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Efficient methods for land drainage design using computerized non steady-state methods

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Abstract: Drainage is a vital part of water resources integrated management. The integrated management of water resources represents a process which promotes the coordination of water, soils and other resources management and development in order to maximize the economic and social sectors in an equitable manner and without compromising the sustainability of vital ecosystems.
During the last decades many researchers created specialized software, with different levels of complexity, in the field of land drainage. This paper will analyze applications as Espadren (from Costa Rica), Drainspace (from United Kingdom) and GDZ RoDrain (from Romania) which are using the non steady-state equations in computing the spaces between drains and will present a study case from Romania.

Key words: drainage, Espadren, Drainspace, GDZ RoDrain

Introduction

The approach of non-permanent regime, in the process of designing drainage systems, describes only a simplified relation, constant, between water-table and flow. In reality, water-table recharge is function of time and as a consequence the underground flow to the drains is not constant. In order to describe the water-table fluctuations as function of time designers are using the non-permanent regime of flow.

The equations which are describing this process are based on the differential equations of non-permanent flow. The both approaches (permanent and non-permanent) are based on Dupuit-Forchheimer assumptions. The only difference is represented by recharge which in the case of non-permanent regime is variable in time.

Equations which are describing the non-permanent regime were proposed by Glover-Dumm, De Zeeuw-Hellinga, Jenab, Guyon, Kraijenhoff van der Leur Maasland and others.

The equations of Glover-Dumm, De Zeeuw-Hellinga, Jenab, Guyon, Kraijenhoff van der Leur Maasland had a large applicability being used in many countries with different climate and soil characteristics.

The calculations were realized for Margina area from Timis County, western Romania.

Methods

Actual researches in the frame of non-permanent regime of drainage are based especially on Glover-Dumm equation.

Glover-Dumm equation is used for describing a water-table level with a decreasing tendency after a sudden rise due to an instantaneous recharge. This situation is typical for irrigated areas where the water-table level is rising usually very sudden during water applications in order to decrease subsequently in a slow way.

Glover-Dumm equation has the following form:

$$L = \pi\left(\frac{Kdt}{\mu}\right)^{\frac{1}{2}}\left(\ln 1{,}16\frac{h_0}{h_t}\right)^{-\frac{1}{2}}$$

where L is the distance between drains, K is the hydraulic conductivity, μ is the drainable porosity, d_r represents equivalent depth of the soil layer below drain level, t represents the necessary period (in days) to decrease the water table level from h_0 to h_t, h_0 is the initial height of water table level, h_t is the desired height of water table level.

The original equation is based only on the horizontal flow and doesn't take in consideration the radial resistance of flow, to the drains, which doesn't reach the impermeable layer. By similarity with the approach of permanent regime, in any situation, with the introduction of Hooghoudt's concept regarding the equivalent soil layer, the resistance caused by convergent flow to the drains will be considered in calculations.

De Zeeuw-Hellinga equations are used for describing a fluctuant water-table. In this approach, a non-uniform recharge is divided in small periods of time in order to accept this recharge as being constant on these small periods. This situation is specific for humid areas with a high intensity of precipitations, concentrated in storms.

We can use the following equations:

$$q_t = q_{t-1}e^{-\alpha\Delta t} + R\left(1 - e^{-\alpha\Delta t}\right)$$

and

$$h_t = h_{t-1}e^{-\alpha\Delta t} + \frac{R}{0{,}8\mu\alpha}\left(1 - e^{-\alpha\Delta t}\right)$$

for simulating drains discharge and the water-table fluctuations basing on a critical distribution of precipitation intensity obtained from records from archives.

In the Kraijenhoff-Maasland equation, the recharge has been considered constant over any time period t instead of instantaneous recharge which was assumed in Glover-Dumm equation.

The height of the water-table midway parallel drains (where x = 0,5L) at any time is given by the following equation:

$$h_t = \frac{4}{\pi}\cdot\frac{R}{S}j\sum_{n=1,3,5}^{\alpha}\frac{1}{n^3}\left(1 - e^{-n^2 t/j}\right)$$

where:

$$j = \frac{SL^2}{\pi^2 KD} = \frac{1}{\alpha}$$

called reservoir coefficient.

We can also compute the discharge intensity, q_t, with the following formula:

$$q_t = \frac{8}{\pi^2}R\sum_{n=1,3,5}^{\alpha}\frac{1}{n^2}\left(1 - e^{-n^2 t/j}\right)$$

To account for the convergence of stream lines in the vicinity of drains not reaching impermeable layer D is replaced by d for Hooghoudt and:

$$j = \frac{SL^2}{\pi^2 Kd}$$

Other two equations which are used in the analyses of non-permanent regime belong to Guyon and Jenab.
Guyon's method explains water table depletion by fictive, wider drain spacing, but it is less precise compared with Glover'Dumm's, even though they are basically similar. This property of Guyon's method limits its application.
Guyon’s method is based on the following equation:

$$L^2 = \frac{32Kdt}{\pi\mu}\left[\ln\frac{(2d+h_t)h_0}{(2d+h_0)h_t}\right]^{-1}$$

where: *K* – soil permeability (m/day); *d* – equivalent drain depth (m); *t* – time of drainage (days); μ - drainage porosity; *h0* – maximal groundwater table depth; *ht*- minimal level of depression curve at the end of depletion process (m).
Jenab proposed a formula for calculation of distances between drains in non-permanent regime considering the following assumptions:

- The soil is homogenous;
- The flow is horizontal and radial, in the formula for calculation of distances between drains being used the equivalent soil depth;
- The formula for calculation between drains is based on heat flux equation;
- The equation’s solution describes the decrease of water-table level as function of time, distance between drains and soil’s properties.

A graphical solution of Jenab formula can be expressed as it follows:

$$L = \frac{1}{C}\sqrt{\frac{4tKD_h}{\phi}}$$

which can also be written as:

$$L = \frac{1}{C}\sqrt{\frac{4tK}{\phi}\left(d + \frac{h_0 + h_t}{4}\right)}$$

where L – distance between drains; K – hydraulic conductivity; D_h – thickness of the soil layer where appears the horizontal flow; d – Hooghoudt’s equivalent soil layer; D – depth from drains line to impermeable layer; h_0 – initial height of water-table level above drains; h_t – final height of water-table level above drains after t period; C – value obtained with the help of graph as function of $D(U_n)=h_t/h_0$; t – necessary time to decrease the level of water-table from h_0 to h_t; Φ – drainable porosity.
Jenab proposes the following formula for the equivalent soil layer:

$$d = \frac{D}{\frac{8}{\pi}\cdot\frac{D}{L}\ln\left(\frac{D}{\phi}\right) + 1}$$

In the frame of this paper I used a number of 3 different software’s: DrainSpace, Espadren and GDZ RoDrain, each of them based on Glover-Dumm formula. With their help I calculated the distance between drains for Margina area, affected by humidity excess and located in Timis County, western Romania. Espadren also offers the opportunity to compute the distance between drains with the help of Jenab formula while GDZ RoDrain also includes applications based on Guyon and De Zeeuw-Heillinga formulas.

Results

For Margina area we have the following information: H_{drain} (drain's depth) = 1,4 m; K = 0,16 m/day; Φ = 0,04; r (drain radius) = 0,04 m; h_0 = 0,8 m; h_t = 0,6 m; t = 2 days.

I also mention that for Margina area, in permanent regime using Ernst formula, we obtained a distance between drains equal with 9 m.

The results are presented in tables.

Table 1. Results obtained in computing the distances between drains for Margina area using Glover-Dumm formula in the frame of DrainSpace, Espadren and GDZ RoDrain applications

t (days)	DrainSpace L (m)	Espadren L (m)	GDZ RoDrain L(m)
2	5,77	15,38	14,07
3	7,71	19,46	17,23
4	9,4	22,93	19,9

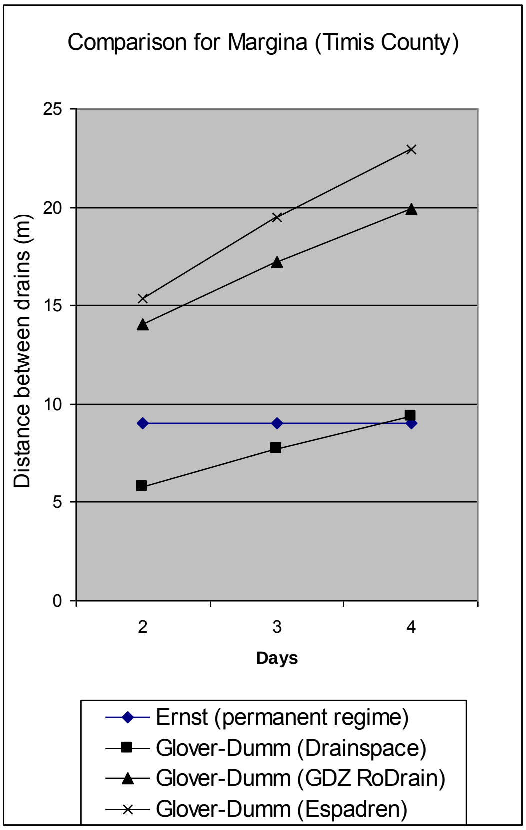

Figure 1 Graphical representation of the results from table 1

As it can be seen from the previous table and graph, DrainSpace offers lower values than Espadren and GDZ RoDrain which presents similar results. On the other side, we can say that Espadren and GDZ RoDrain are presenting much „economical“ solutions that DrainSpace but we must verify if these solutions are technical acceptable.
In table 2 I will present a comparison between the results obtained with Glover-Dumm and Jenab formulas in the frame of Espadren program.

Table 2. Results obtained in computing the distances between drains for Margina area using Glover-Dumm and Jenab formulas in the frame of Espadren application

t (days)	L (m) (Glover-Dumm)	L (m) (Jenab)
2	15,38	13,93
3	19,46	17,66
4	22,93	20,84

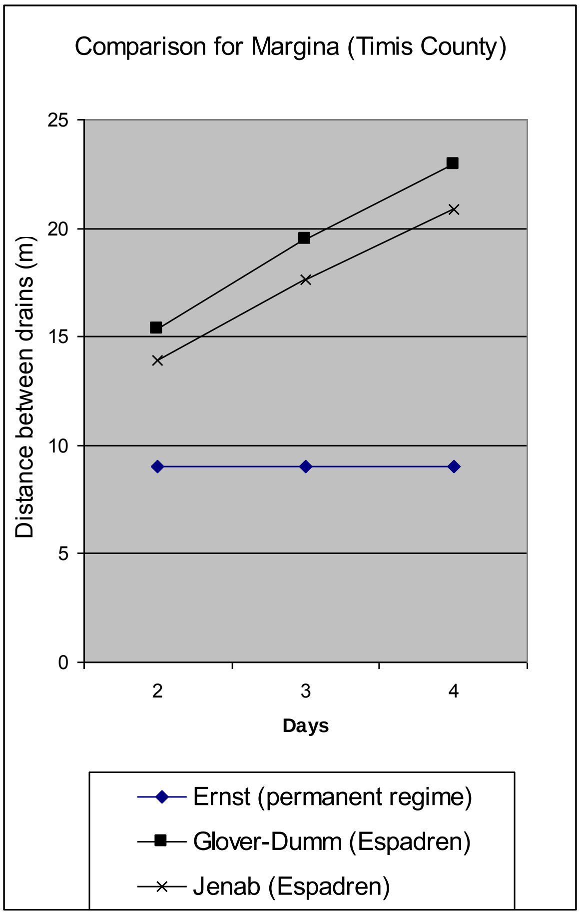

Figure 2 Graphical representation of the results from table 2

Jenab formula is not a very used method being introduced only at the beginning of 2010 in Romanian technical literature. We can compare the results obtained with this method with other results but only at theoretical level due to the less experience in applying Jenab method in Romania.
In table 3 I will present a comparison between the results obtained with Glover-Dumm and Guyon formulas in the frame of GDZ RoDrain application.

