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LAND RECLAMATION, EARTH OBSERVATION &
SURVEYING, ENVIRONMENTAL ENGINEERING

Volume IV

University of Agronomic Sciences
and Veterinary Medicine of Bucharest
Faculty of Land Reclamation
and Environmental Engineering

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CONTENTS

ENVIRONMENTAL SCIENCE AND ENGINEERING

SUSTAINABLE DEVELOPMENT OF RURAL AREA

DISASTER MANAGEMENT

WATER RESOURCES MANAGEMENT

POLLUTION CONTROL, LAND PLANNING

TOPOGRAPHY AND CADASTRE

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ACCUMULATION AND DISTRIBUTION OF HEAVY METALS IN THE CANES OF GRAPEVINE

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Abstract

Heavy metal pollution is a major environmental problem that can affect productivity, quality of the finished product and the quality of human health. Since the 1990s, heavy metal pollution proves to be a problem in some major wine regions. In recent decades several anthropogenic activities have caused a remarkable release of trace metals into agricultural soils. Some trace elements (copper, zinc and manganese) are essential to plant growth and are called micronutrients. These elements are also heavy metals, and are toxic to plants at high concentrations.
The objective of the present research is to evaluate Mn, Zn, Al, Cr and Cu (mg/100g) contents in the canes of grapevines of two local varieties, Royal Feteasca and Merlot grown in two private vineyards located near Craiova, namely Breasta and Simnic, an also their concentrations in soils. Canes and soil samples were collected in April and May 2014. For samples analyses were used the following equipments: mass spectrometer with inductively coupled plasma, flame atomic absorption spectrometer - Avanta, Milestone microwave digestion system.
Determined values for Royal Feteasca variety were higher for vines located in Breasta vineyard, except aluminum content which was higher in Simnic vineyard. For Merlot variety, the values measured were considerably higher for vines located in Simnic vineyard. Following the interpretation of the results obtained, it can be concluded that the results of all metal concentrations in analyzed soils are higher in Simnic vineyard than in Breasta.

Key words*: accumulation, canes, grapevine, soil, heavy metals.*

INTRODUCTION

Heavy metals are naturally present in the environment. Heavy metals such as cooper and zinc, in high concentrations, are toxic for plants, preventing their proper development. In recent decades several anthropogenic activities have caused a remarkable release of trace metals into agricultural soils and therefore on vines plants (Buzatu, 2014).
Grapevines are multiannual plants, hence the significant importance of the influence of the annual ecological offer over production, especially its quality (Costea et al., 2010). The absorption and transportation of mineral elements depend on on their concentration in soil (Vladulescu and Buse-Dragomir, 2009).
The objective of the present research is to evaluate Mn, Zn, Al, Cr and Cu (mg/100g) contents in the canes of grapevines of two local varieties, Royal Feteasca and Merlot grown in two private vineyards located near Craiova, namely Breasta and Simnic, an also to evaluate the Zn, Cr, Cu and Mn concentrations in vineyard soils.

MATERIALS AND METHODS

Analyses were performed using two varieties of vine canes: Royal Feteasca and Merlot. Samples were collected in April and May 2014, from the base and the middle part of each variety. For analyzing the samples was used the following equipment: mass spectrometer with inductively coupled plasma, ICP-MS, Perkin - Elmer Elan 9000, flame atomic absorption spectrometer Avanta PM, Milestone microwave digestion system. Calibration standards were made from stock solutions ICP-MS multi element calibration STD3, monoelement standard solutions 1000 ppm K, nitric acid 65% puris p.a. (Fluka), hydrogen peroxide 30% p.a. (Merck) and ultrapure water, grade 1 according to ISO 3696: 1987.
Amount of about 0.5g of sample, weighed accurately 0.0001g, 8 ml nitric acid 65%; 2 ml H_2O_2, 1 ml ultrapure water was placed in teflon

vessels and were subjected to a heat treatment under pressure program: heating to 180°C with a gradient of 4.5°C/min and held for 20 minutes at 180°C. After cooling, liquid samples were transferred into flasks and were brought to volume of 50 ml using ultrapure water and analyzed according to the specific procedures of the two spectrometric instruments. Control sample (blank) was composed of 8 ml 65% nitric acid; 2 ml H_2O_2, 1 ml ultrapure water being processed under the same conditions as the samples analyzed.

On the field were taken three soil samples in seven repetitions on each depth; samples of the same depth were collected in a bucket and then were mixed well.

Soil samples collected from Breasta vineyard are notated with P1, P2 and P3, and represent mean values of collected samples, and samples from Simnic vineyard are denoted by S1, S2, S3.

RESULTS AND DISCUSSIONS

The results concerning samples from the aerial parts of Royal Feteasca and Merlot varieties are presented in Tables 1 and 2. At the Royal Feteasca variety, evolution of heavy metal content has the following dynamics: the highest concentrations of Mn, Zn, Cr and Cu are found in vine plants from Breasta vineyard compared with Simnic vineyard where concentrations were lower.

Only in respect of Al content are observed pronounced differences between the two vineyards, reaching a maximum of Al content (0.64 mg/100g) in Breasta vineyard and at the vineyard from Simnic were determined concentration of 8.54 mg/100g and 14.76 mg/100g (Table 1).

Within the same cane, belonging to Royal Feteasca variety from Breasta vineyard, the values measured were higher at the base compared to the middle part of the cane, with the following abundance: Mn> Zn> Al> Cr> Cu (Figure 1).

At the canes taken from the vineyard located in Simnic the concentration determined on the base of the canes is lower than the concentrations determined in the middle part. These canes are characterized by a very high concentration in aluminum, determined metals having the following abundance: Al>Zn>Mn>Cr>Cu.

Table 1. Evolution of Mn, Zn, Al, Cr and Cu (mg/100g) content in the canes of Royal Feteasca

Sample canes		Mn		Zn		Al		Cr		Cu	
		April	May	April	May	April	May	April	May	April	May
Royal Feteasca Breasta	base	1.78	1.81	1.61	1.63	0.60	0.64	0.42	0.43	0.29	0.38
	middle	1.59	1.67	1.45	1.47	0.48	0.50	0.36	0.35	0.24	0.32
Royal Feteasca Simnic	base	0.83	0.82	0.88	0.90	8.50	8.54	0.37	0.34	0.33	0.21
	middle	0.89	0.90	1.33	1.35	14.16	14.76	0.16	0.14	0.56	0.28

Table 2. Evolution of Mn, Zn, Al, Cr and Cu (mg/100g) content in the canes of Merlot

Sample canes		Mn		Zn		Al		Cr		Cu	
		April	May	April	May	April	May	April	May	April	May
Merlot Breasta	base	0.83	0.84	1.37	1.40	0.31	0.30	0.34	0.36	0.31	0.27
	middle	0.77	0.78	1.57	1.61	0.26	0.25	0.36	0.37	0.26	0.24
Merlot Simnic	base	1.61	1.59	1.76	1.78	1.60	1.54	0.16	0.20	1.10	1.17
	middle	2.27	2.29	1.61	1.69	4.90	5.70	0.50	0.55	0.95	1.12

If at the Royal Feteasca variety the maximum concentration of Cu, determined in the canes of vines from vineyard Simnic, was 0.56 mg/100g, at the Merlot variety were recorded values of approximately two times higher in May.

Cr content of the canes belonging to Merlot variety was lower than the content determined in the canes of Royal Feteasca, a valid situation in both plantations analyzed.

The contents of heavy metals determined in the canes of Merlot variety are considerably higher in both April and May, compared to Royal Feteasca variety, in the case of Simnic vineyard. Only in respect of Al content, higher values are observed at canes of vine belonging to Royal Feteasca variety.

At Merlot variety, concentrations of Mn, Zn and Al determined in the canes of vine presents higher values for Simnic vineyard, remarking in this case the Al content of the canes that represents almost half of concentrations determined for the canes of Royal Feteasca (Table 1 and 2).

For Merlot variety located in Breasta vineyard, is observed a slight variation in the concentrations of these elements in the middle and basal canes.

The concentration of metal in the canes decreases as follows: Zn>Mn>Cr>Al>Cu (Figure 2).

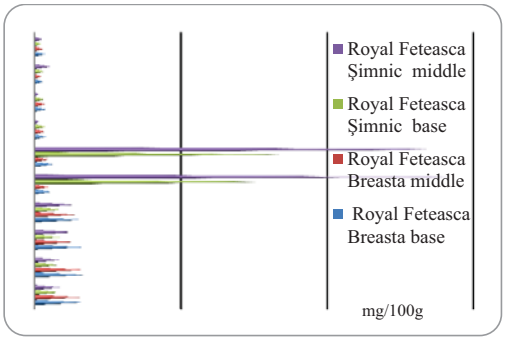

Figure 1. Evolution of Mn, Zn, Al, Cr and Cu (mg/100g) content at Royal Feteasca

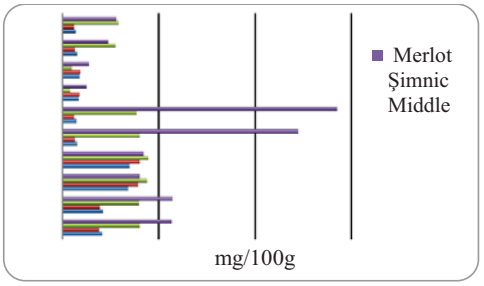

Figure 2. Evolution of Mn, Zn, Al, Cr and Cu (mg/100g) content at Merlot

According to Lindsay (1979) quoted by Vrinceanu et al., 2010, the average content of Cr in soil is 100 mg/kg, and the range of variation is 1-1,000 mg/kg; the average zinc content in soil is 50 mg/kg, and the range of variation is 10-300 mg/kg.

For manganese, the average content in soils is 600 mg/kg, with a range of variation between 20-3,000 mg/kg. Regarding the average content of Cu in soils, according to these authors, this is 30 mg/kg, and can range from 2-100 mg/kg.

The copper concentrations determined in Breasta vineyard have slight variations for P2 and P3 soil samples and the P1 sample, as determined by the depth of 20-40cm, is exceeding the threshold of 100 mg/kg both in April and May. On 0-20 cm depth, in April, Cu concentrations are at the limit of 200 mg/kg, which is the threshold limit intervention for sensitive use soils, and in May this threshold is exceeded (Table 3).

For manganese is specified in the Order 756/1997, as attention threshold, the value of 1,500 mg/kg and 2,500 mg/kg for intervention threshold.

Table 3. Determination of Zn, Cr, Cu and Mn content (mg/kg) in Breasta vineyard

Sample soils	Zn		Cr		Cu		Mn	
	April	May	April	May	April	May	April	May
P1 (0-20 cm)	56.2	50.2	26.2	30.6	191.6	240.8	457.6	469.2
P1 (20-40 cm)	40.4	35.4	26.6	33.4	104.9	156.8	395.2	381.4
P2 (0-20 cm)	30.9	31.4	28.6	30.5	15.9	16.7	374.6	392.3
P2 (20-40 cm)	31.9	32.2	29.8	29.0	15.3	16.4	353.5	390.1
P3 (0-20 cm)	40.4	41.6	32.9	29.4	15.9	18.0	386.8	314.7
P3 (20-40 cm)	41.2	42.0	31.1	25.2	13.4	15.8	400.8	434.8

Determined concentrations of Mn has slight variations in both months of the study, there were recorded the highest concentrations of 457.6 mg/kg in April, and 469.2 mg/kg in May for soil sample P1.

Comparing the values obtained in this study with literature values it can be concluded that they are approximately 150 mg/kg lower for this research.

Zn concentrations determined in soil from vineyard located in Breasta have values between 30.9 to 56.2 mg/kg, being situated around average content of this element in the soil according to the literature. In this case, Zn content is not exceeded for sensitive use soils, which indicate as alert threshold the value of 300 mg/kg and 600 mg/kg for the intervention threshold.

The content of chromium presents the same trend for all the soil samples, the values being in the range from 26.2 to 33.4 mg/kg, determined concentrations being lower than the average content of 100 mg/kg referred to in the literature.

Also in this case, the Cr content is much lower than the alert threshold of 100 mg/kg normed for sensitive use soils (Table 3).

If in Breasta vineyard, the maximum concentration of Zn determined was 56.2 mg/kg, in Simnic vineyard were determined higher values for all samples, the maximum concentration of Zn being 181.62 mg/kg for sample S3, in April (Table 4).

In this research, the values obtained are higher than the average content specified in literature, being situated near the upper limit of the variation of Zn in soils, which is 300 mg/kg. However, the values obtained are situated and close to the alert threshold specified in Order no. 756/1997.

Table 4. Determination of Zn, Cr, Cu and Mn content (mg/kg) in Simnic vineyard

Sample soils	Zn		Cr		Cu		Mn	
	April	May	April	May	April	May	April	May
S1(0-20 cm)	70.5	99.49	48.0	47.2	196.47	252.89	576.6	675.7
S1 (20-40 cm)	71.84	96.2	46.2	44.7	162.23	248.37	565.8	630.7
S2 (0-20 cm)	106.19	86.11	36.7	38.9	113.46	196.47	592.2	757.1
S2 (20-40 cm)	85.4	88.78	42.4	41.7	106.19	162.23	623.2	844.1
S3 (0-20 cm)	181.62	115.04	54.0	52.2	111.41	302.68	780.1	805.9
S3 (20-40 cm)	168.8	92.7	55.7	55.7	100.94	211.46	796.8	898.2

Cr contents determined in Simnic vineyard have slightly higher values than those found in Breasta, but in this situation, the values measured are below the alert threshold of 100 mg/kg.

Cu and Mn concentrations are significantly higher in Simnic vineyard. It is also noted that in May were determined highest concentrations of Cu and Mn in soil. In April Cu concentrations are exceeding the alert threshold of 100 mg/kg, and in May concentrations are above the intervention threshold specified in Order no. 756/1997. The Cu content on 0-20cm depth is greater than the one determined on 20-40 cm depth, a fact confirmed by the results from the literature (Toselli et al., 2009). Although the concentrations of copper are high, this is common in vineyards, taking into account the application of copper-based fungicide treatments over time. The Mn content in Simnic vineyard is between 565.8 to 898.2 mg/kg. The Mn levels in Breasta vineyard are close to the average content of Mn in soil, 600 mg/kg as referred to in the literature.

CONCLUSIONS

At Merlot variety, concentrations of Mn, Zn and Al presents higher values for Simnic vineyard, pointing out, in this case, the content of Al which represents almost half of concentrations determined for Royal Feteasca. Cr content in Merlot was lower than contents determined for Royal Feteasca, in both analyzed vineyards. In May, Cu concentrations are higher at Merlot variety from Simnic compared to Royal Feteasca from Breasta. Based on the research conducted, we conclude that high concentrations of Cu accumulated are due to the use of copper-based fungicides. Copper concentrations are significantly higher in all soil samples in Simnic vineyard.

Following the interpretation of the results obtained, it can be concluded that the results of all metal concentrations in analyzed soils are higher in Simnic vineyard than in Breasta. Analyzed vineyard soils can be classified as unpolluted or slightly polluted soils, as most of the heavy metal concentrations are below the limits imposed by the Romanian legislation, except for the content of Cu in soils, which is greater than the alert threshold and threshold for intervention according to Order 756/1997.

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VOLATILE ORGANIC COMPOUND EMISSIONS AND PHOTOSYNTHETIC PARAMETERS OF *QUERCUS RUBRA* UNDER TEMPERATURE STRESSES

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Abstract

Red oak (Quercus rubra) is a fast growing tree which could be met in a various forests in Central Europe and North America. In a normal condition, it can live until 300-years and can be 5-6 m tall. Anyway due to the climate change, the oak forest is affected by stress conditions including long period of high temperature and drought.
Regarding to volatile organic compounds (VOC) emission, Quercus rubra is a high isoprene and low monoterpenes emitted. The emission is affected by different stress which can be a sensitive signal of stress responses especially in heat stress which can particularly significantly influence all the metabolic processes of the deciduous trees. Our work has been shown that long term heat stress treatments affect foliage photosynthesis as well as different terpene emissions. Under non-stressed conditions, lipoxygenase pathway products LOX emissions were close to detection limit, while in stress condition those compounds emission enhanced.

