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THE ROLE OF HYDRO-AMELIORATION ARRANGEMENTS IN THE PREVENTION OF GROUNDWATER POLLUTION

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***Abstract** :The comprehensive analysis regarding the scientific substantiation of the need to rehabilitate the modernization and extension of the arrangements for regulating the water regime from the surface and soil mass so that the level of pedophreatic water does not rise to join the rainwater highlights some essential aspects. Due to the malfunction of the hydro-amelioration works due to the clogging of the canals, their flooding by vegetation, the reduction of the evacuation capacity by pumping, the damage of the bridges, footbridges and other works, the water evacuation is done at low parameters which causes the rise of pedophreatic level , causing secondary wilting and salinization. The purpose of this paper is to highlight the importance of performing hydro-amelioration works and the influence on groundwater pollution.*(KAREL IAROSLAV LAȚO, LUCIAN NIȚĂ, ALINA LAȚO, 2013)*. Excess moisture has a negative effect on plant development, so crop yields decrease. Excess water favors the multiplication of hydrophilic weeds, it also determines the appearance of fog, a favorable condition for the appearance of pathogens. The soils specific to the studied area, having an adhesive plastic consistency as well as a degree of natural compaction, but also an additional compaction due to the soil works often at too high humidity require additional energy consumption to perform technological works specific to cultivated plants. Another major drawback of these soils is the fact that the periods of time in which good quality agrotechnical works can be carried out, which would contribute to the improvement, even temporarily, of the microbiological activity in the soil, by increasing its air content, are short. , the soil moving from excess moisture to deficit, relatively quickly.(* LOREDANA DARICIUC, I. GAICA, D. DICU 2016*). Due to this characteristic, the farmers in the studied area, practically have to equip themselves with tractors, agricultural equipment and combines, so that they can carry out in a short time the specific agricultural works. "In the area studied in the conditions of flat lands, there are microdepressions in the form of" croves "which, although they are not easily noticeable, in the conditions of excess humidity are harder to blow, remaining like lenses in the wilted plot.*

***Keywords**: water, precipitation, soil work, salinization*

INTRODUCTION

Comprehensive analysis of scientific substantiation of the need to rehabilitate modernization and extend the management for the regulation of the water regime from the surface and the soil mass so that groundwater level does not rise to unite with precipitation water highlights some essential aspects.(D. DICU, R. BERTICI , I. GAICA ,2016)

Existing drainage systems have been designed to lower the level of groundwater to 1.8 m, considered a critical point for the subsidence and divagation area Banato-Crişana Plain,

Through the malfunctional functioning of the hydro-ameliorative works because of the clogging of the canals, the flooding by vegetation, the reduction of the evacuation capacity by pumping, the damage to bridges, footbridges and other works, water evacuation is made at reduced parameters, which causes the phreatic level and the occurrence of permanent excess moisture, determining secondary swamping and salinisation.(DUMA – COPCEA ANIȘOARA, MIHUȚ CASIANA, L. NIȚĂ,2014)

At the same time, the junction of precipitation water with phreatic one leads to the pollution of groundwater with nutrients and pesticides, turning into a serious eluting factor difficult to anticipate and with very limited decontamination possibilities.

Maintaining the phreatic level at 1.8 m is also mandatory from the perspective of the possibilities of improving soil features through agrotechnical measures, their application being largely conditioned by the water content of the soil and, indirectly, by this level of groundwaters of 1.8 m fundamental for soil improvement and protection of groundwater.(L. NIŢĂ, D. ŢĂRĂU, D. DICU, GH: ROGOBETE, GH. DAVID,2017)

MATERIALS AND METHODS

For the analysis of precipitation developments, data from the last ten years recorded in the 70 ANIF stations in the perimeters with land improvement works in the study area were used.

The in-depth analysis of the rainfall regime for a period of 10 years (2009-2019) highlighted an anomaly of the monthly and decadal distribution of the amount of precipitation, with periods of significant rainfall amounts that alternated with droughts, some periods being even long.

In the period 2009-2019, precipitation was irregular in both monthly and annual quantities. Months were reported with very large quantities as well as months in which the amounts of precipitation were insignificant or even 0 mm.