Table 3. Results obtained in computing the distances between drains for Margina area using Glover-Dumm and Guyon formulas in the frame of GDZ RoDrain application

t (days)	L (m) (Glover-Dumm)	L (m) (Guyon)
2	14,07	13,22
3	17,23	16,65
4	19,9	19,62

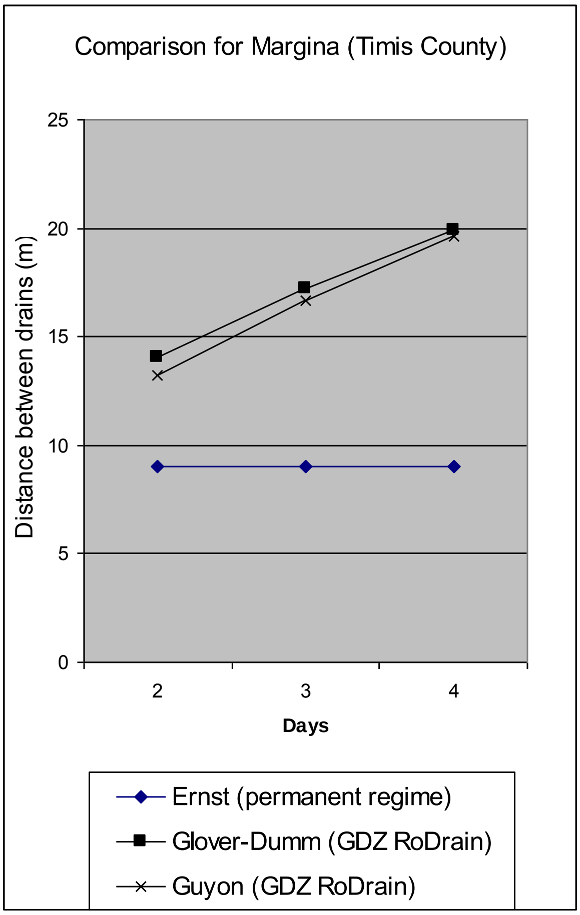

Figure 3 Graphical representation of the results from table 3

Guyon formula it seems to be much economical than Glover-Dumm for a period of time longer than 4 days but due to its less precision we must verify its results and from technical point of view.
Anyway, we can observe from the last two graphs that Espadren and GDZ RoDrain are presenting relative similar results, with small differences between them. Figure 4 will include the results from both Espadren and GDZ RoDrain applications.

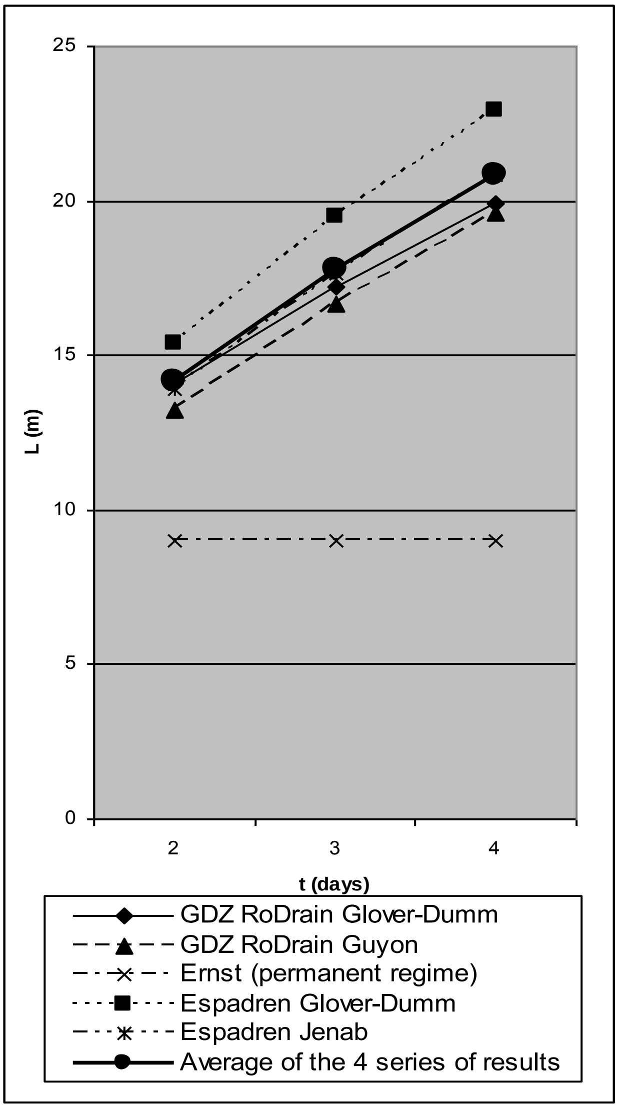

Figure 4 Graphical representation of the 4 series of results from table 2 and 3 and with thick line the average of the 4 series of results

Using the average of the 4 series of results I verify how will function the drainage system if I will adopt a distance between drains of 14 m and I will impose a period of 2 days for decreasing the water table level from 0,8 to 0,6 m knowing that for Margina area, in April, we have 94,2 mm of precipitation. I used De Zeeuw-Heillinga method in the frame of GDZ RoDrain application.
H_{drain} (drain's depth) = 1,4 m; K = 0,16 m/day; Φ = 0,04; r (drain radius) = 0,04 m; h_0 = 0,8 m; h_t = 0,6 m; t = 2 days; d = 0,97; α (reaction factor) = 0,195; q_0 (initial discharged flow) = 0,003 m/day.

Table 4 Results obtained in simulating the behaviour of water-table level for Margina area during the precipitation from April

Day	recharge (m/day) qr	height of water-table level above drains (m) h	flow discharged by drains (m/day) qe
0	0	0,6	0,00380
1	0,005	0,635	0,00401
2	0,006	0,692	0,00436
3	0,007	0,768	0,00483
4	0,007	0,830	0,00521
5	0,005	0,825	0,00517
6	0	0,678	0,00426
7	0	0,558	0,00350
8	0	0,459	0,00288
9	0	0,377	0,00237
10	0	0,310	0,00194
11	0	0,255	0,00160
12	0	0,210	0,00131
13	0	0,172	0,00108
14	0	0,142	0,00089
15	0	0,116	0,00073
16	0,005	0,238	0,00149
17	0,007	0,394	0,00246
18	0,01	0,608	0,00380
19	0,006	0,670	0,00419
20	0,006	0,722	0,00451
21	0	0,593	0,00371
22	0	0,488	0,00305
23	0	0,401	0,00251
24	0	0,330	0,00206
25	0	0,271	0,00169

26	0,005	0,365	0,00228
27	0,006	0,470	0,00294
28	0,007	0,586	0,00366
29	0,007	0,680	0,00425
30	0,005	0,701	0,00438

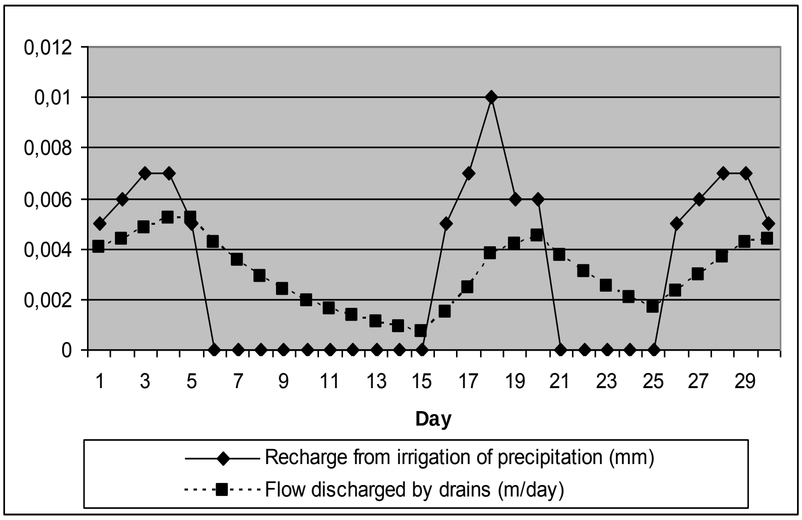

Figure 5 Graphical representation of recharge and discharged flow from table 4

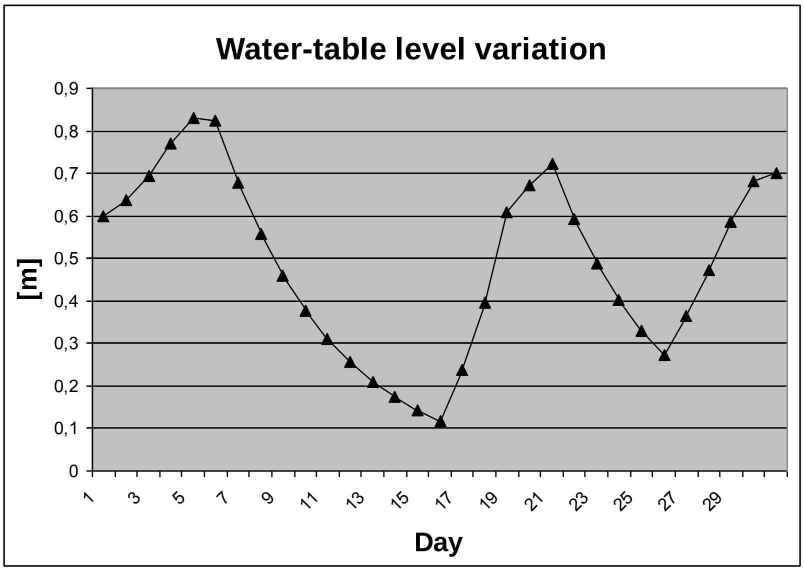

Figure 6 Graphical representation of water-table level variation from table 4

We can observe that the drain system, with a distance of 14 m between drains, will be able to decrease the water-table level from 0,8 m to 0,6 m in 2 days so we can conclude that the obtained values correspond from technical point of view.

Conclusions

The non-permanent regime, which reflects the reality in the frame of drainage systems, was analyzed by many researchers which presented different equations, many of them transposed in computerized applications.

Due to the numerous essential decisions which must be taken in designing and implementing a drainage system, the researchers and designers must used specialized applications in order to obtain accurate results and to eliminate different types of errors which can appear in manual calculations.

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Ecology

THE ROMANIAN BANAT REGION CHALLENGING CLIMATIC CHANGES

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Abstract. The last years presented in Romania large variations regarding the temperatures and precipitations regimes. The western part of this country (which includes the Banat region) was affected by floods and droughts, phenomena which followed at very short periods of time. All of these phenomena can be understood as results of climatic changes. The Romanian Banat region is a very complex one from geographical point of view since it comprises all the relief forms and is situated in an area where can be recorded a moderate continental climate in the northern part and a climate with sub-Mediterranean influences in south. Due to its past hydrological situation, large areas of the Banat region are covered by land reclamation and improvement areas, unfortunately part of them with an improper regime of work. These systems had an important role in facing the effects of climatic changes. Unfortunately still persist the menace of different water crisis situations; result of human activities in the large frame of climatic changes. The maps which are presented in this paper are exposing the actual situation on the areas which are affected by phenomena such as aridity and drought.

Keywords: the Banat region, climatic changes, maps.