Key words*: volatile organic compounds emission, Quercus rubra, .plant stress.*

INTRODUCTION

Almost all plant species are emitters of different volatile organic compounds (VOC). The term *biogenic volatile organic compounds* (biogenic VOCs or BVOC) includes organic atmospheric trace gases other than carbon dioxide and monoxide (Kesselmeier and Staudt, 1999). Volatile isoprenoids – isoprene (5 carbon atoms, C5) and volatile terpenes consisting of isoprene building blocks, monoterpenes, (C10), homoterpenes, sesquiterpenes (C15, SQT), diterpenes (C20), triterpenes (C30), tetraterpenes (C40), polyterpenes (C>40) fatty acid derivatives, benzenoids, alcohols, aldehydes (C5 and C6), ketones, phenylpropanoids, and amino acid derived metabolites – form a major part of plant-generated biogenic volatile organic compounds (BVOC). Plants emissions consist of a complex blend of volatile isoprenoids are usually emitted by plants sometimes a single species emit more than 20 different monoterpenes (Niinemets and Reichstein, 2003; Loreto et al., 2009).
Isoprenoids are synthesized *via* two different pathways from isopentenyl diphosphate. 2-C-methyl-*D*-erythritol 4-phosphate pathway (MEP) is responsible for monoterpene and diterpene production is localized in plastid (Edreva et al., 2007) and the mevalonate pathway (MVA), localized in cytoplasm, and is used to synthesize cytosolic and mitochondrial isoprenoids (Baldwin, 2010).
During different stress conditions plants start to emit green leaves volatiles(GLV) as C6-compound, (Z)-3-hexenal, (Z)-3-hexenal, (Z)-3-hexenol, (E)-2-hexenol, (E)-3-hexenol or (E)-2-hexenal which can be release from plant membranes by phospholipases (Feussner and Wasternack, 2002; Matsui, 2006). Abiotic stress as heat, cold, flooding or drought induces the emission of GLV (see for review (Loreto and Schnitzler, 2010)).
Many studies have been shown a high emission of those C6 compounds as well for biotic stress

(Copolovici et al., 2011; Junker and Tholl, 2013)

The Romanian forests with deciduous trees are dominated by Quercus genus (Popa et al., 2013). Red oak (*Quercus rubra*) is a fast growing tree which could be met in a various forests in Central Europe and North America. In a normal condition, it can live until 300-years and can reach 5-6 m tall.

Our hypothesis has been that VOC emission from plants can be used to quantify the stress impact on the plant.

The long time exposure to middle –high temperature have been used to check the VOC emission in *Quercus rubra.*

MATERIALS AND METHODS

Plant material

Seedlings of *Quercus rubra* are from local origin (Arad National Forest Department ROMSILVA) and were grown in a local greenhouse in 5 L clay pots filled with a 1:1 mixture of commercial potting soil and sand. The plants were watered daily and fertilized once per month with a fertilizer containing microelements.

In all experiments, we used similar-sized 2-yr-old seedlings with 20-25 leaves. The experiment was conducted with plants having fully mature leaves.

Stress application

The heat stress has been applied by keeping one individual leaf in the cuvette at 45 ^{o}C for 6 hours (other parameters have been kept constants: PAR 1000 μmol m^{-2} s^{-1}, CO_2 concentration 385 ppm, relative humidity 65%).

The experiment has been repeated 3 times with individual plants.

Photosynthesis measurements

The monitoring of plants photosynthetic parameters were performed using the GFS 3000 Portable Gas Exchange System (Walz, Effeltrich, Germany) as described before in (Copaciu et al., 2013).

The measurements were performed at a chamber CO_2 concentration of 385 μmol mol^{-1}, photosynthetic quantum flux density was kept at 1000 μmol m^{-2} s^{-1}, and chamber relative humidity at 65%. The air flow rate was 750 μmol s^{-1}.

The leaf were enclose in the cuvette and it was left to stabilize until steady-state values of net assimilation rate (A) and stomatal conductance to water vapor (g_s) (stomata opened) were obtained.

The rates of net assimilation (A) and stomatal conductance to water vapor (g_s) were calculated from these measurements according to (von Caemmerer and Farquhar, 1981).

Isoprene and green leaves volatile measurements

After stabilization following the stress application, the leaves subject to stress were mounted in the clipping cuvette of a commercial gas-exchange system (GFS-3000, Heinz Walz GmbH, Effeltrich, Germany). VOC sampling was performed on adsorbent cartridges via the outlets of each cuvette every day with a flow rate of 200 ml min^{-1} for 15 min by using a constant flow air sample pump (1003-SKC, SKC Inc., Houston, TX, USA). Adsorbent cartridges were analyzed for isoprene and lipoxygenase pathway products concentrations using a Shimadzu TD20 automated cartridge desorber and Shimadzu 2010Plus GC-MS instrument (Shimadzu Corporation, Kyoto, Japan) according to the GC-MS method detailed in our previous studies (Copolovici et al., 2009; Toome et al., 2010). The background (blank) VOC concentrations were subtracted from the emission samples with the seedlings.

RESULTS AND DISCUSSIONS

The emission of isoprene from plants from *Quercus* genus have been shown in many other papers (Monson et al., 2013). *Quercus rubra* have been demonstrated to be isoprene emitters.

The emission of isoprene is constant in the first 30 minutes of temperature stress and decline drastically in the following period of time.

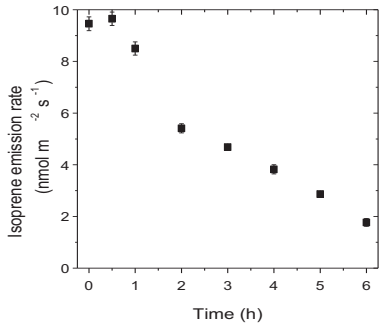

Figure 1. Isoprene emission rate variation function of the time of heat stress for *Quercus rubra* plants

There are a burst of green leaf volatiles (GLV) in the first minutes after the stress application which has been shown as well in many other papers, in case of the temperature stress (Brilli et al., 2011; Copolovici et al., 2012).
The GLV found in the samples were 1-hexanol, (*Z*)-3-hexenol, (*Z*)-2-hexenal, and (*Z*)-3-hexenyl acetate.
Our determinations show that GLV emission increase over first 4 hours and the concentration become constant in the following 2 hours.

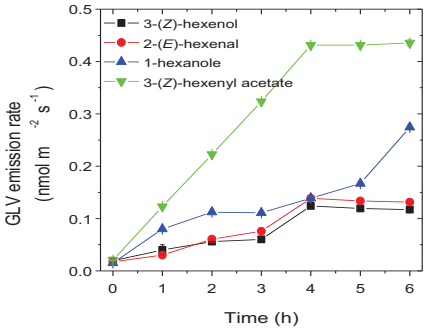

Figure 2. Green leaves volatiles (GLV) emission rates variation function of the time of heat stress for *Quercus rubra* plants

Regarding to monoterpene emission there are an increase after first hour followed by a plateau.
Usually terpene emission cannot be correlated with the time of exposure of stresses (Copolovici et al., 2012).

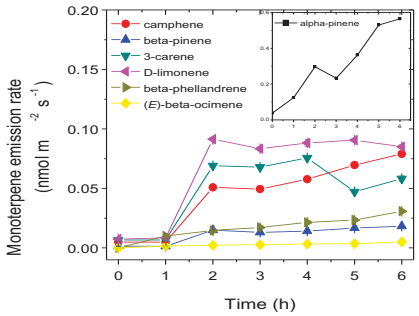

Figure 3. Monoterpenes emission rate variation function of the time of heat stress for *Quercus rubra* plants

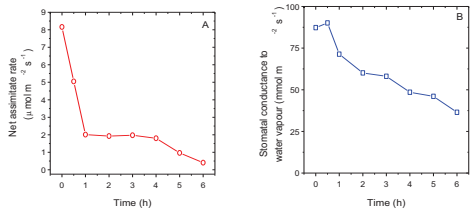

Figure 4. Changing in net assimilation rate (A) and stomatal conductance (B) depending on the time of application of heat stress

The photosynthetic parameters (assimilation rate and stomatal conductance to water vapour) decreased drastically after 30 minutes of stress conditions (Figure 4).

CONCLUSIONS

The results have been shown that photosynthetic parameters decreased drastically after first 30 minutes of exposure while green leaves volatile emissions are increased.
The monoterpene emission rates increased after 1 hours of exposure until a maximum of 0.2 nmol m^{-2} s^{-1} for most of the terpenes. Isoprene emission rate is decreasing, after the first burst, due to isoprene synthetase decreasing activity. The first burst explains the thermotolerance role of the isoprene for *Q. robur* leaves.

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TWO DECADES OF DESIGN AND EXECUTION OF MODERN LANDFILLS IN ROMANIA

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Abstract

The paper deals with the juridical-legislative, technical and administrative framework which substantiated the projects developed and executed in the 20 years, starting with Romania's EU pre-accession till now, respectively the national strategy documents of waste management: the national Plan of waste Management and the National Strategy for waste management, also the local / county / regional waste management plans and strategies, including master plans. All this legislation has been permanently updated and aligned to the European legislation. The article deals especially with the problems encountered by the specialists in the landfills' designing and execution, with examples through case studies. In the year 1994 was put into operation in Ovidiu, Constanta County, the first municipal, ecologic landfill from Romania, followed by that from Sighisoara designed in 1993-1994 and put into operation in 1995. Since the execution of the first ecologic landfill in 1994 till now, over 40 compliant landfills have been executed in Romania with private or public funds.

Key words*: landfill, ecological, lining, case-studies, training.*

INTRODUCTION

In Romania, the wastes' disposal has been made and is made exclusively by storage, according to the Annual Report on the Romanian Environment State from 2013. Till now haven't been put into operation installations for the incineration of the municipal wastes, solution that is currently used at this moment in Europe for the environmental protection. The need to meet the obligations assumed by Romania within the negotiation process with the European Commission on the Chapter 22 "Environment Protection" and the obligations under the Adherence Treaty to the European Union, the Government Decision no. 349/2005 regarding the waste disposal foresees the ceasing and closure of non-compliant landfills.

The construction and put into work of the new landfills has been accelerated together with the Romania entry into the European Union and the implementation, in the period 2007-2013, with structural and cohesion funds, of the project "Integrated Waste Management System", so that at the end 2013 were authorized 33 landfills.

Table 1. List of the compliant municipal landfills, authorized at the end of 2013

County	Landfill
Neamt	Piatra Neamt
Bacau	Bacau
Iasi	Tutora
Braila	Braila – Muchea loc.
Buzau	Buzau – Galbinasi
Constanta	Ovidiu; Costinesti; Mangalia; Albesti; Incinta Port
Tulcea	Vararie
Ialomita	Slobozia
Prahova	Ploiesti – Boldesti; Valenii de Munte
Dambovita	Aninoasa; Titu
Teleorman	Mavrodin
Arges	Albota
Dolj	Mofleni-Craiova
Gorj	Tg. Jiu
Mehedinti	Halanga
Valcea	Feteni
Arad	Arad
Timis	Ghizela
Bihor	Oradea
Satu Mare	Doba
Bistrita-Nasaud	Tarpiu
Brasov	Brasov
Mures	Sighisoara
Sibiu	Sibiu-Cristian
Harghita	CeKend- Odorhei
Bucuresti/Ilfov	Chiajna/Vidra • Glina

THE SITUATION OF THE MUNICIPAL WASTE MANAGEMENT INTEGRATED SYSTEMS

At the end of 2013 were in course of implementing the following projects approved by the European Commission and the Management Authority of Environment, respectively:

- Vrancea, Giurgiu (approved in 2009);
- Arad, Sibiu, Mures, Covasna, Salaj, Botosani (approved in 2010);
- Neamt, Suceava, Cluj, Bacau, Vaslui, Calarasi, Olt, Arges (approved in 2011);
- Caras-Severin, Alba (approved in 2012);
- Prahova, Iasi, Mehedinti, Harghita, Braila, Valcea, Constanta, Maramures, Tulcea (approved in 2013).

The physical stage of project development from Galati, Tulcea, Valcea, Maramures, Bihor and Constanta counties was of 0% at the end of 2014.

Together with the new landfills' put into operation, it has continued the work's ceasing on non-conforming landfills at the terms provided by G.D. no.349/2005 on waste disposal so that at the end of 2013 were in function only 46 non-compliant landfills for municipal wastes which will be gradually closed till 16 July 2017.

In the Government Decision no.349/2005 has been nominated the 240 landfills that must be closed in the period 2004-2017 (Figure 1).

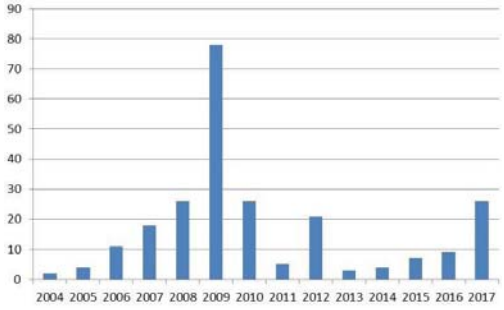

Figure 1. Planning of the non-compliant landfills' closures

It is important to note that, to meet the conditions imposed by the European Union, Romania had to work in some cases simultaneously on several levels, namely: legislative – in order to create the necessary legal framework, technical – in order to produce the technical documentation (projects) needed both for non-compliant landfills closure and for building new ones according to the requirements on environmental protection, educational - for training, public and even local authorities awareness on wastes issue, economical – in order to elaborate the necessary documentation for the investments' financing under the proposed program.

LEGISLATIVE

Among the obligations assumed by Romania in the pre-accession period was the obligation of implementing the European directives in all fields, including waste disposal activities, constructions, public acquisitions, etc.

Public acquisitions in Romania are regulated by Ordinance OUG 34/2006, modified according to Directive 2004/18/ EC and G.D. 925/2006 for approving the implementing rules of the provisions regarding to the award of public acquisition contracts.

The institutionalization of Red and Yellow FIDIC contracts' use and their establishment as contractual framework was made by Order no. 2266/335/2012. Although it was likely to bring a number of undeniable advantages in ensuring the celerity of the award procedure's browsing, this order has also attracted some inconveniences which in practice have been translated into difficulties in the application of contractual clauses and, consequently, in the execution of the construction works.

These inconveniences arise mainly from the fact that these FIDIC contracts were created by the Anglo-Saxon authority (common law) and were adopted into domestic legislation as such, without proceeding to a correlation / adaptation of contractual clauses reported to the applicable legal provisions at national level. Between the contract terms and the (mandatory, compulsory) legal provisions there are certain contradictions or at least inadvertences that lead to disputes settled by the courts (e.g. the interpretation given by the contracting authorities to differences in amounts in comparison with those from the project lists as additional works. In case of Red FIDIC

contracts, the quantities executed and measured by the Engineer are paid).
Without disputing the beneficial effect of introducing these standardized documentation we noted some incompatibilities, discrepancies between the provisions of the Order's Annexes (both those related to the phase of the award procedure and those relating to contract execution phase) and the applicable legal provisions, which have reduced this effect.

