

The influence of the main anthropogenic factors upon soils in the Gorj county

Summary

Gorj county is located within south-west of the country, north of Oltenia region on the middle flow of Jiu river. The total area of the county is 560174 ha, covering a natural landscape with a high diversity: mountain areas, plateaus, depressions. Almost the whole area of the county is under arable and forestry uses, a few part being destined for other purposes. The forests cover 273868 ha from the total area, 250268 ha are under arable use, the neproductive land covers 10251 ha and other uses (roads, buildings, rivers) are spread on 25787 ha. This distribution shows very clear the importance of soil for the development of two important sectors: agriculture and forestry. In the mean time, the need for studies and research related to the soil, especially to its formation and evolution under the natural and anthropogenic factors impact are very important and should be very well pointed.

In agriculture the soil is the main source of food production. It is impetuos necessary to maintain its fertility and productivity in order to obtain competitive economic results along the time. In this order it has to take into account the presence and the intensity of limiting factors that might affect negatively the soil productivity. Suitable technological systems according to the soil characteristics, measures for preventing the negative procesess extension, for ammeliorating, improving and conserving the soil fertility and quality should be implementedat county level.

The agriculture is a very important economic branch within Gorj county, because it is the main source for sustaining the social level of the local population. This is why, there is a need for detailed studies related to the different physical, chemical, biological properties of the soil, in order to establish its fertility. In the same time the limiting factors and processes that affect the soil productivity have to be very well analyzed. In this way, appropriate technological systems for plant cutivation may be implemented.

Besides agriculture, another very important economic branch is related to the exploitation of subsoil resources (coal exploitation), an old activity of the people from this county that have begun in XIX century, in 1885-1890, when Dinca Schileru tried to extract the antracit at Schela. The mining exploitation using open pits for coal extraction from Rovinari, Motru, Jilt was benefic for improving the socio-economic level of the people, because of the increase of work places, of the sallaries, of the urbanism level. But, as other activities, the mining activities had also negative effects on the environmental resources.

Use of coal for energy production by burning in thermo-electric plants was promoted. Secondary compounds such as, gases, ashes, slam were produced and all of this had a negative impact on soil and finally on the environment. The environmental degradation was also determined by other activitis: building materials exploitation, cement production, oil exploitation etc.. Having in mind these local conditions, it is impetuous necessary to identify the degraded areas and its properties. It is necessary to establish appropriate measures and technologies for reclaiming these land and put it in the ecological cycle.

This problem is very important either at local level, or at national and international level. The scientific community, the public authorities and other civil organizations should pay attention to this problem, that is firstly very important from envrionmental point of view.

This is why, all over the world, along of at least five decades, numerous studies and research were carried out in different conditions, that tried on one hand to show the role and importance of soil in agriculture development, in the environmental protection, in economic development, in the prosperity of the society and on the other hand to evidence the soil degradation and pollution as a result of the natural impact, but especially of the anthropogenic one, through unappropriate and/or agresive different activities.

In this context, in this thesis, in the first part, a documentary study is accomplished. National and international scientific paper were analyzed in a synthetic way in order to present the actual stage of the studies and research related to:

- (i) the importance of soil through its major functions for the biomass production, for the protection of different environmental resources and also as a natural habitat;
- (ii) the most important indicators for evaluation the soil fertility and productivity state, the intervals of its variation: optimum and limiting for plants;
- (iii) negative processess responsible for soil degradation, as an effect of the anthropogenic factors impact from conventional agriculture, with special refference to physical degradation (destruction, crustification, secondary or anthropogenic compaction, hydric and windy erosion), agro-chemical degradation (qualitative and quantitative decrease of humus content, reduce of different nutrient contents, nutrition unbalance, acidifiation), aridization, desertification, biological degradation (bacterium and fungus populations and mezofauna decreases), their effects and affected areas at national and international levels;
- (iv) measures and methods for ammelioration, improving and conserving soil fertility and productivity state in the traditional-conventional agriculture;
- (v) agresive effects related to degradation and pollution of soil and environment, as a result of anthropogenic factors impact from some industrial activities: coal exploitation using open pits, coal burning in thermo-electric plants, oil exploitation;
- (vi) measures for rehabilitation and ecological reclamation of the degraded land because of the coal exploitation from the geological surface layers;
- (vii) measures for rehabilitation and ecological reclamation of the degraded land as an effect of oil exploitation activities.

