

## EVOLUTION OF LAND USE CATEGORIES AND THE EROSION DEGRADATION STATE OF THE AGRICULTURAL LANDS IN THE SUCEAVA COUNTY

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### **Abstract**

*The paper aims to bring in the foreground the long-term negative effects of soil erosion on the slope agricultural land in Suceava County. Located in the northeastern part of Romania, Suceava County occupies an area of 8553.5 km<sup>2</sup> (about 3.6% of the country's surface), being the second largest county in the country, after Timis County. Related to the country's largest geographical units, the territory of the county overlaps partially with the Eastern Carpathians and the Suceava Plateau. The relief characterized by a wide variety of forms (mountains, intramontane depressions, hills, plateaus, terraced valleys and river meadows) and the characteristics of the climatic, hydrographic, geological and pedological elements, correlated with the inappropriate exploitation of the land slopes, have determined over time the emergence of the erosion process on agricultural land. In 1990, Suceava County had an agricultural area of 349,502 ha, out of which 182,486 ha of arable land, 91,465 ha of pastureland, 69,960 ha of meadows and 5,491 ha of orchards. Compared to 1990, the total agricultural area increased to 354,820 ha, where 180,451 ha represent arable land, 2,913 ha orchards, 93,052 ha pastures and 78,404 ha of meadows. Between 1990 and 2017, the total agricultural area has increased by 5,318 ha, but the arable land and orchards were reduced by approximately 2,500 ha each, pastures and meadows increased by about 1,500 and, respectively 8,000 ha. More than half of the agricultural area is located on land with a slope of more than 5%. The lack of measures to prevent and combat erosion has led to a decrease in soil fertility, and in some cases to irreversible removing of the large area of land from the agricultural circuit.*

**Key words:** soil erosion, slope land, land use categories, eroded land.

### **INTRODUCTION**

The geographic position of Suceava County in the NE of Romania, with specific climate conditions, more severe than in the rest of the territory (low temperatures, abundant precipitation, high frequency and intensity of the wind) and higher forms of relief that are dominant in the area, represent factors that determine a relatively high degree of soil erosion (Savu P., 1999).

Suceava County occupies an area of 855,350 ha, out of which 354,820 ha (41.48%) represent agricultural land, and more than half of them are situated on slopes with a slope of more than 5%.

In these conditions, an accelerated soil erosion process is noticed, determined also by the intervention of the human factor on the environment, by massive deforestation, excessive grazing and the cultivation of land with large slopes without taking soil protection measures (Ungureanu Irina, 1998).

### **MATERIALS AND METHODS**

The study was conducted using existing data from specialized state institutions such as the Suceava Agriculture and Rural Development Department, the Suceava Agricultural Payments and Intervention Agency and the National Land Improvement Agency Suceava regarding the evolution of the land use categories and surfaces degraded by erosion during the period 1998-2017.

Also from the national database (BDUST-Databased of the Agricultural soil-land units) conducted through the County soil-land Monitoring System for agriculture, data on land degradation by sheet erosion and gully erosion processes were extracted together with the data regarding the lands affected by landslides for the 65 territorial-administrative pedologically mapped units of Suceava County. These studies were carried out at the scale of 1: 10000 or 1: 5000 by the County Office of Pedology and Agrochemistry Suceava.

## RESULTS AND DISCUSSIONS

In 1990, Suceava County had an agricultural area of 349,502 ha, out of which 182,486 ha of arable land, 91,465 ha of pastureland, 69,960 ha of meadows and 5,491 ha of orchards. Compared to 1990, the total agricultural area increased to 354,820 ha, where 180,451 ha represent arable land, 2,913 ha orchards, 93,052 ha pastures and 78,404 ha of meadows (Savu P, Bucur D., 2002).

Agricultural land has a significant distribution in the plateau unit, the arable surface is found in the plateau side and the pastures and meadow in the mountain unit (Figure 1).