PROCEDURE FOR THE AWARD OF ACQUISITION CONTRACT

In this phase, the main faults resulted from:
• the method of preparation the tender documentation (specifications, qualification requirements, etc.);
• the manner in which the contracting authorities responded to requests for clarification on the tender documentation submitted by potential bidders;
• establishing of some restrictive selection criteria;
• the tenders' evaluation period.
Preparation of tender documentation.
The specifications were elaborated, not infrequently, based on feasibility studies and/or projects incomplete, inaccurate, outdated and unrelated to the situation in the field and/or in the absence of geological, hydrological studies both in case of the contracts under Red FIDIC (works designed by the beneficiary) and under Yellow FIDIC (works designed by the contractor).
These circumstances have led, on the one hand, to the tender documentation's contesting at the National Council for Complaints' Solving (CNSC) and thereafter to the dispute continuation at the competent courts and, on the other hand, to disputes between the contractor and the beneficiary on payment of the additional amounts, term extension, solution modifying etc.
Projects for the landfills' closure and relevant specifications were based in many cases on feasibility studies made usually until 2009, when it was anticipated that these landfills will be closed. The existence of some major errors and omissions in the bills of quantities (in case of contracts under FIDIC Red). Thus, in landfill closures were frequent situations where, in fact, the waste has been stored on large areas, off-site, including private lands. This situation has created problems related to the use of European funds in order to ecologize these lands, possible ownership disturbing, additional amounts of works, and so on.
The manner in which the contracting authorities responded to requests for clarification on the tender documentation submitted by potential bidders.
Contracting authorities gave excessively answers like "will comply with the requirements specifications", even in cases where the specification requirements were difficult or impossible to be applied in practice or which literally appliance would lead to counterproductive, oversized solutions in relation to the result followed up by the contracting authorities and the public acquisition contract's object.
Selection criteria - similar experience.
There were situations when the contracting authority has imposed as a requirement for qualification, the experience in similar construction works and / or design with almost equal value to the contract to be awarded or reported to very big amounts, requirement likely to restrict the access to procedure for the Romanian contractors, considering that similar works to those covered by the procedure that meets the requirements of value or quantity have not performed so far in Romania.
Tenders' evaluation period.
There were situations in which the evaluation of the tenders submitted in the procedure lasted unacceptably long, exceeding the limit term set by law in this regard, without a valid reason for this.

CONTRACT EXECUTION PHASE

Subsequently to the award of public acquisition contracts, in the execution phase and during the works, a number of problems related to the actual execution of contracts have been reported, such as:
a) late handover of the site by the contractor, resulting from: late obtaining of urbanism certificates and building permits; difficulties and delay in clarifying the legal status of the

buildings' property on which will carried out the works and/or the existence of some charges affecting the site; delivery of some improper emplacements for the works' execution, that need changes in solutions / location; delay in the utilities' providing.

b) Interpretation of some Yellow FIDIC contracts provisions relating to the contract price.

Although in case of the contracts executed according to Yellow FIDIC, the contract price is a blanket price, in practice there were interpretations of the consultants in the sense that also in this case it is necessary to measure the actually performed works and pay the contractor according to these measurements.

Such an interpretation is contrary both to the spirit of Yellow FIDIC and the applicable law, in case of global pricing establishment, flat rate, this will be paid as such regardless of the amount of works effectively carried out and the costs incurred by the contractor which may be higher or lower based on the contract price, the risk of paying higher costs than the price obtained from beneficiary being assumed by the contractor. In this context, it is necessary to accentuate that the bills of quantities tendered by the contractor under a Yellow FIDIC contract are estimated and do not alter the legal regime of price.

c) Non-appliance/reservation in applying the Guidelines on the main risks identified in public acquisitions and European Commission's recommendations to be followed by the managing authorities/intermediate bodies in the checking process of public acquisitions procedures approved by the common Order no. 543/2366/1446/1489/1441/879/2013.

Although in force since August 2013, the contracting authorities have been reticent in applying the provisions of this Guide that clarify the situations in which public acquisition contract must be amended for the payment of additional amounts/works or those that do not require such a change.

This Guide defines what is meant by substantial change in the presence of which is necessary a competitive public acquisition procedure and distinguishes from this situation other cases in which, during the contract execution appear additional quantities/works due to the application of contractual mechanisms, when it is not necessary the completion of such proceedings for the payment of such amounts / works.

The operator is generally designated based on the tariff and royalty promised to Beneficiary and some performance criteria in landfill operation. The operator trends to complain, after the bid award, deficiencies in the design and execution of the works in order to obtain a price increase from Beneficiary.

To avoid such situations, a solution would have been the rethinking of the biddings' organization so that from one single bid to be designated the association between the Contractor who executes the landfill and the Operator who will achieve its operation after the execution's completion.

TECHNICAL – ECONOMIC

The compliant landfills' design and execution has been made under the following legislation:

- Waste Framework Directive no. 2006/12 / EEC;
- Directive 1999/31 / EC- concerning the wastes' disposal;
- Law no. 211/2011 on waste regime;
- GD no. 349/2005 - Landfills (ED 31/1999 transposition);
- Order no. 757/2004 – Technical Norm regarding the wastes 'disposal (according ED 31/1999 and GD 349/2005).

According to the legislation into force, the landfills' design and implementation must follow some basic rules so that the adverse environmental effects are eliminated or minimized as possible. We are talking about the pollution of surface and groundwater's, soil and air pollution, including greenhouse effect and also the risk of damage to human health throughout the lifetime of the landfills meaning execution, operation and post- closure.

In order to fulfill these mentioned above, the landfills' designing has been made respecting the following 7 basic rules, respectively:

1. Waterproofing system must ensure maximum sealing.
2. The drainage system must be properly sized.
3. The waterproofing system and drainage system must be designed forever, being

necessary to operate in a sustainable manner.
4. Covering the landfill after filling is compulsory and it will be sized based on the risks of pollution resulting from contaminated water, gas emissions and odors.
5. To the extent possible, the location chosen must provide sufficient natural seal guarantees in order to take up eventual problems that may arise in the event of any damages to the designed and executed sealing system.
6. All residual liquids must be collected from a landfill and they will necessarily be treated in a wastewater treatment plant.
7. Landfills will be monitored in order to establish the impact they have on the environment and to intervene in case of pollution.

Although, in some cases, the designers have provided wrong solutions for the non-compliant landfill projects of closure or new ones execution, the authorities refused their correction. As example:

- for some landfill closure projects were designed access roads from concrete slabs, 30 cm thickness, or were provided biogas combustion plants where biochemical processes are completed and no longer biogas is produced; most often landfill modeling has been designed with very steep slopes of 1: 2 or even 1:1, so that the stability of the cover layers is not assured;
- for the projects of new landfills execution, has been provided the purchase of expensive biogas installations that will enter into service after many years and will be physically and morally used until their operation.

The activity done till now in this area has relieved three main directions in which technical problems appeared and produced technical accidents (such as landslides, damages of the waterproofing system) or produced delays in execution and additional costs of resources in order to remedy the problems during execution. The three directions previously mentioned are:

1) Improper locations for the new built landfills and projects without serious studies for the chosen emplacement, which was later found with serious problems of stability or foundation.
2) Solutions to waterproofing system achievement insufficiently studied in terms of internal stability.
3) Insufficient time allocated to the produced settlements due to decomposition of organic waste in non-compliant municipal landfills before the final covering. Closure solutions in one stage instead of two stages, as required by the technical standard on storage approved by the Ministry of Environment and Water Management, Order no. 757/2004.

   These problems have led to disputes on payment of additional works, the need for technical expertise, implementation of controversial and expensive solutions in order to ensure stability, term extensions, etc.

CHOOSING THE LOCATION FOR NEW LANDFILLS

The location of the compliant municipal landfills must correspond to the sustainable development through the environment use on long-term such as the economic, technological and ecological development to meet present and future requirements.

Following preconditions are required to establish the municipal landfill sites:

1) Integration in the provisions of the County Plans of territorial landscaping, general and regional urban Plans and the regulations relevant for both cities and villages. This shows that the urban and territorial landscaping Plans transpose in the territory the strategies, policies and programs for sustainable development in spatial profile, the functional developing directions in territories, the routes for traffic corridors specified in the national, regional and county development plans.
2) Integration in the environmental strategies and policies including developing of works, installations and water management according to the Guiding Schemes on hydrographic basins concerning the planning, development and water management and Improvement Plans for

hydrographic basins focusing on banks protection, hydro-technical constructions and protection areas.
3) Unaffecting of the existing land improvement or planned to be achieved (damming and watercourses regularizations, irrigation, drainage, combating of soil erosion and lands affected by slides, soil amelioration).
4) Correlation with the forest development Program in order to improve the environmental conditions and to optimize the landscape, to protect the communication lines, dams and riverbanks, localities and social and economic objectives, agricultural lands.

The choice of some sites lands loping located was the most often option found in other applications, EU co-financed:

Table 2. Slope inclination of landfill

Landfill	Slope inclination
Feteni, Valcea county	18% on average (14-24%)
Tarpiu, Bistrita Nasaud county	10%
Stauceni, Botosani county	7-8%
Sinpaul, Mures county	13-14%
Dobrin, Salaj county	12.5%
URM Pata Rat landfill, Cluj landfill	8%

LINING SYSTEMS

According to Government Decision no. 349 from 21 April 2005 regarding waste depositing and Annex to the Order of the Minister of Environment and Water Management no. 757/2004 on waste disposal and also European legislation for non-hazardous waste disposal it is necessary to be provided the following conditions and constructive elements:

1) clay geological barrier with a minimum thickness of 1.0 m and 10-9 m/s maximum value for the coefficient of permeability;
2) HDPE geomembrane of 2 mm thickness;
3) drainage layer for leachate, 0.50 m thickness, made of river washed gravel 16/32 sort.

For ecological reasons as well as for the environment protection, waste deposits are provided with lining systems. In the current stage of knowledge and technological capacity, lining is carried out with geomembranes that hold the most important function. The layers of the lining packs are clinging together so strongly that they confine the geomembranes within them. The packs have a sandwich structure, whereas relative displacements can develop between layers, clearly, with expected local frictions. Therefore, these lining packs do not constitute composite systems as such, i.e. they do not fulfill the geometric condition of continuity of strains according to the Principle of Saint Venant.

No matter how well designed and executed is the waterproofing system of a landfill there is the risk of leakage through the liner. The detecting of these leaks can be done if adequate systems for detecting and locating are provided from the design phase. (Feodorov, 2013)

RESULTS AND DISCUSSIONS

Case study 1: Feteni Landfill, Ramnicu Valcea, 2009.

Project name: Construction of a compost station, a new waste deposit in Feteni, and closure of the Raureni waste deposit.

Located in Feteni city, Valcea County. Year of inauguration: 2009. Waste deposit area: 77,000 m^2. Storage volume: 1,300,000 m^3. Volumetric indices: 5.65 Euro/m^3 of waste. Indices of area dedicated to the waste deposit: 95.5 Euro/m^2.

The lining system of the deposit base includes a geosynthetic clay liner, a HDPE geomembrane, a protection geotextile and a filtering geotextile.

In this case the selected location complied with the requirements for minimal distance to inhabited areas, roads, etc., since it is located 6 km away from the city of Ramnicu Valcea, but the access to the deposit is rather difficult, especially in bad weather conditions such as winter-time, because of the steep slopes.

Figure 2. Feteni deposit during the construction works.

Like in most similar projects financed from European funds, the piece of land selected for the erection of the new deposit is inclined, i.e. a large valley surrounded by forest. The level difference is 40 m, from 410 to 450 m from the sea level, and the area is subject to landslides. In 2003 and 2005 geotechnical, hydro-geological and geo-physical surveys were carried out, as well as a stability analysis (2005).

These surveys involved drillings at depths between 6 and 10 m and electrometric surveys. The data that was gathered lead to a labeling of the site in the 3rd category of major geotechnical risk.

In 2004, following the international bidding, the execution contract was granted to an Italian Contractor who pledged to complete the works for 9,298,279 Euro by July 2005. The progress of the works was extremely slow and they could not be completed in due time, which lead the contracting authorities to cancel the contract in October 2006.

The Contractor who was granted the project after the new bidding procedure resumed the works in 2008, only after he carried out a new geotechnical survey and he formulated the technical measures required by the execution of the works in safe conditions.

The project was carried out within the budget fixed by the new bidding process: 7,352,625 Euro.

Out of the total value that was granted for the construction of the new municipal waste deposit 8% were works dedicated to soil stabilization. (Feodorov, 2013)

Case study 2: Dumitra-Tarpiu Deposit, Bistrita, 2012.

Project name: Construction of an Integrated Waste Management Centre, a sorting station and a compost station, in Bistrita-Nasaud County.

Located between Dumitra-Tarpiu villages, Bistrita-Nasaud County. The cell no. 1 deposit area: 34,035m^2. Cell no.1 volume: 1,310,000 m^3. It has been inaugurated in 2012. Final value: 10,920,000 Euro. Volumetric indices: 8.3 Euro/m^3 of waste. Indices of area dedicated to the waste deposit: 321Euro/sqm.

The location is situated on an approx. 10% slope directed on East to West, so that the main technical issues concern the requirement for: 1) the overall stability all through the execution of the works; 2) the overall stability during operation; 3) the local stability of each object comprised in the Integrated Waste Management Centre.

Afterwards, during the earthworks in the area of the compost platform, it was revealed that, although safety measures had been taken, landslides within the slopes were becoming active again.

When carrying out sounding operations at the location of the compost platform aiming to reveal the factors that generated the repeated landslide of the excavated slopes, other geotechnical circumstances than those revealed by preceding surveys were found in the entire location, i.e.: 1) Presence of old polyethylene drains 50 mm in diameter, crossing the location from West to East. The drains are placed 1.50-2.00 m deep. 2) These drains take in the waters that penetrate the slope and discharge them upstream of the plastic materials deposit platform. 3) The foundation soil is made of blackish clay rich in plant refuse of a sludge odor, 2-3 m deep.

Figure 3. Dumitra-Tarpiu deposit, Bistrita, after completion.

In august 2011 the General Contractor sent a request to the Technical University of Civil Engineering in Bucharest (UTCB), Geotechnical and Foundations Department, to perform a "Study regarding the use of the local resources as backfilling in order to carry out the perimeter dams surrounding the waste landfill", and a Technical Expertise as well, both resulting in one Study and two Expertise Reports, based on site findings (technical sightseeing during the execution, in 2010-2011), specific in situ investigations, laboratory testing, and stability calculations. The expertise of both reports identified a lot of causes and presented several technical recommendations, which were then transferred into steps for project adjustment and the composition of new design chapters. (Feodorov, 2013)

Case study 3: Dobrin Deposit, Salaj, 2013
Project name: Integrated waste management system in Salaj County.
Located in Dobrin city, Salaj County. Waste deposit area: 41,546.05sqm. Depositing volume: 950,000 m^3. Landfill value: 5,700,000 Euro.
Volumetric indices: 6 Euro/m^3 of waste. Indices of area dedicated to the waste deposit: 137.2 Euro/sqm.
The Dobrin waste deposit is located north of the Zalau Municipality, on a site covering a total area of 19.5 ha, whereas 6.8 ha will be occupied by the ecological landfill that is going to be built. Again, in this case the land is sloping, with a level difference from 315 m to 265 m from the sea level and a smooth slope ranging 1:7 to 1:8, direction North to South.
The waste deposit was subjected to a bidding governed by red FIDIC regulations. According to the stipulations of this type of contract, the Contractor is required to strictly observe the Beneficiary's project. The designed base lining system consists in a rough HDPE geomembrane on both sides and an unwoven geotextile for protection.
Unfortunately, the Designer did not do stability calculations for the lining system and he included in the design long embankments, reaching even to 53 m, without any intermediate berm, while the designed anchorage trench for geosynthetic materials was merely 0.5 m x 0.5 m.
In these circumstances, the Contractor recommended a new geotechnical survey to be done, tests to determine the friction angle between the geomembrane and the clay layer, as well as a recalculation of the dimensions of the anchorage trench.
The geotechnical drillings that were carried out surveyed the soil to a depth between 10 and 30 m. Land surveys and laboratory analyses revealed the presence of clays that displayed a large amount of swelling and contraction. The geotechnical study led to a labeling of the site in the 2nd category of geotechnical risk, as a difficult site.

Figure 4. Dobrin-Salaj deposit during the works.

Therefore, special measure need to be adopted concerning the infrastructure works, including: 1) 1:3 slope embankments and berms of minimum 4-5 m width; 2) avoiding the exposure of the embankments to humidity and temperature variations, by immediately covering them up; 3) in case excavations are not sloped at the angle of the naturally stable embankment, support works need to be carried out; 4) excavation surveillance and control by a geo-technician; 5) rainfall's discharging measures.
Since any modification applied to a design that is carried out under red FIDIC regulations requires a lot of approvals from the Designer, the Consultant and the Beneficiary, implying a long delay, and the period when the documents were prepared has been very rich in precipitations, negative effects rapidly occurred. Thus, a need appeared to carry out additional stability works on the embankment that had been damaged by landslides. (Feodorov, 2013)

Case study 4: Sanpaul Deposit, Targu-Mures, 2013.

