IMPACT OF LAND USE CHANGES ON THE GEOMORPHOLOGICAL PATTERN BETWEEN 1957-2018 WITHIN SARATA CATCHMENT, REPUBLIC OF MOLDOVA

DOI: <https://doi.org/10.18509/AGB.2020.18>

UDC: 502.52:504.61]:551.311(498)

Silvia Vacula, Lilian Niacșu

“Alexandru Ioan Cuza” University of Iași, Romania

corresponding author: silviana7@yahoo.com

submitted: 03.03.2020

accepted: 17.05.2020

published: 15.09.2020

Abstract

Commonly, the land use pattern highlights the impact of the anthropic activities. Much more, mainly for the agricultural lands of the Republic of Moldova, this represents also a determining factor in land degradation through the manifestation of the geomorphological processes. Located in the southern part of the Moldavian Plateau (Republic of Moldova), our research area is typified by prevalence of soil erosion, sedimentation, gullies and landslides. Under these circumstances, our study aims to analyze the spatial and temporal evolution of land use pattern starting from the 1970s till now and to establish the impact of the geomorphological processes in the state of land degradation. From methodological point of view, our research stands on a comprehensive spatial data base which was created based on successive topographical maps (in scale 1:25,000), aerial photo maps (in scale 1:5,000) and consistent field observations. The overall results show that the present land use pattern of Sarata catchment (70600ha) is characterized by the prevalence of highly fragmented agricultural lands on 2/3 from total area. In opposition, in the case of the period before 1990, the centralized communist policy favored the soil erosion control systems applied either on large arable plots or on widespread vineyards and orchards plantations. Much more, our results highlights that the land use dynamics was substantially influenced by land reforms (e.g. the land reform of 1991) that especially favored soil erosion, the most widespread process at the level of the entire research area. In conclusion, the comparative analysis reveals the irrational land use which is closely related to the decrease of soil & land quality, the main natural resource of the entire country. Also, the need for large-scale (re)implementation of land improvement projects especially on arable lands is substantiated.

Keywords: irrational land use, land degradation, geomorphological processes, land improvement projects.

INTRODUCTION

Sarata catchment is located in the southern part of the Moldavian Plateau (Republic of Moldova), having the surface of 706 km². The Sărata river springs from the bottom of the accumulation lake, located at the southern periphery of the village Sărata-Mereșeni (Hîncești district). It opens in the Prut river at 187 km from the mouth, 1.5 km northwest of the village of Nicolaevca (Leova district). The length of the river is 59 km. It borders in the northwest with the Lăpușnei Basin, northeast with the Cogălnic Basin, south-east with the Ialpuș Basin, south and southwest with the Prut River basin in which it opens. The main tributaries of the river

are: on the right the Orac river (22 km), on the left - the Sărățica river (15 km). The Sărata River is part of the lower Prut River, and is among the last left tributaries that flow over it.

The climate is temperate continental with annual temperature of 9.5-10° C and mean annual precipitation of about 500-550 mm. Implementation of soil and water conservation practices is a very important link to sustainable land use pattern [1], [2], [3]. During the communist period, the Sarata catchment was the subject of widespread land improvement projects [4], [9], [10]. After 1991, a varied complex of non-

conservative land use actions became generalized. Thus, the land use changes, excessive fragmentation of arable land or deforestation have contributed to enhancement of land degradation

[10], [11] through geomorphological processes: soil erosion [5], gullies [6], [7] and landslides [8], sedimentation [5].

Figure 1. The geographic position of the catchment of the Sarata.

Figure 2. Land use within the Sarata catchment, southern part of the Republic of Moldova 1957-1970.

Figure 3. Sarata catchment

MATERIAL AND METHODS

The research stands on a comprehensive spatial data base which was created based on successive topographical maps (in scale 1:25,000), aerial photo maps and consistent field observations. In order to obtain and process the land use map, the

TNT Mips software was used, the map being mapped from 1: 25000 and the polygons were created to estimate the surfaces of each category of agricultural use (fig.4-11).

Figure 4. Extension of the lake Sarata Mereseni (after 1970); forest plantations were missing (1957-1970).

Figure 6. New surfaces of vineyards cultivated in the west of Sarata Noua ; Orchard plantations transformed into arable NV; The emergence of the largest lake Sarata Noua.

Figure 7. Creation of new forest curtains, planting forests after 1970-2018 (aerophotos 2018); surface erosion.

Figure 8. North of Valea Florii - absence of lakes in 1957 and now are presented.

