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## **THE PRESSURE OF NATURAL AND ANTHROPOGENIC FACTORS ON THE STATUS OF SOIL FROM CENTRAL DEVELOPMENT REGION**

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**Keywords:** soil erosion, ravines, landslides, technical and hoeing crops, soil resources

**Abstract:** The most ordinary form of impact on soils is erosion. A very rapid increase of the surfaces affected by erosion is conditioned, in particular, by the non-compliance of environmental requirements concerning exploitation of agricultural land and by the actual inefficient management of land resources. Lately due to the intensive exploitation of land and natural resources, the ecological situation worsened considerably, which has a negative impact over soils from the Central Development Region. Due to of the impact of agricultural activities and pressures of various factors on soil quality to grown the surface of soils eroded. Some factors led to growth the eroded surfaces which are considered high percentage of technical and hoeing crops.

### **Introduction**

The main natural wealth of the Republic of Moldova is soil. Resources of soil are a valuable resource of a nation. As support and living environment for people, plant and animals, the soil cover is the main part of Moldova.

Currently, the soil resources are distributed to a big numbers of land holders under different land relations. Much of the land area available is intended for agricultural. For Republic of Moldova and inclusive for Central Development Region (CDR) agriculture is a very important segment of the economy. Agricultural land constitute about 65.9% of the total area of region, but 61% of the population is employed in this sector.

Although farming ensures of the existence a considerable numbers of people from the region, but paradoxical, agriculture still contribute to environmental damage and reduced quality of the life of people. Impact of the agriculture on the environment affects all its components: air, water, biodiversity and in particular the

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soil which is damage or threatened by agricultural activities which generate pollution and altering the characteristics of natural spaces. The land degradation processes are strongly influenced by the inappropriate human practices, such as the improper land use after deforestation Also it was noticed the extension of the traditional agricultural system, consisting into small up and down hill plots [3].All of this have an obvious impact on the living environment of people.

More than of half from the CDR is occupied of agricultural land, approximately (66%), which form a third of country (table.1) The land resources of the Republic of Moldova comprises 3,384,600 ha of which farmland occupies 2,498,300 ha (73.8%) including arable,1,812,730 ha (72.6%);perennial crops, 298,780 ha (12.0%); meadows 352,550 ha(14.1%); and fallow 14,210 hectares (0.4%). Farmland amounts to only 0.5 ha per caput including 0.4 ha of arable. About 1,877,100 ha is held by 1,310,000 private landowners with the average holding of 1.4 ha divided between two and five individual plots.(Agency for Land Relation and Cadastre 2010).

The Central Development Region has o surface of 10,636 km<sup>2</sup> (1,063,600 thousand ha) or 31% of the total area of the country, is the largest region of Republic of Moldova. It include 13 districts: Anenii Noi, Calarasi, Criuleni, Dubasari, Hincesti, Ialoveni, Nisporeni, Orhei, Rezina, Straseni, Soldanesti, Telenesti and Ungheni.

Table 1. General information concerning of land and soil condition in CDR

Nr. s/n	The indicators	Surfaces, thousand ha	Share of CDR
1	Total surface of region	1063	31% from surface of republic
2	Districts which are in component of region	147	13 districts
3	Agricultural land, total	702	65.9% from surface region, 28.1% from agricultural land by country
4	The soils eroded) , total	297	42.3% of agricultural land subject to soil research
5	Transformed soils (dirt), total	113	16.1% from farmland
6	The total land affected by ravines	5.3	0.5% from region surface
7	The landslides, total	14.9	1.4% from region surface
8	The forest lands, total	221	20.8% from region surface

Source: Land Cadastre, 2012

## 1. Materials and Methods

Based on statistical data and scientific works from authors from Republic of Moldova and from abroad, the article treats the negative processes which occur in the last period in agriculture, the factors which lead at the soil degradation.

The pressure of natural and anthropogenic factors have had a strong impact on soils quality in the republic of Moldova-most of soils are characterized with physical degradation, chemical and biological.