Project name: Integrated waste management system, Mures County.Sanpaul landfill. Located in Sanpaul city, Mures County. Landfill area: 73,986 m^2. Depositing volume: 1,250,000 m^3. Currently is under construction. Project value: 16,820,000 Euro.

Volumetric indices: 13.45 Euro/m^3 of waste. Indices of area dedicated to the waste deposit: 227.34 Euro/sqm.

The location is in the farming field of Sanpaul Village, around 4 km south of the administrative center, on a piece of land that belongs to the Mures County Council. The total site area is of 31.14 ha, whereas 24.88 ha will be occupied by the deposit, the management area and the water-purification stations, and 6.26 ha will be occupied by the mechanical-biologic treatment station (mechanical treatment plant, composting and maturation platforms).

It was noticed on site that the embankments were not been provided with berms, and by studying the design it became clear that almost half of the embankment slopes were designed to a width of 40 m or more. According to the design data, the maximum embankment width is 48 m. The execution contract is a red FIDIC type, and the execution design is handed to the Contractor by the Beneficiary.

Figure 5. Sanpaul deposit-Targu Mures, west and north overview

The most important role in the lining system is clearly played by the 2 mm geomembrane which needs to guarantee the sealing of the deposit all through its designed life time. Therefore, the main target is to protect the geomembrane, so as it will stay below a 3% elongation.

This being considered, the General Contractor proposed the adoption, for the deposit lining system, of a configuration where the geomembrane installed on slopes is protected by a geogrid that fulfills the strength requirements, while the gravel layer is replaced by a drainage geocomposite. The Contractor's proposal has been accepted by the Consultant-Engineer and Beneficiary. (Feodorov, 2013)

Case study 5: Closure Of The Cristesti Deposit, Mures County, 2013.

The non-ecological deposit in Cristesti is situated to the west of the Targu-Mures city, near the Cristesti village. The river Mures flows around 3 km west of the site. Close to the landfill, around 200 m north, also flows the Cocorilor stream. The distance from the site to the first dwellings and commercial area is around 800 m. The access on site is done through a service road which is around 1,000 m from the national road.

Cristesti deposit was officially closed in 2009. From the feasibility study which has been the basis for financing and drawing up the specifications in order to organize the bid for landfill closure resulted in a waste occupied area of 50,000 m^2 and a waste volume of 257,000 m^3.

The use's continuance by the local authorities of Cristesti landfill for waste disposal, taking into consideration that by the initial requirements Cristesti was considered a closed deposit in 2009, constitutes a major change of the initial requirements from Specifications.

In accordance with this normative "municipal landfills are first provided with a temporary covering of soil, during the period with the largest settlements (3-5 years)".

The Contractor's proposal was partially accepted so that the project of landfill closure in Cristesti was done in two phases but the time between the two phases was only 6 months.

In the first phase have been relocated the wastes from the designated site, waste has been covered with soil in a layer of 0.5 m and have been executed 24 wells for biogas capture, works for leachate's capture and drainage,

access roads and fencing. Execution of the first phase was completed in November, 2013.
In the second phase were carried out the biogas collecting system and its neutralization, the entire surface waterproofing with geosynthetic materials, spreading of 1 m thick soil layer and grassing works.
Between phases one and two was made a deposit monitoring in order to follow up, in particular, the evolution of differential settlements that will develop in the relocated wastes' body.

Figure 6. View of Cristesti landfill

CONCLUSIONS

The contracts concluded by the local authorities with various Contractors for the execution of the new landfills and closure of non-compliant landfills, works financed by EU funds, have been based on FIDIC agreements (red and yellow).
Between FIDIC terms of such agreements and Romanian legislation of public acquisition (Ordinance No. 34) there are important differences that have marked the progress of the contract works. There are currently in court litigations between Beneficiaries (County Councils) and various Contractors in order to solve some disputes arising from the different ways of understanding the FIDIC rules and Romanian legislation, Ordinance 34 in particular.

For Romania, the municipal waste management program that had to be fulfilled in accordance with the obligations from entering into the European Community has required a major effort and important resources consumption.
The execution Program development for the new landfills and closure of non-compliant landfills highlighted the fact that the level of knowledge in this area should be much higher and depth. Numerous legal, technical and economic problems occurred during the contracts.
You must know very well that landfills construction and installation works have a hidden essential character. Due to traditional academic conservatism, Romanian technical universities included too little in their programs of higher education issues concerning the calculation and dimensioning of the geosynthetics used for the landfill designing and execution.
Choosing the operators to exploit new landfills is an important step that must be started just from the execution stage.
By the European financing program that finishes at the end of 2015, were built Waste Integrated Management Centres in almost all counties of Romania.
Their operating will require the execution of new waste storage cells and in the same time cells that are filled will be closed. It is therefore necessary that the experience gained in two decades of design and construction of complying landfills to be used.

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GLOBAL WARMING BETWEEN REALITY, APPROACH AND ACCEPTANCE

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Abstract

Impacts of climate change are already being observed and are expected to become more pronounced. Extreme weather events, including heat waves, droughts and floods are expected to become more frequent and intense. Global warming is a natural phenomenon. It is important that the alarm was pulled and the countries of the world cooperate to maintain environmental quality, given that all the people are the main beneficiary of a healthy environment. Climate change is one of the biggest threats to the environment, social and economic framework. Warming of the climate system is unequivocal. Climate change is the biggest failure and the largest scale yet. Observations show increases in global average temperature of the ocean water and an extensive melting of snow and ice and rising global average sea level. Over the past 150 years, mean temperature has increased by almost 0.8ºC on the Earth and about 1ºC in Europe. In early 2009, the European Commission presented detailed proposals on how to achieve these objectives. They include increasing the amount of money invested in the development of less carbon technologies, especially in developing countries, innovative sources of international finance, international carbon market by 2015 and measures to help countries adapt to changes climate. The European Union welcomed the outcome of the climate change conference held in Doha in 2012, laying the foundation for more ambitious international action against climate change in the short term, opening the way for a new common future on climate change to be completed in 2015 and allowed starting from 1 January 2013, a second commitment period under the Kyoto Protocol. Reference points of the international meeting are those concerning our common future, given that the peoples of the world are the ones who should benefit from the local environment, states and every citizen of planet must only through an awareness of the high intensity effort and will be able to achieve the aim of reducing emissions. 21st Century Europe must have the role of a catalyst so that the force has, through experience and its traditions lead to a convergence of efforts of all countries of the world in the fight against pollution of any kind and in particular the pollution caused by exhaust emissions.

Key words: *climate change, common future, global warming, healthy environment, international carbon market.*

INTRODUCTION

Global warming is at the moment an important problem of too much carbon dioxide (CO_2) in the atmosphere. Connected to all the daily men activities, we can appreciate that warming of the climate system is unequivocal. Climate change is the biggest failure and the largest scale yet. Observations show increases in global average temperature of the ocean water and an extensive melting of snow and ice and rising global average sea level. Over the past 150 years, mean temperature has increased by almost 0.8ºC on the Earth and about 1ºC in Europe.

Over the last century, global average temperature has increased by more than 0.7°C. Substantial scientific evidence indicates the 2001-2010 decade is or could be considered the warmest since 1880—the earliest year for which comprehensive global temperature records were available.

Actually, nine of the warmest years on record have occurred in just the last 10 years. In the same time, this warming has been accompanied by a decrease in very cold days and nights and an increase in extremely hot days and warm nights.

Generally speaking, the evidence indicates that an increase in the global average temperature of more than 2 degrees Celsius above pre-industrial levels poses severe risks to natural systems and to human health and well-being.

MATERIALS AND METHODS

In order to characterize the evolution of global warming, there is statistical evidence that

proves that global warming is causing changes to our planet, and changes that will do more harm than good. Some indicators were used show us the important modifications in period at about 100 years.

The data, collected from ministry of Environment, Environmental Status - Daily reports -Situation report-Hydro meteorological and environmental quality within 1990-2014, European Union environmental legislation, Kyoto Protocol, Doha Amendment to the Kyoto Protocol, Romanian environmental legislation.

RESULTS AND DISCUSSIONS

Global warming is a natural phenomenon. It is important that the alarm was pulled and the countries of the world cooperate to maintain environmental quality, given that all the people are the main beneficiary of a healthy environment. Climate change is one of the biggest threats to the environment, social and economic framework. Warming of the climate system is unequivocal. Climate change is the biggest failure and the largest scale yet.

These climate changes can be considered a fact. There is lots of evidence and many scientists have received a lot of similar results in tests relating to climate change and carbon dioxide. Only very few scientists are against climate change and their tests and theories may not have even been checked thoroughly. But is global warming a normal or abnormal phenomenon?

And the answer is that under the impact of greenhouse effect, the world climate knows major changes, in a fast paced, which are so critical to life on the planet. This phenomenon provided 110 years ago, studied in 1955 and which is subject to its effects management projects since 1975, acquired by global warming, a global dimension.

Even so, humans caused global warming, that means that all humans can also do something for reducing pollution and global warming as well.

To avoid this level of warming, large emitters need to greatly reduce heat-trapping gas emissions by mid century. Delay in taking such action means the prospect of much steeper cuts later if there is any hope of staying below the 2°C temperature goal. Delayed action is also likely to make it more difficult and costly to not only make these reductions, but also address the climate consequences that occur in the meantime.

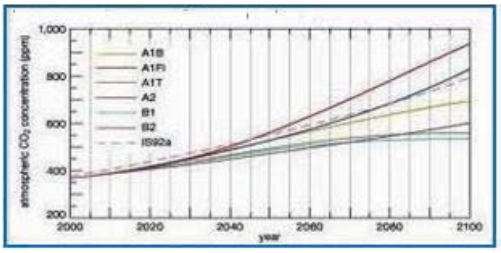

Figure 1. Atmospheric CO_2 emissions

This global warming is a reality. It is confirmed by the consensus of scientific elite world and in the same time, public opinion is becoming more aware and more worried about climate change. Why? Because CO_2 survives in the atmosphere for a long time—few centuries—so its heat-trapping effects are compounded over time. CO_2 puts us at the greatest risk because of irreversible changes and accumulation in the atmosphere.

In fact, there are two different elements that we can associate. One of them is temperature and the other one humidity. When both, temperature and humidity are high, humans can experience considerable heat stress extreme heat may have greater impact on human health. This time we are talking about the combined effects of temperature and humidity which cannot be directly measured but can be assessed by calculation of an "apparent temperature".

On the timescale of centuries to millennia, the magnitude of global warming will be determined primarily by anthropogenic CO_2 emissions.

Stabilizing global average temperature would require reductions in anthropogenic CO_2 emissions. Reductions in emissions of non-CO_2 anthropogenic greenhouse gases (GHGs) (methane and nitrous oxide) would also be necessary. For CO_2, anthropogenic emissions would need to be reduced by more than 80% relative to their peak level. Even if this were to be achieved, global average temperatures

would remain close to their highest level for many centuries.

According to the principle of sustainable development, it is interesting to appreciate that the carbon we put in the atmosphere today will literally determine not only our climate future but that of future generations as well.

Reference points of the international meeting are those concerning our common future, given that the peoples of the world are the ones who should benefit from the local environment, states and every citizen of planet must only through an awareness of the high intensity effort and will be able to achieve the aim of reducing emissions.

21st Century Europe must have the role of a catalyst so that the force has, through experience and its traditions lead to a convergence of efforts of all countries of the world in the fight against pollution of any kind and in particular the pollution caused by exhaust emissions.

Global warming has a lot of causes: carbon dioxide emissions from fossil fuel burning, carbon dioxide emissions from burning gasoline for transportation, methane emissions from animals, agriculture such as rice paddies, and from Arctic sea beds, deforestation, especially tropical forests for wood, pulp, and farmland, increase in usage of chemical fertilizers on croplands.

Because of these different causes, there are a lot of global warming effects: Rise in sea levels worldwide. As the matter of fact, scientists predict an increase in sea levels worldwide due to the melting of two massive ice sheets in Antarctica and Greenland. More killer storms-global warming will significantly increase the intensity of the most extreme storms worldwide. Massive crop failures-generally speaking, there is a 90% chance that 3 billion people worldwide will have to choose between moving their families to milder climes and going hungry due to climate change within 100 years. One of the main causes of this will be the spread of desertification, and all the secondary effects. Widespread extinction of species-by 2050, rising temperatures could lead to the extinction of more than a million species.

Global warming is already having significant and harmful effects on our life. So, we have to take immediate action to address global warming.

That's why 3C members called leaders G8 + 5 countries (Canada, France, Germany, Italy, Japan, Russia, USA, UK, Brazil, China, India, Mexico and South Africa) and national governments around the world to work together to develop policy to combat global climate changes and of course, global warming. In this context, 3C offers the following:

- Reduce Greenhouse Emissions Scientists from the IPCC (Intergovernmental Panel on Climate Change) announces that, to avoid a severe impact on the environment and human, by the end of this century have not recorded a temperature rise of more than 2 degrees Celsius.
- Designation companies and economic markets as leaders transform the economy into one weak issuing greenhouse gas. Methods for reducing greenhouse gases are multiple and accessible to all, without requiring substantial investment. Dynamism and corporate involvement are easier transition to a weak economy issuing greenhouse gas emissions.
- Develop 4 types of policies like strengthen international market transactions carbon emissions. The price for carbon emissions must be set globally and be stable over time, establish some minimum requirements for energy efficient use of resources (here the focus is on transport and construction), accelerate the development of alternative energy technologies.
- Sharing fairly responsibility in the protection of the environment, taking into account the global nature of the problem. Combat Climate Change warns that some climate change is inevitable. In the future, the most affected by the consequences of global warming will be developing countries, which are unable to fight climate change. Therefore, other countries must be willing to accept a fair sharing of efforts.
- Encourage the G8 + 5 to take over the initiative to transform the economy into one weak issuing greenhouse gas G8 + 5, must assume the role of leadership and act as role models in terms of reducing emissions.

• Drafting reports by 3C to help national governments to implement and adapt measures to reduce emissions. Companies 3C promise:

- will share information we hold about their sector to identify measures needed to combat climate warming;
- will be models for other companies in its sectors, in terms of volume decreased emissions;
- will be transparent in their actions and they will refer clients to make the best decisions that comply with the conditions for a sustainable economy.

Thus, between 1910 and 2000 when the average temperature at the Earth's surface has increased by about 0.7°C by 2100 growth will be between 1.4°C and 5.8°C; accepting an average of 4°C (the forecast offered by different scenarios) only within a century there will be a genuine heat shock, the magnitude of warming that ended the last ice age and has radically changed the world map, but its occurrence during some thousands of years!

Meanwhile, if the average level of seas and oceans has increased in the twentieth century, 10-20 cm, a projection until 2100 varies between 20 and 88 cm.

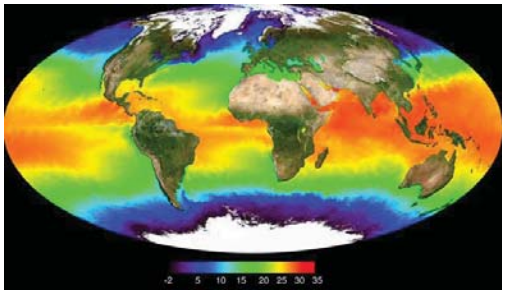

Figure 2. Surface Reflectance and Ocean Temperature by NASA

CONCLUSIONS

We are often talking about global warming.

The planet's temperature is rising and the trend is clear and unmistakable. Every one of the past 37 years has been warmer than the 20th century average. The 12 warmest years on record have all occurred since 1998. The hottest year ever recorded for the contiguous United States occurred in 2012. Globally, the average surface temperature has increased more than one degree Celsius since the late 1800s. Most of that increase has occurred over just the past three decades. So, year 2014 was officially the warmest in history, two separate analyses of NASA and the National Oceanic and Atmospheric Administration determined that temperatures across the globe were, in 2014, the highest level since 1880.

