IMPACT OF THE ANTHROPIC FACTOR AND CLASS OF USE ON THE DRYING-DRAINAGE NETWORK OF THE ROTOPĂNEŞTI-RĂDĂŞENI-FÂNTÂNA MARE SYSTEM IN SUCEAVA COUNTY

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Abstract

The drainage-desiccation developments on the Moldova river meadows in Suceava county were built for the purpose of eliminating the excess water from both the terrain's surface and from its higher levels, origination from rainfall, ground water, from the surface flow and from the surrounding higher ground. After constructing the hydro-ameliorative improvements, special attention must be given to the operation method and to its behavior over time. By operating and using the draining network, mainly shores erosion and bottom of canal clogging occurs, that may be caused by both natural and human factors. Waste disposal, vegetal waste and various packaging materials thrown into the canal, generally beside bridges, speed the process of clogging and shuttering, causing, in upriver, the decommissioning of canals, the overflow of waters accumulated during heavy rain, the flooding of nearby areas, and the malfunction of the desiccating- drainage network. Also, the shore erosion and canal clogging is largely influenced by the lands serviced by the canal category of use. The shore erosion and the canal clogging is greater upon the areas used as pastures, due to a low degree of embankment grassing, to total lack of grassing on some sections, caused by irrational grazing and by the repeated and uncontrolled animal crossing. The canals of the arable land keep their initial geometrical shape, but the failure to perform maintenance works and to grow hygrophilic vegetation and shrubs slows down the flowing of the water and supports alluvial sediment formation and clogging.

Key words: humidity in excess, canal clogging, geometric and hydraulic components of the drainage network

The rational use, protection, improvement, and conservation of the soil makes a constant preoccupation of contemporary engineering, successful development relying completely on that. The natural resources of the soil, together with the other components of the soil, are either directly or circumstantially involved in every aspect of development, exerting an impact over each country's economic strength, at every level of development.

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. These restrictions are caused by either natural factors, or human agricultural and industrial operations, that may act negatively in a synergic fashion.

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 T. et al., 1985).

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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 O., 2009).

The desiccation-drainage system Rotopănești-Rădășeni-Fântâna Mare (*fig. 1*), is located on the left riverbank of Moldova river, and encompasses both its meadow and terraces, as well as its tributaries, Șomuzul Băii and Șomuzel. The first improvement works carried out between 1959 and 1960 included the regularization of Șomuzul Băii and Șomuzel creeks, as well as the draining of 1697 hectares.

