

## Land Degradation by Erosion and Its Control in Romania

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**Abstract:** About 43% (6.4 million ha) of the 14.963 million hectares of agricultural fields is sloping land with erosion potential. Cropland ranges 2.572 million hectares (26% from arable land). Most of the pastures and vineyards are laying out on sloping land (1).

In terms of sediment yield from Romanian agricultural land estimates amount to 106.6 million tons per year. Cropland, grazing land and unproductive land enter this amount with 81.6%. Sediment derived from surface and gully erosion average 72.6% of this amount (2,3).

The average erosion rate in Romania was estimated at 16.28 t/(ha • year).

The total agricultural surface protected by conservation measures till 1990 was about 2.1 million hectares that represents one third from the fields with erosion potential.

**Keywords:** soil erosion, conservation practices, conservation tillage, perspectives

### 1 General features

The territory of Romania, which lies in the southeastern Europe, encompasses 237,500 square Kilometers (58.7 million acres). Romania has a variety of landscapes resulting from its wide range of major relief forms which are very well proportioned: 36 % Carpathian Mountains and Subcarpathians, 34 % hills and tablelands, 30 % plains. Within its boundaries live 23.5 millions people.

Average annual precipitation varies from about 360 mm at the lower elevations (Danube Delta) to 1,450 mm at the 2,000—2,543 meters elevation (Retezat, Fagaras, Rodna Mountains).

The mean annual temperature of country is about 10 C.

For the Romanian agriculture the main soil classes are mollisols (chernozems, gray wooden soils) and argilvisols (reddish-brown soils, brown argoiluvials, brown-luvic soils and luvisols).

The leading crops are corn, wheat, barley, sunflower, potatoes, drybeans, sugarbeet, rye, flax, soybeans, hay etc. Most of them have the growing months of April through September.

### 2 Soil erosion and related problems

#### 2.1 Extent and types of water erosion

Romania is the Central and Eastern European Country which presents the most variate forms created by water erosion because of its natural conditions. The wind erosion is only affecting small areas from the southern part.

The critical erosional season is generally stretched between May-August as the heavy rainfalls during crop-growing months.

Man's activity had an important role in inducing and intensifying of the erosion processes particularly through the land-use, crops structure on the arable land, crop farming, management of pastures and forests. Data from Table 1 illustrate that among agricultural lands most of the pastures (grazingland) and the vineyards are laying out on sloping lands, especially, with erosion potential. Forests are concentrated on mountain area, mostly.

Although the arable land is located on "gentler" slopes this is a major source for soil losses because the high ratio of the row crops (corn, dry beans, sunflower, potatoes) has determined a high rate of the erosion processes. The non-adequate management of the pastures had an unfavorable influence, too.

**Table 1 Use of the sloping lands with erosion potential**

Land use	Areas		Mean slope
	Over 5% slope Millions ha	Percentage from total land, %	value %
Agricultural, From which :	6.367	42.6	
Arable (Cropland)	2.572	26.0	17.0
Pastureland	3.360	75.0	21.8
Wine plantations	0.169	55.0	16.0
Fruit plantations	0.266	75.0	18.0
Forestland	5.748	87.5	40.4

The rate of erosion presents a distinct interest excepting the state of the erosion. Fig.1 shows division into zones of the total erosion in tones/ha/year.

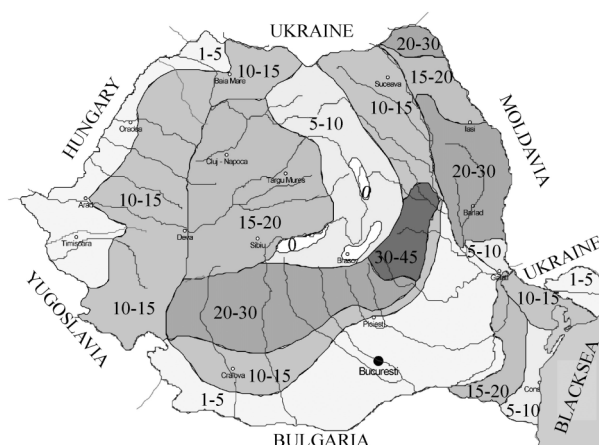
A special attention was given to the sediment sources by contributions of the major land-uses or of the classical erosion types to the making up of the total erosion (see Tables 2 and 3).

