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INTERRELATION OF IRRIGATION AND DRAINAGE, ŢEBA-TIMIŞAŢ SYSTEM, TIMIŞ COUNTY

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Abstract: Irrigation is necessary in a dry climate, in which natural rainfall does not meet plant water requirements. The total concentration and the concentration of the more important constituents must be determined to judge the quality of the water provided from surface water or from groundwater. The soils information must be given in as quantitative and exact a manner as possible. The following soil data will be required: hydromorphic soil properties, permeability for water, moisture storage in the soil, data on salinity and alkalinity, soil mapping units, external factors. Gleysoils and Salsodicsoils cover about 30 % from the surface. The objective of the scientific research was to establish the possibility to re – use of drainage water to irrigate areas adjacent to the region where it originates from. The area is highly unbalanced due to the numerous meanders, old watercourse and river branch of Timiş, Timişul Mort, Bega veche. The majority of soil types present low salinization but the alkalization process is strong and the salsodic subtypes are dominantly. If we consider the area with sodic / salinic soils then the surface reaches 30 % from the territory. The water from the draining canals can be used for irrigation because the quality of this water is very good, or even excellently. In area with sufficiently water provided from the draining canals, reclamation of sodic soils can be obtained by leaching the soil with successive dilutions of high – salt water containing divalent cations.

Keywords: hydric soils, water quality, salts, irrigation, drainage

1. INTRODUCTION

Long before the advent of agriculture, humans began to affect the land and its biota in ways that tended to destabilize natural ecosystems. An example of soil abuse can be seen in the rainfed parts of Mediterranian region, where the land has been denuded. Because all irrigation waters contain salts, the salts tend to accumulate in the soil and groundwater. As the undrained water table rose, it took the salts back into the soil [1] and then declined.

Control of water resources permits the establishment of highly productive agricultural practices in areas where rainfall would be inadequate or unreliable. On the other hand, there are numerous references to the practice of irrigation from wells, tanks, canals and directly from the rivers, but also there also exist vestiges of many canals, tanks and aqueducts which failed, fell into disrepair and disuse after operating for a short time [2]

Irrigation is necessary in a dry climate, in which natural rainfall does not meet plant water requirements during all or part of the year. Interest in quality of irrigation water dates back a comparatively short time. The total concentration and the concentration of the more important constituents must be determined to judge the quality of the water provided from surface water or from groundwater.

Plant roots require air as well as water. If conditions of climate, topography, soil permeability, and irrigation practice combine to cause water – logging of the plant root zone for extended periods, loss of yield or even crop failure are likely to follow. The aim of drainage is to remove the unwanted water in order that soil structure and aeration are maintained and access to the field for cultivation and harvesting is assured [3]

As a result of increasing human activities, much wetland has been drained with a resultant lowering of the ground water table and a consequent increase in the rates of decomposition of organic matter and soil subsidence. Paddy cultivation is on peat soil but also fluvial soil, stagnic soil or gley soil, on about 150 billion ha in the world [4]

For a proper diagnosis of drainage problems, as for the planning and design of irrigation and drainage projects, one must have the appropriate soils information. The required soil data have to be of physical and chemical nature to relate to the hydrological problems. The soils information must be given in as quantitative and exact a manner as possible [5].

The following soil data will be required: hydromorphic soil properties, permeability for water, moisture storage in the soil, data on salinity and alkalinity, soil mapping units, external factors.

The main aspect of drainage is that its discharge capacity should correspond with the quantity of irrigation water supplied in excess of the crop requirements. The subsurface discharge must be related with a minimum depth to the groundwater table, or a maximum rise of groundwater table above the drain

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The area around the territories situated in the low plain Timiş-Bega, respectively Ţeba-Timişaţ system, has an extremely various soil cover because of environmental conditions, especially phreatic water – bearing stratum which is rising at 0.5 – 3.0 m depth and mineralized.

Gleysoils and Salsodicsoils cover about 30 % from the surface [7]

2. MATERIALS AND METHODS

The thesis is based on some surveys effectuated during about ten years in the low plain Bega – Timiş, at 1:10000 scale. It has been used some hydrotechnical data from the Ţeba – Timişaţ drainage system.

In order to determine the soil and drainaged water content were yielded and analyzed soil and water samples.

The objective of the scientific research was to establish the possibility to re – use of drainage water to irrigate areas adjacent to the region where it originates from.

In deciding whether to re – use is acceptable, the first question is the salts concentration and the presence of Ca^{2+} and Mg^{2+} in the soil solution [8]

3. RESULTS AND DISCUSSIONS

Subsidence plain Bega – Timiş is part of Pannonic Depression composed at the surface of gravels, sands and clays.

