Scientific Papers. Series E. Land Reclamation, Earth Observation & Surveying, Environmental Engineering. Vol. VII, 2018
Print ISSN 2285-6064, CD-ROM ISSN 2285-6072, Online ISSN 2393-5138, ISSN-L 2285-6064

NOWADAYS SITUATION OF DRAINAGE SYSTEMS IN THE MOLDOVA RIVER WATERSHED

Minodora AILENEI (RADU), Oprea RADU, Daniel BUCUR

"Ion Ionescu de la Brad" University of Agricultural Sciences and Veterinary Medicine of Iasi, 3 Mihail Sadoveanu Alley, Iasi, Romania

Corresponding author email: opricaradu@yahoo.com

Abstract

The surface and subsurface drainage systems developed in the Moldova River watershed in the County of Suceava have been designed to be used on drainage sectors, and, in order to enhance excessive water capture and discharge, several complementary works have been planned from time to time, namely: land levelling, shaping, deep loosening etc. Due to the extension of the private ownership of the land with drainage systems starting with 1991 and due to the carrying out of soil works on individual plots of land, the land was shaped in the bedding with ridges and furrows, of variable widths, level differences and transverse slopes. Land shaping that does not match the routing of the plastic drain lines and of the drainage network allows the water to stagnate in the furrows and extend the excessive humidity period. The use of the developed areas on drainage sectors facilitates the levelling of small depressions and supports the even removal of excessive water. As maintenance works have not been performed from time to time, this has gradually led to the erosion of slopes and to the slitting of the canal network and of the discharge holes in the drains, which caused excessive humidity to reoccur.

Key words: *humidity excess, surface and subsurface drainage systems, individual land parcels, land shaping.*

INTRODUCTION

The reasonable use, protection, improvement and preservation of soil have been a constant preoccupation lately, as the success of development depends on it. Soil resources, together with the other environmental components, are directly or indirectly involved in all the aspects of the development process, and play an important role in the economic power of any country, at all levels of development (Rauta C. et al., 1998).

Soil quality is more or less affected by one or more conditions, such as drought, periodic excess water, soil erosion, landslides etc (Hornbuckle J.W. et al., 2007; Burja C. et al., 2013).

These conditions are determined either by natural factors or by agricultural and industrial activities that might have a negative synergic action (Lukianas A. et al., 2006).

Excessive humidity is one of the major soil fertility limiting factors, as it is able to diminish considerably and sometimes evencompletely destroy the productive capacity of the land.

After the development of surface and subsurface drainage systems it is very important to use and maintain them properly, in order to preserve the physical, chemical and biological characteristics of the soil (Radu O., 2016).

MATERIALS AND METHODS

Excessive natural rain and/or underground water, together with the constant flooding of the river system in the Moldova River watershed area, have materialized under various formsand intensities, both on horizontal and on sloping land.

The natural conditions of the Baia piedmont plain favor the occurrence and maintenance of excessive humidity both on the surface and underground. The flood plain of Moldova River and the strip-shaped 1.5 km wideterraces, which are almost parallel to the Moldova riverbed, running from NW to SE, with mild 1-5% slopes, with flat areas and many small depressions, allow the water to stagnate.

The wet climate specific to the Moldova River watershed area, the heavy rainfalls of 1-5 consecutive days and the low evaporation and perspiration rates are the main cause of excessive humidity in hardly permeable soils (Nitu T. et al., 1985).

In order to remove the excessive water in the flood plain and terraces of Moldova River in the County of Suceava, three surface and subsurface drainage systems (Rotopanesti-Radaseni-Fantana Mare, Dragoiesti-Berchisesti, Bogdanesti-Baia) and the Baisesti-Dumbrava irrigation and drainage system were developed between 1978 and 1980, which covered 8761 ha of drained land, of which 3059 ha comprised underground drainage works (Figure 1).

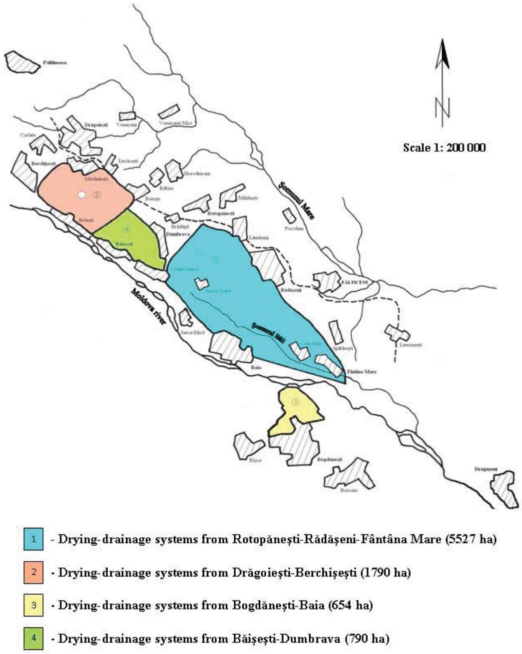


Figure 1. Surface and subsurface drainage systems of the Moldova River flood plain in the County of Suceava

The network of drainage ditches with a total length of 126.85 km comprises main collecting drains, secondary collecting drains, sector collecting drains and belt canals.