AIMS AND BACKGROUND

The actual climatic situation must be known by different categories of people which are involved in activities from hydrological, agricultural and sustainable development fields. This paper intends to offer them maps with different climatic indicators, sufficient for a better understanding of climatic changes phenomenon and its impact on social and economical sectors.

Statistical climatic records[1,2] together with the European Union documents regarding climatic changes, water scarcity and associated phenomenon[3,4] are representing the main tools used in this paper for a conclusive analysis of the Banat region climate. The results were analysed using the actual international specific literature and the last books in this domain[5–8].

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A COMPARISON REGARDING MODELS USED IN AGRICULTURAL DRAINAGE SYSTEMS DESIGN IN BRAZIL AND ROMANIA

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ABSTRACT

Drainage systems for agricultural purposes are systems that make easier the process of draining water from the field so that agriculture can benefit from the effects of continuous reduction of the degree of saturation with water and / or reduce the presence of toxic soluble substances. The main natural factors which influence the excess soil water are: climatic regime, topography and hydrological regime of the territory. They are associated with geological, lithological, soil and hydrogeological ones, which together cause flood phenomena of stagnation and excess water on the land of plains and plateaus on the plane.

The multitude and variability of situations with humidity excess which can appear resulted in the use of numerous computation methods and programs which offer solutions with different levels of efficiency. Manual, classical, methods were replaced by specialized software. These software's are presenting a small risk regarding the potential errors and there are able to present detailed prognosis of the studied phenomenon.

Key words: *DrenVSubIr, SISDRENA, drainage systems design*

INTRODUCTION

Broadly speaking, the objective of subsurface drainage systems is to control the water-table in the soil in order to create proper soil water conditions for crop growth and farm operations. The preparation of a subsurface drainage plan involves the determination of an optimal combination of variables which can be categorized in the following groups: system variables (types of drains, structures and outfalls; alignments, spacing, depths, capacities; materials and construction methods etc.), land use variables (crops and crop rotations, farming systems, farming practices, etc), environmental variables and management variables.

In the design process of a subsurface drainage system, the following main variables must be defined: type and layout of the system, discharge capacity of the system (q), watertable depths to be maintained in the field relative to the soil surface (h), the field drainage base depth (D) i.e., the installation depth of the pipe drains or the waterlevel to be maintained in the ditches (h_{drain}), and spacing of the field drains (L).

Drain spacing formulae may be categorized as either steady state formulae or non-steady state formulae. Steady state formulae are based upon the assumption that a steady constant flow occurs through the soil to the drains. Discharge equals recharge and the water-table head (h) is constant. In the non-steady state formulae all these parameters vary in time and the water-table fluctuates during the drainage process.

Non-steady state drainage formulae enable the water-table behavior over a certain period to be simulated on the basis of the (infiltrated) rainfall and (actual) evapotranspiration data for that period. Water-table hydrographs may thus be developed using the historical daily weather data for a range of basic design criteria. Several computer models as DRAINMOD, SWAP or SISDRENA are especially suitable for such water table simulations.

The most prominent drainage model that is used in North America is DRAINMOD (Skaggs,1981). This model has been used in all regions of the United States, and in many other countries, and is a truly effective method for the design of drainage systems (Skaggs, 1990). Input requirements for the model includes, among other things, the distance between drains, which, considering the technical literature from Romania, is the main element in the process design of a drainage system.

MATERIALS AND METHODS

Even Romanian researchers developed different methods for an efficient design of agricultural drainage systems, unfortunately, these methods were not transposed in computer programs and their resolving processes suppose long time and predisposition to errors.

Only in 2007 appeared a new program, DrenVSubIr, with a friendly interface, program which calculate the distance between drains and also verify the possibilities for applying the sub-irrigation. DrenVSubIR application is developed in Borland Delphi Pascal v7.0 programming system and is created for calculating sizes specific to drainage system such as: determination of the distance between drains with the verifying operation in sub-irrigation.

DrenVSubIR application consists in three modules: “Drainage - Ernst Equation - David” module (for the calculus of resistance coefficient at water entry in drain tube, with and without filter); “Verifying Sub-Irrigation – David Equation” module (for the drainage verifying operation calculus in sub-irrigation) and “Drainage: Technical-Economic Calculation” module (for the specific investment calculus and for establishing the optimum technical-economic solution of drainage). DrenVSubIr application is based on Ernst equation fulfilled with the additional term ζ_{if} proposed by I. David.

$$h = \frac{q \cdot D_v}{K} + \frac{q \cdot L^2}{8 \cdot K \cdot T_e} + \frac{q \cdot L}{K} \cdot \ln\frac{\alpha \cdot D_0}{U} + \frac{q \cdot L}{K} \cdot \zeta_{if}$$

where ζ_{if} (represents the effect of head losses at water entrance in drain due to the filtering material) can be analytically calculated with the following relation:

$$\zeta_{if} = \alpha \cdot \left[\ln\frac{1}{\sin\frac{nb}{2d_0}} + \frac{1-\chi}{2\chi} \cdot \ln\left(A_1 + \sqrt{A_1^2 + 1}\right) \cdot \left(A_2 + \sqrt{A_2^2 + 1}\right) \right] + \beta \cdot \left[\ln\frac{1}{\sin\frac{\ell}{2B}} + \frac{1-\chi}{2\chi} \cdot \ln\left(B_1 + \sqrt{B_1^2 + 1}\right) \cdot \left(B_2 + \sqrt{B_2^2 + 1}\right) \right]$$

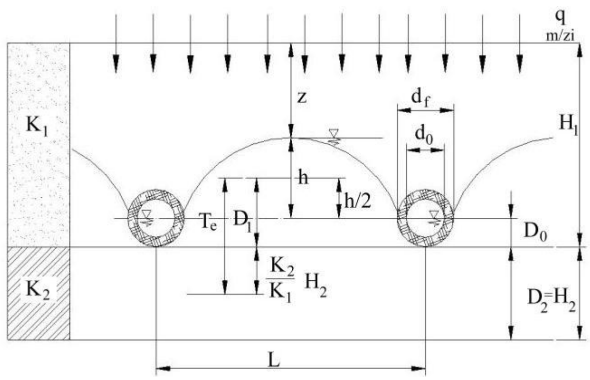

Figure 1 Ernst equation graphic scheme

SISDRENA was coded in Visual Basic 6.0 at the Department of Biosystems Engineering (LEB), "Luiz de Queiroz" College of Agriculture (ESALQ/USP), Piracicaba, SP, Brazil. It is a one dimensional model that accounts for the major components that affect the water balance in a section of homogeneous soil with unit surface area, located midway between two parallel drains and extending from the impervious layer to the soil surface. These components are: precipitation, runoff, infiltration, percolation to groundwater, upstream from the groundwater level to the root zone, evapotranspiration, drainage and vertical "seepage" (figure 2).

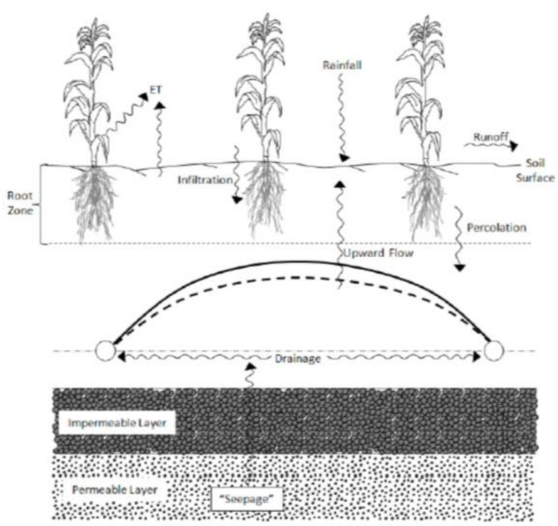

Figure 2 Scheme of the main flow components considered by the model

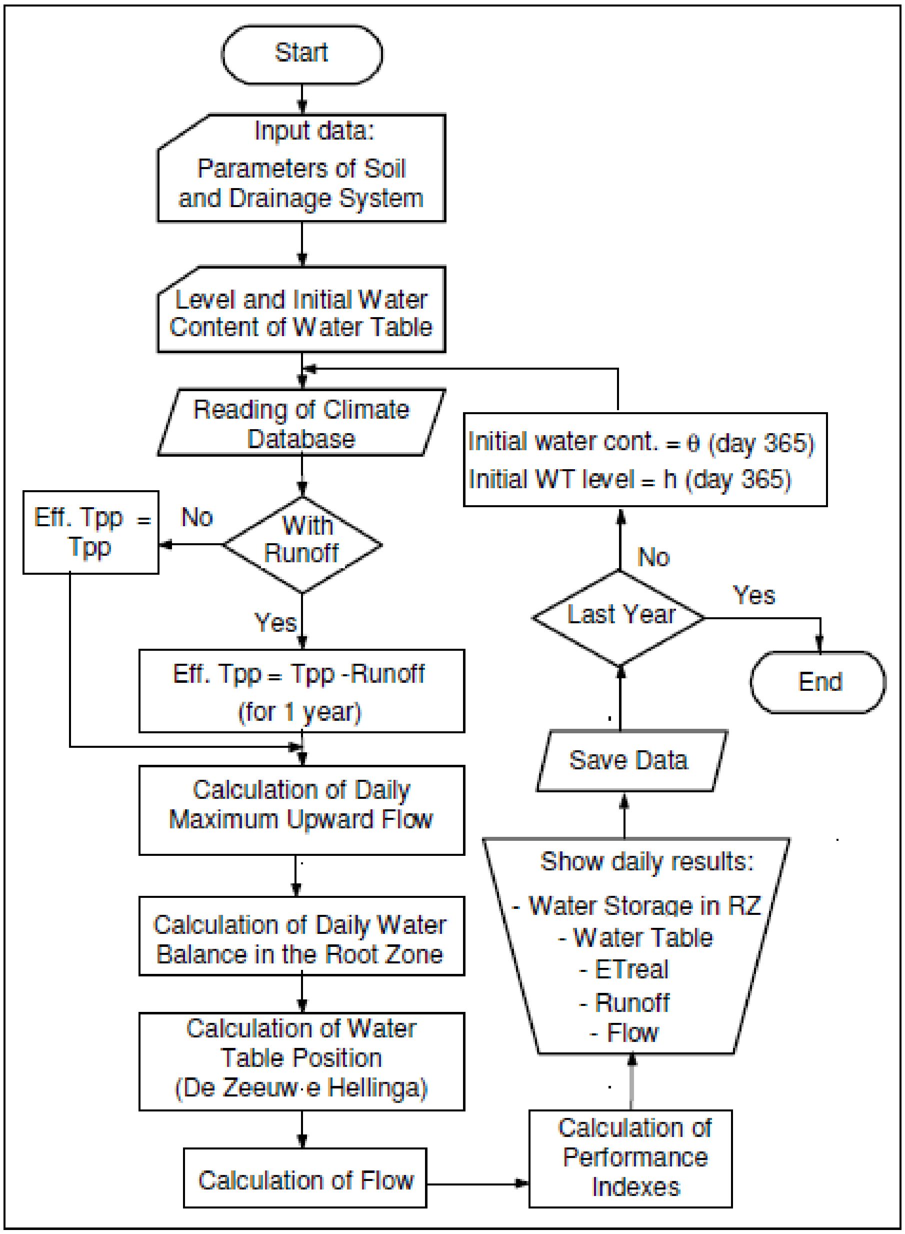

Figure 3 Flowchart of SISDRENA model

The SISDRENA model uses historical daily precipitation and potential evapotranspiration data, soil physical properties, crop characteristics, and drainage system lay-out, in the simulation of runoff, water table position, drain discharge, actual evapotranspiration, and root-zone soil water storage. In the model, the position of the water was estimated by de Zeeuw-Hellinga equation. The model was developed to address some limitations of its predecessor, the SIMDRENO model. Improvements include a more precise way for characterizing the effect of upflux on water table movement and runoff estimation.