**Table 2 Total erosion by land-uses**

No.	Land-use	Total erosion			
		Millions t/year	%		
1	Cropland (Arable land)	28.0	26.2	24.7	22.3
2	Pastures (Grazing land)	45.0	42.2	39.6	35.7
3	Vineyards	1.7	1.6	1.5	1.2
4	Orchards	2.1	2.0	1.8	1.7
5	Unproductive (Abandoned land as gullies)	29.8	28.0	26.4	23.6
	Agricultural land total	106.6	100.0	-	-
	Woodland - total	6.7	-	6.0	5.3
	Total	113.3	-	100.0	-
	Bankrivers and localities erosion	12.7	-	-	10.2
	General total	126.0	-	-	100.0

**Table 3 Total erosion by types of water erosion**

No.	Type of erosion	Total erosion		
		Millions t/year	%	
1	Surface erosion	61.8	54.5	49.0
2	Gully erosion	29.8	26.4	23.6
3	Landslides	15.0	13.1	11.9
4	Gully erosion and landslides on woodland	6.7	6.0	5.3
	Total	113.3	100.0	-
	Bankrivers and localities erosion	12.7	-	10.2
	General total	126.0	-	100.0



**Fig.1** Total erosion, on agricultural lands - t/ ha/ year

These data reflect different input levels to the gross erosion making up. In terms of the physical soil losses from agricultural land estimates run as high as 106.6 million tons per year.

Data in Table 3 show that surface (sheet and rill) and gully erosion are the most important contributing types of erosion.

## 2.2 Erosion rates by crops

Longtime field measurements conducted at Perieni Research Station (Moldavian Tableland) on standard runoff plots with loamy-textured mollisols illustrate the influence of crops on soil losses, as reported in Table 4 (After I. Ionita, O. Ouatu and A. Popa).

**Table 4** Average annual soil losses at Perieni Station between 1958—1984

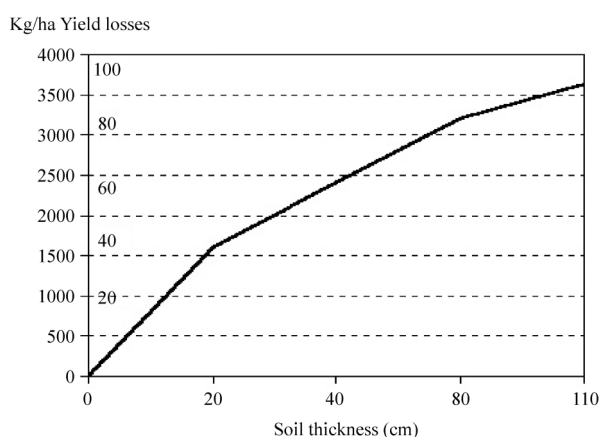
No.	Crop	Soil loss - t/ha/year
1	Corn	14.9
2	Winter wheat	1.7
3	Brome grass	0.5

## 2.3 Yields of crops

One of the most important damages caused by surface erosion is the steady decline of crop yields. Research conducted in Romania has shown a stratification of yields on crops depending upon the thickness of eroded soil (see Fig. 2).(2)

It has been found a rapid increase of crop losses specially when erosion is affecting humus horizon or transitions horizons. Thus for one cm. depth of eroded soil an amount of 60 kilograms grains is losted if is considered an average yield of 4,000 kilograms per hectare for noneroded soils.

For a short time, these losses are large but on long-term they become very high because the crop losses from the previous years are included (totalized).