Table 1. Top 10 Warmest Years (1880–2014) - land and ocean annually-averaged temperature rank and anomaly for each of the 10 warmest years on record.

RANK 1 = WARMEST PERIOD OF RECORD: 1880–2014	YEAR	ANOMALY °C	ANOMALY °F
1	2014	0.69	1.24
2 (tie)	2010	0.65	1.17
2 (tie)	2005	0.65	1.17
4	1998	0.63	1.13
5 (tie)	2013	0.62	1.12
5 (tie)	2003	0.62	1.12
7	2002	0.61	1.10
8	2006	0.60	1.08
9 (tie)	2009	0.59	1.06
9 (tie)	2007	0.59	1.06

Temperatures were warmer than average across land surfaces as well. The global land temperature for 2014 was 1.00°C (1.80°F) above the 20th century average, the fourth highest annually-averaged value on record.

Because land surfaces generally have low heat capacity relative to oceans, temperature anomalies can vary greatly between months. In 2014, the average monthly land temperature anomaly rose from +0.31°C (+0.56°F) in February to +1.32°C (+2.38°F) in March, a difference of 1.01°C (1.94°F). These anomalies also represent the lowest and highest monthly anomalies observed during 2014. The ocean has a much higher heat capacity than land and thus anomalies tend to vary less over monthly timescales. During the year, the global monthly ocean temperature anomaly ranged from +0.46°C (+0.83°F; January, February) to +0.66°C (+1.19°F; September), a difference of 0.20°C (0.36°F)

Governments and individuals need to pay close attention to these statistics in order to figure out

ways to reverse the disturbing trends that are now occurring. The sooner we take heed of these statistics and implement changes that address global warming, the quicker we can reverse the disturbing trends and the less damage will occur to our planet.

Climate and warming process are defined as long-term averages and variations in weather measured over a period of several decades. The Earth's climate system includes the land surface, atmosphere, oceans, and ice. Many aspects of the global climate are changing rapidly, and the primary drivers of that change are human in origin. Evidence for changes in the climate system abounds, from the top of the atmosphere to the depths of the oceans.

Many indicators are being developed to provide public and private sector analysts with up-to-date quantitative information on the effect of weather and climate on vital sectors of states economy and society.

Greenhouse gases have a large effect on the environment and have for millions of years. It is nothing new but the green house concentration became dangerous. In certain stages of Earths life mass extinctions have plagued the earth because of imbalances of greenhouse gases in the atmosphere. The greenhouse effect is natural; however it has been proved by scientists that humans have amplified the rate of carbon dioxide being released into the atmosphere.

Recent years have been extremely warm. Some extreme weather and climate events have increased in recent decades, and new and stronger evidence confirms that some of these increases are related to human activities. All the population of the globe induced climate changes which are accelerate significantly if global emissions of heat-trapping gases continue to increase.

It is important to observe and analyse the great impacts related to climate change which are already evident in many sectors of life and are expected to become increasingly disruptive across the nation throughout this century and beyond.

Climate change threatens human health and well-being in many ways, including through more extreme weather events. Water quality and water supply reliability are jeopardized by climate change in a variety of ways that affect ecosystems and livelihoods.

That why the capacity of ecosystems to buffer the impacts of extreme events like fires, floods, and severe storms is being overwhelmed.

This large ecosystem of Earth is now in danger. All the ecosystems and the benefits they provide to society are being affected by climate change. The capacity of ecosystems to buffer the impacts of extreme events like fires, floods, and severe storms is being overwhelmed.

Planning for adaptation and mitigation is becoming more widespread, but current implementation efforts are insufficient to avoid increasingly negative social, environmental, and economic consequences.

Global warming and climate change have been affecting earth for millions of years. That's why global warming and climate change depend on the orbit of the Earth, amount of animal and plant life, volcanic events and more.

In the last 200 years the amount of carbon dioxide ppm (parts per million) in our air has risen from 290 to 385. These graphs as well as other sources show the clear link between global temperature and carbon dioxide.

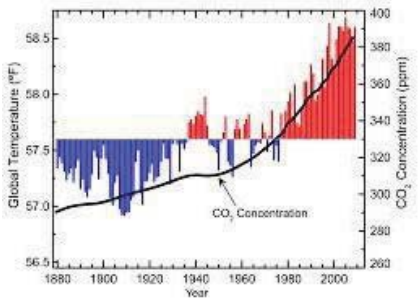

Figure 3. Global temperature and CO_2

The issues of climate change are virtually cyclical. Is true that the human activity affects the increase in temperatures. Developed countries produce large quantities of acidic pollutants.

It is obvious that the Earth is warming. In the past five decades temperature began to change significantly. The last 10 or 15 years were particularly characteristic of each season as temperatures have raised more. This is a finding resulting from data recorded globally and regionally. We must understand that the

Earth is into a multi natural cycle that is not linked to human activity. As a result, the Earth will warm in the next decade. In the very long term, there will be a significant lifting of temperatures around the globe, will be a massive lift water levels seas and oceans. Later will come a new ice age explaining that Earth is cooled by heat. That means that would be possible to install Big Cold.

There has to be no doubt about climate change because global warming is already having significant and harmful effects on our communities, our health, and our climate. We must take immediate action to address global warming or these consequences will continue to intensify. Because global warming is happening now, we have to tackle it together.

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COMPARATIVE ANALYSIS OF EFFORTS AND DEFORMATIONS STATE AT BRICK MASONRY PANELS

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Abstract

This article aims to emphasize the deformation state of a masonry wall, for four situations of masonry reinforcement with polymeric grids. Polymeric grids are referred as seismic reinforcement solutions in the following masonry codes: Eurocode 8, and Romanian codes P100 and CR6. Polymeric grids can be used for confinement and reinforcement of masonry with bricks and mortar due to the properties of grids and mortar, and due to the cooperation between reinforcement and mortar that is anchorage.
The masonry is an elasto-plastic material, to which characteristic curve σ-ε strain-deformation has a characteristic aspect. Deformation energy is represented by the surface determined between the σ-ε curve and the axis ε.
The total specific deformation ε corresponding to a compression stress σ can be decomposed in two parts, one elastic εe, which is cancelled after the removal of external action, and the other plastic, remanent, εp.
The case study present a comparative dynamic analysis of deformations state in structural masonry panels (soft diaphragms) in the following situations: plain, reinforce , confined and reinforced+confined masonry with polymer grids.

***Key words**: masonry, deformations, dynamic analysis.*

INTRODUCTION

The masonry is elastic-plastic material, whose characteristic curve strain-stress (σ-ε) has a specific aspect (Figure1).
The total specific deformation ε corresponding to a compression stress σ can be decomposed in two parts, an elastic one ε_e, which is canceled after the removal of external action, and another plastic, remanent ε_p.

$$\varepsilon = \varepsilon_e + \varepsilon_p \quad (1)$$

The limit specific deformation εlim corresponding to the normalized resistance rn is obtained by integration:

$$\varepsilon_{lim} = \int_0^{R_n} \frac{d\sigma}{E(\sigma)} \quad (2)$$

$$E(\sigma) = \frac{d\sigma}{d\varepsilon} \quad (3)$$

where E(σ) is Young's modulus, relative to variable loading step.

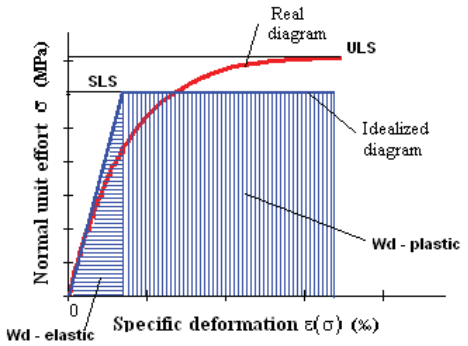


Figure 1 – σ-ε masonry curve

$$W_d = W_el + W_{pl} \quad (4)$$

$$w_d = \frac{\sigma\varepsilon}{2} \quad (5)$$

where:
W_d – deformation energy (J)
W_el – elastic deformation energy (J)
W_{pl} - plastic deformation energy (J)
w_d – specific deformation energy (J/m^3)

MATERIALS AND METHODS

1.The masonry

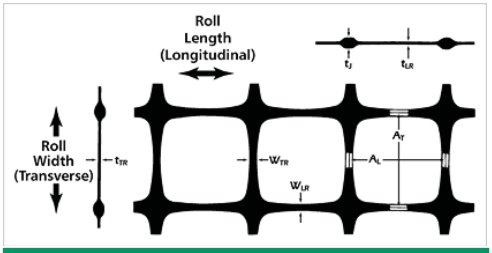
In the state-of-the-art there are two known types of masonry. One type is the original brickwork, composed of burnt soil brick units bonded together with lime mortar. The other type is made of ceramic bricks burnt up to the point of vitrification, using concrete mortar as binder. There are important differences between the two types of masonry, which confer them different properties.

Masonry is reinforced in order to increase its resistance to seismic activity. Original masonry can be armed with non-metallic, polymer-based reinforcements, which works through the anchoring effect.

2. Polymer reinforcement

The current study focuses on the masonry armed or/and confined with polymeric reinforcement grids made under the license of Tensar International Ltd. in UK. These grids fulfill the required seismic reinforcement criteria for strength, strain and stiffness.

The seismic protection method using polymer grids on lime mortar brickworks has been patented in Romania (Sofronie, 1995).



Tensar geogrid - typical dimensions (mm)							
	A_L	A_T	W_{LR}	W_{TR}	t_J	t_{LR}	t_{TR}
RG20	39	39	2.2	2.4	4.1	1.1	0.8
RG30	39	39	2.3	2.8	5.0	2.2	1.3
RG40	33	33	2.2	2.5	5.8	2.2	1.4

Grid type	Grid resistance (kN/m)	Specific weight (daN)
RG20	20	0,2
RG30	30	0,3
RG40	40	0,4

Figure 2. The geometrical and mechanical characteristics of polymer grids (source: http://www.tensar.co.uk/)

3. Dynamic calculation

The dynamic calculation was modeled according to the Romanian standard P100-1/2013, in case of the simplified calculation. For this purpose it was considered an earthquake in Bucharest area (a_g = 0.30g, T_c = 1.6 s, IMG = 225 years), in all four previous cases: unreinforced masonry, reinforced masonry, confined masonry and reinforced + confined masonry (Figures 3-10).

RESULTS AND DISCUSSIONS

1. Unreinforced masonry (URM) subjected to earthquake

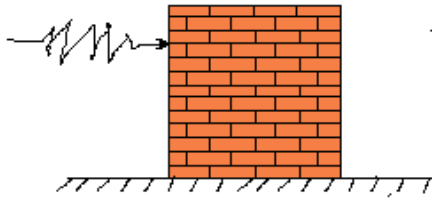


Figure 3. Unreinforced masonry subjected to earthquake

Rc_{URM} = 0.9 MPa – compressive strength URM
E= 0.4 GPa – Young's modulus
G = 0.08 GPa – shear modulus
ν = 0.15 - Poisson's ratio
γ= 18 kN/m^3 – specific weight
ρ = 1834 t/m^3 – volumetric mass density
$\alpha_v = 10^{-5}$ °C^{-1} (sau 10^{-5} K^{-1}) - thermal expansion coefficient
F = Rc_{URM} = 0.9 MPa – applied force

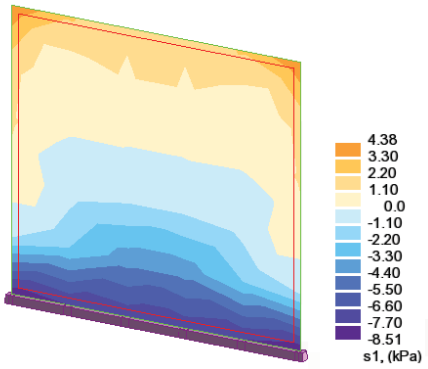


Figure 4. Displacement diagram for unreinforced masonry (T = 0.34s), normal stress ranges (kPa)

2. Reinforced masonry with polymer grids (RM) subjected to earthquake

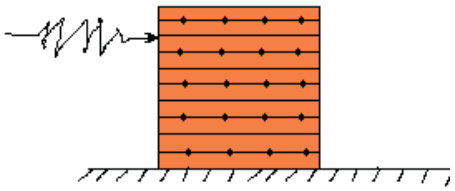


Figure 5. Reinforced masonry in each row with polymer grids subjected to earthquake

Rc_{RM}=1 MPa – compressive strength RM
E= 0.4 GPa – Young's modulus
G = 0.08 GPa – shear modulus
ν = 0.15 - Poisson's ratio
γ= 18 kN/m^3 – specific weight
ρ = 1834 t/m^3 – volumetric mass density
$\alpha_v = 10^{-5}\ ^oC^{-1}$ (sau $10^{-5}\ K^{-1}$) - thermal expansion coefficient
F = Rc_{RM}= 1 MPa – applied force

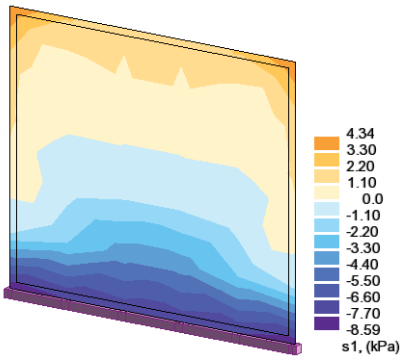


Figure 6. Displacement diagram for reinforced masonry (T = 0.28s), normal stress ranges (kPa)

3. Confined masonry with polymer grids (CM) subjected to earthquake

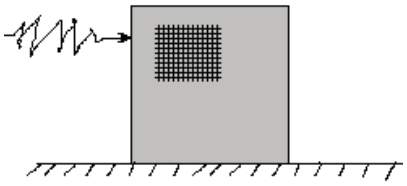


Figure 7. Confined masonry with polymer grids subjected to earthquake

Rc_{CM}=1.06 MPa – compressive strength CM
E= 0.4 GPa – Young's modulus
G = 0.08 GPa – shear modulus
ν = 0.15 - Poisson's ratio
γ= 18 KN/M^3 – specific weight
ρ = 1834 t/m^3 – volumetric mass density
$\alpha_v = 10^{-5}\ ^oC^{-1}$ (sau $10^{-5}\ K^{-1}$) - thermal expansion coefficient
F = Rc_{CM}= 1.06 MPa – applied force

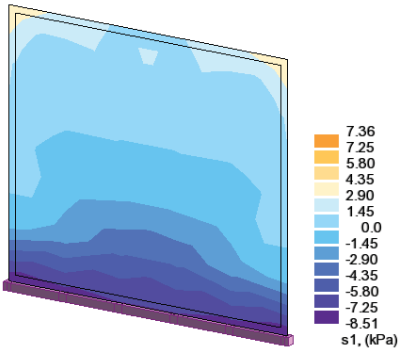


Figure 8. Displacement diagram for confined masonry (T = 0.24s), normal stress ranges (kPa)

4. Reinforced and confined masonry with polymer grids (RM+CM) subjected to earthquake

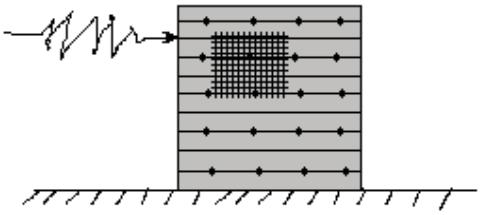


Figure 9. Reinforced and confined masonry with polymer grids subjected to earthquake

Rc_{RM+CM}=1.16 MPa – compressive strength RM+CM
E= 0.4 GPa – Young's modulus
G = 0.08 GPa – shear modulus
ν = 0.15 - Poisson's ratio
γ= 18 kN/m^3 – specific weight
ρ = 1834 t/m^3 – volumetric mass density
$\alpha_v = 10^{-5}\ ^oC^{-1}$ (sau $10^{-5}\ K^{-1}$) - thermal expansion coefficient
F = Rc_{RM+CM} = 1.16 MPa – applied force

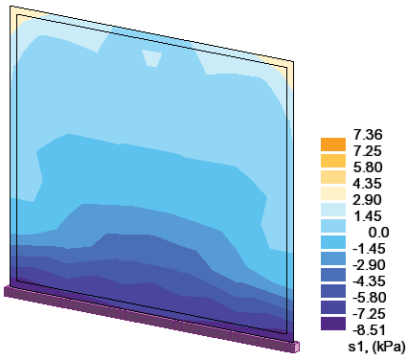


Figure 10. Displacement diagram for confined and reinforced masonry (T = 0.22s), normal stress ranges (kPa)

Tabel 1. Maximum displacements on two orthogonal directions (mm)

unreinforced masonry		reinforced masonry		confined masonry		reinforced + confined masonry	
dir. x	dir. y	dir. x	dir. y	dir. x	dir. y	dir. x	dir. y
0.02	41.2	0.01	27.39	0.01	20.49	0.01	16.41

CONCLUSIONS

1. From the results on y direction, it is noted that, compared to the unreinforced masonry, the maximum displacement of the reinforced masonry wall is reduced by 33.5%, the maximum displacement in confined masonry is 50.3% lower, and reduces by 60.2% for reinforced+confined masonry. Also, comparing the reinforced masonry and confined masonry, the maximum displacement decreases by 25.2%, and in the case of reinforced+confined masonry it decreases by 40.1% comparing to reinforced masonry (Figure 11).