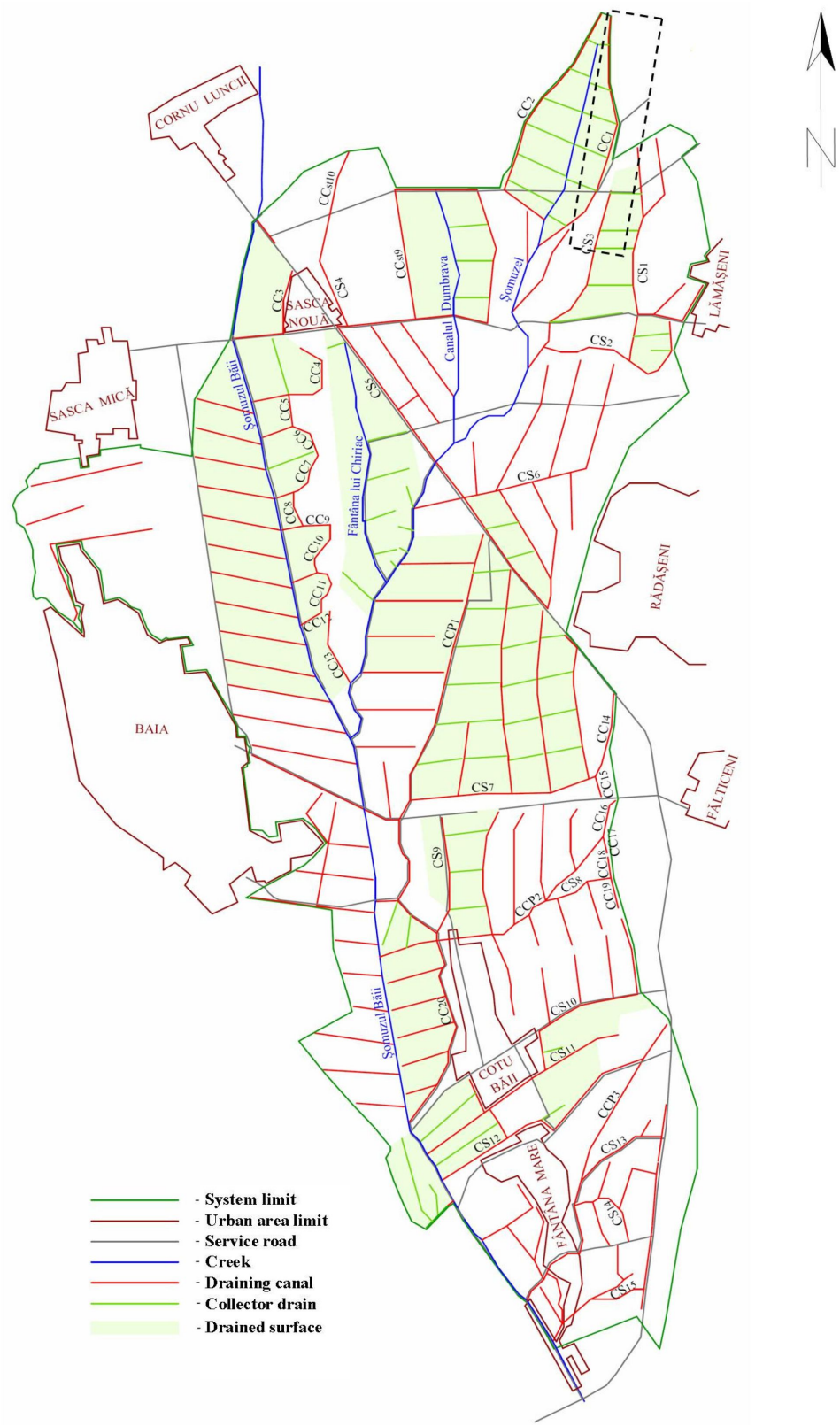


Figure 1 **Drying-drainage systems from Rotopăneşti-Rădăşeni-Fântâna Mare**

For the purpose of improving the process of water excess disposal, the latter deriving from both precipitation and ground water, completion works were carried out throughout the period 1978-1980, as well as new work of desiccation-drainage, and reshaping main collector canals. For that purpose, drainage works were undertaken on a 5527 ha surface, 1806 ha out of which were fitted with underground drainage systems. Drainage works were objectified in a systematic drain and exhaust canals network, spaced 300-400 m apart, of a total length of 168.10 km, including a regularization-desiccation complex.

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 present paperwork is studying the ring canal, (CC_1), of the Rotopăneşti-Rădăşeni-Fântâna Mare, Suceava county, system, of some 3000 m overall length, canal that is collecting the waters originating from a North-East slope, on the side of the village Rotopăneşti, of an approximately 37.50 ha surface area, whose present use is pasture, some 23.00 ha out of which being used as either agricultural land or hayfield.

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. The leveling survey data were gathered using an average precision Zeiss Ni-025 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

For ensuring circulation on the belt channel there were provided two tubular culverts made from simple concrete, with a nominal diameter of 1.00 m, one located on section serving the pasture and another on the separation line between pasture and arable land.

The culvert placed at 2100 m from the upstream of belt channel CC_1, on the separation line between pasture and arable land, is blocked due to improper operation of this section of the area surrounding the channel, which has since 1992 on it pasture, it has not been maintained and different plant debris, waste and packaging have been stored around it (*fig. 2*).

Figure 2 **Blocked culvert**

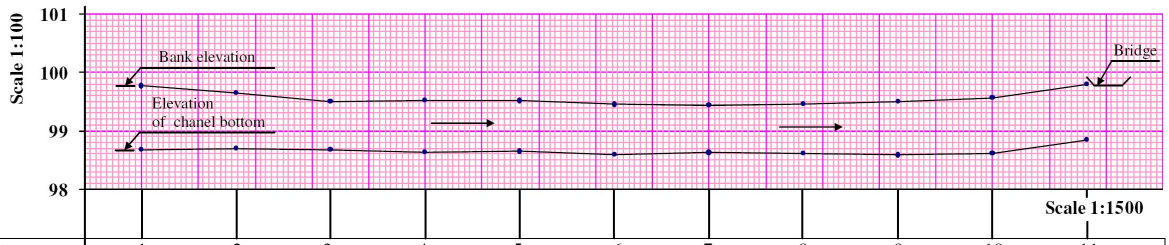
On the longitudinal profile executed on the length of 250 m upstream of the blocked culvert (*fig. 3*), there is a change of longitudinal slopes of the belt channel and counter slopes on sections of 25.00 m with values between 0.05% and 0.94% have been made. The highest counter slope of 0.94% is on the section of 25.00 m, near the blocked culvert, which indicates the storage of waste near the culvert and also silt depositing generated by water collected in the channel in the period when the culvert provided the transit of water to the main collecting channel Şomuzel.