RESULTS AND DISCUSSION

Following this study, for the period 1957-1980 we found 71% for arable area, 10.32% for forestlands and about 7% for areas with vineyards, followed by pastures - 4%. According to the data, aerophotos and observing the others on the field observations it was concluded that the areas have increased for agricultural uses such as vineyards, orchards, villages, forest plantations, lakes (tab.1). It is also important that the important changes in the territory were signaled after the 1991 Land Reform where surfaces with buildings, vineyards and orchards were transformed into arable, accentuating the surface erosion and the silting of the lakes (e.g Sarata Galbena) (tab.fig).

It is observed that for most lakes the area has expanded (due to extension works, regularization) and others have become silted. Thus, a total of about 495.22 ha is estimated for the surface areas of accumulation lakes from the current period (aerophotos 2018) with 41.29 % higher than in the Soviet period (1957-1989) about 204.51 ha .

The intensity of the erosion processes determined the silting of some lakes as a result of the anthropic intervention. Thus, new lakes missing from the topographic maps from 1957-1970 were identified on aerophotograms. Therefore, as a result of the analysis of the 37 lakes of the area and were found:

- 1 lake kept relative the same surface: Cărpineanca N (5.23 ha -5.25 ha).
- 5 lakes have greatly reduced their area, in the case of some, even in half: Lake Sarata-Mereșeni, from 2.82 ha to 1 ha, Lake Brătianovca

de S, from 35.65 to 34.3 ha, Căzlari NE from 6.12 ha to 2.48 ha, Victoria SE 1 from 7.54 ha to 4 ha, Cazangic NE from 1.81 to 1.1 ha.

- 20 lakes were built later, after 1970, thus being part of the great project of anti-erosion planning, at the level of the whole Republic of Moldova: Sărata-Mereșeni S (11 ha), Mereșeni S1 (912.8 ha), Mereșeni SE (1.94 ha), Valea Florii (8.78 ha), Sarata Galbena NE1 (4.3 ha), Sarata Galbena NE 2 (4.95 ha), Carpineanca S (1.25 ha), Orac- Balănei (1.25ha), Ciadâr N (2.35 ha), Colibabovca NV (4 ha), Colibabovca S (3ha), Sarateni NV (11.5 ha), Caracui (5.49 ha), Cazlari E (1.51 ha), Victoria SE 2 (4.66 ha), Victoria SV (3.81 ha), Sărățica Veche (12.5 ha), Sărățica Nouă (4.57 ha), Troian NE (58 ha), Sărata-Nouă (130 ha).
- 3 lakes built between 1957-1970 which no longer exists, being actually silted due to the intense sedimentation processes: Mereșeni 1, Sărata Galbenă, Cîmpul Drept.
- 8 lakes benefited from cleaning, decolmatization, extension works, as anti-erosion measures, so that their surfaces increased - Mereșeni S2 from 5.26 ha to 6.37 ha, Brătianovca de N (Valea Siliști) from 6.12 ha to 7.68 ha, Brătianovca - from N from 4.52 ha to 13.9 ha, Orac - from 9,755ha to 12.5 ha, Colibabovca SV from 4.06ha to 6.58ha, Sărăteni NE from 14.03 ha to 20.8 ha, Cneazevca from 44.89 ha 77.6 ha, Filipeni S of 20.74 ha 25 ha (Tab.2).

Figure 9. Landslides stabilized in the east of Upper Sarata Catchment, cuesta front, (august 2019).

Table 1. Land cover in Sarata catchment (2019)

Land use categorie	Area (ha)	% of total
Arable land	50222.22	71.51
Pastures and meadows	2838.59	4.04
Orchards	1266.93	1.8
Orchards (walnut)	129.29	0.18
Vineyards	5269.63	7.5
Lakes	234.07	0.33
Forestlands (acacia)	2044.19	2.91
Forestlands (acacia-maple)	425.27	0.6
Forestlands (oak-maple)	582.51	0.82
Forestlands (oak-acacia)	1356.17	1.93
Forestlands (oak)	2857.64	4.06
Roads	255.67	0.36
Constructions	1837.91	2.61
Marshes	483.15	0.68
Total area	70228.27	100

Figure 10. Land cover in Sarata catchment in 2018 (in ha).

Figure 11. Areolar erosion and in depth, combined with landslides; stabilized sliding ledges (mounds) (middle basin - affluent Ciadar).

