CONSEQUENCES OF THE UNREASONABLE GRAZING ON THE SURFACES WITH DRAINING WORKS, OF THE DRAINAGE AREA OF MOLDOVA RIVER, SUCEAVA COUNTY

CONSECINȚE ALE PĂŞUNATULUI NERAȚIONAL PE SUPRAFEȚELE AMENAJATE CU LUCRĂRI DE DESECARE-DRENAJ, DIN BAZINUL HIDROGRAFIC AL RÂULUI MOLDOVA, JUDEȚUL SUCEAVA

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Abstract. *The draining improvements were performed on the fields of Moldova River meadow, Suceava County, in order to remove the excess water, from the soil surface and from its upper horizons, deriving from rainfall, ground water and from the surface runoffs on the higher bordering areas. The operation and exploitation of the drainage network produce mainly banks erosion and the silting of channels bottom. Banks erosion and the silting of channels sections are influenced by the speed of the water, banks stability, their degree of coverage with grass and, last but not least, by the category of use of the surfaces serviced by channels. This paper highlights the fact that the unreasonable grazing and the uncontrolled channels crossing by animals over the periods with highly wet soil, lead to the acceleration of bank erosion and, implicitly, to channels silting, this one occurring with an average annual rate of 3-4 cm, almost double compared to the channels servicing the surfaces used as arable and grass land. The silting of channels sections in a higher ratio than 60-70% leads to the overflow of the water collected over the periods with abundant rainfall, the flooding of the bordering fields, the extension of the humidity excess, the settlement of the higrophile vegetation and the disturbance of the drainage network operation in the neighboring areas.*

Key words: excessive humidity, drying-draining system, geometric and hydraulic parameters of the drying network.

Rezumat. *Amenajările de desecare-drenaj au fost executate pe terenurile din lunca râului Moldova, județul Suceava, în vederea eliminării excesului de apă, de la suprafața solului şi din orizonturile superioare ale acestuia, provenit din precipitații, apa freatică şi din scurgerile de suprafață de pe zonele limitrofe mai înalte. Prin funcționarea şi exploatarea rețelei de desecare se produce, cu precădere, eroziunea malurilor şi colmatarea fundului canalelor. Erodarea malurilor şi colmatarea secțiunii canalelor sunt influențate de viteza apei, stabilitatea taluzurilor, de gradul de înierbare al acestora şi, nu în ultimul rând, de categoria de folosință a suprafețelor deservite de canale. În lucrarea de față se pune în evidență că, păşunatul nerațional şi traversarea necontrolată a canalelor de către animale în perioadele cu solul supraumezit, determină accelerarea eroziunii de mal şi, implicit, colmatarea canalelor, aceasta producându-se cu o rată medie anuală de 3-4 cm, aproximativ dublă față de*

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cea a canalelor ce deservesc suprafețele utilizate ca arabil şi fâneață. Colmatarea secțiunii canalelor în proporție mai mare de 60-70% duce la revărsarea apei colectate în perioadele cu precipitații abundente, la inundarea terenurilor limitrofe, prelungirea excesului de umiditate, instalarea vegetației higrofile şi perturbarea funcționării rețelei de desecare-drenaj din zonele învecinate.

Cuvinte cheie: exces de umiditate, sistem de desecare-drenaj, elemente geometrice şi hidraulice ale rețelei de desecare.

INTRODUCTION

Among the main limiting factors of the agricultural production, which occur depending on the local pedoclimatic conditions, we could mention excessive humidity, floods, low permeability and soil compaction, erosion, sliding and others.

For the proper excessive water removal after the construction of the drying-draining systems, special attention should be paid to their operation and behavior over time, also considering the new private land ownership conditions.

MATERIAL AND METHOD

The excessive humidity, which occurs in the Moldova River basin and which is due to rain and/or ground water and to water system overflows, has manifested itself under various forms and at different intensities, on both horizontal and sloped land.

The natural conditions of the Baia piedmont plain support the occurrence and maintenance of excessive underground and surface humidity. The Moldova River meadow and 1.5 km-wide slip-shaped terraces, which are almost parallel with the Moldova River bed and which run north-west and south-east, with small 1-5% slopes, with flat areas and many small depressions, facilitate water stagnation.