The tectonic faults present in the crystalline fundament (at about 2000 m depth) determine a continuous subsidence of the area with 0.5 mm / year in Timişoara town, and 1 – 1.5 mm / year at Sânnicolau Mare town (figure 1)

Figure 1. Map of the territory Bega – Timis

The area is highly unbalanced due to the numerous meanders, old watercourse and river branch of Timiş, Timişul Mort, Bega veche, which have been recrossed by draining canals, poorly maintained and partially clogged.

Another characteristic of the low plain Timiş – Bega is the high level of the groundwater and the dominance of the isophreatic with values of 1 – 2 m.

The territory includes draining arrangements on a surface of 28,063 ha separated in three compartments:

- Cruceni, 16,011 ha divided in 9 draining units with areas of 576 ha up to 4,126 ha;
- Otelec, 7,144 ha, divided in 2 draining units;
- Diniaş, with 9,034 ha, divided in 2 draining units.

Table 1 Groundwater analysis

Forage	pH	EC µS/cm	Total residue mg/l	Ions, mg/l					PO_4^-	NO_3^-
				Na^+	Ca^{2+}	Mg^{2+}	Cl^-	HCO_3^-	mg/l	
Uivar	7.9	962	635	85	13	39	57	505	0.40	1.00
Uivar, domestic well	7.3	2236	1476	425	464	135	397	751	0.50	200
Foeni, domestic well	7.6	1300	858	83	159	95	216	559	0.04	150
Toager	7.0	520	343	55	89	30	46	418	0.48	2.0
Toager, domestic well	7.2	1785	425	199	346	365	911	107.5	0.04	100
Giulvăz	7.2	2072	1320	266	276	131	364	430	-	-

Conditioned by an exudative hydric regime, with ascendent phreatic waters rich in carbonates, and Na – Mg bicarbonates which after evaporation at the soil surface enrich the soil profile in salts, salinization of a few soil types occurs.

Thereby, in the Foeni territory moderate – strong salinization appear such soil types on 369 ha at Foeni, 168 ha at Uivar and at Cruceni, Giulvaz, Dinias

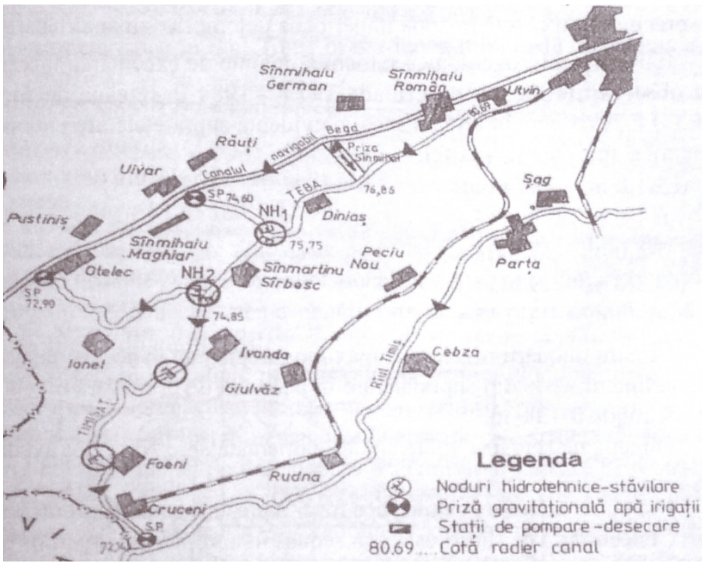

Figure 2. Drainage system Țeba - Timișat

The results obtained by determining the physical properties of investigated mollic gleysols, semihistic, are shown in tables

Mollic Vertic Gleysols, (Gleiosol cernic, pelic), Foeni - Profile description

0-21 cm (Apy) - mollic horizon; dark greish brown, mottled clay loam with moderate subangular blocky structure;

21-38 cm (AzGr) - mollic horizon; dark greish brown with bluish mottled clay loam with strong subangular blocky structure; gleyic properties.

38-80 cm (ACzGr) - dark grey bluish mottled clay loam with fine angular blocky structure; gleyc properties.

80-120 cm (CnGr) – bluish-grey mottled clay loam.

Table 2 Analytical data

	Apg	AzGr	ACzGr	CnGr
Clay	38.1	40.7	39.2	40.4
Silt	28.0	27.9	28.7	25.5
Bulk density	1.55	1.60	1.58	-
Field capacity	24.48	23.23	23.0	-
Ksat mm/h	0.65	0.45	0.50	-
pH	7.54	8.10	8.16	8.25
Humus, %	2.82	2.04	1.38	-
Pmobile, ppm	128.34	14.90	7.91	-
Kmobile, ppm	107	96	92	-

Mollic Gleysols, semihistic (Gleiosol cernic, semihistic), Cruceni - Profile description

0-27 cm (Amg) - mollic horizon; brown blackish, granular structure, mottled clay loam

27-55 cm (AmGr) - mollic horizon; dark brown mottled clay loam with moderate subangular blocky structure; gleyc properties.

55-68 cm (AcGr) - dark grey bluish, mottled clay loam with moderate subangular blocky structure; gleyc properties.

