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THE REHABILITATION AND ASSURANCE THE ABANDONED HYDRO ACCUMULATIONS CASE STUDY

BY

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Environmental Engineering

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Abstract. Before 1989, were built several small hydro-technical works, with the purpose of covering the necessary water in dry periods, but also to mitigate flood waves on the arranged water-course.

After 1989, some of them were abandoned or removed from service, and the areas occupied by lakes basin remained unused because of the wide spread hydrophilic vegetation. In these conditions, to be run again, these accumulations require some rehabilitation works and making them safe.

Keywords: dam; storage; rehabilitation; safety.

1. Introduction

The hydrotechnics scheme Silişte, situated in the village Mărgineni, Neamț county, it was built in 1970-1972, by former CAP Mărgineni, to mitigate the flood flows on the river Celac and to ensure the flow downstream of the dam easement. Also, the accumulation represents an alternative source of water for animal drinking throughs area and eventually for growth fish under natural.

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2. Work Content

Silişte accumulation is made by crossing the watercourse Celac, through an earth dam embedded in both sides of the watercourse, occupying an area of 0.65 ha on NNR, from which body of water S = 0.48 ha.

2.1. Initial State

After 1989, the accumulation has not been use for any reason, being abandoned. At the moment, is as follows:

a. Water accumulation bowl is almost entirely overgrown by aquatic vegetation, cogged up with plant and soil deposits. Water is not retained, flowing to the bottom discharge of tower maneuver; accumulation banks are unequipped, and in patches collapsed in bowl, because of rainwater drainage.

b. In a cross direction, perpendicular to the direction of drainage creek Celac, the dam accumulation is made of earth compacted in layers, by flush between the two banks of the watercourse; bank slopes in both directions are degraded and requires correction by adding compacted earth and bents insurance; the bank from pond is not protected against water, and the opposite should be strengthened and grassy; the crest of wave is used as a way of exploitation (servitude) for agricultural vehicles and animals from area, connecting the both banks of the river.

c. The tower maneuver (monk) is made of concrete, is in a proper condition and throughput whole flow downstream of Celac river by bottom discharge.

d. There's no overflow and no energy disperser for high water discharged from Silişte accumulation (Fig. 1).

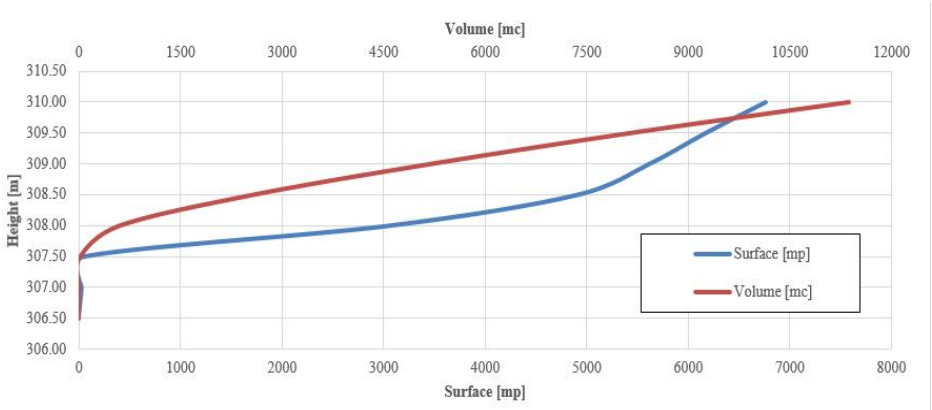

Fig. 1 – Characteristic curves of accumulation in the current situation.

2.2. Rehabilitation and Assurance

For assurance the accumulation, in hydrology and hydraulic calculation aims safe transit of flood waves corresponding calculation and verification probabilities.

The maximum flow rate with a probability of 1% has a value of 24.00 m^3/s, and the flow calculation (5% probability) is 13.00 m^3/s. Growth during flood is one hour and 8 min, and the total time of the flood is 4 hours and 56 min., the shape coefficient of the flood is γ = 0.32 (Fig. 2).

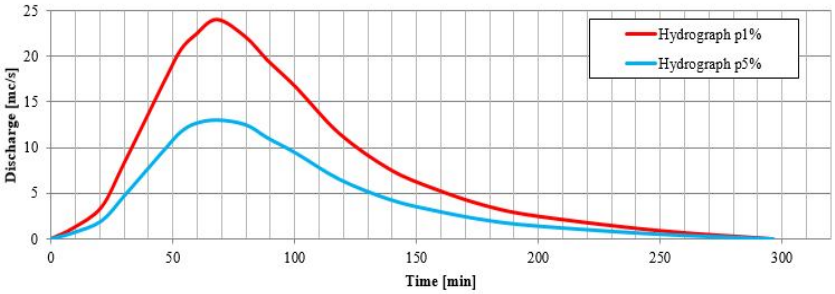

Fig. 2 – Hydrographs probability of 1% and 5% in the reservoir tributary.

a. Reprofiling storage tank

For the accumulation to be able for fish, it is necessary that the mean depth of water in lake must be at least 1.50 m. The surface normal level of retention (NLR = 309.00 m) is 5,616 m^2. To fulfill the minimum condition of 1.50 m – mean depth of water in lake, it will result one necessary volume of water of 8,424 m^3. As currently, the volume to NLR is only 5,196 m^3, it emerged as needed reprofiling the tank lake by digging 3,228 m^3 of river deposits. The bed silt will be deposited and leveled on the borders. For stabilizing the deposits, tree saplings will be planted in these areas.

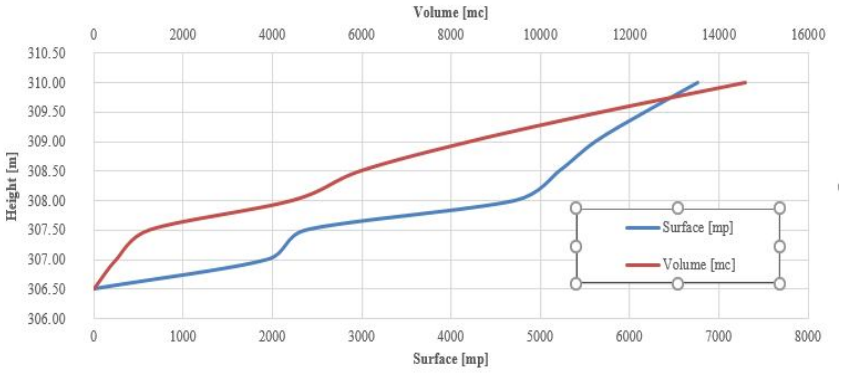

Fig. 3 – Characteristic curves of accumulation after the reshaping.

In the middle of the tank lake, after the reshaping will perform a channel width of 5.00 m and 1.00 m depth from monk and to the lake bottom. It will be a refuge for fish in the cold.

Following the completion of works designed redeployment of accumulation tank will result in an increase in storage capacity of accumulation. Volumes and the corresponding areas of different water heights are shown graphically in Fig. 3.

b. Overflow

For transit safely through the accumulation of flood waves, overflow of waters will be one of "crocodile", which corresponds hydraulic walled weirs.

Length spillway for dimensioning calculations were made to mitigate flood wave assuming various values thereof. He emerged as the optimal length of 19.00 m spillway. This corresponds to a crocodile overflow with a length of 8.50 m and width of 2.60 m on the outside (Figs. 4 and 5).

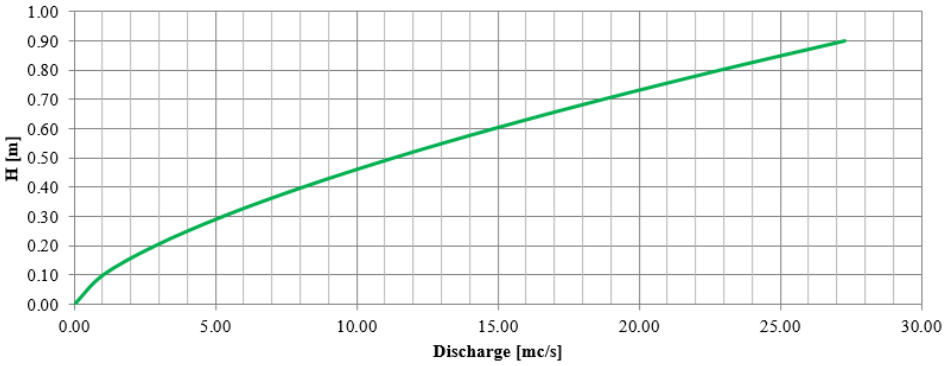

Fig. 4 – Limnimetric key of the overflow type „crocodile”.

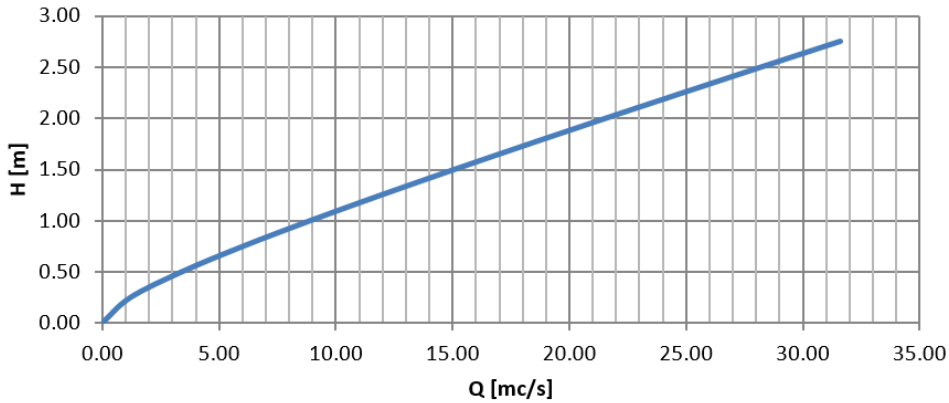

Fig. 5 – Limnimetric key of the overflow channel outlet.

The results obtained from the calculation of flood wave attenuation probability of 1% (Figs. 6 and 7).

h_{max}	W_{max}	Qd_{max}	Qg_{max}	$Qdis_{max}$
2.8990 m	10676 m^3	22.9716 m^3/s	0.1378 m^3/s	22.8338 m^3/s

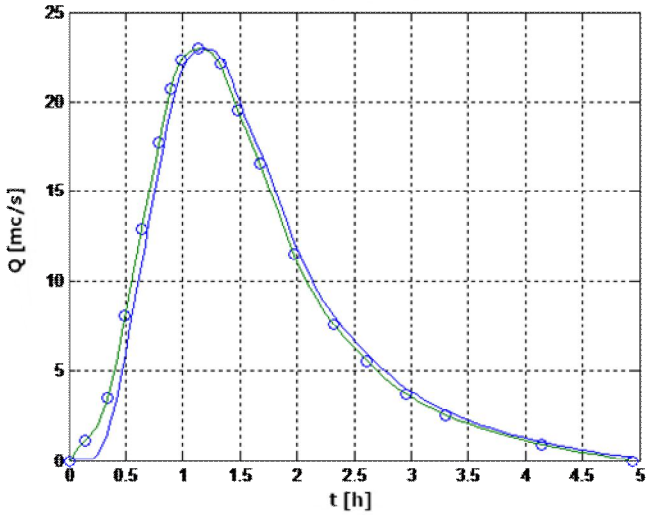

Fig. 6 – Hydrograph with 1% probability of storage attenuated.

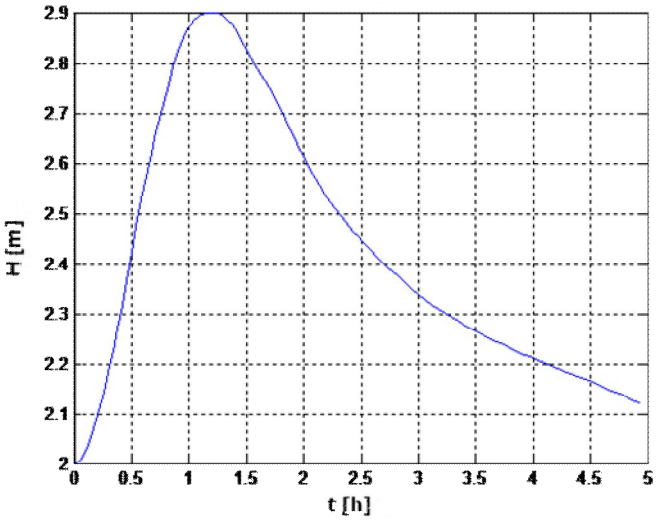

Fig. 7 – The evolution of the water level in the lake
to mitigate flood probability of 1%.