In the second part of the thesis, firstly, the objectives, study methodology and procedure are presented. A case study was carried out within Gorj county related to *the influence of the anthropogenic factors on soil*. The results obtained and the conclusions of the case study are also presented.

The natural landscape of Gorj county is a specific one. From economic point of view, the agriculture and coal exploitation using open pits are the most spread branches within the county. Also, other industrial sectors (coal burning, oil extraction, building materials industry), but at a lower level, are extended in the county. All of these conditions has a major negative anthropogenic impact on soil resources and on the environment. This is why, this thesis has more objectives.

The major objectives of the thesis were:

(i) to identify, stocktake and characterize the soil resources using significant indicators of the dominant soil types specific to each agricultural zone;

(ii) to identify the main limiting factors for productivity of agricultural soils and of technological systems for soil cultivation;

(iii) to establish specific technological measures for soil protection against enhancing and extending natural and anthropogenic degradation, for amelioration, improving and conserving the fertility and productivity state;

(iv) to identify and stocktake the degraded areas under the industrial impact owing to: the coal exploitation using open pits, coal burning in thermo-electric plants, petroleum products extraction, building materials production;

(v) to establish specific technological measures for reclamation of degraded land through different industrial activities in Gorj county and its introducing in the ecological cycle;

The methodology used for attaining the different objectives of this thesis was based on studies and research carried out: in experimental field, in laboratory and in the office. For this, the following steps were attained:

(i) pedological studies and agro-chemical survey for: identification and characterization of local specific conditions and of main soil formation factors within Gorjean area; identification and characterization of the main soil types that cover the agricultural area; estimation of the area under different soil classes and types; identification of the main limiting factors of fertility, based on the physical and chemical soil properties and on the intervals of its numerical values; estimation of degraded agricultural areas; identification of the main destructive anthropogenic factors and estimation of the degraded and/or polluted areas; evaluation and characterization of the land background.

(ii) studies and research in experimental fields located at Rovinari for: amelioration and improving the conditions for plant growing and development on unproductive substratum; including the degraded land as a result of the coal exploitation activities within the ecological cycle; including the slag and ash spoil banks within the ecological cycle; including the land affected by oil extraction activities in the ecological cycle.

The main results obtained in the pedological studies and agro-chemical survey showed the following aspects:

(i) in Gorj, because of the geographical location, the natural conditions (climate, relief, rock, vegetation, microorganisms) determined the formation and evolution of various soil types. The soils, mostly, have moderate to reduced level of fertility and a high vulnerability or susceptibility to degradation through different processes (compaction, water logging, erosion), especially in agriculture. In this branch the anthropogenic impact is much stronger as a result of the conventional agricultural technologies applied and of the possible technological mistakes. The results obtained showed that, on 233864 ha, there are 8 soil classes. An area of 16405 ha is covered by soil associations and complexes.

There are 3 dominant soil classes: Luvisols, Cambisols, Protisols, that cover 212708 ha, that represent 85 % from the total agricultural area. From this, 107496 ha is arable land, that means 91 % from the total arable area.

(ii) for these soils, on large areas, their fertility and productivity state are highly affected by different limiting factors and/or physical and chemical degradation processes,

depending on the soil, land, anthropogenic activities either from agriculture or other branches; the most important limiting factors are related to: the extremely clayey or sandy texture, texture discontinuity on soil profile, surface and deep compaction, reduced permeability for air and water, acidity, low humus and nutrient contents (N, P, K) essential for plant growing and development, temporary surface and/or deep water logging, that generate gleyzation and pseudogleyization, water and windy erosion, landslides. All of these mean different forms of pollution, determined by the industrial activities such as: coal exploitation, oil extraction, coal burning in thermo-electric plants etc.;

(iii) for agricultural practising on these kind of soils, there is a need for evaluation their properties in order to establish complex and appropriate measures (deep loosening, surface and deep drainage, amendments etc.) for reclamation, amelioration and improving their productivity. Otherwise the negative processes will be intensified and extended on larger areas; also, without suitable agricultural equipments and investments, these soils will not have an acceptable productivity, in this way the sustainable agriculture being not promoted;

(iv) the coal exploitation is one of the most aggressive and intensive form of degradation either of soil or environment within Gorj county, in spite of the economic development, determined by this activity and, in spite of the efforts for implementing different specific technologies and measures for reclamation of degraded land. Moreover indirect effects were emphasised by the existing processes within this area such as: erosion, landslide, silting. Also, the underground mining activities affected negatively the soils state by intensifying the landslide, erosion, silting processes;