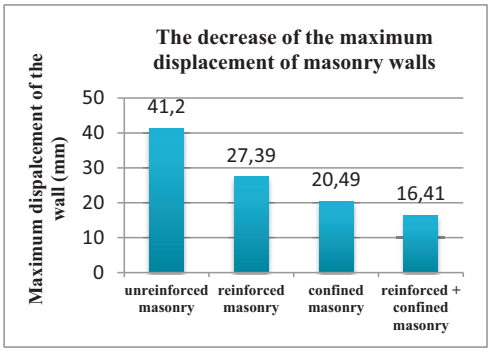


Figure 11. The decrease of the maximum displacement of masonry walls

2. The overall stiffness of the analyzed masonry panel increases by subtracting of the value of the oscillation period (T). Comparing with the unreinforced masonry, the oscillation period of the reinforced masonry decreases by 17.6%, in case of the confined masonry it decreases by 14.3%, and in case of reinforced+confined masonry it decreases by 8.3%. Also, comparing with the reinforced masonry, confined masonry oscillation period decreases by 21.4% and in case of reinforced+confined masonry it decreases by 8.3% (Figure 12).

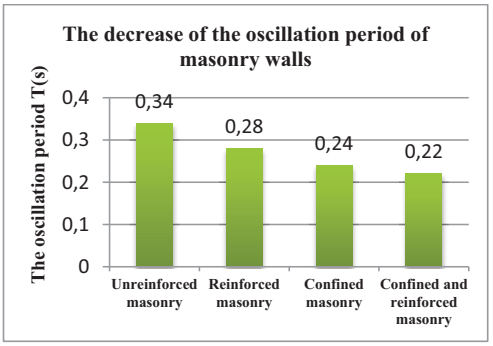


Figure 12. The decrease of the oscillation period of masonry walls

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DRIP IRRIGATION SYSTEM FOR *HIPPOPHAE RHAMNOIDES* ON A SLOPE TERRAIN FROM CENTRAL MOLDAVIAN PLATEAU

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Abstract

Hippophae rhamnoides is a shrub whose fruit is of special importance for the essential elements that it contains: sugars, organic acids, proteins, oils, beta - carotene, trace elements, vitamins, fatty acids, amino acids, etc. For this reason, this fruit is used for direct food but, most often, in pharmaceutical industry. Although it is not a water pretentious fruit in the climatic conditions of Central Moldavian Plateau where extremely drought periods randomly alternates with water excess periods, overcoming them in principle, we can't achieve high yields, without interfering with irrigation works. In this context, the paper presents conceptual aspects and the technical implementation of a drip irrigation system on a slope terrain, of 20 hectares, located near Iasi. The irrigation system has, as a source, the phreatic water taking from an open basin, dug at the heal base, in which the water infiltrates through the borders. From this pond, the water goes to a pit, from where, using a water motor pump, the water goes to a superior attitude where it is placed another open pond, having its bad and margins covered up with a impermeable membrane. The second pond have two functions: storing up and warming the water. The water transmission and distribution system consist of 60 irrigation pipes, 9 transmission pipes and 1 adduction pipe made of 4 sections with diameters that vary between 32 and 225 mm. The total number of drippers is 33000, they are the type of drippers with counterbalance pressure so that a uniform distribution of water to all Hippophae rhamnoides rows should be ensure (15). The pressure uniformity to the upstream end of the irrigation pipes was accomplished by a rigorous hydraulic design which it is presented in the paper. The described system was designed by the authors and, in 2014, it was operational.

Key words*: irrigation, Hippophae rhamnoides, drippers, slope terrain, phreatic water.*

INTRODUCTION

Sea buckthorn (Hippophae rhamnoides) is a branched shrubs part of Romania's spontaneous flora. In our country, it is cultivated from the coastal sands and gravels to the mountainous regions.

Sea buckthorn fruits are used in food service and it presents an invaluable medical and therapeutic potential. They are used for prevention of cardiovascular diseases (Xu et al., 2011; Pang et al., 2008; Eccleston et al., 2002), for retinal functions (Larmo et al., 2014), as an antioxidant, hepatoprotective, anti-cancer, immune modulator, stress, antibacterial, antiviral and anti-radiation (Suryakumar et al., 2011; Guliyev et al., 2004; Suleyman et al., 2001). It has also healing effect upon acute and chronic wounds (Gupta et al., 2006) and it is a potential source of nutrients for nutraceuticals cosmoceuticals (Lalit et al., 2011).

Sea buckthorn is an ideal plant for soil erosion control and land reclamation works (Longsheng et al., 2014). It isn't demanding to climatic conditions, but there are required irrigations for achieving high and stable yields in areas with excessive droughts, such as those in Central Moldavian Plateau.

The drip irrigation systems are successfully used in these areas due to the low consumption of energy and particularly water, being profitable towards the idea of sustainable use of water resources. The water is directly supplied around the plants roots at a low flow for a long period of time by means of the watering pipe located above or on the ground.

So, the drip irrigation system has many advantages: water savings, increased efficiency, low power consumption by reducing the water pressure, shortness term of plant growth (Momolawa et al., 2000; Bresler, 1977).

This paper presents the conceptual elements and details towards the technical operation of a drip irrigation system in the Central Moldavian Plateau.

MATERIALS AND METHODS

The drip irrigation system (Figure 1) designed by the authors of this paper was done on a slope ground, on an area of 20 ha, located near Iasi city.

Figure 1. Overview of the drip irrigation system

As a premise of the irrigation network was the fact that sea buckthorn plantation was divided under the territorial aspect in 7 plots (Figure 3). The cultivated varieties (Figure 3) were Orange Energy and B. Pollmix.

The designed irrigation system includes the following components (Figure 3):

Figure 2. The used variety of sea buckthorn for the plantation establishment

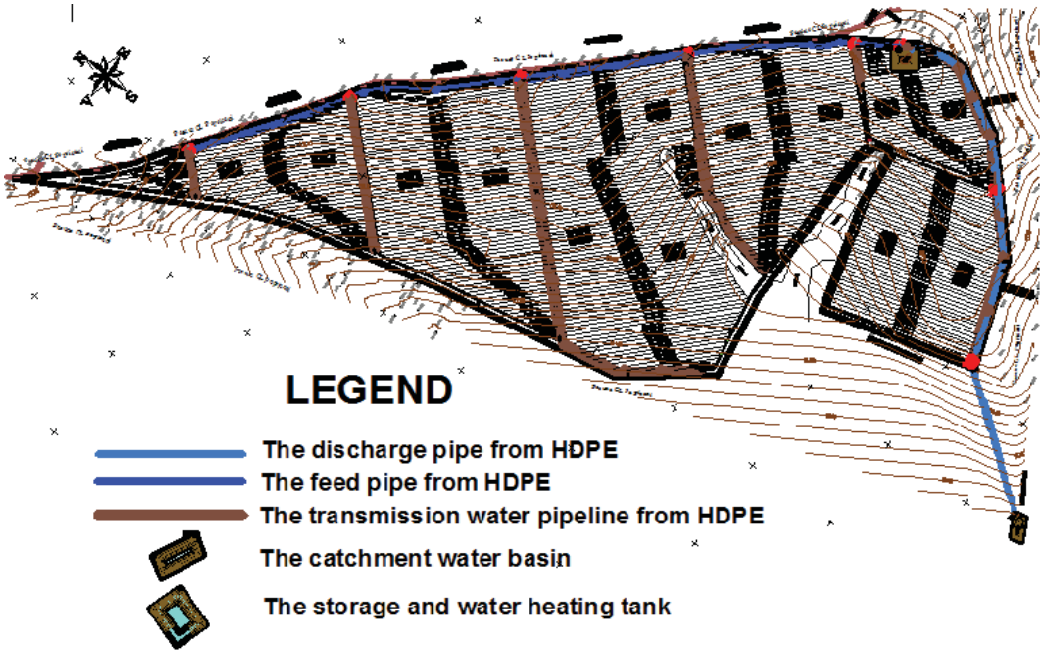

Figure 3. Arrangement scheme of the drip irrigation system

➢ *The water catchment and the base pumping station (SPB)*

The water catchment consisted by the creation of a groundwater basin that catches the phreatic water by slopes and bottom and stores it to a quota share equal to the hydrostatic level of groundwater in the area.

The catchment elements are:

- *Catchment – accumulation basin* (Figure 4) consists of an open basin with a total area of 230 m^2 and a total depth of 3.00 m.

Figure 4. Catchment – accumulation basin

- *Intake - catchment pipe* consists of a drainage pipe made of corrugated PVC, DN 200 mm provided with slots arranged in a circumferential angle of 270^0.

- Shaft collector base pumping station (SPB) is located in the northern part of the catchment basin and consists of a well with concrete pipes walls having an inner diameter of 1 m and a total depth of 5.70 m. The concrete tubes are of precast concrete.

Basic pumping station (SPB) consists of a motor pump placed on the surface that absorbs water from the collector well and transmission it to the storage and water heating tank located on a dominant bench mark. The used motor pump for pumping the water has the following characteristics: Q = 3.10 l/s = 11.15 m^3/s; H = 62 mWS; P = 6.1 hp.

➢ *The discharge pipe*

It bounds the catchment area (pumping station) and the storage and water heating tank. This pipeline has the following characteristics: HDPE material; Dn 75 mm diameter; nominal pressure PN 10 bar; total length of 545 m.

➢ *Filter for retention of the water impurities.*

Before discharging the feed pipe to the storage and water heating a series of two water filters are interposed for retention of the particles by purge. Both filters have the following characteristics: minimum passed flow 3.1 l/s = 11.15 m^3/h; working pressure of 0.10 bar.

➢ *Storage and solar irrigation water heating tank*

This tank (Figure 5) has a key role in the performance of the irrigation system:

Figure 5. Storage and water heating tank

- On one hand, its role is to store the water pumped from the catchment to ensure a sufficient volume of water by means of the irrigation carried out in a single wetting of the entire surface occupied by the sea buckthorn and,

- On the other hand, to favour the irrigation water heating because the water source, as we have seen is the groundwater that has a temperature of max. 13 to 14°C and the optimum temperature of the irrigation water should be as close to the temperature of the soil at the time of irrigation.

➢ *The pumping station (SPP)*

The water from the storage and water heating tank is undertaken by means of a pumping unit and sent to the network. Pressurizing station is composed of a motor pump having the following characteristics: Q = 31.80 l/s = 8.83 m^3/ h; H = 34 mWS; P = 26 hp.

➢ *The transmission and distribution network of irrigation* system was designed in terms of the diameter so that the obtained pressure in the upstream end of the

irrigation pipes is as close to the operating pressure. Given Geomorphology and location of the watering land parcels the transmission and distribution network consists of the following elements:

- *The feed pipeline* - was designed to carry water from pressurizing station (SPP) to transmission pipelines. It was adopted with the following characteristics: material - HDPE; diameter - telescopic consists of 4 sections (section I: Dn 225 mm, L = 4.30 m, section II: DN 200 mm, L = 396.40 m, section III: Dn 75 mm; L = 174.70 m section IV: Dn 32 mm; L = 175.60m); nominal pressure PN 6.
- *The transmission lines* are designed to take the water from the feed pipe and to distribute it to the wetting pipes. Each pipeline supplies water for a rather number of watering pipes.
- *The watering pipes* provides water uptake from the transmission pipelines and the water distribution on the ground through drippers. All watering pipes of the irrigation system are made of polyethylene (POLIDRIP) with a diameter of 20 mm. The connection between the transmission pipeline and the watering pipes is made using rapid clamps.
- *Drippers.* Its type is direct auto regulation of the flow pressure.

RESULTS AND DISCUSSIONS

The authors actually participate to this drip system making its contribution to the adaptability of developed solutions to practical situations in the field. In this respect, the practical embodiment of the designed system is shown as follows.

The catchment - feed pipe has a length of 8.00 m and has been protected in the tank for the purpose of filtering the water as follows: circumferentially in the outer surface of the pipe was covered with a filter - drainage geotextile and also it was introduced into a trapezoidal prism sort gravel having a particle size of 7-14 mm.

The catchment – feed pipe from the point where it enters in the basin slope it is transformed into a properly feed pipe. This feed pipe bounds the drainage type catchment pipe with the catchment well.

Between the basin slope and the accumulation well the feed pipe hasn't slots thus becoming only a transmission line. On this section of pipe its characteristics are: material - PVC, nominal diameter - 200 mm, length - 4.00 m.

The accumulator well was executed firstly to a depth of 2.5 m mechanized with an excavator which conducted an open excavation with a slope of 2.5. Next up, reaching the bench mark of the well bottom, the excavation was executed manually by taking all measures to ensure safety at work.

After execution the excavations, together with the tube placement it was also performed a mechanized filling of the previously drilled area with resulting land from the initial excavation. Each layer of 20-40 cm of padding around the well was well compacted using a vibrating plate.

The top bench mark of the accumulator well is 50 cm above the ground level.

The collected water by the catchment – feed pipe from the catchment – accumulation basin is discharged in the accumulation well. The depth of the catchment – feed pipe inflow in the well is 2.80 m above the ground surface.

The height of the water in the well at hydrostatic level is 3.70 m. So the available volume of water is 2905 at the hydrostatic level.

The discharge pipe comprises of two sections:

- The first section, the total length of 157.5 m, is not laid in the ground but it is set down on the ground when water is pumped. At the end of the pumping the HDPE pipe will be taken as a bunch and properly stored until a new pump.
- The second section runs from the downstream end of the first section to the storage and water heating tank. This section of pipe is laid in the ground.

The connection between the two sections of pipe is done through a compression sleeves HDPE, Dn 75 mm.

The storage tank is opened, in cut, with a total capacity of 500 m3 storage. In plan, the tank is rectangular with sides at ground level, 19.00 and 24.00 m respectively and at the bottom of 9.00 m and 14.00 m respectively. The slope of the tank slope is equal to 1:2. The tank is covered on the whole inner surface with a

waterproof membrane. The geomembrane strips supplied by the manufacturer carefully spread over the entire surface of the inner surface of the tank (including slopes) with an overlap between strips of 10 cm, after which the strip has been anchored to the top of the container by means of an anchoring groove.
Watering pipes (Figure 6) are mounted on the surface of the land being held by wooden stakes at a height of about 50 cm from place to place. In these pipes are installed from 1.5 to 1.5 m prefabricated droppers which discharge a constant flow as long as the pressure in the watering pipe is between 1.5 and 4.5 bar.