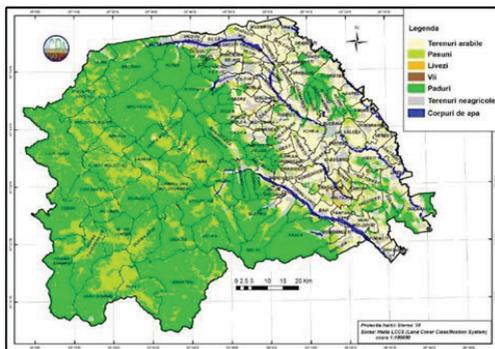


Figure 1. The map of land use categories distribution in Suceava County

As can be seen in Table 1, between 1990 and 2017 there were no significant changes in the total land area, but in 2015, with the changes of the surface of the forest fund, important land areas were introduced in the agricultural circuit. The reduction of the forest fund in the period 2015-2016 by about 11,000 ha was caused by massive and uncontrolled deforestation, most of it illegal.

Out of 11,000 ha deforested land, 5,318 ha were converted into agricultural surface, the land use categories recording the most significant increase are pastures and meadows. More than half of the agricultural area is located on land with a slope of more than 5% (Figure 2).

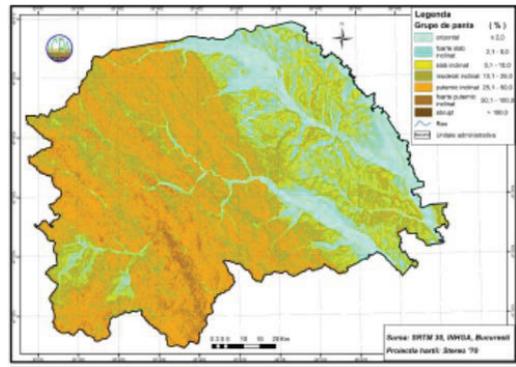


Figure 2. Sloping map in Suceava County

Between 1998 and 2017, the dynamic of land use categories on sloping agricultural lands shows a decrease of about 300 ha/year, by year 2017 arable land decreased by 11%, from 59,600 ha to 53,600 ha. At the same time, the orchards decreased by 37%, at the end of year 2017 remained only 1,400 ha of 2,200 ha as they existed in 1998, and the meadows were reduced by 2% (800 ha), the only increase was recorded by pastures, from 72,600 ha to 77,000 ha (Table 2).

The reduction of the areas cultivated on sloping land, especially arable land and orchards, was caused by the expansion of urban and rural areas, and also by the abandonment of degraded land where no profitable agriculture was possible.

Regarding the areas heavily affected by erosion, as seen in Figure 3, predominant in the Suceava Plateau, especially at the contact between different relief forms, is preponderant an agricultural area.

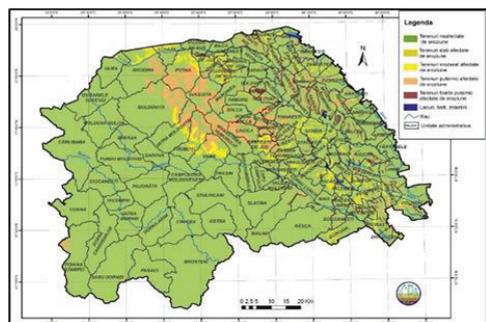


Figure 3. Soil erosion map in Suceava County

Table 1. The distribution evolution of land use categories in Suceava County, 1990-2017 (Suceava Agriculture and Rural Development Department)