68-150 cm (CnGr) - grey mottled clay loam.

Table 3 Analytical data

	Amg	AGr	ACGr	CnGr
Clay	33.7	40.6	35.4	35.3
Silt	24.8	25.7	21.0	21.3
Bulk density	1.20	1.35	1.48	1.44
Field capacity	25.50	24.24	23.16	22.54
Ksat mm/h	5	0.80	1.50	0.65
pH	6.05	7.17	7.67	7.39
Humus, %	4.32	2.58	1.98	-
Pmobile, ppm	20.8	3.79	1.65	-
Kmobile, ppm	147	114	103	-
BSP	77.92	83.60	85.75	-
CECs	26.59	23.55	21.18	-

Verti – gleyic Cambisols (Pelosol gleic), Foeni – Profile description

0-34 cm (Az) – vertic horizon, - dark brown grayish, loamy clay with moderate subangular blocky structure;

34-50 cm (AzGo) – pellic horizon, dark brown bluish loamy clay, mottled with angular blocky structure;

50-100 cm (CzGo) – grey mottled loamy clay;

100-145 (CGr) - loam

Table 4 Analytical data

	Az	AzGo	CzGo	CGr
Clay	48.0	49.5	43.1	22.8
Silt	22.6	22.0	26.0	24.9
Bulk density	1.41	1.48	1.7	-
Field capacity	26	25	23.8	-
Ksat mm/h	0.80	0.55	0.75	-
pH	6.50	7.47	7.89	7.83
Humus, %	2.28	1.38	-	-
Pmobile, ppm	3.84	1.92	-	-
Kmobile, ppm	110	103	-	-
BSP	76.44	82.37	-	-
CECs	28.45	28.65	-	-

The majority of soil types present low salinization but the alkalization process is strong and the salsodic subtypes are dominantly. For example, in Uivar – Chernozems salsodic covers 1161 ha, Vertisols salsodic – 3167 ha, chernozems alkalic 2232 ha, Vertisols alkalic – 856 ha, Fluvisols alkalic – 134 ha.

In the low plain Bega-Timiș, salsodic Soils covers about 10% from the total surface, but adding the soil complexes with Salinic Solonetz results over 19 % from the surface.

If we consider the area with sodic / salinic soils then the surface reaches 30 % from the territory. The presence of these soil types with low level of fertility is explained by the existence of the bottom of soil profile of isolated layers of pedophreatic water, located on lenticular clay layers. It is obvious that the process of salinization – alkalization by the phreatic water is dominant and also the soils are gleyic.

Reclamation of salt- affected soils needs water for leaching the soluble salts from soil profile. The water from the draining canals can be used for irrigation because the quality of this water is very good, or even excellently.

Table 5 Quality of draining water

No.	Samples location	EC 25^0C mmho/cm	Fix residue g/l	Evaluation
1	S.P. Utvin	0.98	0.65	very good
2	S.P. Pustiniș	3.62	3.38	very good
3	S.P. Uivar	0.15	0.09	excellent
4	S.P. Răuți	0.08	0.05	excellent
5	S.P. Otelec	1.35	0.89	very good
6	S.P. Sânmartin	3.59	2.36	very good
7	S.P. Cruceni	1.05	0.69	very good
8	S.P. Rudna	0.96	0.63	very good
9	S.P. Toager	1.07	0.71	very good
10	S.P. Ghilad	0.90	0.59	very good

The main concept for reclamation of sodic soils, implicates the addition of a source of Ca^{2+} for exchangeable Na^{2+} , coupled with excess water to leach the Na^{+} from the root zone, deep into the soil profile. Common soil amendments include gypsum or phosphogypsum which provides electrolytes to prevent clay dispersion.

In area with sufficiently water provided from the draining canals, reclamation of sodic soils can be obtained by leaching the soil with successive dilutions of high – salt water containing divalent cations.

To ensure successful soil reclamation, the depth of water added should be at least 9 – 10 times, the depth of soil to be reclaimed.

4. CONCLUSIONS

The low plain with subsidence phenomena Bega – Timiș, with an area of 28,063 ha, has been included in the year 1985 – 1987 in the ameliorative system Țeba – Timișat. For a normal function the system was divided in three compartiments – Cruceni, Otelec, Diniaș, in which the water is gravitational discharged or with pumps.

The soil cover has a great diversity, however predominantly are Chernozems, Gleysols, Vertisols and Solonetz, all these types of soils are medium – strong alkalinization. Vertisols, Gleysols and Solonetz have a great content of clay, even clay rich in smectites, because of that with small values of hydraulic conductivity.

Due to the soil profile characteristics were necessary a lot of kind of meliorative measures, respectively hydro – pedo – agromeliorative, parts of a land improvement project.

The drainage water analyses reveals the possibility to irrigate the agricultural crops from the drainage system because the quality of this water is appreciated as fine.

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