A methodology for assessing global phenomena of degradation of soil quality, valid for all conditions and uses not exist and can not be elaborated because soil quality is estimated depending on uses or of functions on which fulfills. Soil quality assessment involves measurement of soil properties or qualities that serve as sensitive indicators at modification functions of soil as a resulting from use and management of soil resources. Because soil quality assessment is done indirectly through the use of quantitative and qualitative indicators that measure the properties significant for processes occurring in the soil. In this work was used status indicators of soil quality, which highlighting changes in the evolution of surfaces by aggregating data on soil erosion, surfaces evolution eroded, surfaces evolution the main crops etc. Also were used indicators of pressure on soil resources, which reflect causes problems, because of their economic activities, which it are grouped as environmental indicators, such as consumption of mineral fertilizers and organic; structure of crops, land use change etc [2].

For this study regarding the soil resources and surfaces with crop of field from the Central Development Region were used the following sources: the Land Cadastre [8] reports the National Bureau of Statistics on field crop 2012-2014 [7], Yearbooks concerning the quality of environmental factors and activity of the State Ecological Inspectorate for 2015 [6], bibliographical material and analytical studies in the field [1,3,4,5]. The study covered years 2010-2015.

Collection and processing of materials was carried out from official publications (in written or electronic forms) and existing databases at national and region level. The main methods were used: administrative, statistical, cartographic, bibliography, comparative analyze and synthesis [2].

The main administrative sources were used: Yearbooks on environmental factors and activity of the State Ecological Inspectorate in 2010- 2015.

The statistical method was used in order to characterize the surfaces with the technical crops and with the hoeing crops, on the basis of statistical data which represent the quantitative parameters for the period studied.

The cartographic method was used in map drawing regarding the spatial distribution of land degraded by processes of erosion, landslides and ravines.

The comparative method was used to highlight the share of the surfaces with technical crops and with the hoeing crops for each district from the Central Region.

This method has focused on comparing the shares of use of different crop categories and their dynamics. In order to conduct the researches, the following targets were set: identification and assessment of the impact of the natural and anthropic factors over soils from Central Development Region. The data included in the paper originate from documents drafted by the authors.

## 2. Result and discussions:

The central region of Moldova occupies the intermediate geographical position between forest steppe of north and steppe of the south field. The natural conditions and soil shell are specific and very inhomogeneous. But module of usage of the lands isn't suitable the properties and soils geography. Ecological imbalance between natural and anthropic ecosystems, difficult terrain, heavy rains, reckless privatization of agricultural land, lead to intensification conditions of soils degradation from CDR. Land resources of Central Region are heavily used and represent one of the main natural wealth of the region. The total area of the CDR is 1063181 hectares, that is 31 percent from Moldova surface, agricultural lands is 701 696 hectares, which equals 65.9% of the region surface (74.3% country average), is 28.1% of the agricultural land of the country (table.1). The impact over soil resources, increasing numbers of consumers has led to increased productivity of crops, which also led to an extreme tension between economic activity and the natural environment, that expressed by depleting natural resources. Thus arises need to control soil status predicting changes in framework of the soil cover and also monitoring of their quality.

Table 2. The impact of natural and anthropic over agricultural land from Central Development Region

Nr s/n	Districts	Surfaces of eroded land, ha			Ravines, ha	Landslides, ha
		low	middle	strong		
1.	Anenii-Noi	15246	6748	3092	88,00	292
2.	Călărași	9922	8877	4400	525.2	3325
3.	Criuleni	11033	4643	1144	134	264
4.	Dubăsari	2886	924	544	99,4	33,2
5.	Hâncești	20135	13234	7628	349	1022
6.	Ialoveni	13249	9647	4814	393	932
7.	Nisporeni	10597	5312	4562	442	2188
8.	Orhei	18423	8703	2948	1693	2365
9.	Rezina	10560	5856	1594	330	705.6
10.	Strășeni	11412	5574	3349	274	697
11.	Soldănești	9280	4532	1242	281.3	114.2
12.	Telenești	13351	8171	3352	84.7	586
13.	Ungheni	13727	11229	7228	173	1863
	<b>TOTAL</b>	<b>159821</b>	<b>93450</b>	<b>45897</b>	<b>4866</b>	<b>14388</b>

Conducting systematic of soil tillage, usually lead to activation of the natural processes destructive- erosion, landslides, ravines development on some places. Thus, the soil is subject permanently to change of the structure, compaction,

