SUMMARY

OF DOCTORAL THESIS:

„THE STATE OF QUALITY OF SOME ERODED SOILS FROM GORJ COUNTY”

Soil is a natural body modified or not by human activity, formed at the earth’s surface as a result of long interdependent action of bioclimatic factors on parent material or rock, characterized by a specific three-phase composition (solid, liquid and gas), leachy polydispersed structure of solid phase, the presence of living component, differentiation of vertical composition, continuous and complex dynamics, the quality to be fertile.

By its nature and functions, soil looks like a natural living body, which connects organic kingdom with mineral kingdom, vegetable, whose behavior is as autonomous as any plant, any animal.

The basic quality of soil which is different from the rock on which it was formed is the *fertility*, this representing the main *quality of the soil*.

Fertility is the capacity of soils to put at plants’ disposal nutritive substances and water simultaneously and permanently, in sufficient quantities in relation to their needs and to assure physical and biochemical conditions necessary to the raise and the development of plants, including the fulfillment of the other Davidescu vegetation factors.

Chemical properties of soil (soil reaction, the degree of base saturation, the content of humus and nutritive elements) influence directly the quality of the soil.

Soil is recognized as a fundamental and limited resource, the main mean of production in agriculture, the inexhaustible storehouse of alimentary resources for the humankind.

The reduction in soil quality is due to the production or the intensification of some limitative factors, and can be natural (erosion processes, slides, consolidation, acidification) and anthropogenic (irrational human activity, in the use of soil resources).

Among the processes which affect soil quality, the erosion presents the biggest interest, both concerning the damages it produces, and by affected areas. Soil erosion started at same the time with the cultivation of sloping lands or sandy soils. The pressure of the population over lands determined the intensification of erosion and the degradation of soils, sometimes with calamitous consequences, such as dryness or turning into a desert and the migration of the population towards other territories.

In Gorj county, the agriculture is very important as economic sector, firstly for the maintenance of the level of living of local population. On that account, it must have a very good knowledge of soil, its fertility status, but particularly the various limitative factors and processes that influence its productive capacity.

Considering the fact that at the level of Gorj county, of the total area of 243.768 ha, 139.027,95 ha, namely 57,03% are eroded, contributing almost half to the reduction of the production in different cultivations, we considered necessary to study the quality of eroded soils in Gorj county, with a view to drawing up some recommendations for reducing or stopping the process of erosion, the increase of quality of soils and yields/ha. This desideratum is comprised in the European Community directive concerning the quality of soils, a directive which provides prompt action at European level concerning the protection of the main mean of production which is the soil.

In this context, in the present paper, a documentary study was realized in the first part, based on various scientific papers in the country and abroad which tried to present synthetically the Romanian agricultural real estate and its quality, as well as the erosion as limitative factor of the quality of soils.

In the second part of the paper the objectives, the methods of study and research approached, the results and conclusions of the case study conducted in Gorj county concerning: *THE STATE OF QUALITY OF SOME ERODED SOILS* are presented.

The limitative factors of the soil quality can be divided in three important groups:

- limitative factors depending on soil (texture, porosity, reaction, content in $CaCO_3$, content in nutritive elements);
- limitative factors depending on land factors <others than the soil> (slope, erosion, landslides);
- limitative factors determined by anthropogenic activities (pollution).

In Gorj county, hydric erosion is the most wide-spread form of degradation and affects an area of 139,027.95 ha which represents approximately 57,03% of the total agricultural area, of which 134,940.26 ha surface erosion, and 4087, 69 ha depth erosion.

Therefore, it can say that the erosion made by water is the most complex, serious and extended form of degradation of soils in Gorj county, affecting powerfully the properties of the soil and its production capacity.

The most affected territories by the surface erosion are: Padeş with 7.793,52 ha, Crasna with 5.733,88, Tismana with 4.194,32 ha, Novaci with 3.824,80 ha and Baia de Fier with 3.653,78 ha.

The most affected local territories by the depth erosion are: Bălăneşti with 187,79 ha, followed by Cruşeţ with 142,98, Alimpeşti with 137,50 ha, Bumbeşti-Jiu with 136,08 ha and Muşeteşti with 132,22 ha.

According to objectives, I decided to analyze the quality of eroded soils, choosing three units of soils namely: stagnic preluvosoil, stagnic luvosoil and typical eutricambosoil, wherein I made 6 soil profiles. These soil profiles watched how morphological, physical and chemical properties of the soil influenced the surface erosion, these being made on slopes as follows:

- for stagnic luvosoil, it was studied comparatively a profile place on the plateau where the slope was 2 – 5%, characterized by the following sequence of horizons Ao-Elw-ElBt-Bt_1w-Bt_2w, Ao horizon having a development of 24 cm and one on rugged versant in the middle third with the slope of 10 – 15% having as profile schema Ao-Elw-Bt_1w-Bt_2w where Ao horizon has a thickness of 15 cm. The existence of slow geologic erosion can be observed at this soil by analyzing the development of the surface horizon.