As for the Timiş County, 2009 had two very dry months (April and September) in which there were points where no litre of meteoric water was measured. Thus, in Moravita, Gad or Livezile, in April there were 0 l/sqm. In September, the number of places where precipitation was null was higher (Ghiroda, Livezile, Banloc, Deta, Gad, Diniaş). In counterbalance, June was rainy, with averse who exceeded 130 l/sqm (Deta 137 mm, Diniaş 148.8 mm) (according to the Annexes).(ANIȘOARA DUMA-COPCEA, NICOLETA MATEOC-SÎRB, TEODOR MATEOC-SÎRB, CASIANA MIHUȚ, 2013)

The year 2010 was the wettest in the years analysed. Thus, at SP Mures, compared to 711 l/year in 2010, there were over 1,100 mm, in Cenad there were 1,140 l/sqm versus a normal 790 l/sqm and, in Galatca, compared to a normal 618 l/sqm, there were 1,330 l/sqm. May and June had a surplus of precipitation that exceeded 230 l/sqm/month, up to 271 l/sqm in May in Galatca, 258 l/sqm in the same month in Comloşu, and, in June, 275 l/sqm at SP Mures and 247 l/sqm in Comloşu.(LATO, A.NEACSU, A.; CRISTA, F. ; LATO, K.; RADULOV, I.;BERBECEA, A. ; NITA, L.;CORCHES, M. 2013)

The year 2011 was one of the driest years in the last 50 years. There were places where precipitation fell during the whole year, which in rainy years were reported in one month (Periam 188 l/sqm, Cenei 194 l/sqm, Lugoj 189 l/sqm, Recas 181 l/sqm).

The years 2012-2013 were relatively close in dynamics of precipitation and close to the multiannual quantities. March 2012 was noted for its small amounts of rainwater with values from 0.6 l/sqm in Cebza and Cenei and 9.3 l/sqm in Sinersig. As droughty was December 2013 with precipitation values between 0.5 l/sqm in Comloşu and 5 l/sqm in Banloc. March 2013 was completely opposed to March 2012, recording high meteoric water values of 155 l/sqm at SP Mures and 166 l/sqm in Cenad.

The year 2014 was a rainy one, in which there were pluviometric stations where the amount of precipitation exceeded 1,000 l/sqm (Beba Veche 1061 l/sqm, Cenad 1,156 l/sqm). Rainy months were May and July when precipitation exceeded 200 l/sqm reaching over 257 l/sqm in Cenad in May and 281 l/sqm at Sinersig. November was deficient in precipitation (0.3 l/sqm in Giroc).

April and July 2015 had precipitation below climate normal values. July had a few particular features. While most places showed reduced precipitation (0.2 l/sqm in Livezile, 0.3 l/sqm in Partoş), there were several places where convective clouds determined abundant precipitation (Sannicolau 80 l/sqm, Cenad 55 l/sqm).

The year 2016 had precipitation above normal values. The warm season was rainy, with rainfall that, in June, was far above monthly means. Many places had quantities of over 200 l/sqm (Cenei 266 l/sqm, Compus 281 l/sqm, SP Proletarul 292 l/sqm, SP Bobda II 301 l/sqm, Diniaș 309 l/sqm). December was droughty with rainfall which only isolated exceeded 10 l/sqm (Chevereşu 10.9 l/sqm and Lugoj 11.8 l/sqm).

The year 2017 had a rainfall deficit. The first month of the year had precipitation that did not exceed 15 l/sqm except for Cenad (17 l/sqm), and February either did not excel in terms of precipitation. Also, summer months having abundant precipitation from convective clouds in 2017 were relatively normal. From the point of view of the quantity of precipitation, 2018 was a year close to normal. The summer was rainy, but without exceptional quantities, except for SP Moravita in June with an amount of 254 l/sqm.(NITA SIMONA, NITA L., PANAITESCU LILIANA – 2015)

Somewhat unusual were the amounts of precipitation in February with 128 l/sqm at SP Mures, 140 l/sqm in Cenad and 138 l/sqm at SP Cenad. In 2019, the May and June are noted with monthly rainfall in many places have reached and exceeded 150 l/sqm, culminating with 311 l/sqm at SP Mures in June.

