CONSEQUENCES OF THE USE OF AREAS DESIGNED FOR DRY-DRAINAGE WORKS, IN THE ROTOPĂNEŞTI-RĂDĂŞENI-FÂNTÂNA MARE SYSTEM, SUCEAVA COUNTY

O. RADU[1]

[1]University of Agricultural Sciences
and Veterinary Medicine of Iaşi;
e-mail opricaradu@yahoo.com

The valorisation of production capacity of farming fields and, especially, of arable lands, was done with time by their design for drying, embankment-regulation, underground drainage, soil erosion control works.

Dry-drainage designs were done for removing the moisture excess from soil surface and upper soil horizons, which resulted from rainfalls, ground water and from surface runoff from higher neighbouring areas.

Working and using dry-drainage systems, especially after 1990, under conditions of private property on land, have resulted in changing the constructive parameters of channel network. The evolution of geometrical and hydraulic elements of channels was highly influenced by the way of usage of designed fields and human factor interference. The irrational grazing and uncontrolled channel crossing by animals when soil is excessively wet determined the acceleration of bank erosion and, implicitly, channel clogging at a mean annual rate of 4-5 cm.

Key words*: moisture excess, dry-drainage system, hydrotechnical constructions, geometrical and hydraulic elements of drying network*

Among the main limitative factors of farming production, which are shown according to local soil-climatic conditions, there are moisture excess, floods, reduced permeability and soil compaction, erosion, slides etc.

Under conditions of the wet climate from Rădăşeni-Fântâna Mare-Baia Depression, abundant rainfalls during 1-5 days, under the regime of a reduced consumption by evapotranspiration, are the main source of moisture excess of heavy permeable soils [1]. The rainfall regime shows an uneven spreading during the year, high amounts being recorded in 24 hours or after long-term rains, determining surface runoff, soil particle removal, intensification of bank erosion and, implicitly, channel clogging.

According to data given by A.N.I.F., in Suceava County there is an area of 44.904 ha with dry works, of which 27.455 ha with drainage works. The network of dry channels has a length of 1875 km, while the underground drainage network made of suction drains and collecting drains has a total length of 11.909 km.

After designing hydro-ameliorative systems, a special importance should be given to their working and behaviour mode, having in view the new conditions created after the passage to land private property.

MATERIAL AND METHOD

The Rotopăneşti-Rădăşeni-Fântâna Mare dry-drainage system is situated on the left side of the Moldova River and includes its meadow and terraces and Şomuzul Băii and Şomuzel affluents. The area of this system is of 5527 ha, of which 1806 ha with underground drainage works and a lengthened shape across the Moldova River, having a mean length of 5 km.

The natural conditions of the Baia piemountain plain favour the appearance and maintenance of moisture excess in soil and at soil surface. The meadow of the Moldova River and terraces under the shape of strips with the mean length of 1.5 km, almost parallel to the bed of the Moldova River, directed from NW to SE, with small slopes comprised between 1 and 5%, with flat regions and many microdepressions, make easier water stagnation.

The network of drainage channels is made of main collecting channels, secondary collecting channels, sector collecting channels and belt channels.

Belt channels were designed at a distance of 20-50 m to the slope base, with depths of 1.5-2.0 m and have the role of protecting the drained area by intercepting soil losses from higher neighbouring areas.

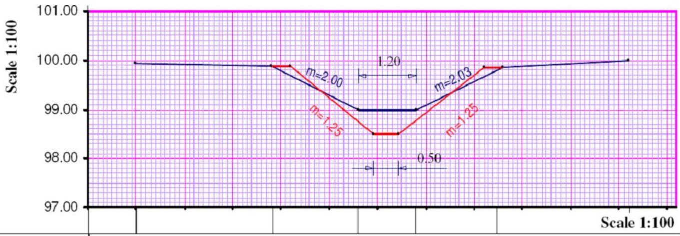
For determining geometrical and hydraulic parameters of the belt channel (CC_1), we made topographic measurements of precision geometric levelling. The observations were made by means of Zeiss Ni-030 and of topographic rods, the level differences being determined on the basis of two horizons of the level instrument.