The results obtained from the calculation of flood wave attenuation probability of 5% (Figs. 8 and 9).

h_{max}	W_{max}	Qd_{max}	Qg_{max}	$Qdis_{max}$
2.6449 m	9029.2 m^3	12.9866 m^3/s	0.1283 m^3/s	12.8584 m^3/s

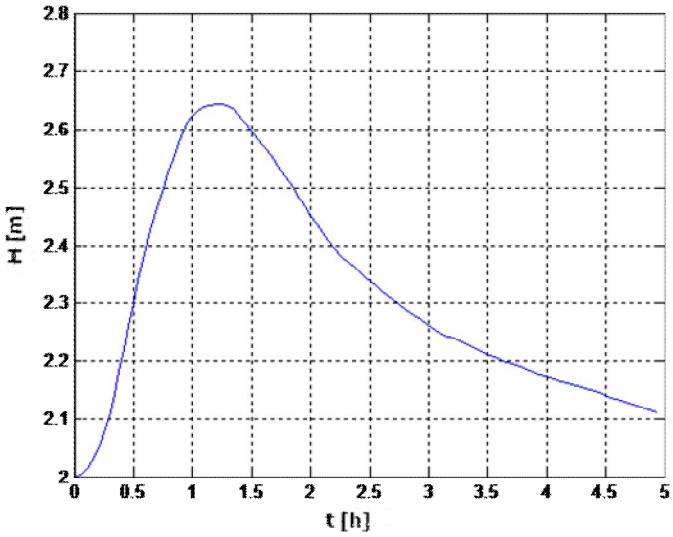

Fig. 8 – Hydrograph with 5% probability of storage attenuated.

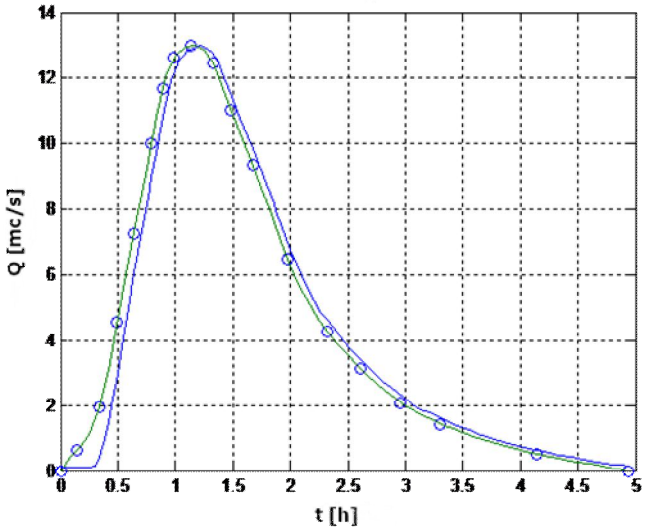

Fig. 9 – The evolution of the water level in the lake to mitigate flood probability of 5%.

c. Earth moving at the dam and screen protectors

Upstream slope will be cleaned of vegetation and compacted clay will perform fillings where it shows irregularities.

Upstream slope erosion protection will be achieved by a screen made of concrete. It will be arranged across an equalizing layer of sand with a thickness of 10 cm over the surface slope. Screen concrete XF3-C25/30 will have a thickness of 10 cm and will be reinforced with a mesh STNB F4. Will be performed at the joints of 2.00 to 2.00 m screen, gaps to be filled later with an asphalt mastic. To the bottom of the screen will lean on a continuous slab of concrete C8/10 having the depth of 1.00 m and width of 50 cm.

3. Conclusions

Following the structural measures that have been suggested, accumulating Silişte can reenter the safety circuit operation, while satisfying the new service at optimal capacity (fisheries), but will also be a line of defense against high water for farmland downstream accumulation.

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REABILITAREA ŞI PUNEREA ÎN SIGURANŢĂ A ACUMULĂRILOR HIDROTEHNICE ABANDONATE
Studiu de caz

(Rezumat)

În România există multe amenajări hidrotehnice de mică anvergură abandonate ce au fost proiectate cu scopul atenuării undelor de viitură de pe cursul de apă amenajat, dar şi pentru satisfacerea necesarului de apă în perioadele secetoase. În acest mod, suprafeţele ocupate de cuveta lacurilor rămânând practic neutilizate datorită vegetaţiei hidrofile prezentă din abundenţă.

În această lucrare se prezintă un studiu de caz în care se exemplifică cum o astfel de amenajare hidrotehnică poate fi repusă în siguranţă în exploatare.

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RESEARCH ON THE RELATIONSHIP BETWEEN SOIL HUMIDITY AND HYDROSTABILITY OF MINERAL AGGREGATES FOUND IN THE DANCU SITE, IAŞI

BY

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Abstract. This research is centered on noting the relationship between soil humidity and soil aggregates stability present in the study area Dancu. For this study were used several laboratory methods applied at international level for each soil property. To determine the soil humidity was used the vials oven drying method and to determine soil aggregates stability was applied the soil aggregates diving method using the Eijkelkamp Wet Seiving Apparatus.

Keywords: hydrostability of soil aggregates and soil humidity.

1. Introduction

Even from ancient times the soil has been the main supply source of the population with food without which we could not exist. For these reasons approach with as much seriousness of the problem of excess or deficiency of moisture is key to solving this variation impacts on soil properties (Stătescu & Pavel, 2011).

The amount of water retrieved at a time in three-phase medium (the soil) is the basic characteristic of one of the most important environmental

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components in the absence could result in serious damage to vital development plants support. (I.C.P.A., 1980).

Soil humidity is one of the most important soil traits because it depends most of the hydraulic characteristics of the soil and beyond. In our study we will discuss the relationship between hydraulic conductivity soil humidity and soil aggregates that contribute to the formation of a certain area. (Filipov & Lupaşcu. 2003).

2. Materials and Methods

From Dancu area (Fig. 1 a) were extracted a series of disturbed samples shown in Fig. 1 b) one for each depth (0,...,20 cm, 20,...,40 cm, 40,...,60 cm and 60,...,80 cm).

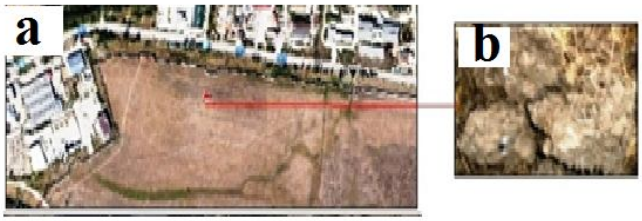


Fig. 1– Presentation of the location study: *a* – zone of sampling soil; *b* – samples harvested.

Analyze of soil humidity was achieved using drying oven (Fig. 2 *d*). soil dried soil vials method (Fig. 2 *b*, *c*).. by weighing their input before and after introduction to drying machine (Fig. 2 *a*).. After the humidity, soil aggregates stability analysis was performed by the Wet Seiving method.

This determination was implemented using the Eijkelkamp Wet Seiving Apparatus (Fig. 2 *a*).

Fig. 2 – The tools used in research: *a* – equipment used to analyze soil aggregates stability - Eijkelkamp Wet Seiving Apparatus; *b*, *c* and *d* – equipment used to analyze the soil humidity.

Soil humidity is determinated with following equation: (Dumitru, 2009):

$$W_g = \frac{b-c}{c-a} \cdot 100, \, [\%], \tag{1}$$

where: W_g is the humidity, [%], a – mass of empty vial, [g], b – mass of vial with wet soil, [g], c – mass of vial with dry soil, [g].

For analyze the soil aggregates stability was taken into account the material scraped from the 4 g of soil analyzed result after drying expressed in percentages

3. Results and Discussions

In Table 1 are presents the results obtained after applying the research methods of the soil humidity and the soil aggregates stability for Dancu study area.

Table 1

The dates of soil humidity and *soil aggregates stability* for Dancu site

Sample	*W*, [%]	$S_a \times S$, [%]
D 0-20 cm	27.03	4.2
D 20-40 cm	23.97	3.22
D 40-60 cm	23.73	31.27
D 60-80 cm	20.87	25.7

According to Fig. 3 where the soil taken from the first depth can highlight the connection between soil humidity and aggregates stability that can be presented by an inverse variation of both features taken into account.

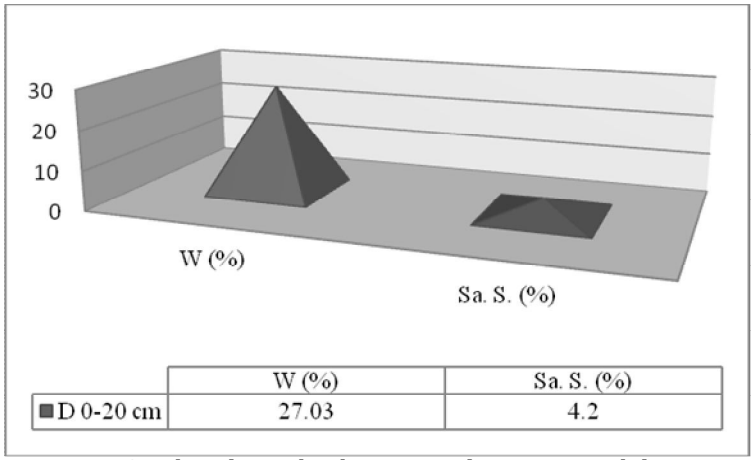
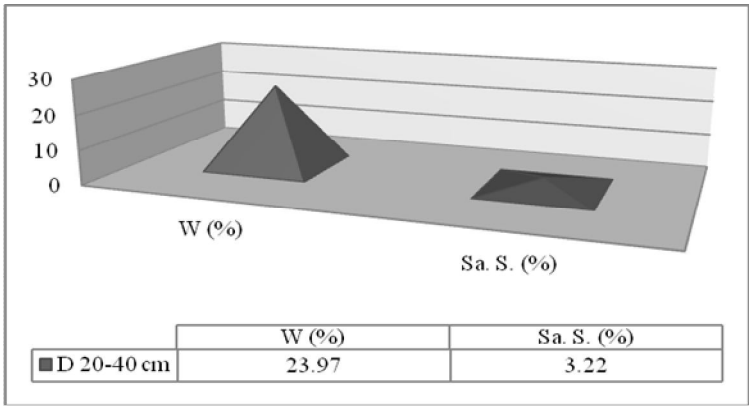


Fig. 3– The relationship between soil aggregate stability and soil humidity for D 0-20 cm.

Thus with increasing humidity decreased the amount of material eroded from the soil aggregates analyzed which means that this is among the best in terms of stability of aggregates substantiated by the presence of a higher content of organic and a significant percentage dust and sand.

As in the of case previously situation presented in Fig. 4 is similar but far greater stability of the soil structure is represented in this case by noting a higher content of clay and a lower dust and sand. In this situation we see that there is a decrease in soil humidity percentages assigned in relation to the increased aggregate stability which means that D 20-40 cm the soil is the most resistant (Table 1).

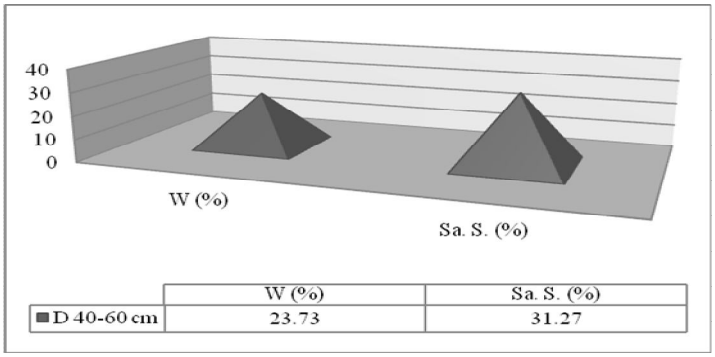


	W (%)	Sa. S. (%)
D 20-40 cm	23.97	3.22

Fig. 4 – The relationship between soil aggregates stability and soil humidity for D 20-40 cm.

Soil samples taken from the depth of 40-60 cm from the other soil samples has posted the lowest aggregate stability of the four samples a value of humidity similar previous case (D 20-40 cm).

This can be attributed to increased bulk density due to compaction and settlement process triggering uneven particle aspect shown in Fig. 5.