In order to discharge the excessive water from the soil, an underground drainage network was developed, depending on the nature and intensity of excessive humidity, made up of plastic drains and collecting drains, with a total length of 1575.12 km.

In order to determine the current state of the surface and subsurface drainage systems, field observations and topographic measurements were carried out and transverse profiles were developed.

RESULTS AND DISCUSSIONS

In principle, effective excessive water discharge from land with surface and subsurface drainage systems is provided by a well maintained drainage network and by adequate land use.

Starting with 1991, the land with surface and subsurface drainage systems has gradually become private property and it has been worked on individual plots, which has led to land shaping in the bedding with ridges and furrows, of variable widths, level differences and transverse slopes, depending on widths of the plots, on the manner in which they were used and on the agricultural machinery used (Radu O. et al., 2008).

The transverse profile analysis (Figure 2) reveals land shaping in the bedding with ridges and furrows with values of the furrow-ridge level differences ranging between 0.211 m and 0.760 m and transverse slopes of 4.3% to 25.3%, due to the individual soil works on the various plots of land.

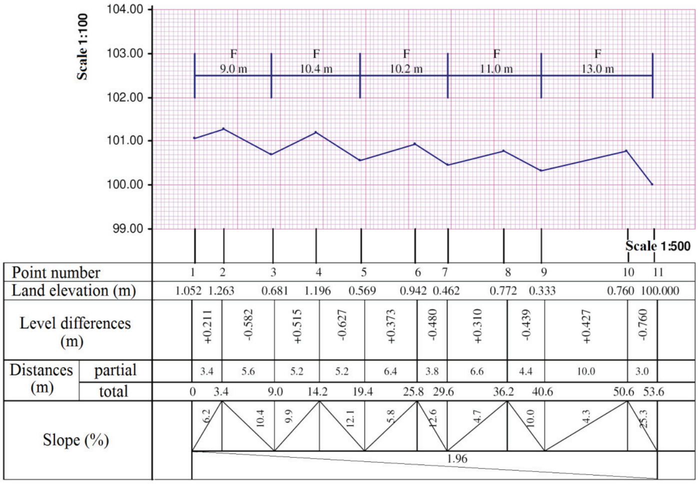


Figure 2. Land shaping by individual soil works

Land shaping due to individual soil works on various plots of land, which does not match the routing of the plastic drain lines and of the drainage network, allows the water to stagnate in the furrows and extend the excessive humidity period. Thus, this land has gradually turned from arable land into grass land (Figure 3).

Figure 3. Land shaping and stagnating water in the furrows

Whereas before 2014-2015, in the Rotopanesti-Radaseni-Fantana Mare surface and subsurface drainage system, the land was used as individual plots (Figure 4), now, due to the lack of workforce caused by an ageing population and due to the occurrence of private entrepreneurs, the land has been taken over and used uniformly on large compact areas or on drainage sectors.

On the left side of the Dumbrava main collecting drain, where the land has been used compactly for several years, the furrows and ridges were generally abolished, which allows for the excessive water from heavy rainfall of 1-5 consecutive days and from snow melting tobe easily discharged (Figure 5).

Figure 4. Use of agricultural land on individual plots

Figure 5. Use of land on drainage sectors

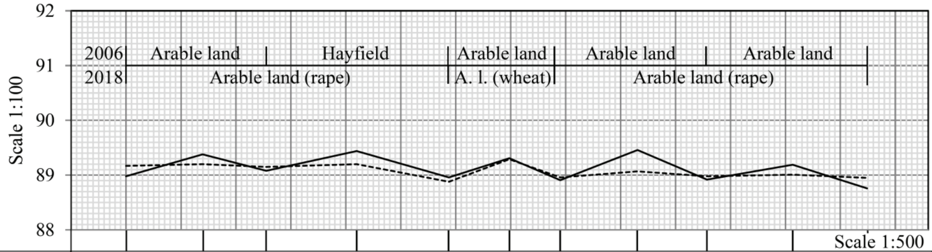
On the right side of the Dumbrava main collecting drain, where the land is used both on individual plots and on larger areas, we found that water stagnates and excessive humidity lingers in furrows and small depressions. Water stagnation on this side of the drain is due to the fact that the land has been used on larger areas for a little while, the areas are smaller and alternate with individual plots, which hinder the performance of soil works in optimal conditions, as the furrows and small depressions have not been completely removed yet (Figure 6).