RESULTS AND DISCUSSIONS

The belt channel (CC_1) of the Rotopăneşti-Rădăşeni-Fântâna Mare System takes all the waters on the slope from north-eastern side with an area of 37.50 ha, used as grassland.

After 30 years of working, in the first section found at 300 m downstream the end of channel CC_1 (*fig. 1*), there is a clogging of 0.48 m that contributed to the increase by 0.70 m of the bottom length, resulting nowadays a value of the coefficient m = 2.00 and an opening of the channel light of 4.83 m.

The section of the channel was initially of 3.15 m^2 and today, it is of 2.68 m^2, causing a diminution of 14%.

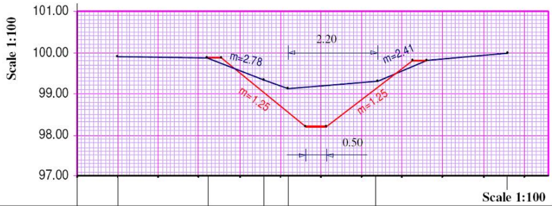


Point number		1		2		3		4		5		6
Land elevation (m)		99.937		99.880		98.981		98.981		99.868		100.00
Level differences (m)			-0.057		-0.899		0		0.887		0.132	
Distances (m)	partial		2.8		1.8		1.2		1.8		2.6	
	total	0.0		2.8		4.6		5.8		7.6		10.2
Land slope %			2.0		49.9		0.0		49.3		5.1	

Figure 1 **Transversal section I through the belt channel (CC_1)**

In the second section (*fig. 2*), situated at 400 m downstream the first section, the belt channel (CC_1) had the following geometrical and constructive elements: mean depth 1.69 m, bottom length b = 0.50 m and slope coefficient m = 1.25.

During the working period, the channel was clogged with one meter, the bottom length reaching 2.20 m, four times greater than the initial one, while the slope coefficient increased at 2.78 on the upstream side and at 2.41 on the downstream side.



Point number		1		2		3		4		5		6		7
Land elevation (m)		99.902		99.854		99.333		99.134		99.307		99.804		100.000
Level differences (m)			-0.048		-0.521		-0.199		0.173		0.497		0.196	
Distances (m)	partial		2.2		1.4		0.6		2.2		1.2		2.0	
	total	0.0		2.2		3.6		4.2		6.4		7.6		9.6
Land slope %			2.2		37.2		33.2		7.9		41.4		9.8	

Figure 2 **Transversal section II through the belt channel (CC_1)**

The analysis of channel discharge section shows that initially it had the value of 4.41 m^2, while today, it is of 2.31 m^2, which means a diminution of about 50%. Channel clogging with almost one meter on this section was caused by excessive grazing on the channel section, the area being exclusively used as grassland and by repeated channel crossing by animals.

Figure 3 shows the longitudinal slope of the belt channel CC_1 upstream the second section. Bank erosion and clogging of channel bottom have caused the change of the longitudinal slope, being found slopes of water discharge of 0.51%

on the first section of 25 m and of 0.34% on the third section and two counter-slopes on the second and the fourth sections, with values of 0.19% and, respectively, 0.09%.

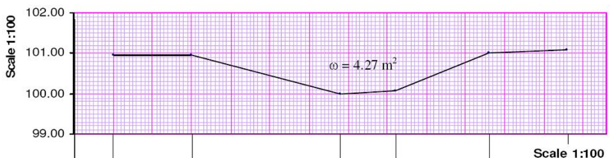
Point number		P_1	P_2	P_3	P_4	P_5 (Sect. II)
Bank elevation (m)		101.126	101.082	100.913	100.668	100.742
Elevation of channel bottom (m)		100.165	100.037	100.085	100.000	100.022
Level differences of channel bottom (m)		-0.128	+0.048	-0.085	+0.022	
		-0.143				
Distances (m)	partial	25.0	25.0	25.0	25.0	
	total	0	25.0	50.0	75.0	100.0
Slope of channel bottom (%)		0.51	0.19	0.34	0.09	
		0.14				

Figure 3 **Longitudinal section P_1-P_5 through the belt channel (CC_1)**

Due to these counter-slopes, water is no longer transported totally and remains for a longer period, causing the appearance of hygrophilous vegetation and the acceleration of clogging. On the analysed profile, we noticed the diminution of the longitudinal slope caused by channel bottom clogging until the value of 0.14%.