The required input parameters, and output parameters provided by SISDRENA are given in Tables 1 and 2, respectively.

Table 1 Required input parameters for SISDRENA

Total daily precipitation, mm/day
Daily potential evapotranspiration, mm/day
Saturated hydraulic conductivity of saturated soil, m/day
Depth to impervious layer, m
Values of drain spacing to be submitted for evaluation, m
Daily upward flow by vertical seepage (optional), mm/day
Drain depth, m
Effective radius of the drain, m
Soil water retention curve
Planting and harvesting dates of the crop
Variation of the effective root system depth throughout the year, m
Daily factors for the crop sensitivity to excess and lack of water
Starting groundwater level above the drains m
Starting volumetric soil water content

Table 2 SISDRENA output parameters

Daily overland runoff, mm/day
Daily infiltration, mm/day
Daily groundwater level, m
Daily drain flow mm/day
Daily water storage in the root zone, mm
Daily actual evapotranspiration; mm/day
System evaluation parameters
Most economical drain spacing

RESULTS

The studies were realized for Faget, an area located in western part of Romania, Timis County. We used a drain of 5 cm diameter with and without filtering material (Filtex δ =0.6 cm, K_{soil} = 0.5m/day, h = 0.6m, depth of impermeable layer = 3m, drain depths = 1.4 m) and we calculate the distance between drains by using two programs: DrenVSubIr (Ernst formula) and Espadren (Ernst formula). Espadren doesnt consider the head losses at water entrance in drains. We obtained the following results:

Table 3

	DrenVSubIr (without filter)	DrenVSubIr (with filter)	Espadren (without filter)
L	16.61 m	22.94 m	20.27 m

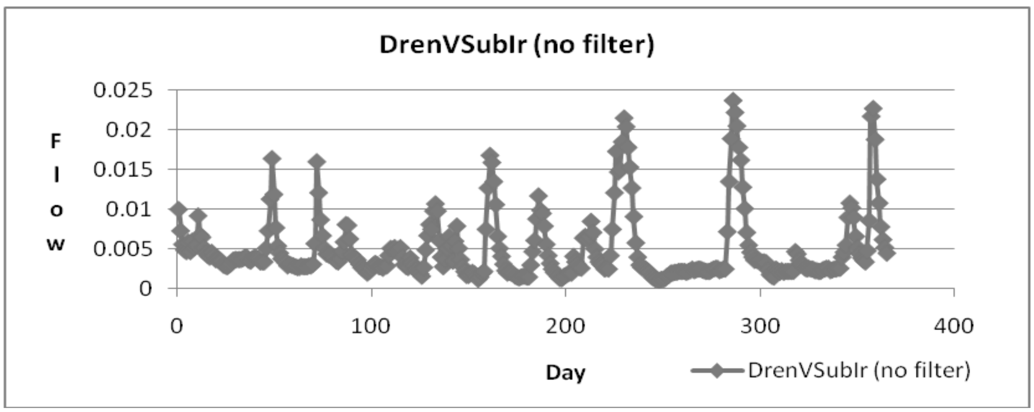

Figure 4 Discharged flow variation (SISDRENA program)

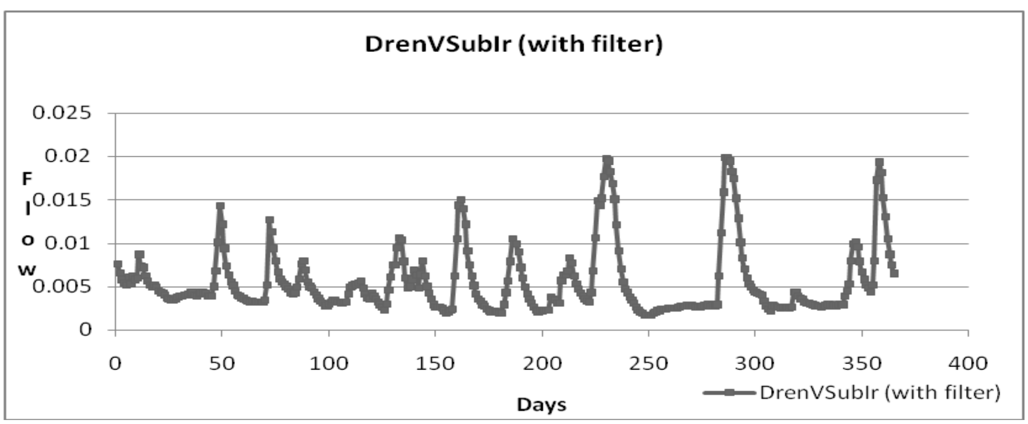

Figure 5 Discharged flow variation (SISDRENA program)

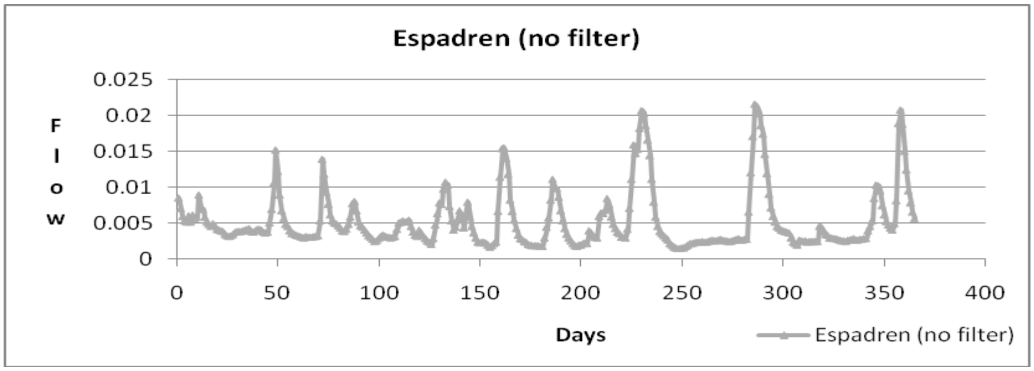

Figure 6 Discharged flow variation (SISDRENA program)

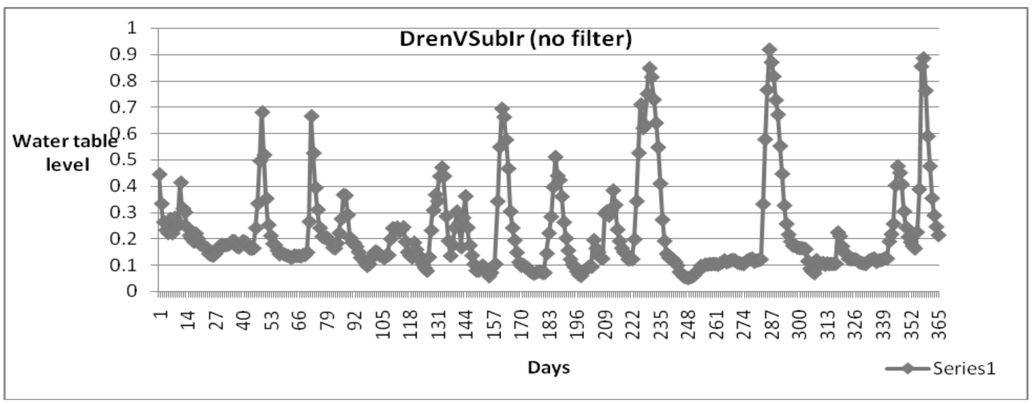

Figure 7 Water-table variation (SISDRENA program)

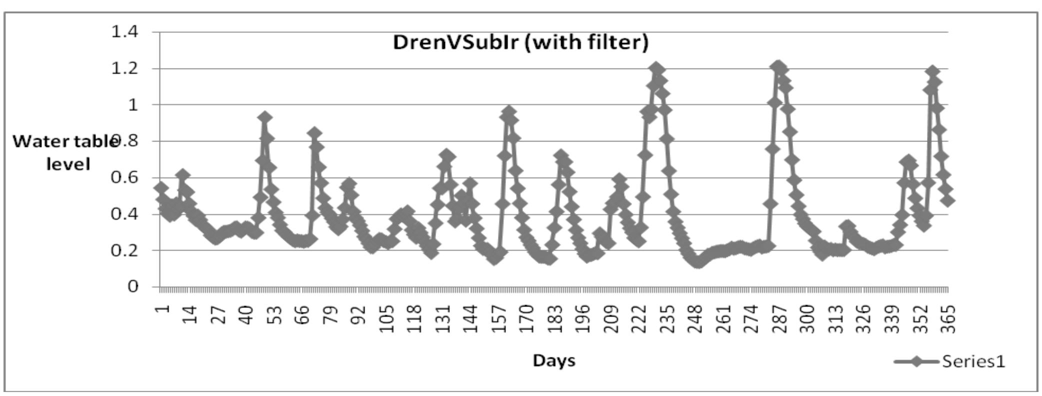

Figure 8 Water-table variation (SISDRENA program)

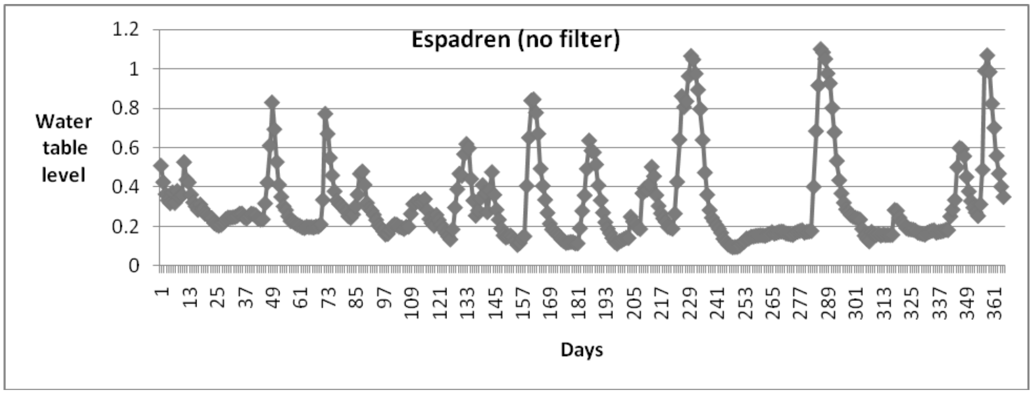

Figure 9 Water-table variation (SISDRENA program)

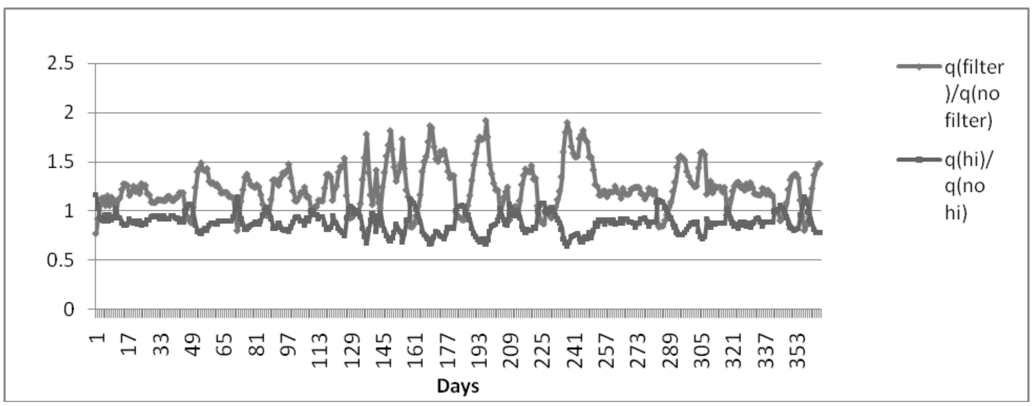

Figure 10 Impact of filtering material and of entrance head losses on discharged flow variation