In the wet climate of the Moldova River basin, the heavy precipitations fallen over 1-5 consecutive days and the low evapotranspiration rate make up the main excessive humidity cause in low permeability soils (Nitu et al., 1985).

The precipitations fallen throughout the year exhibit an uneven distribution, with considerable amounts fallen in 24 hours or after long-lasting heavy rains, which cause surface overflows that carry along soil particles, thus enhancing bank erosion and hence clogging the channels (Radu, 2009).

Three drying-draining systems (Rotopăneşti-Rădăşeni-Fântâna Mare, Drăgoieşti-Berchişeşti, Bogdăneşti-Baia) and the Băişeşti-Dumbrava irrigation-drying system with a total drained area of 8761 ha, of which 3059 ha of underground draining works, were built between 1978 and 1980 in order to achieve the maximum production capacity of the Moldova River meadow and terraces land.

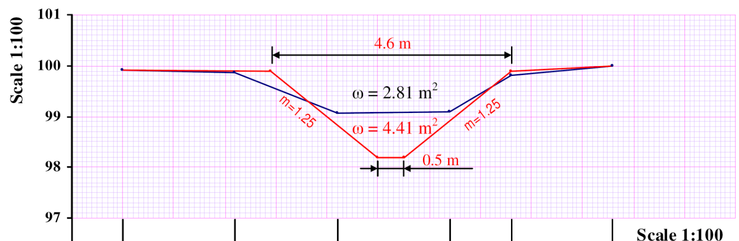
The actual drying channels network includes master collecting channels, secondary collecting channels, sector collecting channels and belt channels. The 1.5-2.0 m deep belt channels were located 20-50 m from the edge of the slopes, their role being to protect the dried-drained surface by catching the overflows from the higher neighboring areas.

The belt channel (CC_1) of the Rotopăneşti-Rădăşeni-Fântâna Mare system catches the water coming from the slope of a north-east 37.50 ha area crest facing Rotopăneşti, which is currently used as grazing ground and which was used as grassland before 1992.

In order to determine the geometric and hydraulic parameters of the belt channel (CC_1), high precision geometric leveling survey measurements were conducted using the radiation and the traversing combined with radiation methods; these measurements enabled us to draft transverse and longitudinal profiles that were compared to the initial profiles of this channel. The leveling survey data were gathered using an average precision Zeiss Ni-030 level and the surveying rod with centimeter marks, and the level differences were determined bases on two levels of the surveying instrument.

RESULTS AND DISCUSSIONS

The upper channels of the drying-draining systems were sized on sections, depending on the slope and outflow of that channel. The section of the CC_1 belt channel that we analyzed, located about 700 m downstream from the end of the channel, initially had the following geometric and constructive parameters: mean depth – 1.73 m, channel bottom width – 0.50 m, channel light – 4.60 m, slope coefficient – 1.25 and channel section – 4.41 m^2 (fig. 1). Relying on the measurements done in 2007, we calculated a mean flow section value of 2.81 m^2, which was about 36% lower than the initial one.

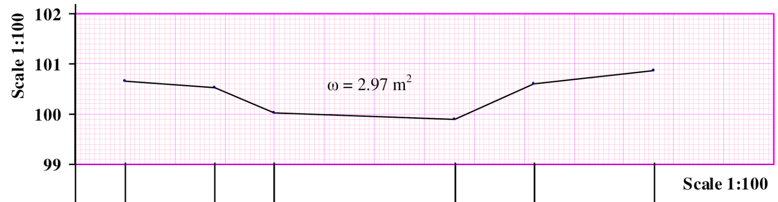


Point number		1		2		3		4		5		6
Land elevation (m)		99.902		99.854		99.075		99.105		99.804		100.000
Level differences (m)			-0.048		-0.779		+0.030		+0.699		+0.196	
Distances (m)	partial		2.2		2.0		2.2		1.2		2.0	
	total	0		2.2		4.2		6.4		7.6		9.6
Slope (%)			2.2		39.0		1.4		58.3		9.8	

Fig. 1 – Cross section in the CC_1 belt channel, 700 m downstream from the end of the channel, on its completion and in 2007