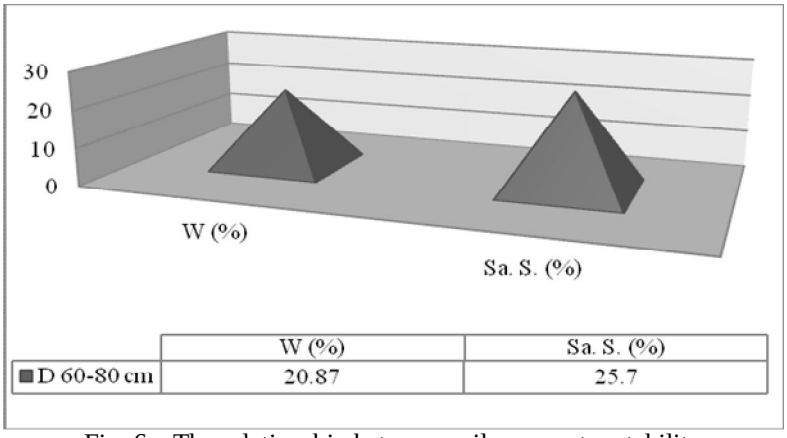


	W (%)	Sa. S. (%)
D 40-60 cm	23.73	31.27

Fig. 5 – The relationship between soil aggregates stability and soil humidity for D 40-60 cm.

In the case of soil taken from the last depth (60,…,80 cm) the aggregate stability value was higher than the humidity actually see in Fig. 6.

But it should be noted that compared to other soils it presented a lower clay content and biggest dust and sand content. Even though this type of soil was richer in carbonate rocks presented a low stability to certain variations of the hydro property.



	W (%)	Sa. S. (%)
D 60-80 cm	20.87	25.7

Fig. 6 – The relationship between soil aggregates stability and soil humidity for D 60-80 cm.

4. Conclusions

After studying of this relationship we can emphasize the following conclusions:

a) soil from the analyzed site presented a series of situations which differed from one to another depth;

b) according to the interpretation of results has resulted as the most unstable soil was extracted from D 40-60 cm depth showed no increased aggregates stability to the action of soil humidity.

The relationship between the two hydrophysical properties (humidity and aggregates stability) is very important because it greatly affects soil hydraulic properties due to the detachment of a quantity of material from the weaker consolidated aggregates that can limit the access and water storage for plants.

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CERCETĂRI PRIVIND RELAȚIA DINTRE UMIDITATEA SOLULUI ŞI HIDROSTABILITATEA AGREGATELOR MINERALE REGĂSITE ÎN SOLUL DIN SITE-UL DANCU, IAŞI

(Rezumat)

Cercetarea de față este axată pe notificarea relației dintre umiditatea solului şi stabilitatea agregatelor de sol existente în zona de studiu Dancu. Pentru realizarea acestui studiu s-au folosit o serie de metode de laborator aplicate la nivel internațional pentru fiecare proprietate a solului.

Pentru determinarea umidității solului s-a utilizat metoda uscării fiolelor la etuvă, iar pentru determinarea stabilității s-a aplicat metoda scufundări agregatelor de sol în apă cu ajutorul aparatului Eijkelkamp Wet Seiving Apparatus.

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METHODS USED IN ROMANIA FOR ESTIMATING THE AGRICULTURAL LANDS VALUE PLACED IN OUTSIDE THE CITIES

BY

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Abstract. In context of the vast process for agricultural new-structure characterized through reinforcing measures of the private properties and real estate market formation, land valuing is a necessary, important and very complex operation.

Taking into account that in our country is not established yet a single and compiling method for land valuing, in the present paper there are presented some of the principles and techniques frequently used in Romania in the above mentioned purpose.

Keywords: estimating; agricultural lands; market economy.

1. Introduction

In market economy, the ground is an object of landed property protected and guaranteed judicially, giving to the owner the right of usufruct, originate in the right of landed rent.

Once entered in the circulation of goods, the lands become an object of transaction and affairs, there for the need to determine it is value.

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The estimation of lands in the market economy is a very important operation because it is value has a share in the chapter of agricultural property, in the same time, the estimation of lands' value gives the possibility of establishing some general and right taxes, some equitable compensation in case of their disappearance as a result of some disasters or case of expropriations for public interest, of amalgamations for organizing/consolidating of territory.

The estimation of lands value places the right documentation at the management of the state's disposal, necessary for some economic – financially investments destined to attenuate the inequality due to lands' different quality. She can be used also at establishing the leasing prices, the compensations for temporary putting the lands out of service, at grating credits etc.

For our country the problem of lands' estimation gained a great importance since 1990, because of the transformations that occurred, like the rebuilding of private property over the lands (Law 18/1991), the freedom of prices, the regulating of the lease as a form of land exploitation, the subvention of agriculture through different mechanisms etc., all these influencing especially the landed rent (the clear income).

Plus, the Romanian agricultural area (14.81 mil. hectare) represents a high percent of the landed content 62.1% (from which: 39.1% arable, 14.3% pastures, 6.4% hayfields, 1.1% vineyard, 1.0% orchards), in comparison with the forests 28.1% and 9.8% other lands.

2. The Value and the Estimation of Lands

The estimation practice follows, mainly, the next values:

a) *The output value*, taken as an economic objective category (variable in time), because it is based on agricultural soil rating of the lands and on the estimation of the clear income related with the quality classes. It is obtained by capitalizing the clear income owed to the land and it gets bigger as the land is more fertile.

b) *The circulation value*, established by the output value and from how much it is hoped to gain. She is build up by the law of requirement and offer, and her determination by calculation is very difficult.

The circulation value/the price depends on the obtainable income, which is powerfully influenced by the capacity of careful management, by the lands position and it is established only on the market. This method consists in determining a lands value by selling – buying price of other lands through calculating the average for the area (region).

c) *The taxable value*, as the value which is required to the tax payers after there are subtracted the mortgaged interests, the capital interests ant the wining percent from the whole net income. For this meaning, the net income and the output value are basic elements for establishing the taxable value.

The estimation of the lands' output value has two different stages:

i) establishing the production's capacities of the basic soils of agricultural soil rating, which also pays attention to the soil characteristics and to the natural conditions;

ii) the estimation of the clear income depending on the concrete conditions of production and related with the result of soil agricultural soil rating.

Through the works of agricultural soil rating, using a system of established indexes for every characteristic of the soil and natural conditions, it is obtained the agricultural soil rating grade which has values between 0 and 100; the characteristic considered most favorable it is noted with (1) and the limitative one with (0). By multiplying the factors between them (18 as number) and with 100 it is obtained the agricultural soil rating grade.

Table 1

The value of a Point of Agricultural Soil Rating, [kg/ha], *for the Main Culture Plants*

Culture	1975 – 1980 period		Years	
	Average technology	Advanced technology	1995	2015
Wheat	60	70	90	100
Corn	80	90	110	130
Sun flower	30	35	40	50
Potatoes	450	550	600	700
Sugar beet	500	600	700	800
Apple	300	500	800	900
Vine	150	200	220	250
Grass, hay	100	110	130	140

Based on the researches made on agricultural productions for many years, it is established the "value" of a point of agricultural soil rating expressed in (kg) of product for the main culture plants (variable in time). Knowing the agricultural soil rating grade and the value of a point of agricultural soil rating it is possible to calculate the average productions at (ha) for each culture plants.

The variability of productions levels at the same work and material costs, brings a large differentiation of the net and global income, of productions costs and this way of profitableness level and agricultural production. In the same time, for estimating the clear incomes level it is necessary to keep in mind the condition of cultivating those plants or cultures that are more profitable for each area (Table 1).

Considering the agricultural soil rating grade intensified, after doing some landed improvements, the average production related with the agricultural soil rating grade, the productions costs (lei/ha, lei/kg), the productions value (lei/ha), the net income ant the obtained average (lei/ha), in Romania, the whole agricultural landed content was defined in 23 natural territorial units, with a certain grade of homogeneity, called agricultural ecosystem, where the landed rent is also different (Fig. 1).

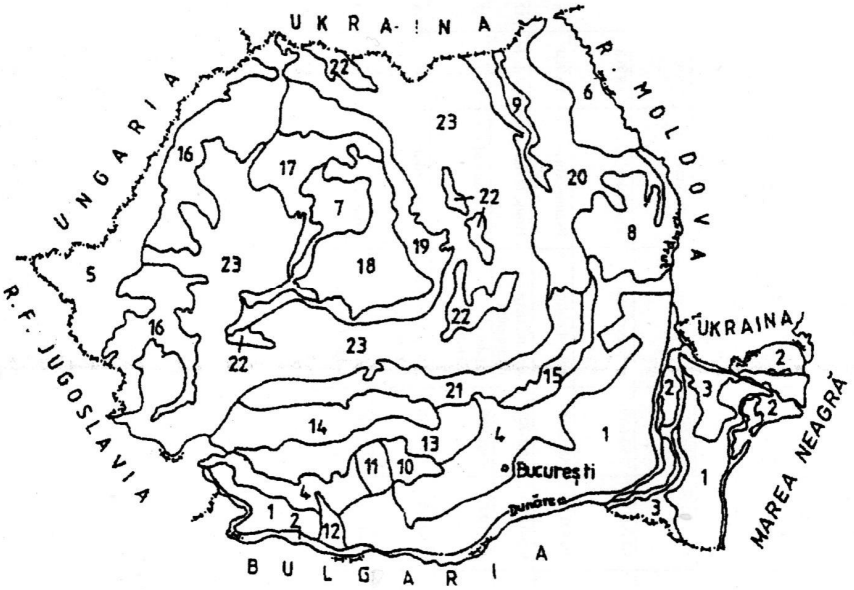

Fig. 1 – The map of agro systems in Romania (Mihalache *et al*., 2001).

Based on the data delivered by research – projection sector, depending on the agricultural soil rating grade it can be obtained the lands value (lei/m²) (Table 2).

Table 2

Lands Value by the Quality

Utilization category	Lands' value, [lei/m²], depending on the soil rating grade								
	10	20	30	40	50	60	70	80	90
Arable	x	x	x	x	x	x	x	x	x
Pastures	x	x	x	x	x	x	x	x	x
……	…	…	…	…	…	…	…	…	…
Vineyards	x	x	x	x	x	x	x	x	x

The values from the table are considered to be average for the arable lands, pastures and hayfields and maximum for the lands cultivated with vineyards and orchards.

The lands output value can be obtained by multiplying the net income with the capitalized rate (100:3 = 33.3 – interest specific for agriculture).

At an administrative territory level, knowing the average grade of agricultural soil rating for each utilization category and the lands value (lei/m²) indicated in Table 2, it is possible to calculate "the land's value calculated by the agricultural soil rating grade".

Because the clear incomes size and the lands value are influenced by some supplementary productions costs, due to parcels position, to the distance

from the processing centrals and markets, to the roads conditions (consolidated or not, slope etc.), to the access to the lines of communication etc., it is necessary to modify the value calculated by the agricultural soil rating grade, by using a correction coefficient (with ± values) to each utilization category from the administrative territory, table no. 3.

Table 3

The Estimation of the Lands Average Value at the Administrative Territory's Level

Nr. crt.	Administrative territory	Surface ha	The agricultural soil rating grade	The value calculated by the agricultural soil rating grade lei/m²	The rectified value lei/m²	The average value in different conditions lei/m²		
						A	B	C
1.	Albeşti	x	x	x	x	x	x	x

Obs.: A – lands placed near localities, with uniform relief, easy to access etc.; B – lands placed in the middle area of the administrative territory (average conditions); C – lands placed in more distanced areas, with unequal relief, hard to access, etc.

3. Methods of Qualitative and Valuable Estimation of the Present Used Lands in Romania

The estimation of lands in Romania is made by landed estimates certified, according to the law, by the Agriculture, Nourishment and Forests Ministry, which uses different methods for determining the lands value, depending on the utilization category and it is cadastral value, not existing yet a unitary methodology.

In case of agricultural lands placed in the outside cities towns are used the next methods:

3.1. The Method of Determining Lands Value Based on the Profit - Method 1

The relationship calculation is as:

$$V_t = (V_p - C_p)N, \quad , \tag{1}$$

where: V_t is the lands value, in the outside cities towns, [lei/ha]; leu = national currency; 1 € = 3.4 lei; V_p – productions value (main production + production and productions increases from the technologic output); N – the number of years in which the capital redeems/capitalization rent (25 – 30 years in Romanian agriculture).

For establishing the lands value through this method the requested surface is to be made a part of a crop rotation (wheat 50%, corn 20%, soy bean 20%, sun flower 10%), depending on soil favourability, respectively the

agricultural soil rating grade (wheat 60 points, corn 55 points, soy bean 47 points, sun flower 44 points) and the areas specific.