There is also a change of the longitudinal slope of the channel in the section executed on the length of 250 m, downstream the totally clogged culvert (*fig. 4*), where the surface served by this section is used as arable land. As plants have not been mowed on the channel section, which caused water stagnation, and this favored the appearance of rush plants and shrubs and the clogging of the sequential channel, counter slopes have been made on sections of 25.00 m, with values between 0.03% and 0.28%.

On first 25.00 m, near culvert, the higher value of longitudinal slope of the channel of 0.75% has been recorded, this reflecting the depositing of plant debris and waste in channels and, especially, near culverts.

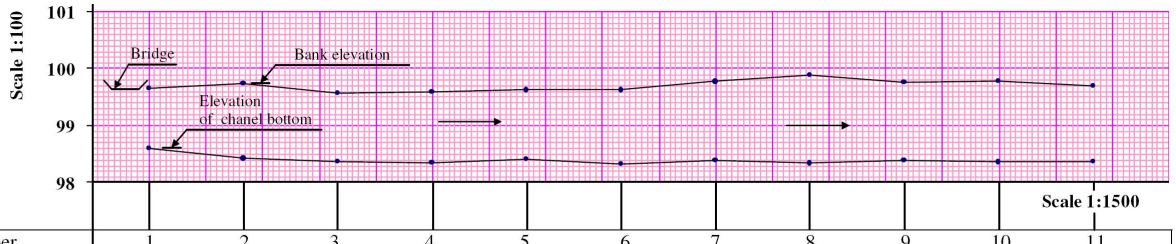
On the next 225 m, there is a longitudinal slope of 0.02%, which shows channel clogging

also in the section which serves pasture and arable land. Totally on the section, there is a slope of water flow of 0.10%, which could provide the transit of water to collecting channel Şomuzel, if periodically such maintenance would have been made.



Point number		1	2	3	4	5	6	7	8	9	10	11
Bank elevation (m)		99.770	99.647	99.508	99.522	99.515	99.452	99.438	99.466	99.503	99.570	99.800
Elevation of chanel bottom (m)		98.677	98.690	98.672	98.630	98.646	98.592	98.622	98.610	98.578	98.611	98.845
Level differences (m)			+0.013	-0.018	-0.042	+0.016	-0.054	+0.030	-0.012	-0.032	+0.033	+0.234
			-0.066									+0.234
			+0.168									
Distances (m)	partial		25	25	25	25	25	25	25	25	25	25
	total	0	25	50	75	100	125	150	175	200	225	250
Slope of chanel bottom (%)			0.05	0.07	0.17	0.06	0.22	0.12	0.05	0.13	0.13	0.94
			0.03									0.94
			0.07									