Year	Total agricultural land		Land use categories							
	ha	%*	Arable		Pastures		Meadows		Orchards	
			ha	%	ha	%	ha	%	ha	%
1990	349,502	40.86	182,486	52.21	91,465	26.20	69,960	20.02	5,491	1.57
2000	349,502	40.86	178,473	51.06	93,749	26.82	74,009	21.17	3,271	0.93
2005	349,762	40.89	180,771	51.68	90,250	25.80	75,711	21.64	3,030	0.86
2010	347,920	40.68	180,678	51.93	90,274	25.95	73,960	21.26	3,008	0.86
2011	347,900	40.67	180,650	51.92	90,450	25.99	73,600	21.15	2,900	0.83
2012	347,805	40.66	180,372	51.86	90,570	26.03	74,053	21.29	2,810	0.80
2013	346,762	40.54	179,495	51.76	90,367	26.06	73,897	21.29	3,003	0.86
2014	347,835	40.66	179,646	51.64	90,563	26.03	74,175	21.32	3,001	0.86
2015	354,821	41.48	180,455	50.85	93,107	26.24	78,407	22.09	2,852	0.80
2016	354,820	41.48	180,451	50.85	93,052	26.22	78,404	22.09	2,913	0.82
2017	354,820	41.48	180,451	50.85	93,052	26.22	78,404	22.09	2,913	0.82

\* of the county's surface

Table 2. The evolution in the period 1998-2017 of the land use categories on the sloping agricultural lands in Suceava county (ANIF Suceava)

Land use categories	Cultivated surface				Situation of the year 2017 compared to year 1998
	1998		2017		
	ha	%	ha	%	
Arable	59,600	100	53,600	89	Surface decreased by 11%
Pastures	72,600	100	77,000	106	Surface increased by 6%
Meadow	63,800	100	63,000	98	Surface decreased by 2%
Orchard	2,200	100	1,400	63	Surface decreased by 37%

Approximately 31,000 ha of agricultural land is affected by sheet erosion, from low to excessive, and on about half of them the erosion process is manifested with high, very high and excessive intensity (Figure 4).

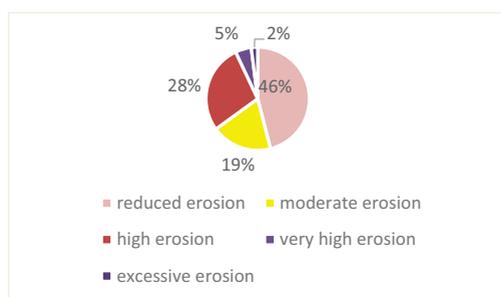


Figure 4. Percentage distribution of agricultural land degraded by sheet erosion

From the analysis of the areas affected by gully erosion, it can be observed a large area occupied gully erosion (Figure 5) due to lack of works and measures to stop them from evolving.

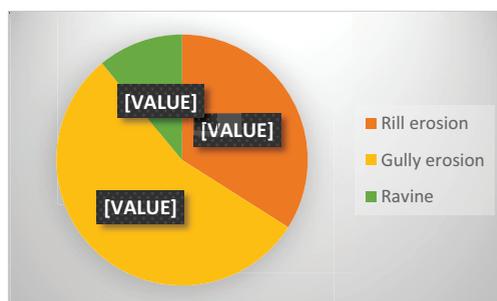


Figure 5. Percentage distribution of agricultural surface degraded by gully erosion

If in 1998 only 4% of the slope agricultural land fund was in an advanced state of degradation by slope processes, in 2017, 18% (35,547.92 ha) of slope agricultural land fund (195,000 ha) are in different stages of degradation through sheet erosion and gully erosion. The increase of surface degraded by erosion was determined by the replacement of anti-erosion cultivation systems with hill to valley agricultural works, the deterioration or decommissioning of special hydro-technical

facilities built up to 1990 for the control of gully erosion, and also by the predominance of the maize continuous cropping in the crop structure.

Also, the most affected land use categories are arable lands (Figures 6 and 7), followed by pastures (Figure 8), orchards (Figure 9) and meadows.



Figure 7. A stabilized gully erosion on arable land in Forăști



Figure 8. Pasture affected by sheet erosion and gully erosion, Preuțești



Figure 9. Terraced surface of a degraded orchard affected by sheet erosion, Fălcițeni

Recommended measures and practices for preventing and combating soil erosion on agricultural land in Suceava County:

After the implementation of Land Fund Law 18/1991 and land repossession, an excessive fragmentation of the land areas occurred, most of them being arranged with the long side in the direction of the hill-valley, therefore obliging the owners of the land to execute the soil works in the direction from hill to valley (Savu P., Bucur D., Dascălu C., 1999; John R., 2018).