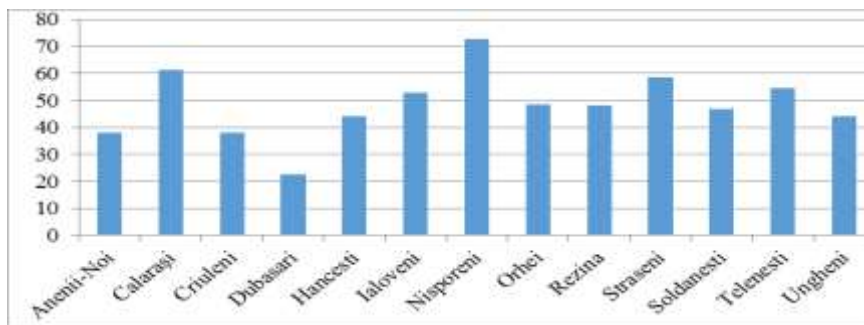


Fig. 1. The share of the eroded surfaces in the framework of the Central Region  
Source: elaborated by authors after data from [7]

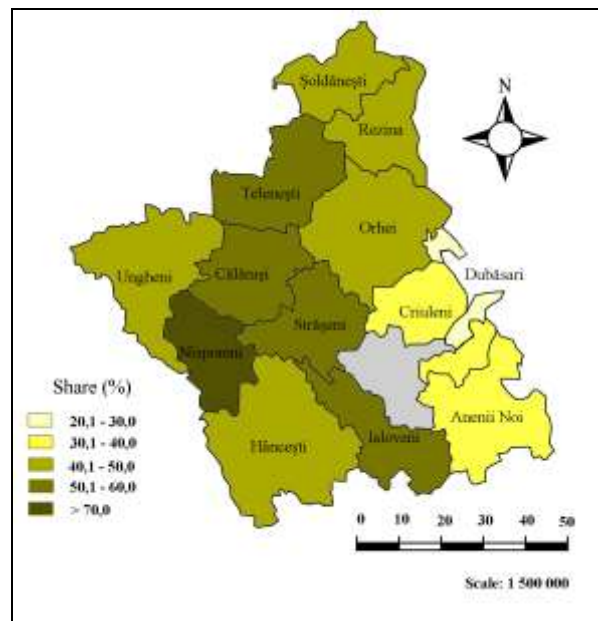


Figure 2. The share of agricultural land affected by erosion in CDR  
Source: elaborated by authors after data from [6]

dehumidification but in some cases salinization and secondary solonchization. The estimates performed in framework of the Central Development Region has shown

that in mostly of the region has increased the surfaces eroded (table.2).At the region level the share of the land eroded is of the 42.3%, which is comparatively higher than on the national average (32.9%) (table.1).While some districts of the CDR (Calarasi, Straseni, Nisporeni) have a high share of the surfaces eroded (Fig.1, Fig.2) but in other districts from this region (Hincesti, Ungheni) have the strong surfaces eroded (table 2.Fig.2).Just as was above mentioned, a negative impact to the soil are the landslides (Fig.3). The landslides are rising in Calarasi, Orhei and Nisporeni districts (table 2, Fig.3). Large areas are occupied with ravines in Orhei district, about 1693 hectares (table.2, Fig.4).