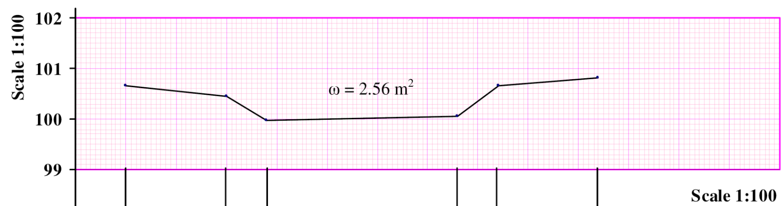
27 years after its completion, the channel exhibited about one meter high clogging (mean deposit rate of 3.7 cm/year) and the channel bottom width was 2.20 m, i.e. 4 times bigger than the initial one. The clogging of the channel on this section is caused both by excessive grazing along the channel and by the animals crossing the channel back and forth in the wrong spots, as this land has been exclusively grazing ground since 1992.

The cross sections performed after 5 years on this section, every 25 m, in the check points P_1, P_2, P_3 and P_4, reveal the uninterrupted clogging of the channel, the layer of deposits being 9 to 15 cm high (fig. 2, 3, 4 and 5). Also, the deposit thickness was found to be about 10 cm higher on the right side of the channel bottom, due to the slit carried along from the left side by the water coming from the higher neighboring areas.



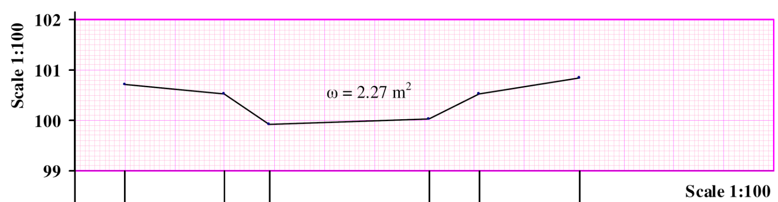
Point number		1	2	3	4	5	6
Land elevation (m)		100.664	100.518	100.038	99.886	100.594	100.874
Level differences (m)		-0.146	-0.48	-0.152	+0.708	+0.280	
Distances (m)	partial	1.8	1.2	3.6	1.6	2.4	
	total	0	1.8	3.0	6.6	8.2	10.6
Slope (%)		8.1	40.0	4.2	44.3	11.7	

Fig. 2 – Cross-section in the CC_1 belt channel, in point P_1



Point number		1	2	3	4	5	6
Land elevation (m)		100.671	100.454	99.970	100.044	100.671	100.822
Level differences (m)		-0.217	-0.48	+0.074	+0.63	+0.151	
Distances (m)	partial	2.0	0.8	3.8	0.8	2.0	
	total	0	2.0	2.8	6.6	7.4	9.4
Slope (%)		10.9	61	1.9	78	7.6	

Fig. 3 – Cross-section in the CC_1 belt channel, in point P_2

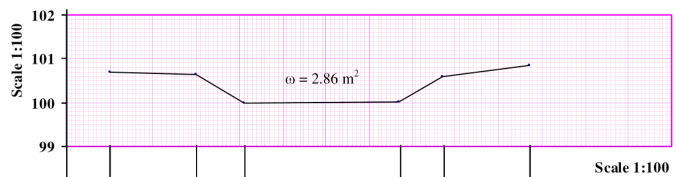


Point number		1	2	3	4	5	6
Land elevation (m)		100.721	100.520	99.925	100.021	100.520	100.830
Level differences (m)		-0.201	-0.59	+0.096	+0.50	+0.310	
Distances (m)	partial	2.0	0.9	3.2	1.0	2.0	
	total	0	2.0	2.9	6.1	7.1	9.1
Slope (%)		10.1	66	3.0	50	15.5	

Fig. 4 – Cross-section in the CC_1 belt channel, in point P_3

The average 12.5 cm thick deposits reveal a mean clogging rate of 2.5 cm/year, which is 1.2 cm/year lower than the one reported over the 27 years duration.

The channel flowing section exhibits values ranging from 2.27 m^2 in point P_3 to 2.97 m^2 in point P_1, the mean channel section on this section being 2.67 m^2, which means a 40% diminution after 32 years of operation. Over the last 5 years of operation, the channel flowing section decreased by 4% as compared to the one measured in 2007, yet the light and width at the bottom of the channel increased considerably. The channel light reaches its maximum 6.4 m value in the checkpoint P_1, which means a 1.00 m increase since 2007 and a 1.80 m increase as compared to the initial value. The maximum value of the channel bottom width is 3.80 m in the section P_2, i.e. 1.60 m higher than in 2007 and 3.30 m higher than the initial value.