Depending on the elements which refers to the crop rotation and the elements from the cultures technology slip it is established the profit per surface unit (lei – hectare) from which, by applying the capitalization rate for 25 years, according to the law it results the circulation value per surface unit (lei/hectare).

3.2. Method 2

The method of determining land's value based on the norms of taxable agricultural income (Government's Urgent Decree 8/2001, regarding the modification of Law 34/1994):

$$V_t = V_{ai} \cdot 25, \tag{2}$$

where: V_t is the land's value, [lei/hectare]; V_{ai} – the taxable agricultural income (G.U.D. 8/2001)

3.3. Method 3

The method of determining the land's value depending on the patrimony (H.G. 764/1991 modified through Government's Disposal 59/1994):

$$V_t = V_p \cdot K \ , \tag{3}$$

where: V_t is the land's value, [lei/hectare]; V_p – patrimony income depending on the quality class/the agricultural soil rating grade (H.G. 59/1994); K – the coefficient of updating the exchange rate leu/dollar.

3.4. The Method of Comparison and Establishing the Average Value

Through this method is established the circulation value of the lands as an arithmetic average of the values obtained by the methods presented at **3.1.**, **3.2.** and **3.3** points.

For the cases of taking out from the agricultural circuit the lands price is multiplied with a series of coefficients (according to normative acts in force), in which case the lands price may increase several times.

Observation. *In all cases it is used either the block estimation or the parcelling estimation.*

The block estimation takes into consideration the determination of land's value without pointing out each part of the land by it is nature. This estimation is used especially in the areas where the qualitative differences between the lands are small.

The parcelling estimation consists in analyzing each parcel of land by it is characteristics and then the separate estimation. The total value is obtained by adding the partials values. This means that the agricultural land is estimated separate by quality, then the pastures land, hay land etc.

4. Conclusions

1. The determination of lands value in general and of those agricultural, forestry or of those under construction etc, especially, is a complex operation of knowing the conditions of growing and developing the plants, because in the end the estimation of one certain land represents it is capacity of producing an adequate income.

2. In all cases, no matter the utilization way of the land, it is value will be determinated absolutely by it is quality, established through operations of agricultural soil rating which takes in consideration mainly the physical and chemical qualities of the soil (the fertility).

3. For the studying of the lands estimation it is considered necessary to be taken in consideration also the placement of lands, applying the correction coefficients (which can have unitary value, under or over unitary), depending on the access ways, on the shape and size of the parcels, the in closer to some production processing centres etc., obtaining in the end the agricultural soil rating grade. The lands estimating value at an „average" level on an administrative/cadastral territory, it answers only partially to the variety conditions existent in it.

4. In the context of the present Romanian economy the operation of establishing the circulation value of the agricultural lands, should not be limitated to characterizing the lands on five classes of quality, but on all the interval between 0 and 100 points of agricultural soil rating , being able to avoid them, and so, some ideas about enhancing the value of natural conditions in Romania and about the lands capacity of production , matter which determinated several times uniforms measures and solutions, economically and technologically speaking, for the land in a whole different way.

5. Regarding strictly by the production capacity and the clear income which can be brought by a hectare of agricultural land, it is price can be calculated according to the known economic procedures related with the capital interests (appreciated at 5…10%, practiced in case of a relative stability period of a states economy, determinated by the evolution of financial – banking parameters and of the inflation).

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METODE UTILIZATE ÎN ROMÂNIA PENTRU ESTIMAREA VALORII TERENURILOR AGRICOLE LOCALIZATE ÎN EXTRAVILAN

(Rezumat)

În această lucrare este arătată o metodă de determinare a valorii terenurilor agricole poziţionate în afara localităţilor. În contextul unui vast process pentru o agricultură sub o nouă structură, caracterizată prin măsuri ale proprietătilor private şi a formării pieţei imobiliare de consolidare, evaluarea terenurilor agricole este o operaţiune necesară, importantă şi foarte complexă. Luând în considerare faptul că în ţara noastră nu este stabilită încă o metodă unică pentru evaluarea terenurilor, în lucrarea de faţă sunt prezentate câteva dintre principiile şi tehnicile utilizate frecvent în România, în scopul menţionat mai sus.

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STUDIES FOR THE MANAGEMENT OF WATER SUPPLY SYSTEMS

BY

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Abstract. This paper shows studies conducted for the exploitation management of urban and rural water supply network. The management is achieved through the creation of special cadaster for the pipeline networks. Meshing water supply system components is achieved using a GIS model. With Autocad and ArcMap software, obtaining of thematic maps on specific system domains is granted. Every component is composed from many subcomponents with specific structural and functional characters. With the help of GIS we seek to specify custom properties using layers of structural and functional domains. The paper presents a series of results in this domain on a national and global plan.

Keywords: pipeline; GIS model; monitoring; ArcMap.

1. Introduction

The continuous growth of technical and economic performance of water supply systems compels the existence of a suitable management of water distribution, maintenance and automation of the operating process.

Drinkable water supply systems of Romania were built in different steps in time and the technical and economic level from that moment. This

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situation is also found at water supply systems from other countries. In the actual stage, water supply systems are facing problems related to water distribution management, completion of repairs, consumption monitoring, automatisation of operational process etc. A big gap of the actual systems is the lack of data on the pipeline network structure and of hydrotechnical constructions located on these. They are not entirely known specific data of hydraulic system type (flow rates, pressure, velocity) structural type (lengths, diameters, material, years of functioning), technologic type (location, material execution, mounting depths) of network evolution (year of commissioning, during operation, rehabilitation) etc., specific data are not fully known. The absence of this information has brought the necessity of a database for optimal exploitation and water supply development in the centre of attention.

GIS model implementation in water supply monitoring, allows the analysis and querying of data that describe in a complex way the pipeline network. The GIS model can create a hydro cadastre that can cooperate with other forms of cadastre. With the help of GIS model the view, editing, updating, location can be achieved also the processing of data from the water supply systems. The activity can be realized from the office in addition from the field. This activity enrols in the water supply management and has the role of improving the exploitation of the transport and distribution of the water supply.

GIS models have the possibility to plan and analyze investments for rehabilitation and town system modernization in order to increase the client satisfaction level. Also the GIS model can program, send and efficiently manage the intervention staff in case of different call for network damage.

2. GIS Models in the Exploitation of Water Supply Systems in Romania

In most countries, the population has developed at the rate of 100 % access to water supply systems and sanitation in Romania in 2013, only 57% of the population had access to water supply network, and 45% to the mains sewer. This distribution is uneven with a high deficit in the countryside against urban area.

Results the modernization necessity of water supply infrastructure, its extension, rehabilitation of the existing network and the improvement of exploitation process. A improvement direction of exploitation process for the network is the integration of information in urban cadastre as a GIS system.

Water supply system is a complex of buildings, installations and measures which have the primary aim to ensure the quality and the quantity of water required by the consumers. The main components of a water supply system: capture, treatment station, pumping stations, headrace, reservoir, distribution network (Fig. 1). Each component have a set of subcomponents with structural and specific functions.

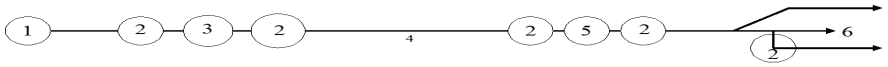

Fig. 1 – The general scheme of water supply: 1 – capture; 2 – pumping stations; 3 – treatment station: 4 – headrace; 5 – reservoir; 6 – distribution network.

The GIS system of Iasi, managed by the S.C. Apavital Company, uses GIS NetSet application and targets the completion of suggestive analyses and complex space by linking textual data with high degree of detail with charts and transposed through the queries in digital thematic maps. Through this model of GIS, a utility system aims to adjust with the EU standards.

Implementing a GIS system of water supply network for Turda region managed by the Water Company of Arieş was achieved in 2011 with the expansion and the rehabilitation of the network.

Fig. 2 – GIS interface of Turda city (Water Company of Arieş).

The software used is composed of Autocad Civil 3-D and Topobase Audesk so they joined surveying awarded, routes of pipelines, reservoir, pumping stations, pipeline with technical data such as diameter, year , material flow and entered into a centralized system.

With these database facilities, the design and management of water networks and with the function of analysis for GIS models, it facilitates the process of inspection, monitoring and maintaining of water supply systems.

The network of water supply and sewerage of Bucharest is administrated by ApaNova Bucharest. The implementation of GIS system has started since 2005 and has been tested by the end of 2012, this system was created in cooperation with Esri Romania using ArcGIS Server and runs on Oracle database. The GIS portal ApaNova Bucharest integrates components of software, hardware and data sets, it is seen that an integral part of the company's enterprise system and is used as a support in decision-making processes, information on the activities of management, operational, structural and functional.

GIS portal of the town benefits from many applications with different features on the structure and functional areas such as applications for viewing sewerage network and water of Bucharest city, drains cleaning scheduling, sewer pipes programming, water network.

The interface of GIS platform has a database containing chart information type and grouped as layers that have location information system

with textual address, damaged items, customer name, number, order number, status, number of commercial billing lock (Fig. 3) with the help of the application abnormalities can be detected and action plans accomplished.

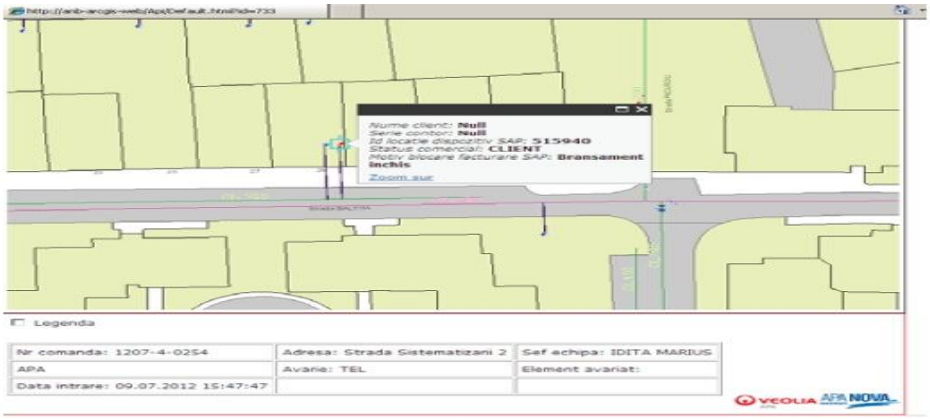

Fig. 3 – The interface of ApaNova Bucharest (ApaNova).

The water network system of Timişoara city is under the control of the Aquatium Company. The process of implementation of the GIS system has been stretched out in several stages. The first step has aimed to collect topographic measurements of 218,509 points completed in 2013. A second step involves the processing of data with the help of evolved software, and the third stage is represented by the use of data collected through various types of statistics. The fourth phase consists to realize mathematical modelling of urban networks. Timişoara has not yet completed the GIS system and by now it can only create local models.

As a development direction of the urban system using GIS models, aims to involve investment departments, public departments, customers, by interconnecting these systems with applications used by mobile phones that are more and more advanced.

Nationally every city manages it's own GIS models of water feeding systems after their own liking by using different softwares, platforms and application as: GIS NetSet, AutoCAD Civil 3-D, Autodesk Topobase, ArcGIS Server (Table 1). Not all the cities benefit of advanced GIS systems, many of the romanian cities had still remained at the analogical map stage and old databases that do not meet our days requirements.

Table 1

The GIS Programs used for the Monitoring of Water Network System

City	Water Company	Program
Iaşi	SC ApaVital Iaşi SA	GIS NetSet
Turda	Compania de Apa Aries	Autocad Civil 3D, Autodesk Topobase
Timişoara	Aquatium	Work in progress
Bucureşti	ApaNova Bucureşti	ArcGIS Server

In the context of the commencement of the work for the elaboration of Romania's general cadastre I consider that, apart from the creation of a real-estate cadastre, a series of projects need to be put in motion, projects that are necessary for the execution of the utility cadastre in a unitary system.

3. Applications of GIS Models in Water Supply Systems on International Plan

The GIS model situation of water supply systems is evolved on an international plan in countries such as: Turkey, Netherlands, France and United States of America. Although these countries have well developed GIS systems, they are still in search of improvement and development modalities of these. However, not all the countries in the world are well at this chapter, considering the economic level development. A similar situation can be found in Kosovo where the system is still in the project stage

In Kosovo the urban cadastre is defined by the cadastre law and it will be drafted in conformity with it, included in the KCLIS registers (Kosovo Cadastre Land Information System) maps and text. Until now, just Pristina city has a GIS water supply system implemented, in the rest of the country the situation is still at the project step.