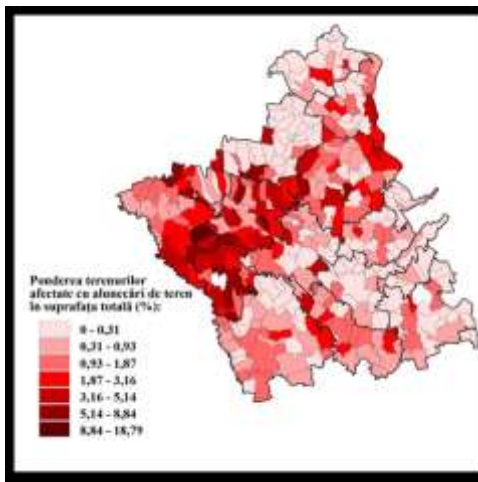


Figure 3. The areas affected by landslides in Central Development Region

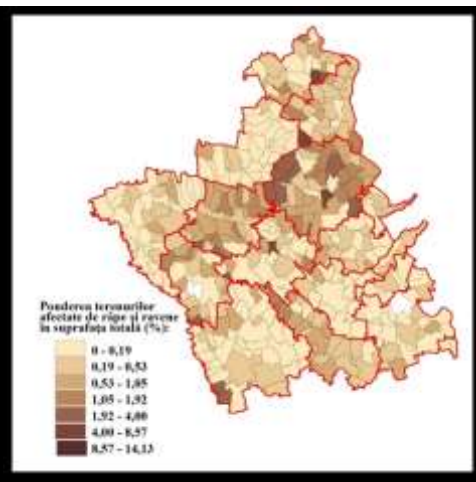


Figure 4. The areas affected by ravines in Central Development Region

Source: elaborated by authors after data from [8]

In the recent years according to statistical data (CDR) but not only in this region saddle worsened the crop of sowing structure, mainly due to the considerable increase in the share of technical crops such as in agricultural enterprises and in the farms, with over 35-40% and in some districts with over 45% (Soldanesti, Rezina).Also is need to noted that in some districts which have a high degree of erosion (Nisporeni) in some years (2012) for example, the share of the technical crops grew up at 43.7% (Fig.5).According to the Technical Regulation "Soil protection measures in framework of the agricultural practices", approved by Government Decision no. 1157 / 13.10.2008, one of the preventive measures which need to taken by of the users of agricultural land in order to minimize various forms of soil degradation is to reducing till at 20% the share of the technical crops, but of rape till at 5% in crop rotation component [1].

Also in the last 20-25 years has increased significantly the share of the hoeing crops. In the last century the hoeing crops has been occupied from of 15-20 till 40-45 of the percent [4], now the share of the hoeing crops in structure of agricultural land crops sowing with field crops and vegetables in the Central Development Region grew up at the 63-66%. for example, in Ialoveni and Criuleni districts the hoeing crops in last years were about 66%., but in Nisporeni district in 2015 share of the hoeing crops were 82 percent. (Fig. 6).Increasing of the share the hoeing crops both in the country but also in the Central Region, which has a rugged terrain and high degree of recovery of soils, where concomitant with uses of agricultural modern machinery to the high-power, as well as performing some a numbers of operations works on soils, led and lead to intensifying erosion, loss of soil humus and worsening physic-chemical and biological soil.

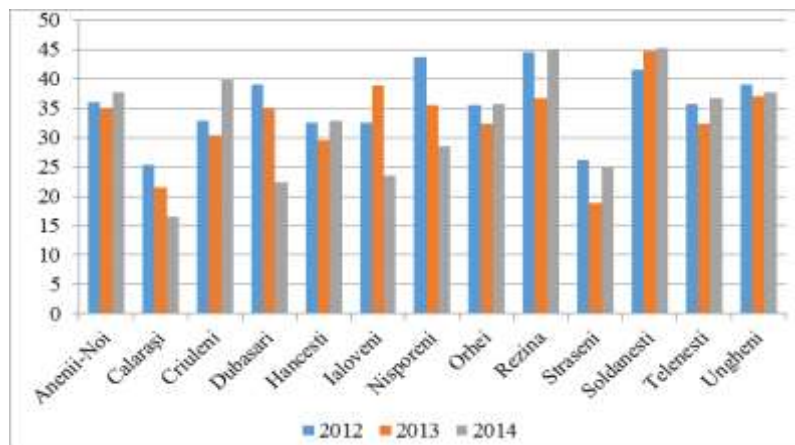


Figure 5. The share of the technical crops in structure of sowing of the CDR.

Experimentally it was demonstrate that cultivation of the hoeing crops lead to acceleration of the processes of mineralization and to at establishment a negative balance of the humus from the soil. Each hectare of as such crops, consume, without taking into account the erosion over 1-2 tons of humus [4]. Also, in according with the some studies [4], agricultural lands from the Center Region, good for cultivate of the hoeing crops, where the erosion processes have occurs in a lesser extent, occupy less than 50% of the territory, other arable lands (53%) are situated on slopes greater than 3 degree. In the Straseni, Ungheni, Telenesti districts the arable lands with a slope at the 3 degree till 5 degree, occupies more than 32% but with slope of 5 degree till 7degree, occupies 18%. In the Straseni district over 60 percent of arable land are located on slopes with inclination of at 4-10 degrees and more [4].