Figure 6. The watering pipe

These pipes have been coupled underground (in the transmission pipe) by means of a special necklace (bracelet) and then brought to the ground surface up to a height of about 50 cm from the soil surface. At the upstream end of the pipeline it was installed a brass ball valve of 3/4 ".
Further on, the watering pipe rests next to each buckthorn bush on a wooden stake through wire bonding. At the downstream end of the watering pipe was fixed by gluing a plug end.
Table 1 presents data on the designed and built network elements.
Irrigation system described above was put into service and operated with very good results in the summer of 2014.
Regarding this operation was found that:
- Source provided unrestricted flow required for watering the whole plantation;
- The storage and water heating tank managed under the climatic conditions of the summer 2014 to heat the water up to 4 degrees Celsius;
- Drippers functioned properly and have not been reported any problems, but with rare exceptions, cases of clogging them;
- About 0.5% of the installed drippers had manufacturing mistakes and had to be replaced.
Plantation performed well and the level of grip was on average about 70%.

Table 1. The total number of watering pipes served by each transmission line in part

Nr crt	Name of the transmission pipe	Total number of served watering pipes	Maximum flow of the transmission pipe (l/s)	Characteristics of the transmission pipes			
				Material	Diameter (mm)	Length (m)	Nominal pressure (PN) - bar
1.	CTP 1	43	4,57	HDPE	50	183,00	6
2.	CTP 2.1	9	0,23	HDPE	20	37,00	6
3.	CTP 2.2	38	6,64	HDPE	63	197,80	6
4.	CTP 3	57	5,56	HDPE	50	239,70	6
5.	CTP 3.1	14	0,15	HDPE	20	57,30	6
6.	CTP 4	81	9,32	HDPE	63	423,00	6
7.	CTP 5	67	6,51	HDPE	50	267,70	6
8.	CTP 6	39	3,04	HDPE	40	157,00	6
9.	CTP 7	12	0,46	HDPE	32	46,10	6

CONCLUSIONS

The achievement of the irrigation system and cultivation of sea buckthorn in ecological conditions can bring:
- Contribution to increasing the population's health;
- Creating jobs for local people who will work in the plantation;
- Business development in rural areas;
- An efficiency example without environmental consequences, of the European money for the people from the area;

- Bringing a safe and steady profit to the beneficiary of investment;
- Development in our country of manufacturing industries for the fruit even if at first it will be a substantial export of the annually obtained production for external processing.

The achieved drip irrigation system led to corresponding results and the phreatic source with the storage and water heating tank constitutes an effective and sufficient solution for small irrigation developments.

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PARTICIPATION OF RURAL WOMEN IN THE AGRICULTURAL SECTOR AND ITS IMPACT ON THE SUSTAINABLE DEVELOPMENT OF THE VILLAGE (CASE STUDY OF RURAL WOMEN IN BARZOK AREA OF KASHAN)

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Abstract

The main objective of this study is to investigate the impact of economic activities of the rural women on the sustainable development, and to identify the influential factors (individual, family, organization) on the rate of their participation in the agricultural activities in Barzok area of Kashan. The research method was descriptive – analytic, and the required information was collected based on the survey and library studies. the Statistical population consisted of 6,300 rural women being active in the agricultural sector of the area and by using the Cochran formula, 320 persons of them were identified as the sample size, having been interviewed by simple random sampling method. Coefficient of Cronbach's alpha for the determination of the reliability of the questionnaire was 71/5. For describing and analyzing of the data, we used the SPSS software, single variable t-test and Spearman correlation coefficient. The research's findings show that the economic activities of the rural women are effective in the sustainable development of the area. Based on the viewpoint of the regional authorities, this relationship were examined with consideration to three sectors of rural women's education, support for their economic activities and formation of the cooperatives of the rural women, and according to that, education of the rural women with the mean of 60/3 has allocated the maximum amount to itself. Also, the correlation coefficient between agricultural activities and the age, the income of horticulture and size of the family showed the significance level of p ≤0/05. Consequently, there is a relationship between age, size of the family, income of the horticulture and the rate of agricultural activities of rural women, meaning that the agricultural activities of the rural women go up in tandem with the age and size of the family, followed by the raise of horticulture's income.

Key words: *agricultural sector, farmer women, rural economy of Barzok area, women's participation.*

INTRODUCTION

Rural women as half of the rural population have an important role in the economic and social activities, and in order to achieve the rural sustainable development, it requires to pay more attention to the women involved in the economic and social activities alongside the men (Mirak Zadeh and others, 2010). Studies and observations fulfilled regarding the rural women show that farmer woman enjoying local experience and knowledge of producing food products, play an important role in agriculture, in a way that women form the majority of farmers around the world, producing 50% to 60% of the world's food (Moshiri R., 2010, 2006). Since 1970, world attention and research projects were fastened on the women. In this regard, national and international agencies began their discussion and examination in connection with making women involve in the control and orientation of the development's objectives. Thereby, researchers and policy makers came to a different understanding about men and women in the field of agricultural and industrial projects (Amiri, 2005).

Illustrating the importance of rural women's role in production, this is enough to know one of the accomplishments of the United Nations' world conference of "Decade of Women" held under the title of "Equality, Development and Peace" in New York in 1980 is that two thirds of the total work of the world is done by the women, and rural women do the most of that (Khatami, 2003). According to the United Nations' report, although women form 49% of the population in the village, 65% of the agricultural sector's activities of the village is done by them (Ali Mohammadi, 2008). Based on the statistics of the census in 2006, our

country's rural women have allocated 13% of the portion of occupation to themselves (Statistics Center of Iran, 2007). The undeniable fact is that rural women provide, averagely, about 40% of the force work in the agricultural activities, but their roles and activities have been neglected in discourses of rural sociology. Ignoring women's portion in the economic activities, especially agriculture, has caused the effect of their work's value not to be considered in the national computations. A cooperative approach of the development have been underlined since the early 2001s, and on the importance of cooperation as a tool as well as one of the development's objectives has been emphasized. In such a development, as half of the population, women are recalled to the cooperation, since it is impossible to achieve the sustainable development without women's active cooperation in all the fields such as family, economic, social and so on (Bozarjomehri, 2010). In Iran the role of rural women has been disregarded as well. In addition to their key roles in the economy of the household, they form a big part of work force in the economy as the invisible and undefined factors.

Despite the high value of their work and activities for family and the economy of the society, they have not enjoyed the appropriate roles according to their activities, socially. Undoubtedly, they must be considered among the most disadvantaged class in the society (Amini and others, 2009). Considering the fact that half of the women's population in both developed and developing countries work in the agriculture and animal husbandry sector of the villages, it is of much importance to design and fulfill educational-promoter programs for this stratum.

The objective of this study is to examine the impact of women's economic activities' increase in the sustainable development of the area. To achieve the above goal, the following hypotheses were examined. A) The relationship between individual characteristics of farmer women (age, family size and horticulture's income) and their agricultural activities. B) The impact of women's economic activities in the sustainable development of the area. And also, how much is answered to the question of position and role of rural women in the agriculture sector of Barzok area.

RESEARCH METHOD

The method used for the research can be introduced from various aspects. From the aspect of objective, the research is practical, and also it's descriptive - correlational in terms of type. Because it is not only dealing with the cognition and description of the impact of rural women's economic activities in the sustainable development of the region under study, but also it deals with the analysis as well as the correlation of relationships between variables influencing the rate of cooperation. Research questions have been assessed by data collection. Data collection was performed by two methods of library and survey which the latter has been done by the questionnaire technique including open and closed questions (two and multiple choices) as well as the spectrum of Lykrit scale. The statistical population of the research consists of rural women who are active in the agricultural sector of Barzok. The sample size has been determined by the use of simple random sampling and Cochran formula. With the certainty of t=96/1, coefficient of accuracy d=0/05, proportion of attribute's presence p=0/7, statistical population N=6300, and sample size n=320. In order to present an appropriate interpretation of the data, firstly, we have dealt with the examination of statistical population by using the descriptive analysis. After the descriptive examination, using inferential method, statistical analysis of the data has been done so as to test the hypothesis. The hypothesis has been tested by using one variable T-test and Spearman Correlation Coefficient.

RESEARCH FINDINGS

Individual characteristics

From the total sample size of 320 rural women, 87/8% are married, and 12/2% are single. The average age is 40/50 and 81/9% of the rural women are literate, including 41/4% at the elementary level, 22/4% at the pre high school and 18/1% at the high school level, and

also18/1% of the rural women are illiterate. Regarding the statistics of literacy, it can be said that most of the rural women are literate but the quality of literacy level are low among them.

Family characteristics

The range of family size is oscillating between 2 and 11, and its average is about 5/6. By the same token, rural families are nearly crowded. Moreover, 2/8% of the rural women are in charge of their families, and the rest of 97/2% are under protection of their fathers or husbands.

The role of rural women in different activities of Barzok area

According to the survey examinations, women are engaged in different fields of activities, and most of them are doing several activities together such as housekeeping, handicrafts, horticulture and etc., especially in spring and summer that they work in tandem with men in farming as well as horticulture. Based on the results shown in Table 1, horticulture activities are more than those of farming and handicrafts in this area. The highest abundance is with women working in more than one case with the percentage of 58/9%, and farming has allotted the lowest percentage of 0/3% to itself.

Table 1. Distribution of farmer women based on different activities

Types of women's activities	Abundance	Percent
Farming	1	0/3
Housekeeping	50	15/6
Horticulture	68	21/2
Handicraft	9	1/9
Others	7	2/2
More than one case	189	58/9
Total	321	100

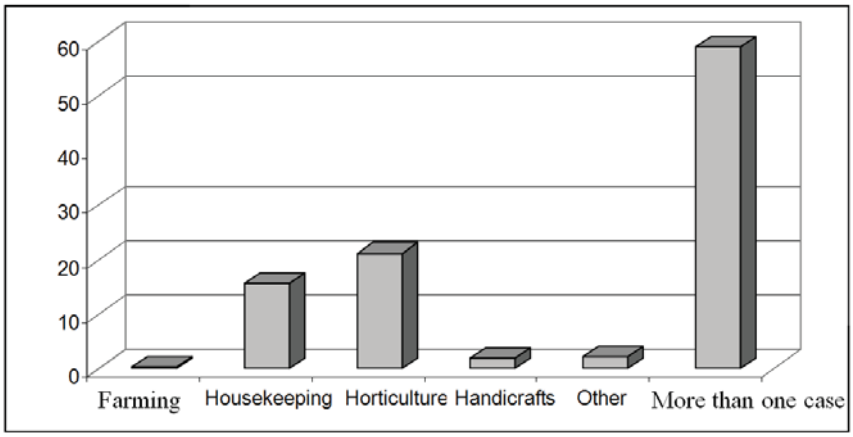

Figure 1. Distribution of farmer women based on the activities

Activities of women in horticulture

Having an effective role in the employment, income, producing foodstuffs and bringing money, horticulture is included in the farming activities. Furthermore, many products can be nurtured in the shadow of trees, and trees can refine the air. Enjoying the appropriate climate, soil and suitable sources of water in the area, the conditions are so much favorable for nurturing the fruit trees. Consequently, the number of fruit gardens is much more than the

number of farmlands. Rural women are so much engaged in the horticulture activities, because farming is one of the most important sources of income in the families. The highest rate of their cooperation is in the harvest of products with the percentage of 57%, and the lowest rate is 0/3% which includes planting, pre harvest, marketing and sale.

Table 2. Distribution of farmer women based on their horticulture activities

Horticulture activities	Abundance	Percent
Planting	1	0/3
Pre harvest	1	0/3
Harvest	183	57/0
Keeping and changing the products	8	2/5
Marketing and selling the products	1	0/3
Others	6	1/9
More than one case	121	37/7
Total	321	100

The position and role of rural women in farming

Regarding the level of economic development in country, women play an important role in the development of farming as well as the village in the majority of developing countries. According to F.A.O's report to the Food Security Congress, women averagely have produced 50% of the agricultural products in the recent decade. In spite of the fact that agriculture and related activities are the economic foundations in the villages of developing countries, proportion of rural women in agriculture as well as the other economic sections have been hidden and that's why the real value of women's cooperation in economic production have been ignored and it does not count in the evaluation of economic activities. Table 3 demonstrates that the rate of women's activities in agricultural section is 63%, showing their high cooperation in this section.

Table 3. Results of two sentences test based on the agricultural activities of women

Farming activities of women	abundance	proportion	p
Low activity	119	0/37	
High activity	202	0/63	0/001

Analysis of personal characteristics of rural women and their agricultural activities

Based on the results of Table 4, below, the correlation coefficient between agricultural activities of women and their age, horticulture's income and their family size was significant at the level of $05/0 \geq p$. Therefore, the agricultural activities of women are directly associated with the age, horticulture's income and size of the family. Women with older ages and crowded families are much more engaged in the agricultural section than those who are young with thinly populated families.

Table 4.Correlation coefficient between agricultural activities and age, size of the family and horticulture's income

Variable	Agricultural activity		
	n	p	r
Age	298	0/001	0/413
Family size	298	0/002	0/209
Horticulture' income	298	0/001	0/289

The raise of efficiency's effect and organizing rural women's economic activities in the sustainable development of the region

Considering three sections of education of rural women about agriculture and sustainable development of the area, supporting women's activities and formation of rural women's cooperatives, we have studied raise of efficiency's effect as well as organizing the rural women's economic activities in the sustainable development of the area under the study. Based on the results of table (5) below, the highest mean number of the answers, 60/3, was related to "effectiveness of rural women's education in the improvement of sustainable development" and "effectiveness of rural women's education in the raise of agricultural products" and the lowest mean number is 11/3, which is related to "the effectiveness of creating rural cooperatives in the development of the area".

Table 5. The effect of rural women's economic activities in the sustainable development of the area

Variables	Mean	Standard of deviation
Education of rural women in the improvement of the sustainable development	60/3	0/699
Education of rural women in the raise of agricultural products	60/3	0/516
The influence of rural women's insurance in the sustainable development	40/3	0/843
The influence of the agricultural products' insurance in the sustainable development	44/3	0/726
Support of the economic activities of the rural women	30/3	0/675
Variables	**Mean**	**Standard of deviation**
Formation of rural women's cooperatives	11/3	0/978
Bank loans to rural women	3/3	1/07

CONCLUSIONS and RECOMMENDATIONS

Being the main producers of food and income for the rural families, women form half of the population of rural society and produce an important part of the agricultural products in the world. Rural women undertake 50% to 60% of the world's food production, and the average participation of rural women in this section is estimated about 40%. According to the findings of the research, the position and role of rural women in the area under study is higher than the average level, and they have an effective role in agricultural activities especially horticulture. Therefore, it can be said that women's activities in the agricultural section are so much effective in the economy of the village.

Based on the results of Table 2, women are most engaged in the harvest activity to about 57%, but there are a few women who are paid and most of them are not. Some factors including individual characteristics (age, education), family characteristics (size of family, income) and organization characteristics (participation in educational and promoter classes) are effective on the women's participation.

According to the results of Table 4, the correlation coefficient between the age, horticulture's income, size of the family and the rate of agricultural activities is significant. Since women form half of the area's population and they are actively engaged in different fields, especially agricultural section, so we cannot ignore the active role of women in the economic activities. Based on the findings of Table 5 it can be said that education of rural women in different fields of agriculture causes the increase of agricultural products and subsequently sustainable development of the area.

Governmental organizations' support for the women's activities is one of the other effective factors in the increase of economic activities' effectiveness of women, resulting in the effectiveness of women's activities in development. Generally, it can be said that there is a direct connection between raise of the

efficiency and organizing rural women's economic activities and its effect in the sustainable development of the area.

There are some recommendations to ameliorate the economic condition, the agricultural condition of the area under study and recognizing women's role in the force work of agriculture, such as: raise of the women's productive skills, how to make good use of the resources, professional training to ameliorate profit making, the method of fighting with the pests, which plays an important role in the improvement of economic condition and the augmentation of added value of rural women's activities, raise of rural women's access to credits (offering credits and loans to the rural women, especially women in charge of the family, will improve the situation of employment and living of the family in the area, and also is effective in the development of agriculture), creating Social Security Insurance and legal support for rural women's force work, especially women in charge of the family, considering the fact that women in this area are so much engaged in the agricultural activities, but they do not receive any support from the governmental organizations, preparing a way to offer health care and other social services, improve the situation of women in the area and raise their security against damages of the work.

Education of rural women and raise of their literacy's level are so much important, and the government or related organizations should provide the text book's content based on the rural women's needs and make them available for them.