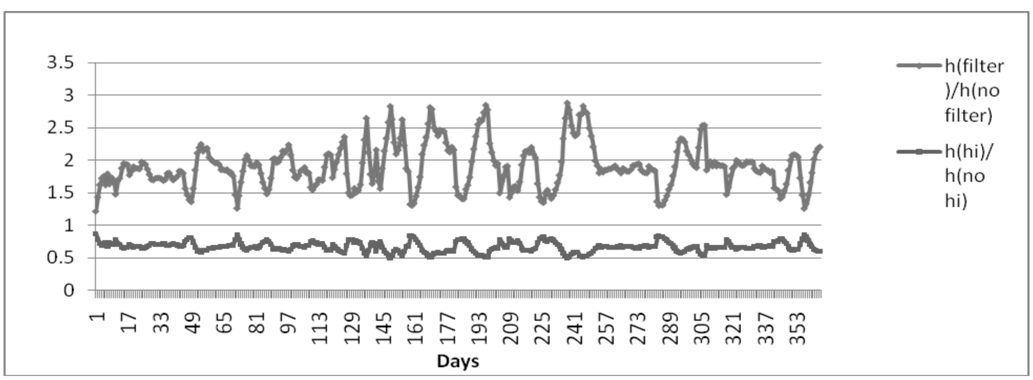

Figure 11 Impact of filtering material and of entrance head losses on water-table variation

DISCUSSIONS AND CONCLUSIONS

According to Romanian technical literature, the main element in designing a subsurface drainage system is represented by a correct calculation of distance between drain. The main researches were focused on this direction while in other countries (Western Europe, USA, Asia, South America), valuable researches were orientated to water-table variation and on discharged flow.

The multitude and variability of situations with humidity excess which can appear resulted in the use of numerous computation methods and programs which offer solutions with different levels of efficiency. Manual, classical, methods were replaced by specialized software. These software's are presenting a small risk regarding the potential errors and there are able to present detailed prognosis of the studied phenomenon.

The most prominent drainage model that is used in North America is DRAINMOD (Skaggs, 1981). This model has been used in all regions of the United States, and in many other countries, and is considered to be a truly effective method for the design of drainage systems (Skaggs, 1990). In other countries were developed similar models as: SISDRENA, DRENAFEM etc., models which proved that can compete with DRAINMOD and can be used efficiently in researches.

Input requirements for the model includes, among other things, the distance between drains. This element is very important to be determined correctly.

Some models developed so far for the determination of distance between drains didn't consider in their procedures the presence (or not) of filtering materials while other models didn't consider the head losses at water entrance in drains. These two factors can cause appreciable errors in drainage hydraulic design. In terms of filter material, the most important characteristic, with impact in designing distance between drains, is the thickness of the filtering material and not the initial permeability coefficient or permeability coefficient for filtering material after silting. The lack of considering these two factors, can lead to differences (in terms of distance between drains) of about 25% to 35% which will have a significant impact on discharged flow and on water-table variation.

It this idea, it is very important to improve the existing models in order to increase their complexity and the elements considered in calculations for a better hydraulic design of drainage arrangements. The authors will continue to analyze different models, to compare their results and to propose efficient solutions for an effective design of drainage systems.

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The study of head losses for land drainage pipes with and without filtering materials

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Abstract: - Knowledge of head losses in agricultural drainage systems may prove to be very important both in the design phase to establish an optimal distance between the drains and then into the operational phase of the drainage system for tracking efficiency. This work will be based on interpretation of data obtained in the laboratory and further processed using specialized software engineering design of drainage systems.

Key-Words: - drainage, DrenVSubIr, Espadren, entrance head loss, radial head loss

1 Introduction

In the calculation of horizontal drains should be taken into account the water movement characteristics near and into the drain. Regarding the conditions of water entry in drains, we have the following characteristic situations:

- entrance conditions appropriate to ideal drain;
- entrance conditions appropriate to real drain (drain provided with slots or holes through which water enters the drain and that give rise to hydraulic resistance;
- entrance conditions appropriate to real drain with filtering material, when the movement take place in an homogeneous porous environment [1,7].

Real input conditions, i.e. drain provided with slots and holes, the presence of filtering material or the existence of a clogged area near the drain, can substantially influence the piezometric share that forms midway between drains, representing the amount of hydraulic resistance through the massive porous environment, through the filter and the drain holes [1, 7].

Filter effect has been analyzed by Widmoser more recently by Stuyt, first obtaining a formula for the case of very thick filter and drain tube provided with continuous longitudinal slots. Theoretical and experimental studies on the effect of local phenomena in filter-drain tube complex were undertaken by many researchers, being putting out the necessity of a careful analysis of local hydraulic phenomena near the drain which can influence in certain conditions, in a decisive way, the drainage efficiency [5].

The flow towards a subsurface drain, according to Ernst, (Érnst, 1954) can be divided in a vertical flow, a horizontal flow, a radial flow and an entry into it. The total loss of head (h_t) will be the sum of all differences presented in the following picture and expressed by vertical head loss (h_v), horizontal head loss (h_h), radial head loss (h_r) and entrance head loss (h_e) [4].

The total head loss according to Ernst is [2]:

$$h_t = h_v + h_h + h_r + h_e \quad (1)$$

One assumption used in drainage design is that of an "ideal drain", without entrance resistance, whereby the drain can be considered as an equipotential. Entrance resistance was neglected by many authors because they considered that the drain surround (envelope material and loosened soil in the trench) has a very high hydraulic conductivity compared to undisturbed soil. Practical experience has shown that this cannot always be taken for granted. For a rational designing of drainage systems is required the completion of the drainage calculation formulas for ideal drains with an additional term which takes into account the head losses from the drain-filter complex [6].

The formula proposed by I. David (Romania) includes the terms proposed by Ernst and is fulfilled with the additional term ζ_{if} :

$$h = \frac{q \cdot D_v}{K} + \frac{q \cdot L^2}{8 \cdot K \cdot T_e} + \frac{q \cdot L}{K} \cdot \ln\frac{\alpha \cdot D_0}{U} + \frac{q \cdot L}{K} \cdot \zeta_{if} \quad (2)$$

A VIEW ON LAND DEGRADATION AND DESERTIFICATION ISSUES

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ABSTRACT

Land degradation and desertification are important global issues in the third millennium. While land degradation is world-wide spread, desertification is referring only to degradation of drylands. In a world with more than 7 billion people and a limited pedosphere there is great need to restore existing despoiled drylands and to combat increasing desertification.

Actual statistics are presenting alarming values. 25% of Europe and 40% of the world lands are drylands. 30% of semiarid Mediterranean drylands are affected by desertification and more than 30% of the region's population suffer from severe degradation.

Even if exists a lot of information about the issues that have lead to the loss of land quality and desertification, this information is dispersed, diffuse and largely unavailable to users. This paper will try to conclude on some points but without admitting that will offer the best picture for understanding land degradation and desertification issues

Key words: land degradation, desertification, drylands

INTRODUCTION

During the last decades, the scientific community in special and the humanity in general agreed that topics like land degradation and desertification are "hot" topics and they are surrounded by many, again, hot questions.

Perhaps the most 5 important questions (which were raised by Stafford Smith & Reynolds in 2002) on these two concepts are the following [1]:

- Which are the causes and the consequences of land degradation?
- Which is the border between natural land changes and anthropogenic land changes?
- The observed changes are reversible or not?
- Which is the amount of land affected or at risk?
- Which is the role and success of various abatement efforts?

In addition to these questions, Ellis et all (2002) raised another 3 questions [2]:

- The deserts are expanding?
- Which is the extension of this phenomenon?
- What are the causes (natural or anthropogenic)?

Then what is land degradation? What is desertification? How we should make the difference between them? One option may be to differentiate them using two terms: time and value, both of them being strongly linked to land degradation and land restoration.

LAND DEGRADATION

First of all we must understand the difference between soil and land. Soil represents the layer of material which covers the land (part of the world uncovered by water). The land is a complex ecosystem comprising beside soil and vegetation, biota as well as eco-hydrological processes operating within the system [3]. In this way, when we discuss about land degradation we must consider the loss of lands productivity and delivery of services.

Using as base two important international documents, UNCCD land definition from 1986 as well as the conceptual framework of Millennium Ecosystem Assessment, land as concept can be reduced to "terrestrial ecosystem", in this way, land degradation being a "reduction or loss of ecosystem services, notably the primary production services" [4]. In addition, Blaikie and Brookfield (1987) consider that land degradation has validity only in the social context of benefits for humanity which results from ecosystems using by people [5].

Wasson (1987) defines land degradation as being "a change to land that makes it less useful for human beings" [6]. Kimpe and Warkentin (1988) consider that "land degradation is a decrease in the optimum functioning of soil in the ecosystems" [7].

A 'classic-type' definition of land degradation was by Arntzen & Veenendaal in 1986 stating that land degradation comprises "all processes which cause bush encroachment, soil erosion and ultimately result in desertification". In this case, desertification refers to "land degradation which is difficult and/or costly to reverse". [8]

Warren & Agnew (1988) use changes in productivity as one of the main factors in defining land degradation while Ponzi (1993) stresses that present changes in productivity must be distinguished from changes in long-term production potential. [9, 10]

The definition of Abel and Blaikie (1989) has a more general meaning: [land degradation can understand it as an effectively permanent decline in the rate at which the land yields livestock products under a given system of management. 'Effectively' means that natural processes will not rehabilitate the land within a time-scale relevant to humans, and that capital or labour invested in rehabilitation are not justified. [...] This definition of degradation excludes reversible vegetation changes even if these lead to temporary declines in secondary productivity. It includes effectively irreversible changes in both soils and vegetation". [11]

Arntzen (1990) consider that reserving the term degradation for ecologically irreversible changes it becomes too narrow and he propose a more inclusive definition which states that "man-induced decreases in productivity are considered rangeland degradation when they have a lasting impact on rangeland productivity". [12]

The role played by economics was emphasize especially by Warren & Agnew (1988) and Biot (1991), the last one defining land degradation as „an environmental process which occurs when the ability of the land to produce the goods and/or services people demand from it is found to be declining. [...] what matters in the case of land degradation is not the reduction in soil depth or the increase in salinity, the reduction in organic matter or surface sealing, but its impact on the ability of the soil to generate 'well-being' through the range of goods and services this land produces. Economics is a fundamental part of any definition of and deliberation about land degradation.” [9, 13]

GLASOD (Oldeman et all, 1991) consider land degradation as being a state, a situation when land lost its function, or its productivity is reduced. The main feature of land degradation – agreed by most of the researchers – diminishing land productivity. We discuss here about “an action” which may take us to a preliminary conclusion: land degradation is not a state but a process. [14]

Land degradation is certainly a state if we analyse not the processes leading to a situation but the final state of the land. A clearly difference must be made between degradation (reversible/temporary situation) and desertification (which is a result and in almost all cases is irreversible). Going further, if we will analyze deeper the meaning of „degradation”, we will see that degradation is not meaning „removing” but „not having” or „acting in opposite to”. In this way, land degradation will not mean the loss or decreasing some of its qualities but a land without necessary (requested) qualities or with qualities which are not in concordance with the expectances from this land.