Is knowing that with the higher the organic soil matter content the better is the soil aggregation. The soils without organic matter are more compact. The compaction reduces infiltration capacity of water, nutrient solubility and productivity, so and soil carbon sequestration capacity [5].By experiences were proved that majority of types of the soils which are affected by erosion do not

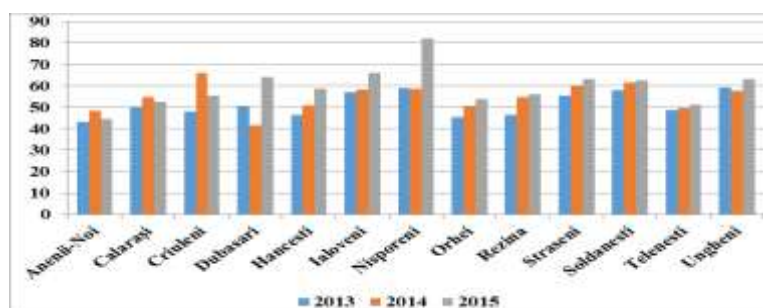


Figure 6. The share of the hoeing crops in the sowing structure of the Central Development Region.

Source: Figures 5-6 are elaborated by author after data from statistica.md [7]

Table 3 .The quantities of mineral and organic fertilizers used in the Central Development Region, thousand tons

No.	Districts	Mineral fertilizers		Organic fertilizers	
		2013	2014	2013	2014
1	Anenii-Noi	681	3978	3010	1
2	Călărași	37	47	410	13
3	Criuleni	707	833	10	52
4	Dubăsari	477	248	-	-
5	Hâncești	547	702	668	285
6	Ialoveni	106	225	-	--
7	Nisporeni	39	1720	7	-
8	Orhei	774	862	55	-
9	Rezina	879	926	-	-
10	Strășeni	238	165	-	-
11	Șoldănești	1407	1382	51	-
12	Telenești	2780	2026	801	-
13	Ungheni	726	1343	-	40
	<b>TOTAL</b>	<b>9398</b>	<b>14457</b>	<b>5012</b>	<b>391</b>

Sources: table 3 is elaborated by author after data from [7]

receive organic fertilizer and not are seeded with grasses of legumes multiannual. So after 50-60 years the soils lose till at 50% of humus reserve. In such of soils suddenly decreases of the accumulated energy for decades, it takes place worsening the situation of the wild fauna and flora, has place a significant decrease biological qualities of the soil [4] .When using the insufficient quantities of organic fertilizers,



the soils are subject erosion "biological" unpredictable, that is as damaging as that caused by water. Thus and the balance of the nutrients in the soil becomes negative. The quantities of minerals and organic fertilizers which are used on agricultural lands in the Central Region have decreased significantly compared to the 90s of the last century. In accordance with table 3 the share use of the mineral and organic fertilizers in the Central Region is very low. Some districts (Nisporeni, Ialoveni, Orhei, Rezina, Șoldănești and others), for example in 2014, did not use organic fertilizers (table.3).

### Conclusions

1. The estimates have demonstrated that on the Central Development Region level the share of the eroded surfaces is 42.3%, which is comparatively higher than on the national average (32.9%). While some districts (Calarasi, Ialoveni, Nisporeni) have a share higher of the eroded surfaces.

2. The data analysis us demonstrates that almost in all districts of the Central Development Region has increased considerably in the structure of crops the share of the sowing technical crops, which is over 30-40% and in some districts this indicator passes of over 45 present (Soldanesti, Rezina).

3. The share of the hoeing crops in the structure of arable land sown with of the field crops and of vegetables has increased till at 63-66% and in some districts (Nisporeni) in 2015, this share reached 82 percent.

4. The quantities of the fertilizers used on farmland in the Central Region a decreased significantly compared to the 90s of the last century, while some the districts in recent years almost, not using organic fertilizers.

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