Figure 3 **Longitudinal section on the CC_1 canal, upstream of the culvert**

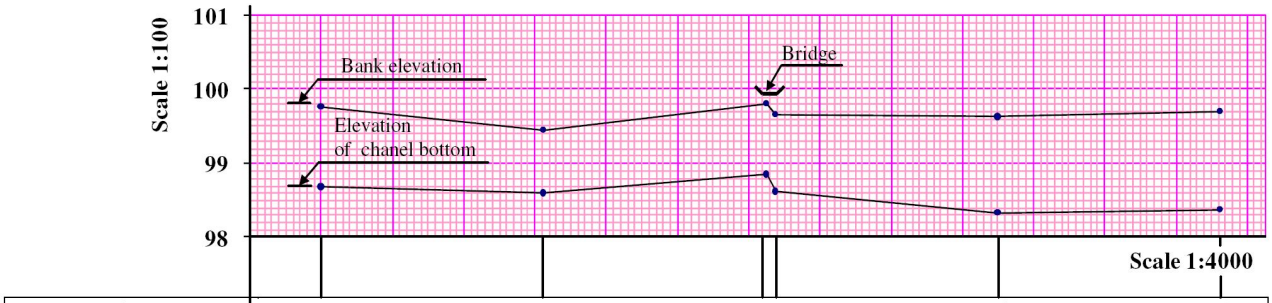


Point number		1	2	3	4	5	6	7	8	9	10	11
Bank elevation (m)		99.658	99.740	99.569	99.590	99.631	99.627	99.779	99.893	99.772	99.787	99.699
Elevation of chanel bottom (m)		98.610	98.422	98.372	98.345	98.409	98.327	98.397	98.337	98.400	98.362	98.370
Level differences (m)			-0.188	-0.050	-0.027	+0.064	-0.082	+0.070	-0.060	+0.063	-0.038	+0.008
			-0.188	-0.052								
			-0.240									
Distances (m)	partial		25	25	25	25	25	25	25	25	25	25
	total	0	25	50	75	100	125	150	175	200	225	250
Pantă fund canal (%)			0.75	0.20	0.11	0.26	0.33	0.28	0.24	0.25	0.15	0.03
			0.75	0.02								
			0.10									

Figure 4 **Longitudinal section on the CC_1 canal, downstream of the culvert**

Channel clogging produced by the depositing of waste near culvert comes also from the longitudinal profile executed upstream and downstream the blocked culvert. (*fig. 5*). By analyzing Figure 5, we see that the elevation of channel bottom upstream the culvert is approximately 23.00 cm higher than downstream. If the section of the tube upstream is totally clogged, the elevation of the tube being less than approximately 11.00 cm relative to channel bottom, the section of the tube is not totally clogged downstream, the elevation of the tube being higher by approximately 8.00 cm relative to channel bottom. Although, upstream the culvert, there is a counter slope of 0.07%, totally on the section of 500 m there is maintained a longitudinal slope of 0.06%, which could provide the transfer of water collected by channel on the section serving pasture to main collecting channel Şomuzel, if the blocked culvert would not function as a dam.

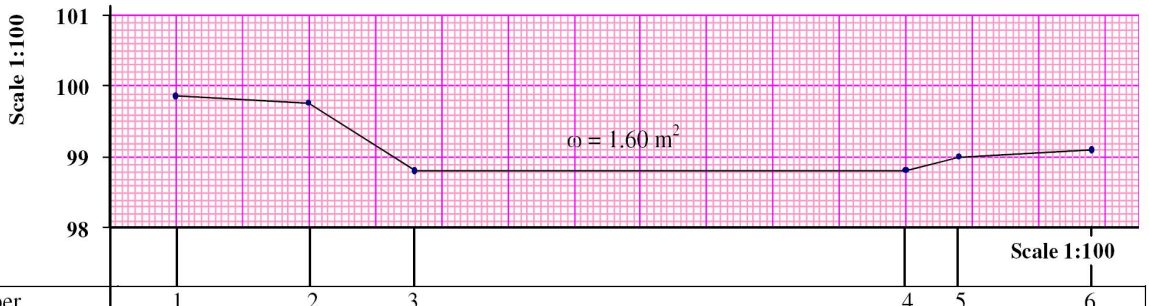
Pasture on the channel section and the repeated crossing by animals, especially of cattle, the neighboring surfaces being used in warm season for cattle pasture and in the rest of the year of sheep, determined the erosion of banks and channel clogging, changing the flow section of the channel. On the belt channel section of 250 m, which crosses pasture, the flow section of channel placed at a distance of 25.00 m, the values are between 1.60 m^2 and 3.89 m^2.



Point number		1	2	3	4	5	6
Bank elevation (m)		99.770	99.452	99.800	99.658	99.627	99.699
Elevation of chanel bottom (m)		98.677	98.592	98.845	98.610	98.327	98.370
Level differences (m)		-0.085	+0.253	-0.235	-0.283	+0.043	
		+0.168			-0.240		
		-0.307					
Distances (m)	partial	125	125	5	125	125	
	total	0	125	250	255	380	505
Slope of chanel bottom (%)		0.07	0.20	4.7	0.23	0.03	
		0.07				0.10	
		0.06					

Figure 5 **Longitudinal section CC1 channel upstream and downstream of the culvert blocked**

Big difference between values of flowing section (2.29 m^2), confirm again the erosion of banks and channel clogging due to repeated and uncontrolled crossing by of the section by animals, here is also an area where animals turn around. The small value of the flow section is of 1.60 m^2 (*fig. 6*), it has been recorded at 250 m upstream the blocked culvert, near the place where during heavy rainfall and snowmelt, the water collected by the belt channel flows forming a body of water.