Point number		1	2	3	4	5	6
Land elevation (m)		100.698	100.655	100.000	100.008	100.585	100.842
Level differences (m)		-0.043	-0.65	+0.008	+0.58	+0.257	
Distances (m)	partial	2.0	1.1	3.6	1.0	2,0	
	total	0	2.0	3.1	6.7	7.7	9.7
Slope (%)		2.1	60	0.2	58	12.9	

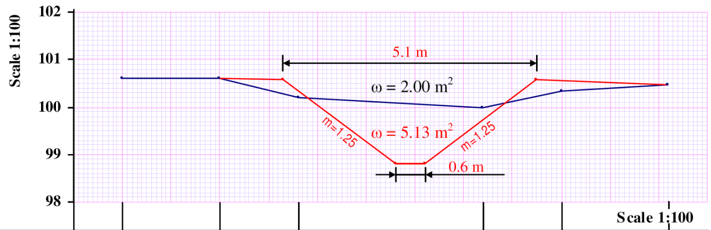
Fig. 5 – Cross-section in the CC_1 belt channel, in point P_4

These changes detected in the geometric and hydraulic parameters of the channel reveal the bank erosion caused by the animals repeatedly crossing the channel back and forth, by the grazing carried out along the channel where the soil is overwatered, as the water stagnates in the channel because of the longitudinal slope decrease and of the hygrophilous vegetation.

We measured a 1.40 m high clogging in the cross-section of the CC_1 belt channel performed 1200 m from the upstream end, in 2007, which determined the increase of the channel bottom width from 0.60 m to 2.30 m and the decrease of the cross-section by 67%, from 5.13 m^2 to 1.71 m^2. These changes and the complete obstructing of a footbridge located 2100 m from the upstream end prevents the transfer of the water coming from the slope into the Şomuzel master collecting channel, which determines the overflow of the collected water and the formation of a pool of about 1.00 ha located about 1500 m from the upstream end. This overflowing water floods the neighboring land, extending excessive humidity, supporting hygrophilous vegetation growth and decreasing grazing ground quality.

The cross section performed, in 2012, 20 m upstream from the pool formed because of overflow also reveals the changes occurred in the geometric and hydraulic parameters of this channel (fig. 6).

The initial geometric and hydraulic parameters in this section were: channel depth – 1.80 m, bottom width – 0.60 m, channel light – 5.10 m, slope coefficient – 1.25 and channel section – 5.13 m^2.



Point number		1		2		3		4		5		6
Land elevation (m)		100.616		100.604		100.192		100.000		100.330		100.477
Level differences (m)			-0.012		-0.412		-0.192		+0.330		+0.147	
Distances (m)	partial		2.0		1.6		3.8		1.6		2.2	
	total	0		2.0		3.6		7.4		9.0		11.2
Slope (%)			0.6		25.8		5.0		20.6		6.7	

Fig. 6 – Cross section in the CC_1 belt channel, 1500 m downstream from the end of the channel, on its completion and in 2012

After 32 years of operation, the measurements reveal a 1.43 m high channel clogging and a 2.00 m^2 flow section, which means a 61% decrease as compared to the initial values. This cross section also reveals a significant increase in the channel bottom width to 3.80 m and in the channel light to 7.00 m. In this case, the alteration of the geometric and hydraulic parameters was also accelerated by the grazing done along the channel and by the animals, especially cattle, crossing it back and forth. The neighboring land is used for cattle grazing during the summer and for sheep grazing the rest of the year.

CONCLUSIONS

1. Intensive grazing and animals, especially cattle, crossing the channel back and forth have led to substantial changes in the geometric and hydraulic parameters of the CC_1 belt channel.

2. The mean clogging rate is 3-4 cm/year in the section under survey and it is due especially to bank erosion caused by animals repeatedly crossing it back and forth.

3. The diminution of the channel flow section by 60% and the complete obstructing of a footbridge have resulted in the overflowing of the collected water, in the disruption of the operation of the draining network, in the extension of the excessive humidity period and in the support of hygrophilous vegetation growth on the areas dried by open channels.

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