In Netherlands the concern for the protection of the underground utility system has began from the 80's through the establishment of KLIC (Kataster Line Infrastructure and Cable), in 2008 this centre was transferred under the national service system of cadastre from Netherlands. Through interconnection of the two systems, the operators were forced to take part on the development of the digital system. It is desired that in the near future a new cadastre system to be introduced.

In Serbia, the first urban cadastre law was published in 1974 and in 2005 the manual for database creation and urban cadastre maintenance show up. By the year of 1998, 7819 km were digitized and implemented in digital systems and in year 2011 the number has raised to 11,000. The programs Serbia used are ArcGIS for Desktop (Arc Map).

In the United States of America, Florida, there is a GIS system implemented in ArcGIS with its interface as a control panel structured on a group of layers with base maps from which the type of maps can be selected, the water supply system infrastructure; a group of operational layers with functions as working panel, customer calls, SCADA, losses and network reports. This advanced system works in real time, for example, in the moment when a team is sent on the field, the team sends information to the system and this registers them. Also, every pipeline from the distribution network has information attached about its material, diameter, installation date (Fig. 4). The system memorizes all the informations received from the customers, investors, intervention teams and are kept as a historic of the network that can be accessed in any moment depending on the operators necessary.

Fig. 4 – The parameters of the distribution system of the system of water supply.

Turkey has a model of the water supply system where each operator has its own GIS model, this it is not organized at national level. The figure presents the city's GIS system in Istanbul which is observed working on layers: the colour blue is suitable for water distribution network with attributes such as ID, length, diameter, type and pressure.

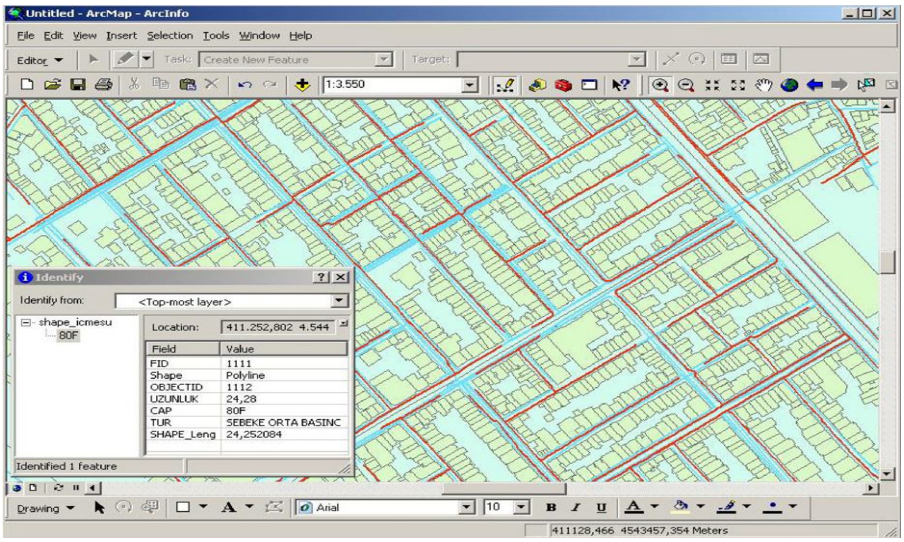

Fig. 5 – GIS model of water supply in Istanbul (Fatih *et al.*, 2010).

Internationally the GIS models of water supply systems have evolved to in comparison with Romania, although some countries have implemented advanced models; they are in a continuous process of editing and improvement. Both nationally and internationally it can be observed that the access to this type

of data is "often restriction due to the fear in a terrorist attach" (Brumbelow *et al.*, 2007).

4. Conclusions

1. The modelling of the water supply systems by GIS facilitate the interrogation process, shorten the working time, reduce the maintenance costs, modernize and rehabilitation through textual data improvement with graphs.

2. GIS models use queries to create digital maps and reports that facilitates the communication with authorities and water supply system clients.

3. Considering the continuous evolution of cities extension, it is necessary to implement a GIS system for water supply systems for distribution management and exploitation costs reduction.

4. Hydro cadastral type system is necessary for the realization of an efficient and modern management of water supply systems.

5. The actual technology of water supply systems exploitation is evolving, thus the improvement of GIS models through different database and updating of work programs emerges.

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STUDII PRIVIND MANAGEMENTUL SISTEMELOR DE ALIMENTARE CU APĂ

(Rezumat)

Sunt prezentate studiile efectuate privind managementul exploatării rețelelor de alimentare cu apă urbane şi rurale. Managementul se realizează prin realizarea unui cadastru special al rețelelor de conducte. Discretizarea componentele sistemului de alimentare cu apă se realizează cu un model GIS. Prin programele Autocad şi ArcMap se permite obținerea unor hărți tematice pe domenii specifice ale sistemului. Fiecare componentă este formată dintr-o mulțime de subcomponente cu caractere structurale şi funcționale specifice. Cu ajutorul programelor GIS se urmăreşte specificarea proprietăților pe layere particularizate pe domenii de structură şi funcționare. Lucrarea prezintă o serie de rezultate în acest domeniu pe olan național şi pe plan mondial.

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FLOW MEASUREMENT CONSIDERATION INFLUENCE FACTORS FOR SELECTING WATER METERS

BY

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Abstract. Current metrology requires the presence of new methods of measurement, including automatic calibration, based on modern principles of achievement. In this area they are made permanent contributions to obtain methods and techniques that ensure high accuracy results while simultaneously automating basic metrology operations and processing of numerical results

The complexity of technical issues to be answered, calibration systems and the current flow measurement requires continuous adaptation and modernization.

Increasingly, instead of traditional methods and installations for measuring, verification or calibration is taken methods and modern installations, automated and computerized based in particular on the use of virtual instrumentation.

The main factors which influence the selection of a measuring device include: accuracy requirements, cost, legal constraints, range of flow rates, head loss, type of measurements and records needed, operating requirements, longevity of device for given environment, maintenance requirements, construction and installation requirements, device standardization and calibration, field verification, troubleshooting and repair, user acceptance of new methods, vandalism potential.

Keywords: flow; water meter; accuracy; maintenance; calibration.

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1. Introduction

The importance of studying, knowledge, use and improvement of the flow meters is given by the need to manage energy resources, that with increasing consumption of liquid fuels, gaseous fuels and water requires precise determination of the quantities of raw materials and energy balance sheets.

Modern flow meters shall measure fluids under a variety of conditions caused by: state fluid flow regime, the flow area environment.

Measurement of water supplied is motivated by objectives:

a) economic, is explained by optimizing the use of existing networks in exchange for extending their related costs, including costs of water treatment. By optimizing consumption and costs are reduced extension of the evacuation of wastewater and excessive loading of existing ones;

b) environment, providing the necessary impetus water conservation and protecting water sources by reducing consumption;

c) allows technical-directed water to better locate network losses, and thus to reduce or eliminate them in a timely manner;

d) another objective consists of a fair distribution of the costs of extraction, purification and distribution of water depending on its consumption.

The requirements for a water meter are:

a) provide a correct measurement and consumption on the debts for which it was designed;

b) present a minimal pressure drop between input and output fitting networking;

c) to be inexpensive and simple in its construction;

d) easy to install and maintain;

e) free of excessive wear of the parts in motion after a running time;

f) be composed of materials that do not corrode upon contact with water;

g) does not produce vibrations that can damage pipes;

h) do not stop in any case, water supply, causing crashes;

i) occupy a small space.

The main factors which influence the selection of a water measuring device include:

Accuracy

The target or desired accuracy of the measurement system is an important consideration in measurement method selection. Most water measurement devices can produce accuracies of ±5%. Some devices are capable of ±1% under laboratory settings. However, in the field, maintaining such accuracies usually requires considerable expense or effort (*e.g.*, special construction, recalibration, maintenance, etc.). Selecting a device that is not appropriate for the site conditions can result in a nonstandard installation of reduced accuracy, sometimes greater than ±10 %.

Accuracies are usually reported for the primary measurement method or device. However, many methods rely on a secondary measurement, which typically adds error to the overall measurement

Cost

The cost of the measurement method includes the cost of the device itself, the installation, secondary devices, and operation and maintenance. Measurement methods vary widely in their cost and in their serviceable life span. Measurement methods are often selected based on the initial cost of the primary device with insufficient regard for the additional costs associated with providing the desired records of flows over an extended period of time.

Legal Constraints

Governmental or administrative water board requirements may dictate types of accepted water measurement devices or methods. Water measurement devices which become a standard in one geographic area are often not accepted as a standard in another area. In this sense, the term "standard" does not necessarily signify accuracy or broad legal acceptance. Many water districts require certain water measurement devices used within the district to conform to their standard for the purpose of simplifying operation and maintenance.

Flow Range

Many measurement methods have a limited range of flow conditions for which they are applicable. This range is usually related to the need for certain prescribed flow conditions which are assumed in the development of calibrations. Large errors in measurement can occur when the flow is outside this range.

In some cases, secondary devices can limit the practical range of flow rates. For example, with devices requiring a head measurement, the accuracy of the head measurement can limit the measurement of low flow rates. For some devices, accuracy is based on percent of the full-scale value. Then, at low values, the resulting accuracy is much lower, limiting the usefulness of such measurements. Generally, the device should be selected to cover the range desired. For practical reasons, it may be reasonable to establish different accuracy requirements for high and low flows.

Head Loss

Most water measurement devices require a drop in head. On new projects, incorporating additional head loss into the design can usually be accomplished at reasonable cost. However, a tradeoff usually exists between the cost of the device and the amount of head loss. For example, acoustic flow meters are expensive and require little head loss; sharp-crested weirs are inexpensive but require a relatively large head loss. The head loss required for a particular measurement device usually varies over the range of discharges. In some cases, head used in measuring flow can reduce the capacity of the channel at that point.

Type of Measurements and Records Needed

An accurate measure of instantaneous flow rate is useful for system operators in setting and verifying flow rate. However, because flow rates

change over time, a single, instantaneous reading may not accurately reflect the total volume of water delivered. Where accounting for water volume is desired, a method of accumulated individual flow measurements is needed. Where flows are steady, daily measurements may be sufficient to infer total volume. Most deliveries, however, require more frequent measurements. Metering is essential where water users take water on demand. Metering and automatic recording devices are available for many measurement devices. For large structures, the cost for water-level sensing and recording hardware is small relative to the structure cost; but for small structures, these hardware costs do not change and thus become a major part of the measurement cost (often more costly than the structure itself).

Many water measurement methods are suitable for making temporary measurements (flow surveys) or performing occasional verification checks of other devices. The method chosen for such a measurement might be quite different from that chosen for continuous monitoring.

Operating Requirements

Some measurement methods require manual labor to obtain a measurement. Current metering requires a trained staff with specialized equipment. Pen-and-ink style water-stage recorders need operators to change paper, add ink, and verify proper functioning. Manual recording of flows may require forms to be filled out and data to be accumulated for accounting purposes. Devices with manometers require special care and attention to assure correct differential head readings. Automated devices such as ultrasonic flow meters and other systems that use transducers and electronics require operator training to set up, adjust, and troubleshoot problems. Setting gate controlled flow rates by simple canal level references or by current metering commonly requires several hours of waiting between gate changes for the downstream canal to fill and stabilize.

Device Environment

Any measurement device with moving parts or sensors is subject to failure if it is not compatible with the site environment. Achieving proper operation and longevity of devices is an important selection factor. Very cold weather can shrink moving and fixed parts differentially and solidify oil and grease. Water can freeze around parts and plug pressure ports and passageways. Acidity and alkalinity in water can corrode metal parts. Water contaminants such as waste solvents can damage lubricants, protective coatings, and plastic parts. Mineral encrustation and biological growths can impair moving parts and plug pressure transmitting ports. Sediment can abrade parts or consolidate tightly in bearing and runner spaces in devices such as propeller meters.

Measurement of wastewater and high sediment transport flow may preclude the use of devices that require pressure taps, intrusive sensors, or depend upon clear transmission of sound through the flow. Water measurement devices that depend on electronic devices and transducers must have appropriate protective housings for harsh environments. Improper protection against the site environment can cause equipment failure or loss of accuracy.

Maintenance Requirements

The type and amount of maintenance varies widely with different measurement methods. For example, current metering requires periodic maintenance of the current meter itself and maintenance of the meter site to assure that is has a known cross section and velocity distribution. When the flow carries sediment or debris, most weirs, flumes, and orifices require periodic cleaning of the approach channel. Electronic sensors need occasional maintenance to assure that they are performing properly. Regular maintenance programs are recommended to ensure prolonged measurement quality for all types of devices.