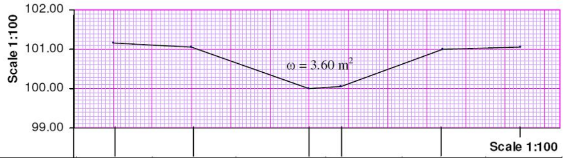
Sizing of this belt channel was done on sections, according to slope and collected flow that depends on the area and specific flow.

If on the studied section, the initial channel section had the value of 4.41 m^2, we found a higher diminution in the transportation capacity as they advance downstream, because of channel bottom clogging. Thus, the area of the transversal section of the belt channel CC_1 decreases on the studied section every 25 m (*fig. 4, 5, 6 and 7*), from the value of 4.27 m^2 in point P_1 to the value of 2.31 m^2 in point P_5 (second section). Analysing the channel discharge sections on the studied section, we found a mean diminution in the transversal section by 30%.



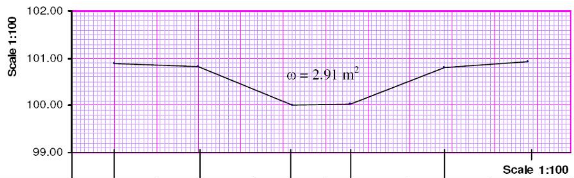
Point number		1	2	3	4	5	6
Land elevation (m)		100.960	100.961	100.000	100.077	101.012	101.099
Level differences (m)		+0.001	-0.961	+0.077	+0.935	+0.087	
Distances (m)	partial	2.0	3.8	1.4	2.4	2.0	
	total	0	2.0	5.8	7.2	9.6	11.6
Land slope (%)		0.1	25.3	5.5	39.0	4.4	

Figure 4 **Section through the belt channel (CC_1), in point P_1**



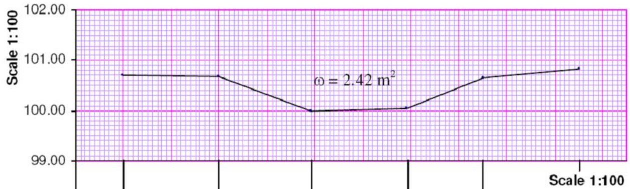
Point number	1		2		3		4		5		6
Land elevation (m)	101.047		101.045		100.000		100.042		100.999		101.044
Level differences (m)		-0.102		-1.045		0.042		+0.957		+0.045	
Distances (m) partial		2.0		3.0		0.8		2.6		2.0	
Distances (m) total	0		2.0		5.0		5.8		8.4		10.4
Land slope (%)		5.1		34.8		5.7		36.8		2.3	

Figure 5 **Section through the belt channel (CC_1), in point P_2**



Point number	1		2		3		4		5		6
Land elevation (m)	100.885		100.828		100.000		100.022		100.810		100.922
Level differences (m)		-0.057		-0.828		+0.022		+0.788		+0.112	
Distances (m) partial		2.0		2.2		1.4		2.2		2.0	
Distances (m) total	0		2.0		4.2		5.6		7.8		9.8
Land slope (%)		2.9		37.6		1.6		35.8		5.6	

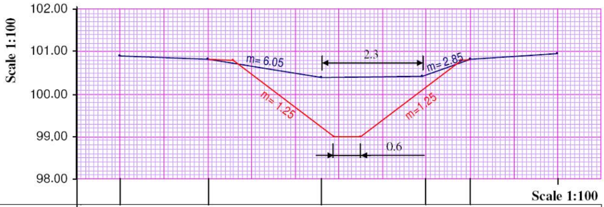
Figure 6 **Section through the belt channel (CC_1), in point P_3**