Table 1.

Values of abundant rainfall recorded in May and June 2019 in representative places in Timiş County

Nr. Crt	Stationary	May	June	**Total Year**
1.	Beba Veche	149,1	238,2	**628,0**
2.	SP Mures	223,3	311,7	**927,4**
3.	SP Teremia	146,2	69,7	**426,6**
4.	SP Cenad	145,1	185,4	**730,1**
5.	SP Galaţca	142,5	101	**556,0**
6.	Becicherec	157	137,3	**519,3**
7.	SP Cruceni	166,6	93,7	**548,6**
8.	SP Jimbolia	130	172,1	**568,1**
9.	SP Proletaru	136	174,8	**616,1**
10.	SP Diniaș	146,7	104,4	**542,9**
11.	Otelec	136,5	106,5	**518,7**
12.	Ionel	132,1	96,3	**582,7**
13.	SP Cenei	150,5	103	**542,2**
14.	SP Bobda II	153,5	137,5	**1048,5**
15.	Rudna	152,6	99,9	**560,2**
16.	Grăniceri	153,7	77,5	**547,2**
17.	SP Gad	147,8	104	**591,0**
18.	SP Cebza	146,4	71,5	**437,0**
19.	SP Banloc	134,9	89,8	**412,2**

20.	SP Livezile	153,9	161,2	**648,3**
21.	Partoș	172,4	56,4	**498,4**
22.	SP Topolea	140	80	**436,1**
23.	SP Moravița	100,5	66,6	**469,7**
24.	Lugoj	136	141,5	**678,8**
25.	Sinersig (SP Dicșani)	142	128	**625,1**
26.	Ghiroda	118,2	20,9	**502,8**
27.	Giroc	118,5	74,5	**517,5**
28.	Șag	125,8	77,9	**540,2**

RESULTS AND DISCUSSION

Negative effects of excess water on the sustainability of agricultural activities in the studied area

Numerous studies on soil fertility formed under excess moisture conditions have revealed that their productive potential is 20-40% lower compared to soils whose genesis was carried out under moderate humidity conditions.

The lower productive potential of these soils is caused by less physical, chemical and biological properties, less favourable to plant growth and development, previously presented attributes.(ANIȘOARA DUMA – COPCEA, CASIANA MIHUȚ, L. NIȚĂ, 2014)

They are accompanied by specific agro-phyto-technical aspects.

These soils, characterized by a high clay content, have a small porosity, which reduces the air exchange with the atmospheres in addition, excess water make these soils “cold soils”. These soils require 4-5 times more heat to increase the temperature with 1ºCelsius.

In winter, they freeze stronger and deeper, compared to other types of soil, and thaw is 10-20 days late.(ANIȘOARA DUMA COPCEA , CASIANA MIHUȚ1, LUCIAN NIȚĂ1, 2015,)

Consequences on winter crops are negative: delayed vegetation resumption and delayed maturity of plants increasing the risk of critical plant growth phases for plant water with warm and dry periods.

The delayed resumption of vegetation in the spring implies the prolongation of the rest period of plants, which contributes to the weakening of their vigour and, implicitly, a more difficult start in the spring with negative consequences on production.

For spring crops, the sowing delay caused by the earlier lack of minimum germination temperatures was also an important negative effect.

In these situations, critical plant growth phases for plant water overlapped the periods in which, frequently, extremely high temperatures were recorded on the background of drought (July-August).

Negative effects on production consist, in this case, in a deficient pollination of (maize, sunflower), grain resorption (maize, soy), flower abortion (soy) etc.

Excess moisture has a negative effect on plant morphology on soils with excess water: the root system increases superficially and is lower in volume.