Table 2. . Distribution of lakes in the basin within the Sarata catchment

Nr.	Lakes	topographic map 1957-1989 (ha)	aerophotos-2018 (ha)
1	Sărata-Mereșeni	2.82	1
2	Sărata-Mereșeni S	-	11
3	Mereșeni	0.27	-
4	Mereșeni S 1	-	12.8
5	Mereșeni S 2	5.26	6.37
6	Mereșeni SE	-	1.94
7	Brătianovca de N (Valea Siliști)	6.12	7.68
8	Brătianovca de N	4.52	13.9
9	Brătianovca de S	35.65	34.3
10	Valea Florii	-	8.78
11	Sărata Galbenă	19.78	silted
12	Sărata Galbenă NE 1	-	4.3
13	Sărata Galbenă NE 2	-	4.95
14	Cărpineanca N	5.23	5.25
15	Cărpineanca S	-	1.25
16	Orac	9.755	12.5
17	Orac Balănei	-	1.25
18	Ciadăr N	-	2.35
19	Colibabovca SV	4.06	6.58
20	Colibabovca NV	-	4
21	Colibabovca S	-	3
22	Sărăteni NV	-	11.5
23	Sărăteni NE	14.03	20.8
24	Caracui	-	5.49
25	Cneazevca	44.89	77.6
26	Căzlari NE	6.12	2.48
27	Căzlari E	-	1.51
28	Victoria SE 1	7.54	4
29	Victoria SE 2	-	4.66
30	Victoria SV	-	3.81
31	Sărătica Veche	-	12.5
32	Sărătica Nouă	-	4.57
33	Cîmpul Drept	16.19	silted
34	Troian NE	-	58
35	Cazangic NE	1.81	1.1
36	Sărata-Nouă	-	130
37	Filipeni S	20.74	25
	Total area	204.51	495.22

Thus the degradation of the lands is in a continuous increase, although the anti-erosion Programs and the conservation practices (from the Soviet period) are still partially preserved in the territory. It is very important and absolutely necessary to continue to implementation projects of erosion management

and land conservation practices for reducing soil erosion and lake sedimentation. In conclusion, soil erosion in the Sarata catchment is the most important degradation process and is directly related to the increasingly anthropic intervention, especially due to land reforms.

ACKNOWLEDGEMENTS

This work was co-funded by the European Social Fund, through Operational Programme Human Capital 2014-2020, project number POCU/380/6/13/123623, project title „PhD Students and Postdoctoral Researchers Prepared for the Labour Market!”.

REFERENCES

- [1] Ioniță, I., Niacșu, L., (2010), Land degradation and soil conservation within the Pereschivul Mic catchment – Tutova Rolling Hills, Lucrări științifice – vol. 53, seria Agronomie, Ed. „Ion Ionescu de la Brad” Iași , Romania.
- [2] Niacșu, L., 2017. Land degradation and soil conservation within the Moldavian Plateau. Habilitation Thesis, Univ. „Al. I. Cuza”, Iași, 102 pp, Romania.

- [3] Ioniță I., (2000a) Geomorfologie aplicată – Procese de degradare a regiunilor deluroase, Editura Univ.”Al. I. Cuza”, 249 pp, Iași, Romania.
- [4] ICPA “Nicolae Dimo”, 2004 “Eroziunea solului”, Republica Moldova.
- [5] Ioniță, I., Rădoane, Maria, Mircea, S., (2006), “1.13 Romania”, In “Soil Erosion in Europe”, Editors John Boardman and Jean Poesen, Publisher John Wiley, Chichester, England. alea Bârladului, Analele științifice ale Universității „Al. I. Cuza, tom XII, Iași, Romania.
- [6] Rădoane, Maria, Ichim, I., Rădoane, N., (1995), Gully distribution and development in Moldavia, Romania, Catena 24: 127-146, Romania.
- [7] Ioniță, I., (2000b), Formarea și evoluția ravenelor din bazinul Bârladului, Ed. „Corson” Iași, Romania.
- [8] Pujină, D., (1997), Cercetări asupra unor procese de alunecare de pe terenurile agricole din Podișul Bârladului și contribuții privind tehnica de amenajare a acestora, Teză de doctorat, Univ. „Gh. Asachi”, Iași, Romania.
- [9] Niacșu L., 2012. Pereschiv catchment (Tutova Rolling Hills). Geomorphological and pedogeographical study with special regard on land use, Ph.D. thesis, Alexandru Ioan Cuza University of Iasi, pp 308 ,Romania.
- [10] Niacșu L., Stoian L., Topsa G. 2012. Land degradation and soil conservation within the Simila catchment – Tutova rolling hills, Present environment and sustainable development, 6 (2), 465–475, Romania.
- [11] Motoc, M. 1983. Ritmul mediu de degradare erozională a solului in R. S. Romania. Buletinul Informativ al A.S.A.S., 13, Bucuresti, pp. 47-65, Romani