- for the second soil unit, stagnic prevulosoil, a soil profile was executed on plateau with the slope of 2 – 5%, characterized by a profile of type Ao-Bt_1w-Bt_2w-Bt_3w, the thickness of the horizon at the surface being 22 cm, and a profile on the same versant in the middle third where the incline of the versant is 10 – 15%, approximately with the same profile schema Ao-Bt_1w-Bt_2wC-C, in this case Ao horizon having a thickness of 14 cm, thing that proves the occurrence of the surface erosion.

- for the third soil unit, typical districambosoil, was studied equally on the same plateau with slope of 2 – 5% where the configuration of the profile is Ao-Bv_1-Bv_2-Bv_3 with Ao horizon of 30 cm and half-versant on a slope of 10 – 15%, where a part of Ao horizon was removed by erosion, so that it has at this profile the thickness of 17 cm.

I also studied the phenomenon of erosion in the Experimental field Preajba Gorj, where I placed according to Perieni model three experiments for three crops (corn, natural grassland and sown grassland), with three variants and three repetitions, according to the method of blocks placed separately, in order to determine the amount of eroded soil and the amount of fertilized elements lost along with the eroded soil. Equally, I watched in these experiments the influence of the fertilization on corn, natural grassland and sown grassland yields.

Natural grassland variants were the following:

- V_1 – remained unfertilized witness;

- V_2 – was fertilized with $N_{60}P_{60}K_{60}$ using complex manure of type $N_{15}P_{15}K_{15}$ - 2.5kilo/parcel;

- V_3 – was fertilized with $N_{100}P_{90}K_{60}$ using complex manure of type $N_{15}P_{15}K_{15}$ - 3.75 kilo/parcel + NH_4NO_3 - 0.206 kilo/parcel.

Sown grassland variants were the following:

- V_1 – remained unfertilized witness;
- V_2 – was fertilized with $N_{60}P_{60}K_{60}$ using complex manure of type $N_{15}P_{15}K_{15}$ - 2.5kilo/parcel;
- V_3 – was fertilized with $N_{100}P_{90}K_{60}$ using complex manure of type $N_{15}P_{15}K_{15}$ - 3.75 kilo/parcel + NH_4NO_3 - 0.206 kilo/parcel.

For sawn grassland, the following mixture of plants was sawn:

- Dactylis glomerata 20% (210 gr.);
- Lolium perene 20% (228 gr.);
- Phleum pretense 20% (228 gr.);
- Trifolium pratense 15% (120 gr.);
- Lotus corniculatus 25% (282 gr.).

Corn variants were the following:

- V_1 – remained unfertilized witness;
- V_2 – was fertilized with $N_{60}P_{60}K_{60}$ using complex manure of type $N_{15}P_{15}K_{15}$ - 2.5kilo/parcel;
- V_3 – was fertilized with $N_{100}P_{90}K_{60}$ using complex manure of type $N_{15}P_{15}K_{15}$ - 3.75 kilo/parcel + NH_4NO_3 - 0.206 kilo/parcel.

Researches were made on a typical luvosoil located on a relief with the slope of 10-12%, on parent materials represented by fluviatile terrace deposits, where groundwater depth is 5-10 m with natural vegetation represented by grassland acidophilous species. The soil is characterized by a profile of type Ao, EA, He, BT1, B, C.

Fine clay fraction is found in the soil analyzed in small percentage, less than 15%, thing that determines a loamy texture.

Chemically speaking, it is found that the soil has a high humus content of 2.68% in value in Ao horizon and decreases on the soil profile to 0.32%. Soil reaction is, the pH maintaining throughout the depth of the profile a value between 5.1 and 5.4. In terms of supply with chemical elements, it is found that the soil has a very low content in mobile P (6 ppm) in surface horizon, this decreasing to 1 ppm in the following horizons. The K mobile insurance degree in ppm is good in Aţel and Ao surface horizons, having the value of 174 ppm and 144 ppm respectively, and a middle insurance in AEl horizon (76 ppm) and in El horizon (46 ppm) and a low supply in BT_1, BC and C horizons where the value is below 40 ppm.

Through the three years of experimentation, it was revealed the fact that the biggest losses of soil were recorded for maize crop (during the three years of experimentation 5.27 t/ha/year on average), followed by sown grassland (1.25 t/ha/year) and natural grassland (0.6 t/ha/year).

