soil erosion process, during the experimenting period the dynamics of the pluvial regime in the addressed area has been studied.

The pluviometrical regime between 2009 - 2011 has recorded significant deviations from the multiannual average values. Reported to the vegetation period, conventionally established between April 1 - September 30, the three years of experiments can be characterized as very rainy (2009), extremely dry (2011) and normal (2010).

Apparently, except year 2011, it appears that the precipitations have quantitatively sufficed in order to insure water as a vegetation factor at the level of plant request. In reality, by time repartition, these did not create optimal conditions for crop growth and development. In this respect, the situations for the months of June and July 2009 and June 2010 are relevant, when fallen precipitations represented 40 % (139 mm), 35.2 % (122 mm) and respectively 41.6 % (174 mm) of the total produces in the warm season. Furthermore, due to the land sloping, the precipitations with a clear torrential character were poorly revaluated, as shown in the level of ordinary productions.

During 2009 - 2011 the precipitations average quantity of 528.8 mm, 412.5 mm (75 %) have determined liquid leakages on the surface of the land.

The average quantities of beaten soil recorded in the same period in Scobâlţeni water basin were of 0.16 t/ha for perennial grasses in the second year of vegetation, 3.88 t/ha for beans, 6.37 t/ha for corn and 6.73 t/ha for sun-flower.

Simultaneously with the beaten sediments, annual average quantities of nitrate of 1.469 kg/ha have been washed for perennial grasses in the second year of vegetation, 5,326 kg/ha for colza, 17,603 kg/ha for corn and 18,353 kg/ha for sun-flower.

Analyzing the relations between drained water and beaten soil for a sample of nine cultures, the existence of a very significant correlation between the two parameters has been noticed, expressed in Pearsen correlation coefficients with values between 0.814 in 2009 and 0.959 in year 2011.

The regression equations show that for all the studied crops the quantity of beaten soil increases with the growth of the drained water. The limit value of the admissible erosion (6 t/ha/year) is exceeded only for the corn and sun-flower cultures for drained water volumes bigger than 38 m^3/ha.

Maintaining the erosion process of the soil within the tolerable limits on the versants with the slope of 14 - 16 %, under the conditions of obtaining profitable crops, imposes adopting a structure of the cultivated plants, drought tolerant and less pretentious at soil fertility, where legumes and perennial grasses represent 40 %, peas 20 %, wheat 20 % and corn 20 %.

Chapter VI (14%) contains the research results regarding the identification of possibilities to profitably value the arable versants in Moldavian Plain under the conditions of maintaining the soil fertility and the environment quality.

The obtained results regarding the manifestation rate of the erosion process in different crop systems, highlights the fact that on the lands with slope of 16%, the soil losses through erosion were under the value of 2.0 t/ha only in the case of crop-rotation of three and four years that contain two or more soils cultivated with grasses and perennial legumes.

On these lands, the colza crop-rotation of autumn - wheat - corn and two soles cultivated with perennial grasses have determined the decrease of the annual average quantities of beaten soil with 70.5% (4.49 t/ha) and of the mineral element leakage (nitrate, phosphorous and potassium) with 65.4% (13,092 kg/ha) in comparison to the corn monoculture.

The crop-rotation peas - wheat - corn and two cultivated soles with perennial grasses, where corn is 20 and grasses and annual and perennial legumes are 80 %, has determined the decrease of the annual average losses of soil through erosion with 69.3% (4.42 t / ha) and of the mineral element losses with 64.4% (12,888 kg/ha) in comparison to the same corn monoculture.

On the beaten sloping lands, with reduced content of organic matter and nutritive elements, the crop - rotations that include ameliorating plants, fertilization with manure and plant debris (straw, corncobs) can replace the mineral fertilizers for up to 50% where it contributes to the increase of the organic matter content in soil.

The combined application of the mineral fertilizers (N80P60) and manure (30 t/ha) has determined, in comparison with the unfertilized sample, the growth of the organic carbon content in soil with 34% on the poor beaten soils and with 45% on the hard beaten soils.

For the crop-rotations of three and four years that include ameliorating crops, the administration of the same dozes of fertilizers has had as effect during 2009 - 2011, the increase of the wheat crop with 158 - 161 % (2704 - 2792 kg/ha) and respectively with 88 - 94 % (3252 - 3623 kg/ha) for corn.

In order to preserve the water and soil on the arable versants, the necessity to use the crop system in grass bands, whose width is differentially adopted according to the slope of the land, is confirmed. For the oro-pedo-climatic conditions of the investigated area it is recommended that the grass bands have the width of 3.6 m, and be cropped with a mixture of legumes and grasses made of alfalfa 60 % and orchard grass 40 % or sainfoin 60 % and bromus inermis leyss 40 %.

The use of an organo-mineral fertilizing system has triggered, both on weak and very beaten soils, maintaining the pH in the field of poor acid or neutral reaction (6.6-7.1).

The potassium quantities removed together with the beaten sediments were strongly correlated to the carbon organic content ($r = 0,875$ respectively, $n = 11$) suggesting that bigger transport of organic carbon is responsible for losses of these nutritive substances.

The thesis ends with the presentation of the conclusions and recommendations resulted from the studies and observations upon the soil erosion process and of the possibilities to restraint its effects within the admissible limits.