Construction and Installation Requirements

In addition to installation costs, the difficulty of installation and the need to retrofit parts of the existing conveyance system can complicate the selection of water measurement devices. Clearly, devices which can be easily retrofit into the existing canal system are much preferred because they generally require less down time, and unforeseen problems can be avoided.

Device Standardization and Calibration

A standard water measurement device infers a documented history of performance based on theory, controlled calibration, and use. A truly standard device has been fully described, accurately calibrated, correctly constructed, properly installed, and sufficiently maintained to fulfill the original installation requirements and flow condition limitations. Discharge equations and tables for standard devices should provide accurate calibration. Maintaining a standard device usually only involves a visual check and measurement of a few specified items or dimensions to ensure that the measuring device has not departed from the standard. Many standard devices have a long history of use and calibration and, thus, are potentially more reliable. Commercial availability of a device does not necessarily guarantee that it satisfies the requirements of a standard device.

When measuring devices are fabricated onsite or are poorly installed, small deviations from the specified dimensions can occur. These deviations may or may not affect the calibration. The difficulty is that unless an as-built calibration is performed, the degree to which these errors affect the accuracy of the measurements is unknown. All too frequently, design deviations are made under the misconception that current metering can be used to provide an accurate field calibration. In practice, calibration by current metering to within ±2% is difficult to attain. An adequate calibration for free-flow conditions requires many current meter measurements at several discharges. Changing and maintaining a constant discharge is often difficult under field conditions.

Field Verification, Troubleshooting, and Repair

After construction or installation of a device, some verification of the calibration is generally recommended. Usually, the methods used to verify a permanent device (*e.g.*, current metering) are less accurate than the device itself. However, this verification simply serves as a check against gross errors in

construction or calibration. For some devices, errors occur as components wear and the calibration slowly drifts away from the original. Other devices have components that simply fail, that is, you get the correct reading or no reading at all. The latter is clearly preferred. However, for many devices, occasional checking is required to assure that they are still performing as intended. Selection of devices may depend on how they fail and how easy it is to verify that they are performing properly.

User Acceptance of New Methods

Selection of a water measurement method must also consider the past history of the practice at the site. When improved water measurement methods are needed, proposing changes that build on established practice are generally easier to institute than radical changes. It can be beneficial to select a new method that allows conversion to take place in stages to provide educational examples and demonstrations of the new devices and procedures.

Vandalism Potential

Instrumentation located near public access is a prime target for vandalism. Where vandalism is a problem, measurement devices with less instrumentation, or instrumentation that can be easily protected, are preferred. When needed, instrumentation can be placed in a buried vault to minimize visibility.

2. Conclusions

The target or desired accuracy of the measurement system is an important consideration in selection water meters and measurement method.

Maintaining the accuracies usually requires considerable effort (special construction, recalibration, maintenance, etc.).

Therefore it is necessary to take into account the factors that influence the choice of water meters to ensure the required accuracy and cost efficiency water consumptions metering.

For water meters, periodically verification/calibration is required to assure that they are still performing as intended. Selection of devices may depend on how they fail and how easy it is to verify that they are performing properly.

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CONSIDERAŢII PRIVIND MĂSURAREA DEBITULUI
Factori de influenţă în alegerea apometrelor

(Rezumat)

Importanţa studierii, cunoaşterii, utilizării şi perfecţionării debitmetrelor este dată de necesitatea gestionării resurselor energetice, care odată cu creşterea consumului de combustibili lichizi, gazoşi şi de apă, impune determinarea precisă a cantităţilor de materii prime şi a bilanţurilor energetice..

Complexitatea problemelor tehnice la care trebuie să răspundă, sistemele de etalonare şi măsurare a debitului actuale necesită o continuă adaptare şi modernizare.

Debitmetrele moderne trebuie să asigure măsurarea unor fluide aflate într-o mare varietate de condiţii determinate de: starea fluidului, regimul de curgere, secţiunea de curgere, mediul de lucru.

Asigurarea eficientei contorizării consumurilor de apă presupune să se ţină cont de factorii care influenteaza alegerea apometrelor în sopul asigurării exactităţii cerute şi eficientizarea costurilor.

Principalii factori care influenţează alegerea unui dispozitiv de măsurare includ: cerinţe de precizie, cost, constrângeri legale, gama de debite, pierdere de presiune, informaţii de măsurare şi înregistrări necesare, cerinţele de funcţionare, durata de exploatare a dispozitivului pentru mediu dat, cerinţele de întreţinere, cerinţele de construcţie şi de instalare, standardizare dispozitiv şi calibrare, verificare, depanarea şi reparaţii, acceptarea de utilizare a unor noi metode, posibilitatea de vandalism.

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STUDY OF “SMS” PROGRAM APPLICATION ON IZVORU MUNTELUI – BICAZ STORAGE LAKE

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Abstract. This paper treats the problem of eutrophication for Izvoru Muntelui – Bicaz lake, the biggest in our country, analyzed and solved with the help of “Surface Modeling Systems” program. "SMS" is a comprehensive environmental program used for hydrodynamic modeling of one-, two- and three-dimensional. By using the "SMS" we realized a conceptual model of the variation in concentrations of the four indicators studied, in the nodes created. The results for the four indicators chosen correspond to previous research conducted on water of the Izvoru Muntelui – Bicaz lake.

Keywords: modeling; eutrophication; surface water quality parameters.

1. Introduction

Engineers, particularly civil engineers, have been the principal developers of the field of water-quality modeling. Stimulated by the awareness that water-borne pathogens were one of the prime causes of disease, civil engineers began to design urban water and wastewater systems in the late

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nineteenth century. Consequently, civil engineers became involved in the development of water treatment plants, distribution networks, and wastewater collection systems. The goal was to deliver an adequate quantity of potable water to the urban populace and to safely carry off its wastes.

Some design goal had to be established that would protect the environment adequately but economically. To determine this proper level of treatment, it was necessary to predict water quality as a function of waste loading. Therefore, civil engineers began to develop mathematical models for that purpose. We can define a mathematical model as an idealized formulation that represents the response of a physical system to external stimuli. Thus, a mathematical model was needed to compute quality (the response) in the receiving water (the system) as a function of treatment plant effluent (the stimuli).

Empirical models are based on an inductive or data-based approach. Regression techniques can be employed to statistically estimate the assimilation factor. Mechanistic models are based on a deductive or theoretical approach. This involves the use of theoretical relationships or organizing principals. Mechanistic water-models are based on the conservation of mass; that is , within a finite volume of water, mass is neither created nor destroyed. In quantitative terms the principal is expressed as a mass-balance equation that accounts for all transfers of matter across the system's boundaries and all transformations occurring within the system.

Water-quality modeling has evolved appreciably since its innovation in the early years of the twentieth century. There were four periods in the development of water-quality modeling (1925-1960, 1960-1970 – computerize-tion, 1970-1977 – biology, 1977 – present-toxics).

The principal water quality problem addressed since 1970 was eutrophication. As a consequence, modelers broadened their own scope to include more mechanistic representations of biological processes.

2. Experimental

"SMS" ("Surface Modeling System") is a comprehensive environmental program used for hydrodynamic modeling of one-, two- and three-dimensional developed "Environmental Modeling Research Laboratory" (EMRL) at Brigham Young University, in cooperation with US Army Corps of Engineers Waterways Experiment exactly Station (USACE-WES) and the US Federal Highway Administration (FHWA).

SMS is a pre- and post-processor designed for modeling, analysis and design of surface waters. The program includes tools for:

a) management, editing and viewing hydraulic and geometric data;

b) creating, editing and inclusion in "mesh/grill" data for numerical analysis; this includes;

c) "mesh" for finite element ("unstructured grids") with tools to:

c_1) linear and quadratic elements;
c_2) all triangular "nets" or triangular-quadrilaterals combinations
c_3) incorporating the 1D "mesh" in 2D and 3D;

d) "grids" for finite differences ("structured grids") with tools for:
d_1) rectilinear grids and known rotation;
d_2) appropriate grids to the bottom;
d_3) triangular irregular networks (TINs).

Program Interfaces are specifically designed to facilitate the use of numerical models and include the SMS modules. The program consists of the following six **modules**:

Mesh. It contains tools for editing of unstructured networks and interfaces for a number of SMS sub-programs.

Boundary Fitted Grid ("grill" Bottom appropriate conditions). It contains tools for editing "grids" structured and appropriate to the bottom two sub interfaces.

Cartesian Grid ("grill" Cartesian). It contains tools for editing "grids" Cartesian structured and SMS interfaces for three sub-programs.

Scatter Point. Used for surface modeling with triangular irregular network (TINs) used for background data.

Map .Used to build conceptual models using GIS objects.

1-D (one-dimensional). It contains tools for one-dimensional modeling rivers, including an editor of crossing sections for two sub-programs and interfaces of SMS.

A window of SMS program is organized into the following sections (Fig. 1).

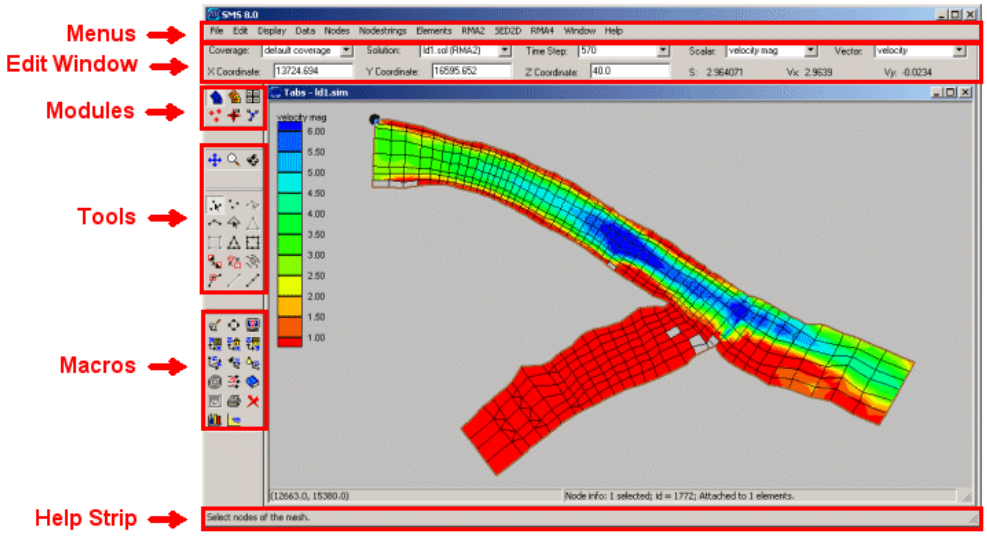

Fig 1 – SMS window.

This set of menus (Fig. 2) corresponds to the sub-module MESH with TABS considered current model. For the construction of models in SMS program there are two methods: direct approach and conceptual modeling approach. In the first method, the first step is to create a mesh or a grid. Model parameters, data from the source and bottom conditions are treated as direct networks, nodes and elements of the net. This approach is only suitable for simple models. The most effective approach to build realistic, complex and conceptual models is a conceptual modeling. With it we create a conceptual model using GIS features, including points, arcs and polygons.

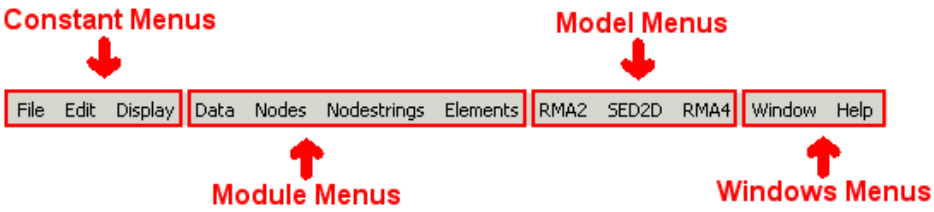

Fig. 2 – SMS menus.

Objectives by using this kind of model for Bicaz lake are:

1. comparing and verifying data collected in the field (on the lake) with the processed ones in the laboratory;

2. studying the evolution of water quality in the lake through a program performing, frequently used by foreign researchers in solving the quality of surface waters.

We choose two models: MASH and MAP. MESH module is designed for using finite elements. A finite element mesh is defined as a network of triangulation or quadrilatere elements constructed of nodes. Its creation requires the use of bathymetric information and establish extremity for the study area. MAP module produces tools for defining the conditions in the study area and the characteristics of the finite element mesh with establishing those which may be created in place. Then SMS interpolates bathymetric and hydro-chemical, biological, bacteriological data of the network. At building the model using SMS, the first step is importing and registering a scanned digital image or of a GIS file or even aerial photos (Fig. 3).