Point number	1		2		3		4		5		6
Land elevation (m)	100.716		100.668		100.000		100.040		100.663		100.836
Level differences (m)		-0.048		-0.668		+0.040		+0.623		+0.173	
Distances (m) partial		2.0		1.9		2.0		1.6		2.0	
Distances (m) total	0		2.0		3.9		5.9		7.5		9.5
Land slope (%)		2.4		35.2		2.0		38.9		8.7	

Figure 7 **Section through the belt channel (CC_1), in point P_4**

In the third section (*fig. 8*), situated at 1200 m of the upstream end, we found a clogging of 1.40 m, which determined the increase in the channel bottom length from 0.60 m to 2.30 m and the decrease in the transversal section by 67%, from 5.13 m^2 to 1.71 m^2.



Point number		1		2		3		4		5		6
Land elevation (m)		100.897		100.812		100.382		100.421		100.807		100.963
Diferenţe de nivel (m)			-0.085		-0.430		+0.039		0.386		+0.156	
Distances (m)	partial		2.0		2.6		2.3		1.1		2.0	
	total	0		2.0		4.6		6.9		8.0		10.0
Land slope (%)			4.3		16.5		1.7		35.1		7.8	

Figure 8 **Transversal section III through the belt channel (CC_1)**

In the section comprised between 700 and 2100 m, the channel was clogged at a percent of 70-80 % and the capacity of taking over affluent flows diminished, while in the upstream, a water area of 1.00 ha appeared, because the bridge was totally obturated (*picture 1*) and there is no longer ensured the transfer of flows from slope runoff to the main Şomuzel collecting channel.

On a route of 850 m, upstream the obturated bridge, before the confluence of CC_1 channel to Şomuzel collector, the neighbouring areas are used as arable land and channel clogging is more reduced; instead, we found the hygrophilous vegetation that contributes to the diminution of discharges on this channel (*picture 2*).

For avoiding the acceleration of clogging in this section, too, removal of hygrophilous vegetation and recovery of channel section are required.

Upstream sector of the protection channel, where dry areas are used as grassland and channel crossing by animals is done both in the periods with few rainfalls but also when the field is overwet, thus determining high degradation and modification of the discharge section, there are necessary unclogging and recovery of channel section, designing bridges for animals, in order not to allow the moisture excess on low areas and the disturbance of downstream dry-drainage works, because of floods in the periods with abundant rainfall.

Figure 1

Figure 2

CONCLUSIONS

1. On the lands used as grassland, where the area covered with grass of channel slopes is highly degraded, while on some sections it lacks, because of excessive grazing and uncontrolled channel crossing by animals, the mean clogging rate is of 4-5 cm/year, which is double compared to the channels on the arable usage areas.

2. Bank erosion and channel clogging determine the modification of longitudinal slope, showing varied values, sometimes achieving counter-slopes that favour water stagnation and sedimentation of alluviums, increasing the mean rate of clogging and accelerating their disturbance.

3. In dry-drainage systems, the lowest deficiency that appeared at a component part must be immediately repaired, in order not to lead with time to the acceleration of degradation.

BIBLIOGRAPHY

1. Nitu, T. şi colab., 1985 – *Influenţa lucrărilor de desecare-drenaj asupra apelor freatice şi suprafreatice din Câmpia piemontană Rădăşeni-Fântâna Mare-Baia, mijloc de creştere a producţiei agricole la hectar.* Primul Simpozion de Îmbunătăţiri Funciare, Bucureşti.
2. Radu, O., 2007 – *Evolution of the geometric and hydraulic parameters of the channels of the Rotopăneşti-Rădăşeni-Fântâna Mare drying-draining system of Suceava county, after 27 years of operation.* Lucrări Ştiinţifice, seria Horticultură, U.Ş.A.M.V. Iaşi, anul L, vol. 1 (50). Editura ,,Ion Ionescu de la Brad” Iaşi.