A better option will be to use the expression of land declassing instead of land degradation. Land declassing can be defined as a lowering of land services delivering due to some causes, factures and pressures (natural of human induces).

A very interesting analysis of what „degradation” means is given in the work „Patterns of Land Degradation in Drylands”. When we analyse the state of land degradation, we will measure its physical and biological properties and not its inherent or potential utility. „Degradation” can be „measured” only with respect to a known use (past, present or future). [15]

Land degradation as is understands it today can be natural or human induced. Looking at the previous paragraphs, land degradation due to natural causes can be expressed as land declassing while land degradation due to human causes (and considering that we are leaving in a world dominated by selfish financial purposes) can be understand as land despoiling.

Which is the genesis of land degradation? According to a study realized in 2009 for the European Parliament, there are at least 5 macro-pressures driving land management changes [16]:

- Demography
- Economy;
- Policy;
- Technology;
- Climate changes.

According to Lal R., land degradation implies replacement of climax vegetation with secondary vegetation, alteration of humus quantity and composition and adverse changes in soil quality and related ecosystem services. In contrast to land degradation, soil degradation is caused by natural and anthropogenic perturbations in the hydrological cycle, nutrient cycling, energy budget and activity and species diversity of soil biota. [17]

A common conceptual framework for land degradation (using actual terminology) can be represented as it follows:

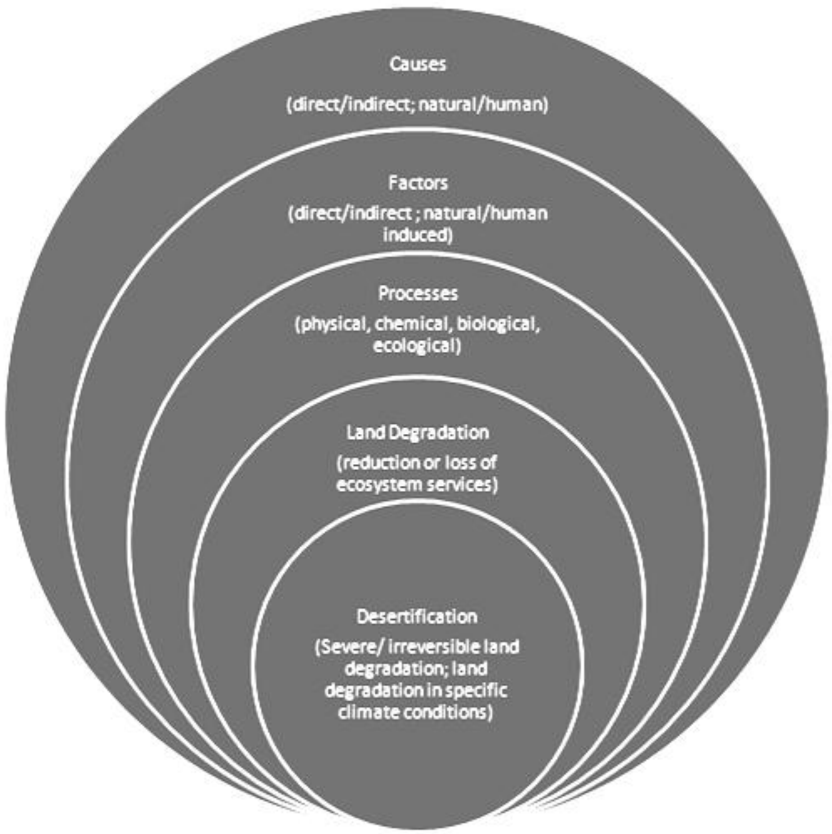

Figure 1 Conceptual framework for Land Degradation Study

DESERTIFICATION

Desertification is the most severe form of land degradation – the wasteland. Desertification doesn't mean that land is turn to desert because typical desert land forms in the geomorphic sense do not usually form in sub-humid or semi-arid zones due to land degradation.

Historical evidence during the last few centuries shows three main epicentres of desertification: the Mediterranean region, Mesopotamia and the loessial plateau of China, with serious and extensive land deterioration [18].

If we are going to analyze the word „desertification" from etymological point of view, we can conclude the following:

- The word is derived from Latin language
- The word "desert" has a twofold origin. On the one hand we have the adjective "desertus" meaning uninhabited and on the other hand we have the noun desertum meaning a desert area
- We have the also the verb "fication" meaning an act of doing [19].

What desertification means? Where and how we should use it?

Lavauden is credited to having used the word desertification in a paper in 1927. He said „'throughout the whole Sahara – I dare to say – desertification is fully artificial: uniquely man-made'[20].

The concept of desertification was first introduced in the scientific literature by Aubreville in 1949. Aubreville described desertification as the changing of productive land into a desert as a result of ruination of land by man-induced soil erosion in the humid and sub-humid tropics where he worked.The following, many times contradictory, meanings were partially reviewed by Verstraete in 1986. [21, 22]

Who we should blame? First of all maybe we should take a look back in the history. Ancient writers were aware about the influence of humans on landscape degradation. Some clues can be found in the Bible, Jeremiah 12:10-11: "Many shepherds will ruin my vineyard and trample down my field; they will turn my pleasant field into a desolate desert. It will be made a wasteland, parched and desolate before me; the whole land will be laid because there is no one who cares". Even from that times, a definition of desertification included economical aspects (in this case references to a vineyard).

Columella, in his great work De Re Rustica, emphasizes human's carelessness on natural factors leading to agricultural degradation. In the first century, it was estimated that our world had a population of about 200 millions while now we are more than 7 billions . Using this comparision can be desertification considered as an entirely humans fault? Hardly to say in our days but probably no. Geologists, geographers and paleoclimatologists are all aware that deserts known expansion and contractions in the past due to natural causes. But what is natural now? Still, we can't consider desertification strictly literally. We didn't create and probably that, only humanity, will not be able to create typical desert land forms in the geomorphic sense.

In 1924, Huntington view the land degradation in the Mediterranean area as a result of adverse climatic changes (hypothesis of climatic determinism). 20 years later, Lowdermilk emphasized the human factor as a cause for desertification: "By neglect, ignorance and suicidal agriculture, peoples have bequeathed to their descendants "man-made deserts" of sterile, rocky and gullied lands". [23, 24]

In 1976, Meckelein identified 5 components which can define desertification [25]:

- climate
- hydrological processes

- morphodynamic processes
- soil dynamics;
- vegetation dynamics.

Glantz (1977) consider that exists more than 100 definitions for desertification, this number proving the complexity of this problem. None of these definitions includes all of the desertification study directions (causes, mechanisms, manifestations, impact) [26].

There is a common point in all these definitions: desertification is an adverse environmental process. It was developed an entire list with negative descriptors of desertification:

- deterioration of ecosystems [27];
- degradation of various forms of vegetation [28];
- destruction of biological potential [29];
- decay of a productive ecosystem [30];
- reduction of productivity [31];
- decrease of biological productivity [32];
- alteration in the biomass [33];
- intensification of desert conditions [34, 35];
- impoverishment of the ecosystem [18].

Nelson (1988) states that „desertification is a process of sustained land (soil and vegetation) degradation in arid, semi-arid and dry sub-humid areas, caused at least partly by man" and which „reduces productive potential to an extent which can neither be readily reversed by removing the cause nor easily reclaimed without substantial investment". [36]

Soule (1991) and Reynolds (2001) state that desertification principally consists of three major components [37, 38]:

- Meteorological (drought, atmospheric dust, air temperature, elevated atmospheric CO_2, variability of precipitation)
- Ecological (nutrient cycling, plant growth, regeneration, mortality, microbial dynamics, plant cover, herbivore life cycles, evapotranspiration)
- Human dimension (loss of habitat, fragmentation of habitat, overexploitation, spread of exotic organisms, air, soil and water pollution, climate change).

In a much more complex approach, desertification should also include in its definition and other concepts as land capability, land sustainability, vulnerability, resilience and carrying capacity [39].

In 2002, Prince gave the following definition for desertification: "Desertification refers to the process by which changed biogeophysical conditions emerge owing to human actions that cannot be supported by the resource base (mainly rainfall) and that will not quickly return to their former, non-desertified conditions, either naturally or by application of minor management practices". [40]

The definition proposed in this paper has the following form: Desertification is the process by which emerge unsustainable biogeophysical conditions due to human actions supported by a water scarcity climatic factor, conditions that will not quickly return to their non-desertified form, either naturally or by application of an integrated management based on sustainable land reclamation practices.

CONCLUSIONS

On a planet with more than 7 billion people land and soil health are more than essential in order to cover the necessary quantities of food. Meanwhile we need to sustain land and soil health in order to be able to response properly at the climatic changes and to maintain the so much necessary hydrological flows.

Land degradation is a very complex system involving different types of interactions and links between processes, generated by causes and affected by factors. If we want to reduce the extent of land degradation, scientifically robust and accurate information is needed for a consistent monitoring, for establishing priorities in land restoration and for adopting appropriate solutions.

For a better understanding of desertification we must continue our researches on the links between social and economic factors, we must better understand the factors affecting the ecosystem services and we must involve all the stakeholders bridging together the people with know-why and those with know-how.

There will be a continuous need to develop new specific solutions for land degradation, tailored measures for land restoration. We will have to better understand the land's value to society considering the continuous demand for new lands.

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The impact of climate changes on water balance from western Romania using computer tools

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Abstract: - Global climate is changing and the impacts on water resources can be hardly predicted. Climate change creates variations in water storage and fluxes at the land surface, in storage in soil moisture and groundwater, seasonal snow packs; wetlands and reservoirs, precipitation, runoff and evapotranspiration.
This paper will use a program to analyze the impact of climate changes on water balance from western Romania using as input data temperature and precipitation values for a period of 30 years.

Key-Words: climate changes, water, Romania, water balance

1 Introduction

Climate changes are alterations on long-term of weather components as temperature, precipitation etc. Generally, when we discuss about the impact of climate change, we firstly talk about water. Water is a vital component of our environment, society and is one of the main components of climate changes.
The impact of climate change on water is undeniable and is experienced most directly on water availability. Perhaps the most visible direct impacts of climate change on water, relentless in expression and covered area, are land degradation and floods.

2 Climate change influences in water balance

The water balance plays a key role in the interactions between climate and biosphere. Water balance, which includes elements as precipitation, runoff, evapotranspiration will not remain unaffected by these shifts induced by climate change. Climate change alters precipitation patterns leading to fundamentally differences in comparison with a past situation. Evapotranspiration also presents variations across a landscape due to temperature, humidity, wind and vegetation cover.

3 Climate in Western Romania

For Timiş County, characterized by a moderated continental temperate climate with Mediterranean influences, and with periods in which the climate in unpredictable, were identified 4 major regional climates as it follows: low plain regional climate, high plain regional climate, hills regional climate and mountains regional climate [1].
The annual average temperatures presents variability depended on the relief forms, with values from 4º - 7ºC (in mountain areas) to 10º - 11ºC. During spring and summer, the dominant air masses are temperate type of oceanic provenience and they bring the most important contribution regarding precipitation volume. In this sense, an obvious example is the flooding from 2005. The cyclones and warm air masses influence from Adriatic Sea and Mediterranean Sea are felt especially during winter by the frozen and solid precipitation missing while during summer are periods with extreme hot temperatures [2].
The precipitation regime has an irregularly character, with wetter years than the average followed by years with very few precipitations.