For the conceptual approach of the model, we use characteristic objects: nodes, arcs and polygons. We used the geography of the lake (north longitude and east latitude) in the IMAGE format, GIS file. In the MAP module, by conceptual modeling approach, we defined contours to create the model for an area of the Izvoru Muntelui lake, between two sampling stations from which we took the data (physical, hydro-chemical, biological). To do this, between the stations Hângu and Rugineşti, we established two sections by the lake: 1-1 and 2-2, which values are known for the following parameters: water temperature (ºC), pH, dissolved oxygen (mg O_2/l), oxygen saturation (% O_2), organic matter

(mg $KMnO_4$/l), nitrates (mg NO_3/l), nitrates (mg NO_2/l), ammonium (mg NH_4^+/l), total phosphorus (mg P/l) alkalinity (total mval./l), hardness (also. degrees germ.), calcium (mg Ca^{2+}/l) total iron (mg Fe/l), magnesium (mg Mg^{2+}/l), bicarbonate (mg HCO_3/l), TDS (mg/l), chlorine (mg Cl/l) and sulphate (mg SO_4/l) (Fig. 4).

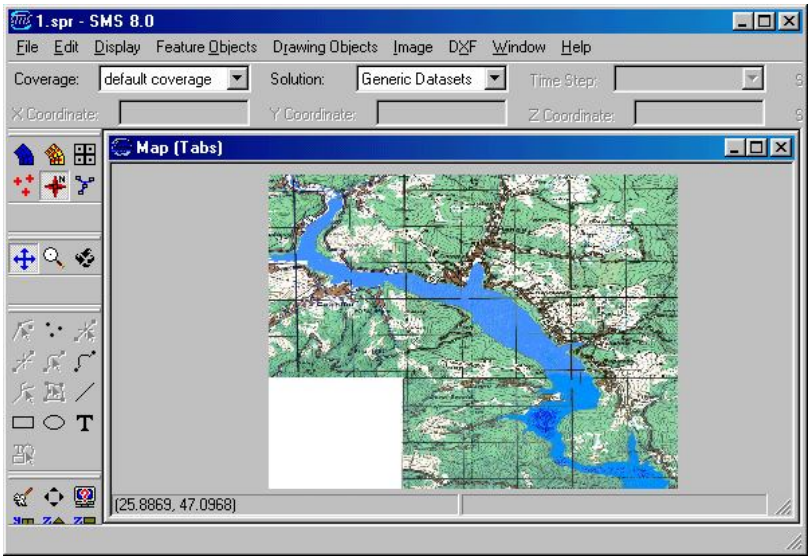

Fig 3 – Importing the GIS file (Izvoru Muntelui – Bicaz lake) in SMS program.

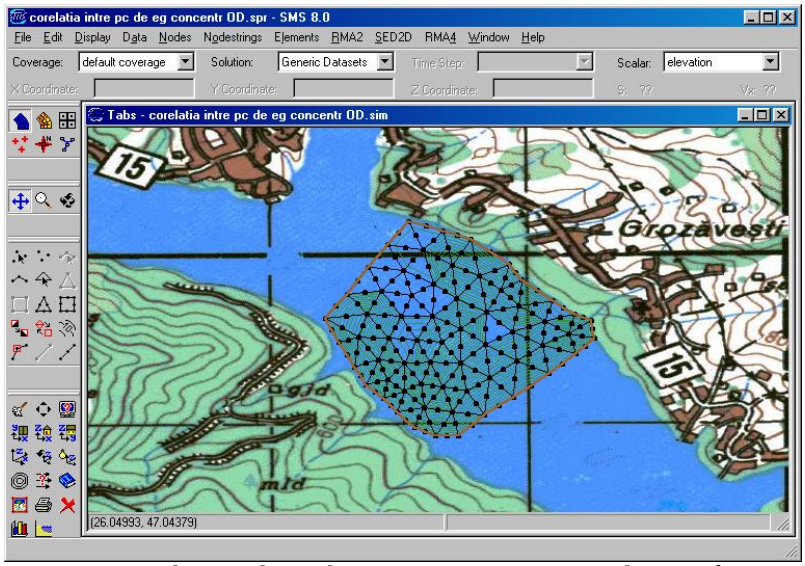

Fig 4 – The correlation between concentration equal points for dissolved oxygen indicator.

We choose for the study area the following four parameters: dissolved oxygen; organic substance; ammonia; total phosphorus. Data were collected to a depth h = 10 m. Also, determinations were made for 0 m, 20 m, 30 m, and the depth is done in such a manner analogous to the manner used for the depth of h = 10 m.

For the organic substance indicator, in points with h = 10 m, we obtained the correlation from Fig. 5.

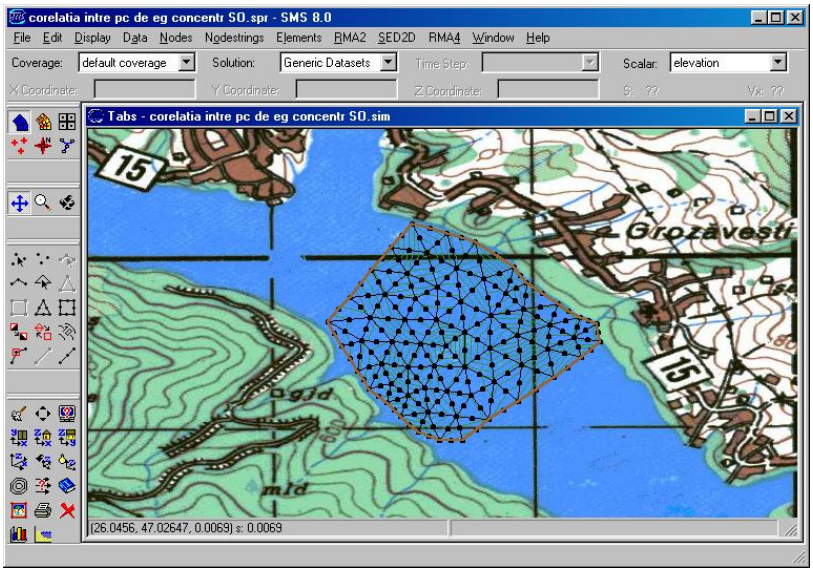

Fig. 5 – The relationship between equal points concentration for the organic substance.

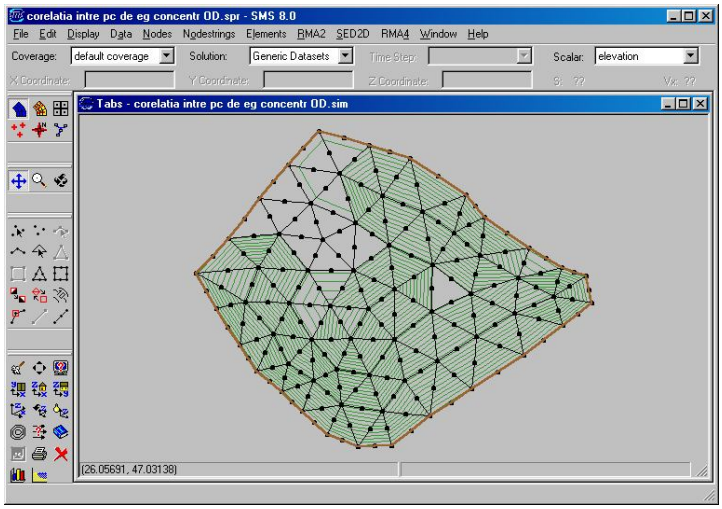

Fig. 6 – Polygon in MESH mode for the dissolved oxygen parameter.

From the MAP module, we selected polygon obtained and converted to MESH module. Here, the program automatically interpolates the values entered for the boundary nodes, helped by some known values of waypoints (Fig 6).

3. Results and Discussions

In a polygon, the SMS program indicates the value of the distribution for equal concentration curves. Thus, we obtained the following conclusions:

a) indicator dissolved oxygen concentration equal curves grow from the inside out;

b) indicator organic substance, equal concentration curves grow from the inside out;

c) indicator NH_4, curves equal concentration increases from the outside;

d) indicator total phosphorus concentration curves equal increase from the outside.

With characteristic parameters entered into the program, it automatically checks them. Thus, using SMS program, we conducted a conceptual model of the variation in concentrations of dissolved oxygen, organic matter, NH_4 and total P in the network.

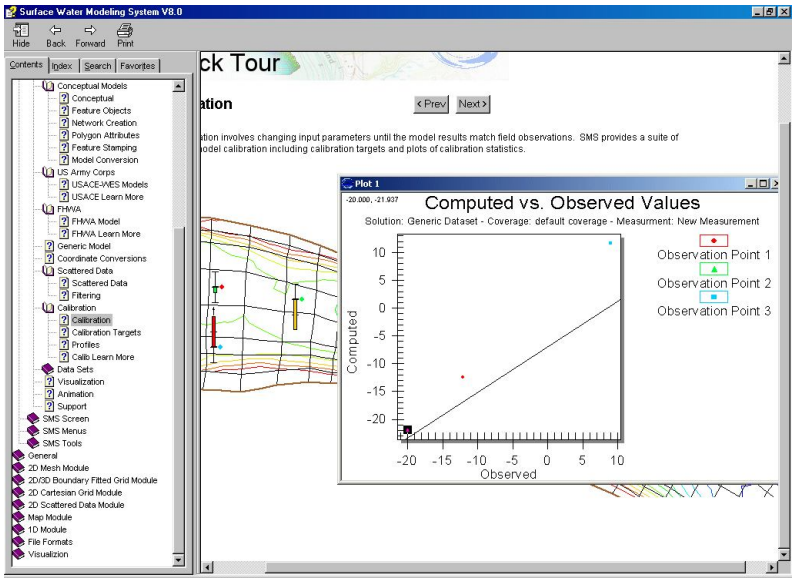

Fig. 7 – The model calibration.

Model calibration involves changing the input parameters until the results match exactly the model of lake conditions. SMS contains a number of options to calibrate the model, among which targets specific calibration plots and statistical ones (Fig. 7).

4. Conclusions

By using the "SMS" we realized a conceptual model of the variation in concentrations of the four indicators studied, in the nodes created.

The results for the four indicators chosen correspond to previous research conducted on water of the Izvoru Muntelui – Bicaz lake.

They support the mathematical and graphical calculations and fits the lake water in terms of in the mesotrophic-oligotrophic category. We obtained the same results applying mathematical calculus with *Cărăuş*'s formula for the entire lake.

In the same manner, we can extend the model for any depth of the lake and also for any storage lake. Expanding research for the whole surface of the lake, possibly taking into account other water depths (20 m, 30 m, etc.), we can draw conclusions about trophic lake fits, but also on water quality in the lake, depending on the parameters (data) as known to it. The "SMS" verify the field data automatically, signaling errors that may occur, thereby contributing to the accuracy of our results.

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STUDIUL APLICĂRII PROGRAMULUI "SMS" PENTRU LACUL DE ACUMULARE IZVORU MUNTELUI - BICAZ

(Rezumat)

Această lucrare tratează problema eutrofizării pentru lacul Izvoru Muntelui - Bicaz, cel mai mare din țara noastră, analizată şi rezolvată cu ajutorul programului "Sisteme de Modelare a Apelor de Suprafață". "SMS" este un program cuprinzător de mediu utilizat pentru modelarea hidrodinamică a una, două şi trei dimensiuni. Prin utilizarea "SMS" am realizat un model conceptual al variației concentrațiilor celor patru indicatori studiați, în nodurile rețelei create. Rezultatele pentru cei patru indicatori aleşi corespund cercetărilor anterioare efectuate pe apa lacului Izvoru Muntelui – Bicaz.

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RESEARCH ON THE INFLUENCE OF CLIMATE AND OF THE DANUBE HYDROLOGICAL REGIME LEVELS ON THE GROUNDWATER IN AN AREA FROM BIG ISLAND TO BRĂILA

BY

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Abstract. In our writing, there are presented the obtained results from an analysis for a period of 10 years. The writing presents the dynamic of the phreatic levels under the influence of the Danube’s climate and hydrological regime. The analysis were done in one of the most important agricultural area of Romania: Braila’s Great Island - Filipoiu hidroameliorative system. The processing and interpretation of the dates succeeded to quantify the influence of the climate and of the Danube's water levels over the phreatic dynamic. In conclusion, we can say that the main influence factor of the phreatic levels is Danube river, but the influence of the local climate is not negligible.