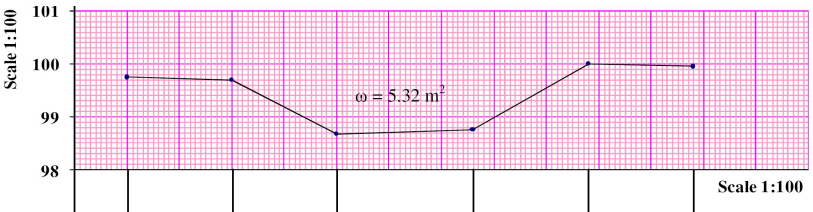
Point number		1	2	3		4	5	6
Land elevation (m)		99.863	99.770	98.806		98.820	99.006	99.098
Level differences (m)		-0.093	-0.964	+0.014		0.19	+0.092	
Distances (m)	partial	2.0	1.6	7.4		0.8	2.0	
	total	0	2.0	3.6		11.0	11.8	13.8
Slope (%)		4.65	60.25	0.19		23.3	4.60	

Figure 6 **Transversal section through CC_1 canal 250 m upstream from the blocked culvert**

Downstream the blocked culvert, the values of the flow section of the channel are higher than upstream and grow, in general, towards downstream. If the value of section near the culvert is of 3.75 m^2, higher by approximately 1.00 m^2 relative to upstream the culvert, of 2.84 m^2, it grows at 250 m downstream to 5.32 m^2 (*fig. 7*).

On the belt channel section which serves pasture and arable land, the channel maintains its initial geometrical form, but the fact that maintenance works have not been done on time and the appearance of hydrophilic plants and shrubs, favor the slowdown of the speed of water flow, the alluvial sedimentation and clogging.

Also, hydrophilic plants represented by rush (*Typha latifolia*), grows the rate of clogging due to rich plant mass and high content of cellulose (*fig. 8*).



Point number		1	2	3	4	5	6
Land elevation (m)		99.748	99.699	98.684	98.758	100.004	99.951
Level differences (m)			-0.049	-1.015	+0.074	+1.246	-0.053
Distances (m)	partial		2.0	2.0	2.6	2.2	2.0
	total	0	2.0	4.0	6.6	8.8	10.8
Slope (%)			2.45	50.75	2.85	56.64	2.65

Figure 7 **Transversal section through the CC_1 canal, downstream, 250 m from the clogged culvert**

Figure 8 **Rush plants on the channel**

CONCLUSIONS

On the desiccated-drained areas utilized as pastures, the bank erosion and canal clogging are particularly high, due to the low degree of grassing of the slopes, virtually absent on some sectors, caused by irrational grazing and by the repeated and uncontrolled animal crossing, on both the times of draught and times when the soil is over-humidified. Throughout the periods of severe draught, when vegetation is scarce, excessive grazing boosts the vegetation subsiding, through the destruction of less developed plants. Also, the grazing, especially that of cattle, at the time when the soil is over-humidified, causes the destruction of vegetation cover through both the sinking and asphyxiation of plants.

The canals of the arable land keep their initial geometrical shape, but the failure to perform maintenance works and to grow hygrophilic vegetation and shrubs slows down the flowing of the water and supports alluvial sediment formation and clogging.

Canal clogging and the appearance of hydrophilic vegetation cause the longitudinal slope to alter, presenting different values along canals, oftentimes creating counter-slopes which cause the water to stagnate and the depositing of silt, heightening the average canal clogging rate and accelerating their decommissioning.

The depositing of household residue, of vegetal residue, and of various packaging materials into the canals, generally nearby culverts accelerates the process of clogging and blocking.

The decrease in the canal transit section by some 60% compared to the initial value and the obstruction in some culvert flow section causes-throughout the times of heavy rainfall- water overflow and the flooding of nearby areas, a prolongation in the phenomenon of humidity in excess, a reduction in the quality of pastures by water plants reinstatement, and a boost in the downstream canals bank erosion, that play the role of overflow water collectors.

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