In the cross profile (Figure 7) it is found that in 2006 the surfaces resulted after modeling processes have slopes between 3.5% and 8.6%. The level differences between the highest and lowest altitudes of sloped surfaces were range between 0.27 m and 0.55 m. In 2018, the amplitude values of level differences ranged between 0.33 m and 0.41 m. The slope of the surfaces varied between 7.1% and 7.5% for the small individually parcel. In large plots, values of level differences were only by 0.03 m and 0.32 m and transverse slopes ranging from 0.4% to 3.8%.

The analysis of the section of the Dumbrava main collecting drain (Figure 5), which serviced mainly arable pieces of land for about 40 years, reveals its natural slitting. Drain slitting is due to the non-performance on time of maintenance works, to the fact that the grass was not cut and the wooden vegetation was not removed, which increases roughness, reduces the water flowing rate and supports the deposition of alluvial sediments in the drain section.

At the time of our field observations, the Dumbrava drain section was cleared of the wooden vegetation, but the surface and subsurface drainage systems, which include a network of drains of various sizes, were generally invaded by well-developed wooden vegetation (Figure 8). The discharge holes in the surface plastic drains were less clogged that the collecting drains located deep into the ground. The discharge holes in the plastic drains of inferior rank and in the drains located on grass land were more clogged than the others (Figure 9).

Figure 6. Land use on larger areas and individual plots



Point number		1		2		3		4		5		6		7		8		9		10		11
Land elevation (m)	2006	388.98		89.38		89.08		89.44		88.96		89.31		88.91		89.46		88.92		89.19		88.76
	2018	389.17		89.20		89.15		89.20		88.88		89.29		88.96		89.07		88.98		89.01		88.95
Level differences (m)	2006		0.40		-0.30		0.36		-0.48		0.35		-0.40		0.55		-0.54		0.27		-0.43	
	2018		0.03		-0.05		0.05		-0.32		0.41		-0.33		0.11		-0.09		0.03		-0.06	
Distances (m)	Partial		6.96		5.80		8.22		8.39		5.50		4.64		7.03		6.32		7.80		6.77	
	Cumulated	0.00		6.96		12.76		20.98		29.37		34.87		39.51		46.54		52.86		60.66		67.43
Slope (%)	2006		5.75		5.17		4.38		5.72		6.36		8.62		7.82		8.54		3.46		6.35	
	2018		0.43		0.86		0.61		3.81		7.45		7.11		1.56		1.42		0.38		0.89	

Figure 7. Land shaping in 2006 and 2018

Figure 8. Shrub vegetation in the canals

Print ISSN 2285-6064, CD-ROM ISSN 2285-6072, Online ISSN 2393-5138, ISSN-L 2285-6064

Figure 9. Discharge holes in clogged plastic drains

CONCLUSIONS

Individual soil works on plots of land have led to land shaping in the bedding with ridges and furrows, which does not match the routing of the plastic drain lines and of the drainage network, allow the water to stagnate in the furrows and extend the excessive humidity period, and implicitly unevenly discharge the excessive water in the land with draining systems.

Land use on drainage sectors has allowed the abolishment of furrows, ridges and small depressions and hence the discharge of excessive water.

As maintenance works have not been performed from time to time, this has gradually led to the erosion of slopes and to the slitting of the canal network and of the discharge holes in the drains, which caused excessive humidity to reoccur.

The discharge holes in the plastic drains of inferior rank and in the drains located on grass land were more clogged than the others.

The discharge holes in the collecting drains, which are deeper into the ground than plastic drains, were clogged both in the grass land and in the arable land.

REFERENCES

Burja C., Burja V., 2013. Sustainable development of rural areas: A challenge for Romania, Environmental Engineering and Mangement Journal, 14 (8), 861-871.

Hornbuckle J.W., Christen E.W., Faulkner R.D., 2007. Evaluating a multi-level subsurface drainage system for improved drainage water quality, Agricultural Water Managemnet, 89(3), 208-216.

Lukianas A., Vaikasas S., Malisauskas A., 2006. Water management tasks in the summer polders of the Nemunas Lowland. Irrigation and Drainage 55(2), 145-156.

Nitu T. si colab., 1985. Influenta lucrarilor de desecare-drenaj asupra apelor freatice şi suprafreatice din Campia piemontana Radaseni-Fantana Mare-Baia, mijloc de creştere a productiei agricole la hectar. Primul Simpozion de Imbunatatiri Funciare, Bucuresti, 169-186.

Radu O., Bucur D., 2008. The functional efficiency of the drainage network from the Moldova watershed under conditions of the agricultural exploitation on individual plots. International Conference on Agricultural Engineering, Hersonissos – Crete, Greece, 20-28.

Radu O., 2016. Evaluarea comportarii in exploatare a sistemelor de desecare-drenaj din lunca raului Moldova. Editura „Ion Ionescu de la Brad” Iasi, 8-9.

Rauta C., Carstea St., Tuhai A., 1998. Elemente fundamentale ale strategiei dezvoltării agriculturii durabile. Bucuresti, 52-57.