Keywords: groundwater; Brăila; Danube.

1. Introduction

Brăila big Island - I.M.B. (Brăila’s pond, as it was known before the damming) is the meadow situated between the main channels of the Danube -

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Macin or Old Danube in eastern and Cremenea and Vâlciu in the western part of the island.

Brăila's big Island has an average of 60 km long by 20 km wide and an area of about 96000 ha (only the space between the main channels, Cremenea and Macin without the external meadow). The altitude decreases from south 8.5,…,9.8 m to north 3.0,…,4.0 m, being the lowest unit of relief from Braila's county.

Before damming and draining I.M.B. was a complex of lakes, ponds and river levees (Fig. 1). After damming, draining and levelling - modelling works of the land, this island has become potentially one of the most fertile agricultural areas from Romania.

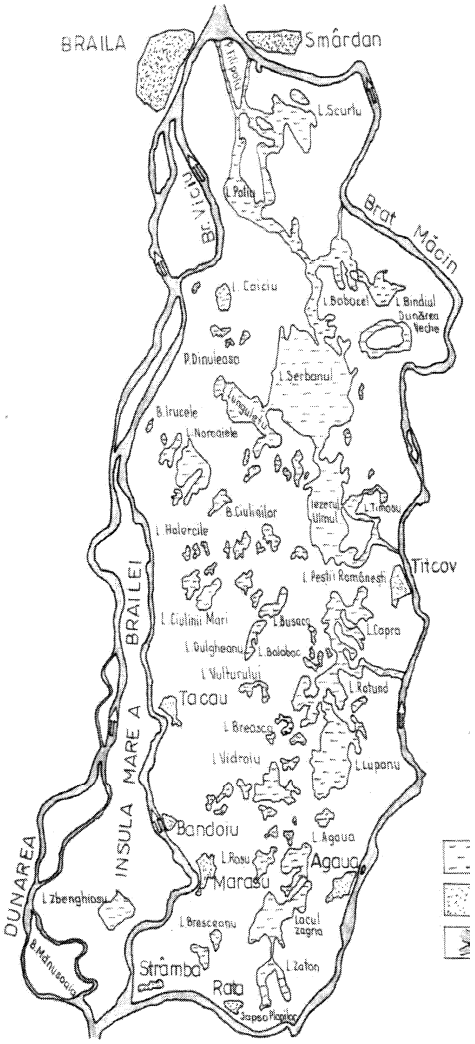

Fig. 1 – Natural regime of Braila's Big Island Hydrography.

An overwhelming importance in getting, in I.M.B. (Fig. 1), in substance of an not irrigated soil, a high and stable agricultural crop it has the ground position relative to the ground surface. That is why the study of the dynamics of groundwater levels and quantify the various factors influences acting on it is an operation of great importance for the progress of agriculture in the area (Cojocaru *et al*., 2001; Cojocaru & Cismaru, 1989).

In this context, the paper presents, based on field research carried out over a number of years, two of the main factors influencing the position of the groundwater level towards the surface of the land: climate and hydrological regime of the Danube.

2. Experimental

2.1. Methods

Research on the dynamics of groundwater levels under the influence of climate and hydrological regime of the Danube were made in Filipoiu hydroameliorative system, which occupies the entire northern part of the island, totaling an area of 7,379 ha. In this area it were installed a total of 19 hydrogeological wells in which the groundwater levels were measured monthly.

3. Results and Discussions

3.1. Climate influence

Depth data upon the groundwater levels, measured in the 19 hydrogeological wells form Filipoiu system, were firstly processed, in order to zone the groundwater depths, based on the annual average during the growing season. This reflects the general way of processing which can focus us on the long-term dynamic evolutionary trends of the groundwater levels. Table 1 shows the obtained zoning based on the carried out measurements in a period of about 10 years.

Table 1

The zoning of the groundwater depths in Filipoiu system during the growing season

Groundwater depth, [m]	Surface, [%], in the period		
	Dryness	Rainy	Medium
Surface level	–	1.0	0.4
0 – 1	5.5	10.9	6.6
1 – 2	22.4	45.4	33.0
2 – 3	45.0	34.4	46.0
3 – 4	24.0	7.7	13.0
4 – 5	2.6	0.6	1.0
5 – 6	0.5	–	–

As it is shown in Table 1, the most extended zone in the period with medium climate is with groundwater depth between 2 and 3 m. The next area, in order of decreasing is the water situated between 1 and 2 m. The remaining areas have a low share (total 21%).

Research has revealed that the highest groundwater levels are achieved in the spring season, especially from April to May. This season, the groundwater depths below 1 m were measured mainly in the peripheral areas of the system and especially along the Danube dam, on a strip with a width less than 100 m. As for the rest, the groundwater depth generally ranges, between 1 and 2 m (33-35% of the surface during wet years and 28-52% in dry years) - Fig. 2.

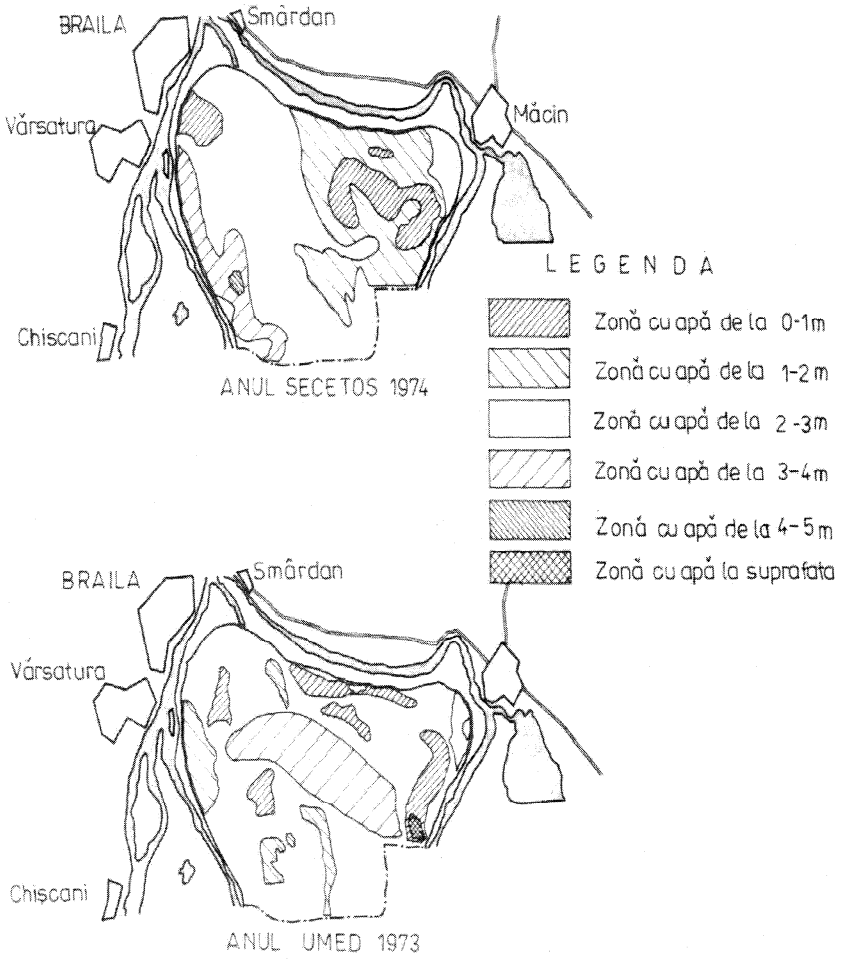

Fig. 2 − The zoning of groundwater depths in Filipoiu system the dry year (1974) and wet year (1973).

In the particular case of drought year – 1974 (Fig.2.) the groundwater on almost half of the Filipoiu system (45%) stood during the growing season, at depths between 2 and 3 m. The following areas were with depths of 3,…,4 m – 24%; 1,…,2 m – 22%; > 3 m – 3% and 0 to 1 m – 6%. In the wet year 1973 (Fig. 2), hydrogeological situation was entirely different. The most common depths were between 1 and 2 m – 45% from the surface and the other (in order of area expansion size) 2,…,3m – 35%; <1m – 12%; > 3m – 8%.

3.1. The influence of Danube hydrological regime

In order to determine the influence of Danube regime on the groundwater levels, it was correlated the monthly average of the groundwater depth from Filipoiu system with the measured monthly average level of the Danube at Braila. Fig. 3 shows the correlation obtained by taking as elements of correlation the measured groundwater levels in three representative boreholes (sand bank near the shore - the Pies. III.1, in the next inwardly area - Pies. III.8 and in the central area - the Pies. III.2.) from Filipoiu system. Analyzing the data shown in Fig. 3. there may be a very good correlation between the measured values, which attests that the Danube is an important source of influencing the regime of the groundwater levels in the studied area. A confirmation of this observation could be the observation that in October and November, when the levels of the Danube reached the lowest levels, the depths of groundwater is between 2 and 3 m on about 50-60% of the studied system.

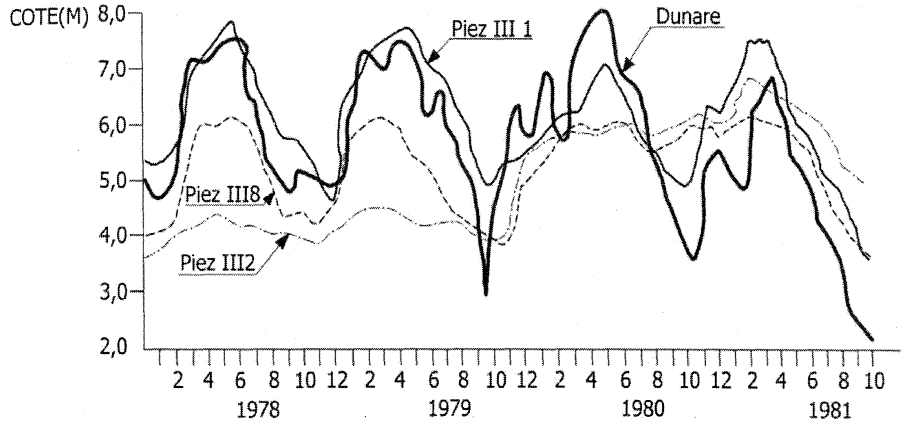

Fig. 3 − The correlation between Danube water level at Brăila and measured ground water levels at several representative points from Filipoiu system.

In addition, the measurements showed that at distances under 2 km from Danube, variations of about 1 m of free surface in the Danube corresponds to variations of the groundwater levels exceeding 30 cm and over 2 km away, the variations are between 20 and 30 cm. Temporary gap between making times of these changes, for growth, are between 15 and 30 days and for decreasing the

gap has negligible values (1,…,5 days). The small gap for decrease is explained by overlapping, during critical periods in water, the effect of evapotranspiration over the declining share in the Danube water surface.

4. Conclusions

The conducted and presented research from this paper leads us to the following conclusions:

a) the predominant element in influencing the dynamics of groundwater levels in the studied Filipoiu system from I.M.B. is the Danube. This effect is very strong in the areas nearby the dam (below 100 m) and smaller towards the central area of the system;

b) the groundwater heavily influenced area by infiltration from the Danube is a strip nearly parallel to the dam, with an average width of about 2 km;

c) the climatic regime for the studied area is an important influence element of the hydrogeological regime. Relatively high soil permeabilities causes a rapid infiltration of storm water into the lower lithological strata, which produces raising the groundwater levels;

d) in the wet years, the dominant depth of groundwater levels is of 1,…,2 m (~ 45% of the surface), while in the dry years, on the same surface, the groundwater levels have depths between 2 to 3m.

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CERCETĂRI PRIVIND INFLUENŢA CLIMATULUI ŞI AL REGIMULUI HIDROLOGIC AL DUNĂRII ASUPRA NIVELURILOR FREATICE DINTR-O ZONĂ A INSULEI MARE A BRĂILEI

(Rezumat)

Sunt prezentate rezultatele obţinute în urma unei analize pe o perioadă de 10 ani. Se prezintă dinamica nivelelor freatice sub influenţa climatului Dunării şi regimului hidrologic. Analiza a fost efectuată într-una dintre cele mai importante zone agricole din România: Insula Mare a Brăilei – sistemul hidroameliorativ Filipoiu. Prelucrarea şi interpretarea datelor a cuantificat influenţa climei şi a nivelului apelor Dunării asupra dinamicii freaticului. În concluzie, putem spune că principalul factor de influenţă al nivelului freatic este fluviul Dunărea, dar influenţa climatului local nu este neglijabilă.