This thing can be explained by the fact that on the one hand the rich foliar mass on area unit attenuates the shock of rain drops, allowing the infiltration of the water into the soil up to the level of the field capacity, the excess flowing towards the downstream, and on the other hand the maize was sown at 70 cm distance between rows, the land being worked with the motor hoe and weeded once during the growing period, therefore the soil was mobilized from other variants and trained easier by the rainwater.

In terms of fertilization it appeared that chemical fertilizers administered at the beginning of the vegetation period influenced the quantities of eroded soil. The indirect effect of manures on erosion was due to their influence on vegetable mass growth of crops. Thus, it was observed that the biggest losses of soil were recorded in unfertilized variants for all three crops, because the vegetable mass of these plants was less developed and therefore the soil less protected.

The quantity of eroded soil was influenced therewith by the quantity of precipitations fallen. Thus, the biggest losses of soil coincided also with the biggest quantities of precipitations fallen in one month.

In terms of losses of nutritive elements due to erosion it was found that the loss of 0.21 t humus results in a decrease in humus content by 0.0076%, from 2.9% to 2.8924%.

In respect of nitrogen, the loss of 0.0085 t/ha calls for a decrease in nitrogen content by 0.00030%, from 0.11% to 0.1097%.

Phosphorus and potassium losses by erosion are still lower than those of nitrogen and humus.

It should be noted however that losses are cumulative and, for a long term, they increase a lot with significant effects on soil structure and fertility. Such a consequence is the disappearance of Aţel horizon from the versant due to erosion. This horizon being present however on the plateau.

Regarding the influence of the fertilization on hay yields for natural grassland, hay yields, it was found that hay yields were influenced favorably by fertilizers, the fertilization with $N_{60}P_{60}K_{60}$, for the research period on average, for the variant fertilized with $N_{60}P_{60}K_{60}$, in comparison with witness variant without fertilization was realized a percentage increase by 107.3% and a crop increase of 1.6 t/ha, very significant. For the variant fertilized with $N_{100}P_{90}K_{60}$, for the research period on average, in relation to witness variant, was recorded a production of 4.04 t/ha, which represented a percentage increase by 117.6% and a crop increase of 2.54 t/ha, also very significant.

Sown grassland responded favorably at the fertilization with nitrogen, phosphorus and potassium. Therefore, for three years on average, the hay production for the sown grassland, for the unfertilized witness variant was the lowest of 2.82 t/ha, for the fertilized variant with $N_{60}P_{60}K_{60}$, the average production was 5.97 t/ha, thing that, in comparison with the witness variant represented a percentage increase by

110% and a crop increase of 3.4 t/ha, very significant; and for the variant fertilized with $N_{100}P_{90}K_{60}$, for the research period on average, in relation to the witness variant, was recorded a production of 6.65 t/ha, which represented a percentage increase by 133.7% and a crop increase of 3.8 t/ha, also very significant.

Average corn kernel yields for the research period 2006 - 2008 were the following: for the fertilized witness variant was 2103.3 kilo/ha, the lowest as a matter of fact. By V_2 variant fertilized with $N_{60}P_{60}K_{60}$, was obtained a percentage increase by 77.6% and a crop increase of 1608 kilo/ha, very significant. For V_3 variant fertilized with $N_{100}P_{90}K_{60}$, for three years on average, was obtained the production of 4296.3 kilo/ha, thus being realized a crop increase of 2193 kilo/ha, very significant.

In terms of main changes concerning agro-chemical indicators - pH, humus, total nitrogen, mobile phosphorus and mobile potassium, according to their initial and final values, under the influence of erosion and fertilization (dependent on the nature of crops), the following aspects were observed:

- In view of inertia of main agrochemical indicators and their tendency to stand against the influence of external factors, after some short-term experiments, on a versant with low slope, we can talk only about an approximate assessment of evolution tendency of agrochemical parameters under the influence of erosion and fertilization.
- This tendency is of decrease in humus and total nitrogen concentrations for corn crops and sown grassland, but a slight increase in case of natural grasslands, a decrease in phosphorus concentration and to a lesser extent in potassium concentration and a decrease in the pH of aqueous suspensions of soil.

In order to stop the erosion process in Gorj county, I suggest the following prevention and control measures:

- antierosional organization of the territory;

- determination of the crop structure according to erosion degree and the protection it provides for the soil;
- use of a crop system which assures the reduction of speed, flow and water volume which flows on versants;
- land area modeling in view to retaining a bigger quantity of precipitations;
- execution of some agrotechnical anti-erosion works;
- execution of some special hydrotechnical works for water interception discharge on versants;
- control of depth erosion;
- maintenance of soil erosion control works.