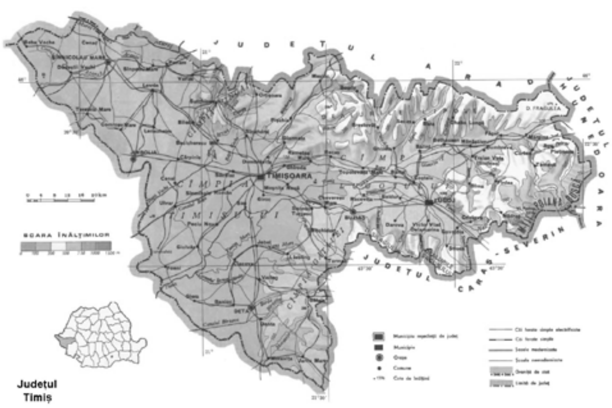

Fig. 1 Geographical map of studied area [3]

The analyzed area covers the Aranca River's hydrographic basin, a plain area having a slope

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Article

Threats to Sustainability of Soil Functions in Central and Southeast Europe

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Abstract: A diverse topography along with deforestation, changing climatic conditions, long-term human settlement, overuse of agricultural lands without sustainable planning, cultural difficulties in accepting conservative land management practices, and wrong political decisions have increased the vulnerability of many soils to degradation and resulted in a serious decline in their functional capacity. A progressive reduction in the capacity of soils to support plant productivity is not only a threat in the African continent and its large desert zone, but also in several parts of Central and Southeastern Europe (CASEE). The loss of soil functions throughout CASEE is mainly related to the human activities that have profound influence on soil dynamic characteristics. Improper management of soils has made them more vulnerable to degradation through water and wind erosion, organic matter depletion, salinity, acidification, crusting and sealing, and

ECOSYSTEM SERVICES PROVIDED BY LAND RECLAMATION AND IMPROVEMENT WORKS. STUDY CASE: TIMIS COUNTY

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ABSTRACT

Agriculture is a major contributor to climate change but is also heavily impacted by it. Sustainable land and water management plays an important role in climate change mitigation and adaptation strategies. Some key elements of sustainable land and water management are represented by land reclamation and improvement arrangements (irrigation and drainage mainly). The main goal of land reclamation and improvement arrangements (irrigation and drainage) is to improve agricultural production. Irrigated agro-ecosystems maximize agricultural production but they can also provide and other services such as: erosion control, flood retention, sediment retention, groundwater recharge and habitat for birds. The economic value of ecosystem services provided by land reclamation and improvement works may be substantial larger than the crops' value.

This paper will explore and analyze the ecosystem services provided by land reclamation and improvement works from western Romania (Timis County).

Keywords: land reclamation and improvement, ecosystem services, land and water management

INTRODUCTION

Global population is expected to increase from 7 to 9 billion until 2050, situation which will lead to an even significant increase of food demand and, consequently, of water needs [5, 6, 7]. Agricultural lands and agricultural production are threatened by climate changes especially due to the severe changes in rainfall and temperatures variability. The increasing pressure on lands and agricultural water management stemming from complex water-food-energy linkages requires an improved integrated land and water resources management [1]. Water scarcity and water excess (water logging) have a negative impact on agricultural productions and can be managed with the help of land reclamation and improvement arrangements (irrigation, surface drainage, deep drainage, soil erosion control etc.).

According to the ecology dictionary, land reclamations means to make land able for a more intensive use through changing its general character (by example: by drainage of excessively wet land, irrigation of arid or semiarid land, recovery of submerged land from seas, lakes and rivers).

Land reclamation counteracts a specific form of land degradation while land improvement refers to increasing the land value and its productive capacity. Land reclamation and improvement works includes mainly irrigation and drainage systems but also soil erosion control works. Land reclamation and improvement arrangements are managing land, water and plants, are both energy users and providers, have a strong impact on land management and are answering to climate changes by mitigating their effects and by creating microclimates.

Land reclamation and improvement works are a significant part of agricultural water management and have influences spread in all components of land-water-climate-energy nexus. They provide important ecosystems services including groundwater recharge, flood retention, carbon sequestration, erosion control, accumulation of soil organic matter, recycling of soil nutrients, supporting diversity by providing habitats for flora and fauna.

Integrating these different benefits in the framework of agricultural water management requires breaking down disciplinary boundaries between engineers, ecologists, agronomists, economists, hydrologists and climate scientist and the appliance of some reliable climate-energy-economic models as well as land-use models.

An improved understanding of ecosystem services provided by these works and of relations developed in the frame of land-water-climate-energy nexus and the implementation of climate adaptive land reclamation and improvement systems will decrease the pressures on basic resources.

CLIMATE CHANGE CHALLENGES ON AGRICULTURE

The ability of agriculture to respond to future challenges may depend, at least in part, to the potential changes in its adaptive capacity. A number of indices of adaptive capacity have been developed to capture different elements of social and economic vulnerability to climate change [3, 8].

Defining and selecting the determinants of adaptive capacity is essential. It is important to consider agricultural innovation and technology as a main determinant, as well as natural capital, social capital and economic capital.

European agriculture is thus predicted to suffer variable consequences from climate change. At the same time, agricultural systems provide a changing portfolio of ecosystem services at the local and regional levels. The interplay of climate change and land use results in differential dynamics of biophysical impacts for different regions in Europe (Figure 1).

Interlinked climate change adaptation and mitigation options need to be devised for these diverging contexts which moreover differ in socio-economic conditions and institutional arrangements. Importantly, for such options to be manageable they need to fit to local agricultural systems and be acceptable for local land users (farmers and users of ecosystem services) [9, 10, 11].

The technical options to address climate impacts in agriculture have often been considered as adaptation strategies to climate variability [2]. In the context of incremental climate change, the limits to such approaches need to be better understood, and their interactions with the provision of other ecosystem services becomes more important [4, 12].

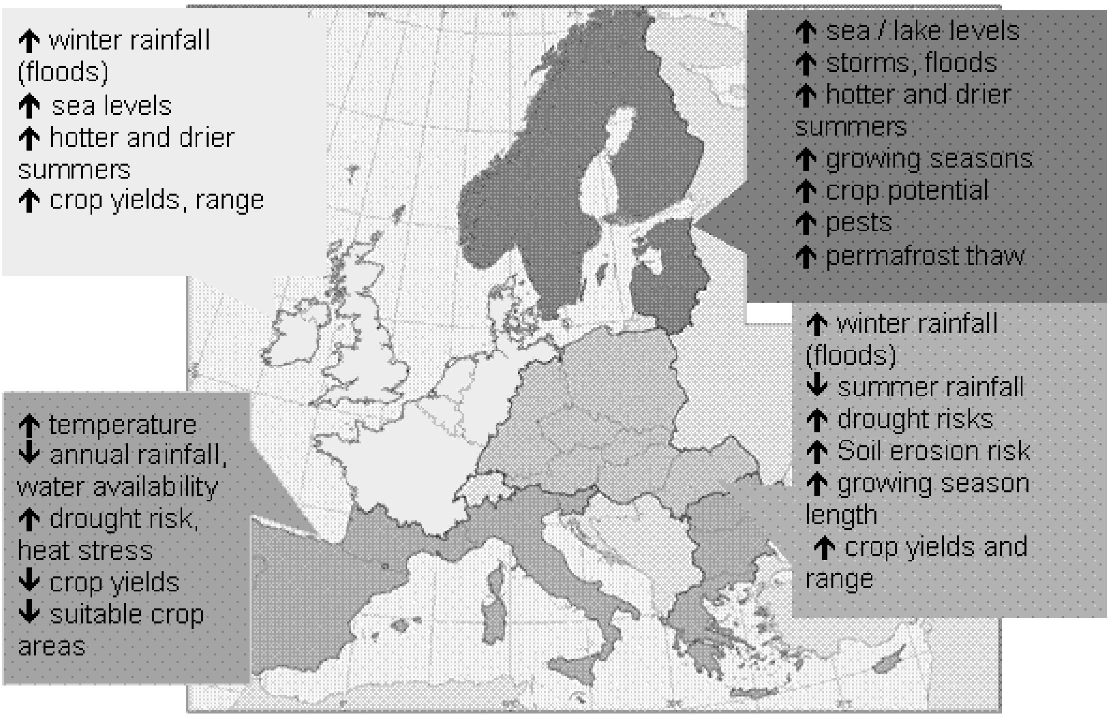

Figure 1 Projected impacts from climate change in different EU regions [15].

LAND RECLAMATION AND IMPROVEMENT ARRANGEMENTS IN TIMIS COUNTY

For mitigating and/or removing the negative effects of climate changes and in order to prevent land degradation (land slides, soil erosion), in Timis County were implemented land reclamation and improvement arrangements including irrigation, drainage and soil erosion control works. Some arrangements are complex integrating several types of works (irrigation with drainage, soil erosion control and drainage), which works simultaneously or alternative in spring, summer or autumn according to area necessities.

On the territory of this county were established 42 surface drainage arrangements, 2 irrigation arrangements and 13 soil erosion control arrangements which cover agricultural and non-agricultural surfaces having well established borders. The National Agency of Land Improvements – Timis Branch owns and manages land reclamation and improvement works covering a total surface of 480.000 ha which represents almost 70% of Timis County territory. Before 1990, in Timis County were executed land reclamation and improvement works covering 16379 ha for irrigations, 438000 ha for drainage and almost 41000 ha for soil erosion control. Currently, the irrigation arrangements are those which recorded a significant regression regarding the covered area, from more than 16000 ha to less than 1500 ha.

Due to the lack of interest from the public authorities, the lack of funds for this sector and a legislation which has been changed too often, the situation of irrigation arrangements is very bad, part of works being devastated while other having a limited capacity of operation. Some arrangements were given to water users associations for exploitation. However, in the last years some private investors implemented some irrigation arrangements but very small as covered area. Most of the surface drainage arrangements are currently operational and very useful in evacuating the water excess but important amounts of money are necessary for their maintenance and operation. In the last 25 years, soil erosion control works were neglected. As a consequence, many of them need rehabilitation works. More than that, there is a strong need to extend these works in order to respond properly to latest problems regarding land degradation.

In the next figures are presented the areas covered with different types of land reclamation and improvements arrangements.