Thus, by merging the cultivated surfaces, the anti-erosion cultivation systems previously used can be implemented: contour plowing, contour buffer strips, strip cropping and terracing (Savu P., Bucur D., Ilișescu C., 1999; Dan S. et al., 2018).

Also, another urgent measure is aimed to (re) afforesting highly degraded land through ravines, where both soil fertility and level of soil mechanization have low values (Rafael Blanco-Sepúlveda, 2018; Hao C. et al., 2018; Auerswald K. et al., 2019).

The deforestation of large forest areas and their conversion into agricultural land where unsustainable agriculture is practiced has led to a decrease of soil fertility, and implicitly of agricultural production (Zhujun C. et al., 2019). It also determined the degradation not only of cultivated land, but also of roads, access ways and properties (Muqi Xiong et al., 2018). Therefore, in order to restore the ecological balance in the deforested areas, it is necessary to reforest them, but also to extend the silvic protection plantations on all the degraded agricultural lands and silvic areas (M. E. Lucas-Borja et al., 2019; Mahbulul A., 2018; Camera C. et al., 2018).

Regarding the special hydro-technical constructions for controlling gully erosion forms, the absence of maintenance work, inappropriate agricultural practices, as well as certain natural factors (especially the relief and torrential precipitations) led to their degradation (Léa Kervroëdan et al. 2018; Jianlin Z. et al., 2018). Consequently, in order to ensure hydrological balance on gully erosion forms, it is advisable to rehabilitate degraded works, wherever possible, through unclogging activities, rehabilitation of the drainage network, rehabilitation of the road platform etc.

Last but not least, the application of relatively new soil conservation measures such as the minimum tillage and no tillage system, which suppose abandoning ploughing or even all the soil works such as direct drilling (Valentin G. et al., 2018; Jesús Rodrigo-Comino et al., 2018; H. Vijith et al., 2018). It is also recommended to use the so-called green crops, sown immediately after harvesting the previous crop, which are designed to protect the soil during winter and to improve the physical, chemical and biological properties, implicitly to increase the fertility and resistance to erosion.

## CONCLUSIONS

In 2017, Suceava County had an area of 354,820 ha of agricultural land, arable land of 180,451 ha, orchards and nurseries of 2,913 ha. The pastures and meadows totals 93,052 ha and respectively 78,404 ha.

Between 1990 and 2017, the total agricultural area has increased by 5,318 ha, but the arable land and orchards were reduced by approximately 2,500 ha each, pastures and meadows increased by about 1,500 and respectively 8,000 ha.

The reduction of the forest fund in the period 2015-2016 by about 11,000 ha was caused by massive and uncontrolled deforestation, most of it illegal.

Out of 11,000 ha deforested land, 5,318 ha were converted into agricultural surface, the land use categories recording the most significant increase are pastures and meadows.

The dynamic of land use categories between 1998 and 2017, on sloping agricultural lands shows a decrease of about 300 ha/year, by year 2017 arable land decreased by 11%, from 59,600 ha to 53,600 ha. At the same time, the orchards decreased by 37%, at the end of year 2017 remained only 1,400 ha of 2,200 ha as they existed in 1998, and the meadows were reduced by 2% (800 ha), the only increase was recorded by pastures, from 72,600 ha to 77,000 ha.

In 2017, 18% (35,547 ha) of the slope agricultural land fund (195,000 ha) are in various degree of sheet erosion and gully erosion.

The ecological and economic consequences of soil erosion will continue to manifest with increasing intensity as long as prevention and

control measures are not taken, simple measures such as the cultivation of good protective plants, mulching, contour plowing, and other more complex works, such as special hydro-technical amelioration works for combating ravines (gabions, brushwood dams, concrete weir, dams, etc.).

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