(v) in Gorj county, 80000 ha are affected by degradation and pollution at different levels. From this total area 10303 ha are affected by mining activities, 50000 ha by the coal burning in thermo-electric plants from Rovinari and Turceni, 1000 ha by oil and natural gases extraction and 19000 ha by spoil banking;

(vi) on the Gorjean territory three types of pollution were identified: *physical, chemical and biological*;

physical pollution is a rare express. In this thesis, physical pollution refers exclusively to soil and cover two aspects within the Gorjean territory: first is that soil pollution is a natural body, that means that soil, physically is destroyed (disappears) by the excavating activities and second soil pollution is determined by terracing and transport activities, affecting the physical intrinsic properties. Physical pollution comprises: *pollution through excavating; pollution through spoil banking; pollution through underground extraction; pollution through surface terracing activities*;

chemical pollution within Gorj area is determined by many sources, but three of them are wide spread on large areas: power industry, oil and natural gases extraction industry (oil, salt water, mixed pollution), building materials industry;

The studies and research carried out in the sterile and ashes spoil banks at Rovinari showed:

(i) the mining exploitations using open pits have major negative effects on the environment, especially on soil, affecting the agricultural and forestry ecosystems and changing negatively the local relief, the hydrologic and hydro-geologic regime, the climate, the atmosphere etc.;

(ii) the sterile spoil banks are formed from a complex and very unomogenous mixture of different lithologic materials: sands, marls, sandy clays, coaly clays and unexploitable

coals, that have various properties, affecting the quality of substratum and finally the evolution of the soil formation. These controlled deposits are affected by important processes such as, modelling, erosion, compaction, frequent phenomenons influencing the bank's stability;

(iii) introducing the affected areas within the ecological cycle means a real challenge, being an extremelly complex and long term process; within the Gorjean territory, along the time a lot of efforts were carried out for ammeliorating and improving the environment, practising either agricultural or forestry technologies, but less environmentally friendly;

(iv) introducing the sterile spoil banks within agricultural cycle is possible, but just applying integrated agricultural technologies, based on pioneer plants within the crop rotation, organic and mineral fertilization, amendments, sprinkler irrigation, seed preparation and its maintainance during the vegetation period, all of these carried out in optimum humidity condition, in order to avoid substratum degradation;

(v) on the sterile spoil bank located at Banca Unchesului different technological variants were tested (30 cm soil cover + 10 t·ha⁻¹ organic manure, N₆₀P₆₀K₆₀, N₈₀P₈₀K₈₀, N₁₀₀P₁₀₀K₁₀₀ and N₁₀₀P₁₀₀K₁₀₀ +30 t·ha⁻¹ of organic manure) under three crops: maize, wheat and pea; the application of organic and mineral fertilization together determined the best results for crop yields, increases of 165 % for maize, 189 % for wheat and 75 % for pea (medium of 143 %); the organic fertilization affected positively the physical, chemical and biological soil properties, the availability of the mineral nutrients for plants, improving the biological activity of spoil bank; the mineral fertilization improved the soluble nutrients supplyement essential for plants at the first vegetation stages; the crop yields differences between the variants minerally fertilized with N₁₀₀P₁₀₀K₁₀₀ and that's of the same mineral fertilization doses plus 30 t·ha⁻¹ organic manure was of 57 % for maize, 53 % for wheat, 17 % for pea;

(vi) in another experiment higher doses of mineral fertilizers on organic and plant residue fertilization fund were tested for different plants: sugared sorghum, wheat and maize. The mineral fertilization doses were: N₀P₀K₀, N₅₀P₄₀K₄₀, N₁₀₀P₈₀K₈₀, N₁₅₀P₁₂₀K₁₂₀ on 50 (t·ha⁻¹) and 100 (t·ha⁻¹) organic fertilization doses, 10 (t·ha⁻¹) wheat straw residue dose, 20 (t·ha⁻¹) hashed sorghum, 20 (t·ha⁻¹), hashed stalk corn funds. The best results were obtained in the variants with the together highest organic and mineral fertilization doses. The plant residues leaded to satisfacatory results on an intense mineral fertilization fund;

(vii) the mineral fertilization in complex with the organic one leaded to positive results of the yield for all tested plants and also for grapes;

(viii) the ammelioration and reclamation of the land affected by oil extraction activity might be carried out by cleaning and removing works.