Figure 2 Irrigation arrangements in Timis County [14]

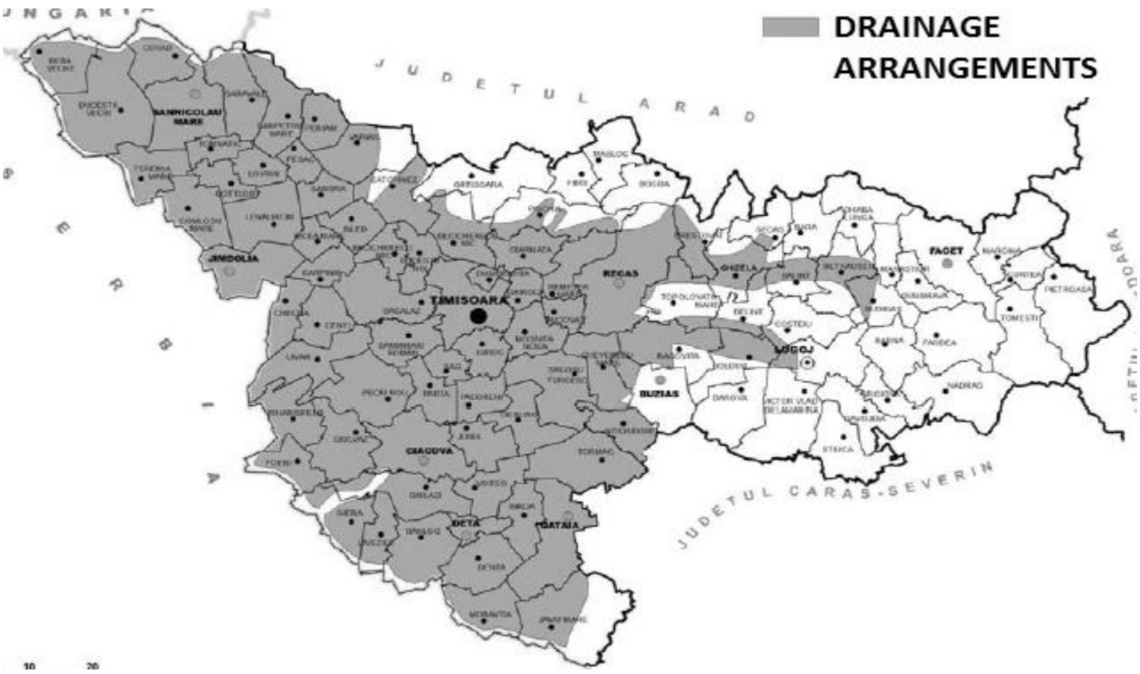

Figure 3 Drainage arrangements in Timis County [14]

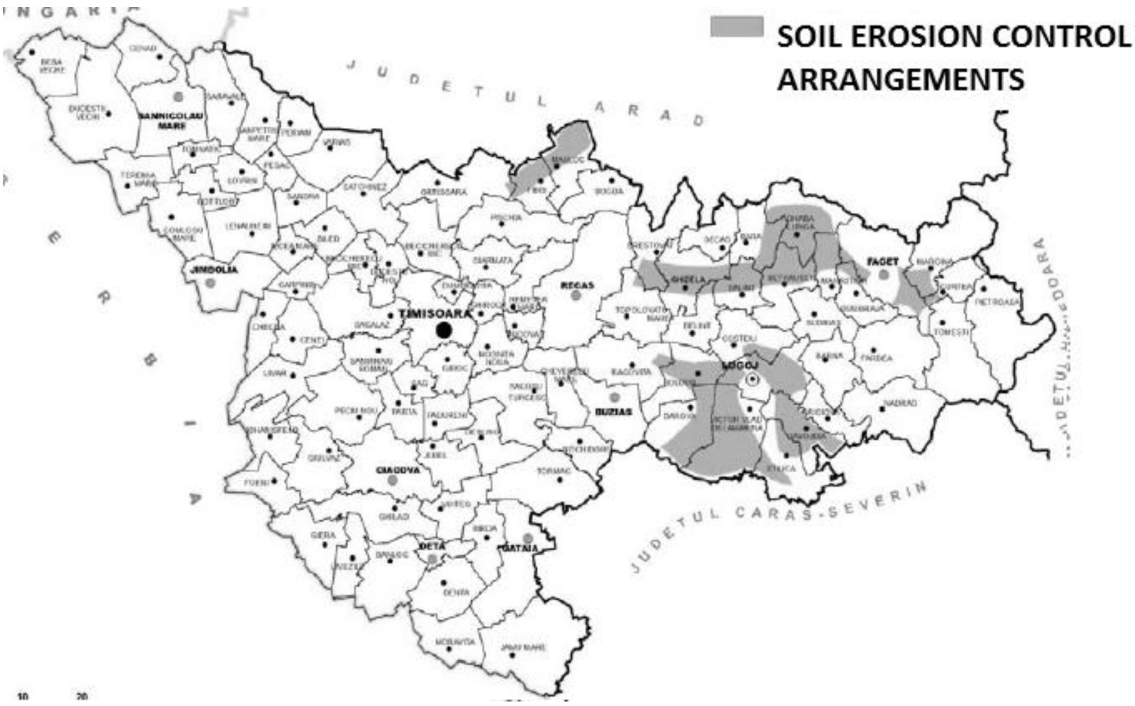

Figure 4 Soil erosion control arrangements in Timis County [14]

ECOSYSTEM SERVICES PROVIDED BY LAND RECLAMATION AND IMPROVEMENT WORKS. COMMENTS ON THE SITUATION FROM TIMIS COUNTY

The Millennium Ecosystem Assessment report from 2005 defines the ecosystem services as being the benefits which people obtain from ecosystems and distinguishes four categories of ecosystem services (supporting services, provisioning services, regulating services and cultural services), where the so-called supporting services are regarded as the basis for the services of the other three categories.

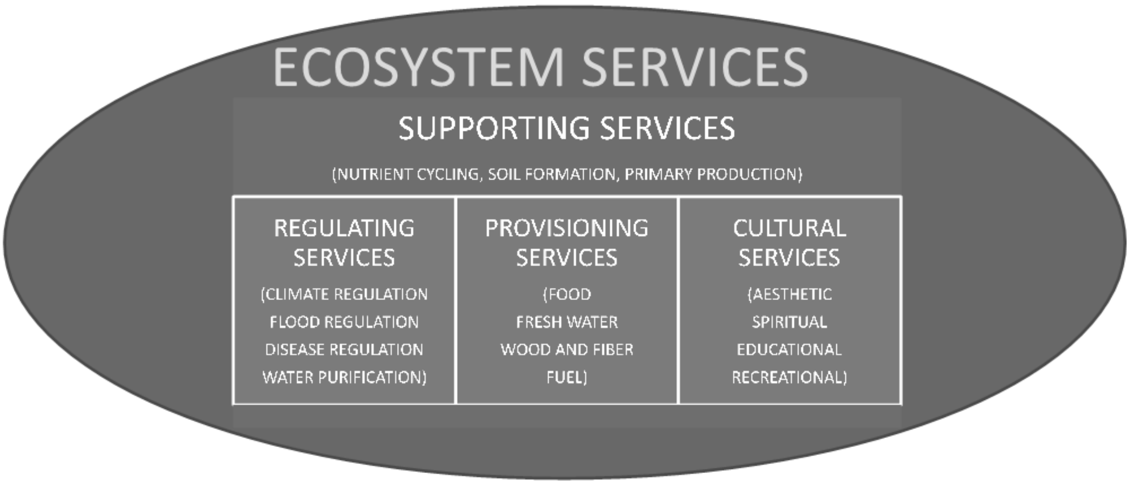

Figure 5 Categories of ecosystem services (reproduced after Millennium Ecosystem Assessment Report from 2005, www.millenniumassessment.org)

Land reclamation and improvement arrangements, especially irrigation and drainage works, possess the capabilities to provide important ecosystem services mainly from the first three categories: supporting, provisioning and regulating services. The main potential supporting ecosystem services are including soil erosion control, soil nutrients recycling and soil organic matter accumulation. It is very difficult to identify these services on Timis County territory covered by land reclamation and improvement works. The lack of implementing sustainable land management measures is an important impediment in gaining these services. Sustainable land management is defined as the use of land and water resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions. The tillage reduction in combination with land covers restoration and the maintenance of water in soil are only a few parts of an efficient and sustainable land management will have a positive impact on increasing agricultural productivity and will also deliver important services like reducing the erosion [13].

Two of the most important regulating ecosystem services for Timis County are flood retention and groundwater recharge. Unfortunately, the uncontrolled and intensive drainage practiced in western Romania severely affected the capacity of groundwater recharge. Currently, in extreme western part of Timis County as well as in some areas from northern part, aridization becomes more and more clearly a feature of local climate.

Timis County was one of the most affected areas by flooding in 2005. The drainage canals which were not properly maintained together with an underestimation of pumping stations discharge capacities contributed to long-term stagnation of water from floods and implicitly to land degradation. Experts from academia and land reclamation system have issued a disastrous scenario for agriculture and for the western part of Romania: without rapid intervention in land improvements, floods will make Romania to lose more than one million hectares of arable land in the Western Plain.

Flash floods, which are specific to hilly areas and have as main factor the massive deforestations from the last years, can cause also significant land degradation especially when there are other phenomena such as landslides, although usually have an impact on relatively small areas.

An indirect factor of land degradation due to flooding is represented by political involvement in flood management. Land reclamation system from Romania, which handled so far by embankments, drainage and floods, passes in recent years through a series of perpetual reorganizations being very unclear what is the purpose of these actions. In a new reorganization, the National Administration of Land Reclamation is reconsidered in a new form, which involves massive layoffs with a severe negative impact on maintaining and operating the existing water excess (flood) management infrastructure.

There are numerous examples in which interventions to restore flood defense works were limited to recover the affected works and not according to the physical condition and their continued degradation. Staff and insufficient funds made impossible current maintenance and repair embankments, dams, channels, culverts.

CONCLUSION

The ecosystem services and their maintenance in a continuous flow are very important for humanity. Unfortunately, the continuous demand for food made the Agricultural management from the last century to cause widescale changes in land cover, watercourses, and aquifers. Ecosystem services were highly degraded including the processes that support ecosystems and the provision of a wide range of ecosystem services.

In countries like Romania, a sustainable agriculture can't be practiced without land reclamation and improvement arrangements. Irrigation and drainage works are very important in provision of food. However, the emphasis on practicing an intensive agriculture in order to maximize the crops can harm and prove to be very costly from ecosystem services point of view. There are numerous studies which emphasize the importance of exploiting the ecosystem services, especially because of economic and ecological reasons. Irrigation and drainage works with a sustainable management can prove to be more valuable on ecosystem services part instead of focusing mainly on intensifying agriculture.

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Successful and Unsuccessful Stories in Restoring Despoiled and Degraded Lands in Eastern Europe

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ABSTRACT

Worldwide, there are over 2 billion hectares of degraded and deforested land. These places have lost their ability to provide nature's benefits to people and the planet. The complexity of land degradation forms imposed reestablishment techniques' identification of lands' economical, social and cultural potential through rehabilitation, remediation, reclamation, mitigation and restoration measures. Several restoration projects were implemented in Eastern Europe, part of them being successful while other not so successful. Understanding what went right and what went wrong are key elements for future restoration projects. However, there are enough signals that in some cases a little attention was paid to sharing and/or observing restoration project results mainly because each project was considered to be unique, not connected to other similar cases or because of a mentality which considered that sharing negative results is shameful. This paper gathered and put together several restoration, reclamation and remediation case studies from Eastern Europe, stressing both positive and negative results.

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INTRODUCTION

General considerations:

Land degradation affects large areas of Eastern Europe where social, economic and political changes generated high pressures on land resources, all of these under the global climate change. There is great need to restore existing despoiled and degraded lands and to combat increasing desertification. In Eastern Europe can be identified several main categories of despoiled and degraded lands: drylands, lands with water excess, waste rock dumps, abandoned lands, deforested lands, polluted lands. Environmental degradation resulted from activities like land-use change, resource extraction, waste deposits, aggressive deforestations or indifference and disinterest which alter numerous functions and services provided by ecosystems.

Land degradation is defined by the FAO as a "process which lowers the current and/or potential capability of soil to produce goods and services". This definition focuses more on soil degradation processes which is considered to be the most significant land degradation processes.

The main feature of land degradation – agreed by most of the researchers – is diminishing land quality and productivity. In this sense, we need to mention here the definition proposed by Stocking and Murnaghan which states that land degradation is a composite term describing how one or more of the land resources changed for the worse. We discuss here about "an action" which may take us to a preliminary conclusion: land degradation is not a state but a process. However, applying modern techniques for land works and considering the state-of-art in land use, can be considered this progress degradation? On the other side land development works may have both positive of negative effects. In the last case, can we discuss about negative land development? If we will analyze deeper the meaning of „degradation", we will see that degradation is not meaning „removing" but „not having" or „acting in opposite to". In this way, land degradation will not mean the loss or decreasing some of its qualities but a land without necessary (requested) qualities or with qualities which are not in concordance with the expectances from this land.

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