This makes roots, during dry periods when excess humidity disappears, the no longer get the water that is more in-depth.(POPA M.; LATO A.; CORCHES M.;RADULOV I.; BERBECEA A.; CRISTA F.; NITA L.; LATO KI;POPA D 2016)

Depending on the duration and the moment of excess moisture, a reduction in crop yield occurs. If excess moisture occurs during cereal twinning, the main and coronary roots are less developed, which leads to the reduction of the number of ears. If excess moisture occurs in spring, during the formation of the ear, the number of grains in the ear decreases.

In general, the most negative effects occur when excess moisture occurs in stages of maximum plant activity (blooming, bounding, etc.).

Excess moisture at the end of winter determines crops to lose 15-25% of the surface due to the death of the plants in the mall depressions in the plots.

In the years with a cold season, during precipitation the losses reach 50% of the surface, the crops being compromised and requiring re-sowing with spring crops.

The same situation occurs frequently, if precipitation exceed in May in the crops sown in the spring.(NIȚĂ SIMONA, NIȚĂ LUCIAN DUMITRU ,MIHUȚ CASIANA, KOCIS ELISABETA, PANAITESCU LILIANA, LUNGU MARIUS, 2014)

Excess water favours the multiplication of hydrophilic weeds, harder to control, and of virus-carrying insects, vectors for transmitting diseases to plants, animals or humans. Excess humidity determines the formation of the fog that is a favouring factor for pathogens that cause plant diseases, requiring additional treatments, so additional costs as well as an increase in environmental pollution. The soils specific to the studied area, having an adhesive plastic consistency as well as a natural compaction, but also a supplementary compaction due to soil works often at too high humidity, requires additional energy consumption for the technological works specific to crops.

This additional consumption is necessary to perform soil aeration works on a longer depth so that the soil aero-hydric regime is more favourable to the growth and activity of the root system.(NIȚĂ SIMONA, NIȚĂ LUCIAN, PANAITESCU LILIANA, 2015)

Of course, these additional works for improving soil aero-hydric regime determine additional expenditure for farmers.

Another major inconvenient of these soils is that the periods of time in which agrotechnical works of good quality can be carried out, which contribute to the even temporary improvement of the microbiological activity in the soil by increasing its air content are short, soil moving, relatively quickly, from moisture excess to moisture deficit.

Due to this feature, farmers in the studied area practically need to over-purchase tractors, agricultural machinery and combines so that specific agricultural works can be carried out in a short time.

In the area studied in the conditions of flat land, micro-depressions are met in the form of “tableland” which, although not easily noticeable, in the conditions of excess moisture, are harder, remaining as lenses in the dried parcel.

Soil work, as the main link of soil management, requires complex approaches that can be made by applying measures to protect against aggressive and consecutive processes leading to degradation, with the help of monitoring and efficiency actions, to improve soil and environmental quality.(DANIEL DORIN DICU, PAUL PÎRSAN, JELENA MARINKOVIC,2014)

Thus, a number of natural factors affecting soil fertility, excess or water deficiency, are very diverse situations where farmers must apply on a case-by-case basis.

Measures against soil physical drainage are:

1. Reducing multiple soil preparation and crop maintenance works with a single passage to minimize the number of equipment passages;
2. Destroying, through cutting and incorporating vegetal debris in the soil, through disking and ploughing works;
3. Implementing cop rotations in which to introduce (improving) perennial grasses, which would minimize agricultural work;

4. Using agricultural machinery equipped so to reduces soil compression action;
5. Avoiding cultivating crops leading to soil degradation;
6. Reducing the share of technical crops in the composition of crop rotations and performing soil restoration works on the areas with such crops.

Measures meant to prevent secondary soil compaction:

1. Carrying out works according to the soil and climate conditions and introducing ameliorative crops;
2. Applying measures meant to ensure progressive increase in humus content and soil structure improvement;
3. Reducing the number of equipment passages and performing multiple works on a single passage;
4. Changing, along the years, the sowing depths, and periodically performing a deep aeration work.

Measures against degradation and rehabilitation of soil structure:

1. Carrying out soil works at optimal time;
2. Carrying out a minimum soil work system;
3. Establishing a 4- to 6-year-old crop rotation containing ameliorative cultures (legumes and perennial grasses);
4. Practicing the annual incorporation of fresh organic matter so as to provide a positive balance of humus in the soil and the intensification of processes that include the activity of living organisms in the soil, especially mesofauna (earthworms);
5. Using substances that improve soil reaction, maintaining it within optimal limits;
6. Using special ploughs;
7. Performing works at low speeds;
8. Using large width tires and caterpillar tracks that increase contact area;
9. Covering the land surface with vegetal debris and other organic matter.