**Fig.2** Correlation between losses of crop yield and surface erosion

### 3 Methods of soil erosion control and land improvement

In Romania existed and are still maintaining the traditional conservation measures on the agricultural fields. Among them are mentioned the following: contouring (the practice of tillage and planting on the contour), stripcropping, buffer stripcropping, agroterracing on cropland, wine and fruit plantation terraces, gully control structures, perennial grasses in the crop rotation system and artificial revegetation of the denuded fields by shrubs and trees.

Unfortunately, these methods have not been generalized. Consequently, in some areas were practiced on large scale methods that enabled increasing of erosion as follows: up-and-down hill plot layout and farming, land clearing for agricultural purposes on hillsides with high risk of erosion.

New methods were implemented besides traditional methods, such as bench terraces on cropland, conservation tillage, terraces by steps concurrently constructed with the field broking for wine and fruit plantations, treatment system of fruit plantations by technological alleys, vegetated and mechanical waterways, interception drainage for wet soils on slopes etc.

The basics of conservation tillage is to leave sufficient crop residue on the soil surface to significantly reduce soil erosion and, which involve less energy than conventional tillage.

Over the period 1992—1998 different tillage treatments were considered.

Based on long-term data, illustrated in Table 5, it might be concluded that tillage leaving a protective cover of previous crop residue on the surface represent a new opportunity to control soil erosion.

**Table 5** Influence of tillage on soil losses (1992—1996)

Base tillage	Erosion (t/ha)					Average
	1992	1993	1994	1995	1996	
Continuous fallow	18.2	26.2	-	19.4	23.3	18.4
Unprotected (Plowed, check plot)	4.7	17.1	0.8	8.0	13.8	8.9
Partly protected (chisel)	3.3	24.4	-	0.6	3.7	6.4
Protected in wheat stubble (No-till)	2.7	7.2	-	0.8	2.1	2.6

Within the above mentioned, experimental site the nutrient losses have been determined for the first time in Romania under non-conventional tillage. Also, a great concern was focused to establish the rate of nutrients losses through water and soil, respectively (see Table 6).

**Table 6 Influence of tillage on the mean nutrient losses for the period 1992—1996**

Tillage		Continuous fallow	Unprotected (Plowed, Check)	Partly protected (chisel)	Protected in wheat stubble (No-till)
Humus kg / ha		407.0	231.6	148.6	58.9
Nitrogen Loss	Total kg / ha	20.3	13.4	6.8	3.2
	Water %	4.6	19.1	8.7	10.2
	Soil %	95.4	80.9	91.3	89.8
P <sub>2</sub> O <sub>5</sub>	Total kg / ha	5.2	4.5	1.6	0.9
	Water %	10.2	13.7	10.5	15.3
	Soil %	89.8	86.3	89.5	84.7
K <sub>2</sub> O	Total kg / ha	4.7	3.8	1.6	0.7
	Water %	20.8	43.3	32.2	67.8
	Soil %	79.2	56.7	67.8	61.7

The basics of these methods is to leave sufficient crop residue on the soil surface to significantly reduce soil erosion and, which involve less energy than conventional tillage.

Over the period 1998 different tillage treatments were considered.

Conservation tillage systems also reduce nutrient losses. Of these, over 93 percent at organic matter, over 83 percent at phosphorous and over 60 percent at potassium are lost through eroded soil. (Table 6)

The total agricultural surface protected by conservation measures is about 2.1 million hectares, that means approximately 30% from the fields with erosion potential.

#### 4 Present day and prospective problems

Romanian Parliament has approved of the landed property law. Through it the land of former agricultural cooperatives is restored to legitimately landowners. This is affecting over 90% of the agricultural land area. The remainder lands belong to agricultural state units that were turned into agricultural societies (companies) with state capital. Now the putting in possession of injured people is taking place with a top limit of 10 hectares per family.

The landed property law includes two provisions which are not of a nature to create conditions for the extension of conservation measures. One of these stipulates that the land reallocation has to be usually done on the old locations. This means, in most cases, the plots will be up-and-down hill disposed. The second is referring to the successors' right up to the fourth degree! This enables an increasing rate of dividing into lots (land chopping) that was very high in past, too. Moreover this means the allotment of about 2 millions people who never had a connection with agriculture.

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