For the preservation of water in the soil, it is necessary to apply differentiated agrotechnical practices, all agricultural year round; with a proper rotation of agricultural technological components, the water retention methods in the soil are as follows:

1. Using crop rotation and crop setting containing at least three plant species: straw cereals, weeding crops and technical plants, legumes.
2. Carrying out soil works at the optimal time. Optimal water content for soil work is defined as “soil moisture in which soil works produce the maximum percentage of small aggregates,” and lower limit of the work is defined as “moisture in which soil resistance is twice its resistance to optimal humidity”.
3. Applying stubble turning immediately after harvesting straw cereals, rape, legumes, at a depth of 9-12 cm, which reduces water evaporation and favours the infiltration of precipitation water. The amount of water retained in the soil increases 3 times, the evaporation decreases by about 10% and vegetal residues act like mulch.
4. Not ploughing at low depths or upon preparation of germination beds. This is not justified at depths of over 30 cm in the case of ploughing and over 10 cm in the preparation of the land for sowing.
5. On slope land, it is recommended to work the soil along level curves, to avoid the speeding up of water leakage and soil erosion;
6. The soil layer aerated after the ploughing should be cleaned of weeds to avoid soil coverage and allow the penetration of water in the soil.

7. As regards the germination bed prepared during the sowing period, it will be done on the depth of sowing.
8. Making the necessary irrigation to complete the lack of water.
9. Carrying out soil mulching.
10. Implementation protective curtains to favour climate improvement because they reduce wind speed and, as a result, soil water evaporation.
11. In the case of moist soils, with high clay content, it is recommended to perform deep (40-80 cm) soil aeration, improving soil aero-hydric regime. Deep aeration should be carried out every 5 years, having the desired effect only if the layer is fully penetrated and with good drainage;(LAURA SMULEAC, SIMONA NITA, ANISOARA IENCIU, ADRIAN SMULEAC, DICU DANIEL-)
12. Deep soil aeration should be done together with other works that improve drainage, the most effective way being crop rotations containing weeding crops and legumes, accompanied by the application of 50-70 t/ha manure.

CONCLUSIONS

Excess water in the soil because of inappropriate drainage has a number of serious direct effects on the sustainability of agricultural activity in the area:

1. Soil degradation;
2. Additional technological costs;
3. Low productions;
4. Increased number of agricultural equipment;
5. Additional soil and water pollution.

The best practice in the area, under these conditions is to “bypass” these micro depression areas. Subsequently, when the soil is resting, works can be carried out in these micro-depressions also.

Excess water drainage is the main solution to significantly diminish these shortcomings.

The favourable effects of drainage are the results of improving soil aeration that entails:

- Improving the thermal regime, which means that soil can be work earlier, and with better soil works;
- Intensification of aerobic processes that lead to complete mineralization of organic soil matter and restoration of its fertility potential;
- Predominance of oxidation processes that allow the formation of the compounds assimilable by plants.

Soil physical and hydro-physical properties change favourably. Thus, there is an increase in porosity, and improvement of structure and permeability. As a result, soil water capacity increases to meet the needs of plants during drought periods.

Improving soil properties favourably influences plant growth.

Plants can develop a normal root system that exploits a higher volume of soil, covering the water and food needs more easily.

Eliminating excess water also leads to the disappearance of specific weeds (horse tail, common sundew, sedge, club rush, reed, Dutch rush, etc.). At the same time, some diseases and pests are prevented. Timely conducted agricultural works allow the use of older plant varieties with higher productivity. The association of drainage with a specific, ameliorative cultivation technology enhance the favourable changes mentioned, resulting in production (amendment, fertilization, deep sowing).

Large production increases that can be obtained from the disposal of excess moisture make the management investment recoverable within a short period of time (5-7 years).

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