There are hopes, in near future, that the situation of farmers' lives, especially farmer women will be fully improved.

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MODERN TECHNIQUES FOR INVESTIGATION OF SOME OF THE SOIL PHYSICAL PROPERTIES

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Abstract

The protection of soils and thus maintaining the ability to perform their ecological function requires careful analysis of the soils properties. The diversification of protection and de-pollution techniques of the soil determines the development of investigation techniques, both of the composition and of the soil characteristics.In this regard, experiments performed in the Laboratory of Soil Science from the Technical University "Gheorghe Asachi" University, and other institutions with which the University has collaborative relationships represents an important contribution to the development of research methodology of soil for various purposes. Some of the most significant results were obtained in soil physics and refers to: the use of infrared spectrometry in research of soil matrix composition, the study of soil porosity by electron microscopy and medical imaging technique, the experimental determination of hydraulic conductivity of soil and the use of mathematical models in research on aero-hydric soil regime.Themineralogical composition of the clay in soil was studied using IR spectra obtained with a Shimadzu spectrophotometer Iraffinity-1. Colloidal inorganic matrix or clay, as it is commonly called, has a number of properties which are a result of the characteristics of its components. The quality of the clay can be established by identification of these components and their proportions. Clay minerals identified in studied clay soils are: illite, smectite (montmorillonite), kaolinite and chlorite. In addition, spectrometry revealed the presence of vermiculite elements or poorly expressed inter-stratifications.QUANTA electron microscope 3D Dual Beam 200, used in the study of the soil porosity, is a combination of two systems:- SEM is an electron microscope that produces enlarged images of a variety of samples performing a magnification of over 100,000x at a high resolution digital format.- FIB is an ion beam system that provides high resolution images.In the field of soil science, for research on porous environment, axial tomography using X-ray (X-ray computer tomography - CT) or Gamma is a highly effective and innovative method for investigating soil structure, spatial distribution of porosity and ground water content.Experimental determination of the soil hydraulic conductivity was made on a modern complex installation, having the possibility of recording data and their automatic processing.Land MOHID software was used to simulate water flow through porous media (soil). It solves the Richards equation for saturated and unsaturated porous media. Currently, soil hydraulic properties are described by using the Van Genuchten equation. However, the model is prepared, where appropriate, to include any model which describes water content and the hydrostatic pressure or the relationship between the conductivity and hydrostatic pressure, respectively. The simulation results showed that the MOHID Land computer program, with adjustments made by Porous Media Module Properties, PREEQC and Sediment Quality, is a pertinent tool for analysing issues like: soil water dynamics, transport of solutions and transformations undergone by the different substances and some components of the air from the soil.For the soil water dynamics simulation using Land MOHID software, it is necessary that the input data such as rainfall, irrigation and soil characteristics (hydraulic parameters) to be representative in the studied area and obtained as result of high rank analysis and quality studies. The conclusions emphasize the importance of results and contributions to the development of knowledge, which are appreciated as result of a coherent and relevant analysis of the scientific literature.

Key words*: soil, properties, MOHID, software, microscopy.*

INTRODUCTION

The physical properties of the soil have a decisive role on the water and air regime in the soil. In recent decades, for this reason, the research in the area aimed, among other things, a continuous improvement of their investigation methods. Out of these properties, porosity, hydraulic conductivity and matrix composition represented priorities for research in the laboratory of Soil Science, Faculty of Hydrotechnics, Geodesy and Environmental

Engineering from Technical University "Gheorghe Asachi" of Iasi.

RESEARCH IN SOIL POROSITY

1. Study of soil porosity by electron microscopy

1.1. Description of Quanta 200 3D Dual Beam microscope

The electron microscope QUANTA 200 Dual Beam 3D (Figure 1) is a combination of two systems:

- SEM is an electron microscope that produces enlarged images of a variety of samples giving a magnification of 100000 x at a high resolution and in digital format.

Figure 1. Quanta 200 3D Dual Beam Microscope

The integration of the two systems provides a powerful analytical tool for obtaining any information, from any sample, in three dimensions.

Users can switch between the two beams for a fast and accurate navigation and grinding. SEM and FIB convergence to a shorter working distance allows an accurate "slip and watch" of the analysed section at high resolutions. The workstation provides an optimum between processed materials, resolution and automation.

The standard presentation of Quanta 200 3D system is based on a dedicated controller microscope together with power supply panel of the microscope's console (vacuum gun, column and platform).Computer's support contains various other parts that are generally accepted as essential or are dedicated to particular applications such as forensic analysis and material defects. User interface devices are the peripherics of microscope's controller, the software and the hardware.

The FIB/SEM workstations provide a wide range of possibilities that would not be possible with FIB and SEM separate tools:

- High resolution images of the electron beam FIB section, without erosion of interest characteristics;
- Photos and videos of the real-time electron beam sections during milling with ion beam;
- Neutralization of focused electron beam charge during FIB milling;
- Elemental high resolution microanalysis of cross-sectional defects;
- Surface imaging of samples with electron beam during navigation without erosion or implantation of gallium ion beam;
- On site preparation of TEM Samples by conductive coating.

Increasing the desktop image size - scanned area ratio of the sample. A higher magnification is achieved by reducing the size of the scanned area of the sample.

Quanta 3D supports two visualization sizes: Quad and Full Screen modes. Zoom for current display is always set in data bar, so a 500x image in Quad mode is 1000x in full screen mode, the size being thus doubled.

Digital Scanning provides a complete digital image, the image capture being performed by scanning, in a fraction of time, at a high resolution in pixel format. The samples are replaced through a chamber door that, when opened, provides access to the sample platform (Figure 2). Replacing the sample takes a few minutes.

Figure 2. Preview of Sample Platform

- FIB is an ion beam system capable of rapid and precise milling of various geometries (up to

μm) of the sample material, revealing the sub-surface structure, getting sections, deposition of layers, etc. Ion system also provides high resolution images.

1.2 Description and "SEM image processing"

With the microscope were analysed soil samples taken from Podu Iloaiei, Iasi County, at different resolutions.

SEM is an instrument that produces a magnified image greatly by using electrons instead of light. A beam of electrons is produced at the top of the microscope by an electron gun. The beam follows a path down through the microscope. It travels through electromagnetic fields and lens then focuses on the lower floors of the microscope, towards the sample. Once the beam hits the sample, electrons and X-rays are ejected from the sample, recaptured and analysed, thus, the images being recorded (Figure3):

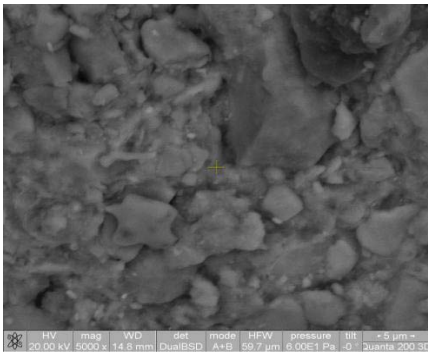

Figure 3. Picture of the soil sample zoomed 5,000 times

Investigation of the soil samples with the scanning electron microscope (SEM) shows a great variability of shapes and sizes of pores generated by the composition of the analysed sample.

Figure 4 presents the analysed soil sample from Podu Iloaiei, where its composition and porosity can be seen. It consists of pores of different sizes. Also, it can be seen some gravel and of course some natural cracks.

The SEM images were processed using a program called ImageJ, which allows the calculation of porosity. This is a public domain Java application dedicated to image processing. It is conceived by the National Institutes of Health, USA. The platform provides all the basic functions already implemented for the analysis and image processing, and also read/write functions for all standard image formats.

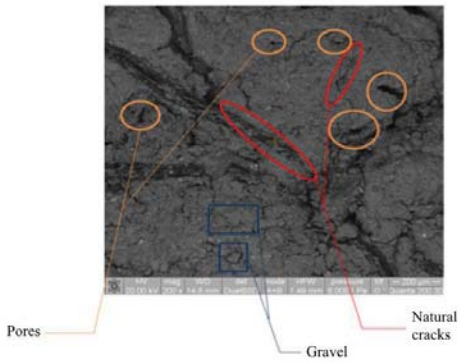

Figure 4. The SEM image View of the soil sample

The histogram in figure5 represents a simple frequency chart that can express the percentage of entities (classes). Thus, the Y-axis shows the variation of the number of pixels in the analysed image and the X-axis shows the variation of the grey tints. For the zero value of X-axis the tint is black, and the tint is white for the X-axis value of 255.

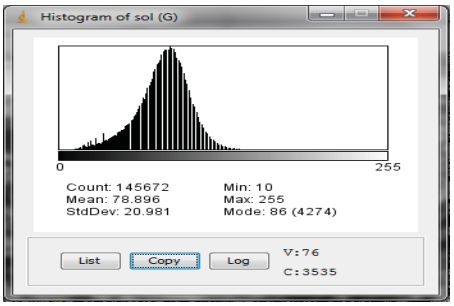

Figure 5. The Histogram of the soil sample

2. Soil porosity study using medical imaging technique

2.1. Description of the equipment

The scanning process of the two studied soil samples was held in Na Homolce hospital in Prague, the Laboratory of Computer Tomography Images of the Department of Neurology from the Czech Republic (Figure 6),

under the guidance of Professor Specialist, Dr. M. Tuma.

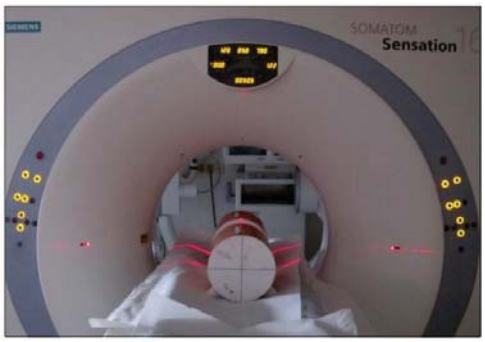

Figure 6. Positioning the soil sample for computed tomography

The internal structure of the two soil samples were analysed using a standard Siemens Somatom Sensation 16 (Siemens, Forchheim, Germany) CT scanner. The 25 cm height soil sample, that has previously been dried naturally, was placed on the bed of the medical device and secured by means of plastic holders. In Figure 7 is presented the lateral and frontal scanning of the soil sample.

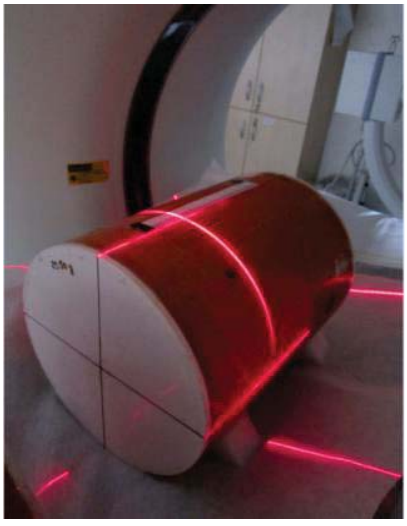

Figure 7. Scanning the soil sample

Making CT images using magnetic resonance was necessary for getting information about the internal structure of the two studied soil samples.

2.2. Obtained results

Figure 8 shows the CT image of the number 17 soil sample, revealing its internal structure, composed of pores of various sizes that are characteristic for the property of the heterogeneity of the soil. Also, one can notice the existence of different sizes gravel, which is part of the composition of the samples. We can distinguish here also numerous natural cracks that can represent potential preferential flow pathways.

On the perimeter of the sample, it can be seen how the gaps in the soil were filled with silicone, to create a good tightness between it and the tube, hence to preserving intact its natural structure. CT image processing was performed using ImageJ software that allowed the calculation of the average, minimum and maximum of the surface of gravel fragments existing in the ground section.

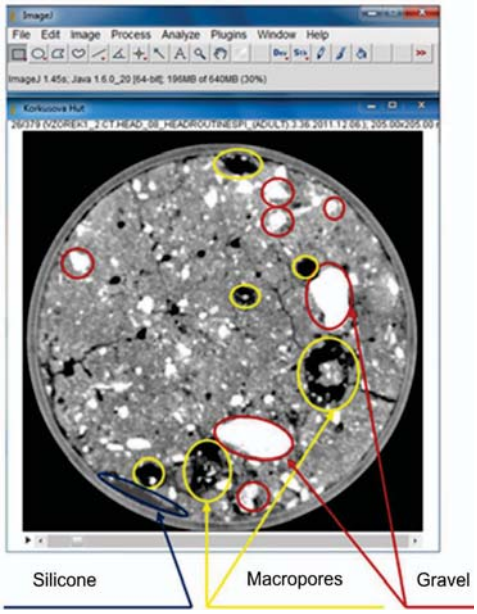

Figure 8. CT image of the soil sample

1. Soil sampling

At first, the ground surface is cleaned by removing residual plant, roots and rocks.

Then a T-shaped steel cross is placed on the ground having mounted 3 steel cylinders at its ends (Figure 9).

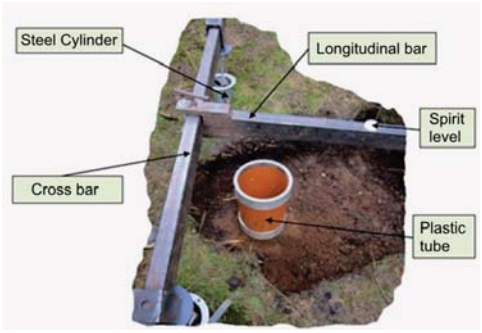

Figure 9. Field positioning of the equipment and soil sampling

2. Preparation of soil samples and carrying out the experiments

Before starting the experiments concerning the infiltration of water, soil samples were transferred from a plastic tube to another and treated with silicone in order to prevent the phenomenon of water by-passing along the probe walls. Soil samples were subsequently equipped with tensiometers and TDR-es and positioned in the facility designed for carrying out the research (Figure10).

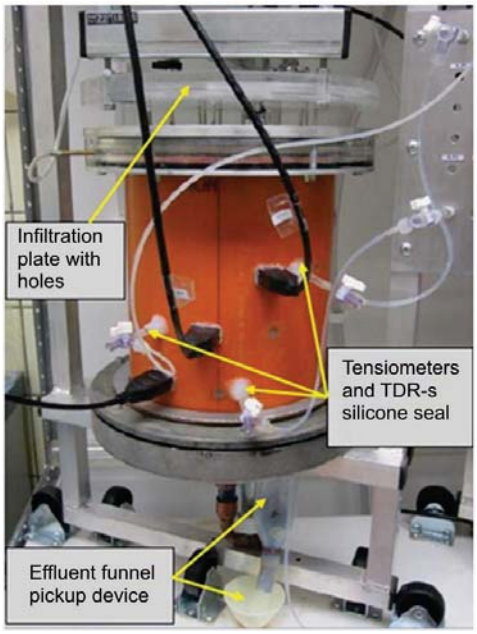

Figure 10. Equipping the soil sample before starting the experiments

To conduct the experiments and record all the parameters specific to the ground water hydraulic flow and transport processes were used CR850 Datalogger Control Measurements, SN 5384, Model RJ1816HPL, type 4X, Campbell Scientific Ltd. Leicestershire, UK and CR23X Micrologger, SN 7673, RS 232, Campbell Scientific Inc., Utah, USA (Fig. 10) which includes: CR23X_RenMat, CR23X_TenzoMass, CR850_Control, CR10X_ TDR.

These advanced devices are activated automatically using LoggerNet 4.1 software that allows transmission of the start and stop signals at time intervals set by the user. It can record and collect data on any computer that is connected to a Local Area Network - LAN or Wide Area Network - WAN and it is also able to operate on different types of micro-loggers such as: CR500, CR510, CR10, CR10X, 21X, CR23X, using PakBus types of operating systems or CR databases, such as Series CR200, CR1000, CR3000, CR800 series, CR5000, CR9000 and CR9000X.

3 Obtained results

The first part of the experiment began on 25 January 2012 at 13:38:33 and ended on January 26, 2012 at 5:21:57 pm. The total time of infiltration was 15 hours, 43 minutes and 24 seconds. The second part began on January 27, 2012 at 07:17:18 pm and ended on the same day at 22:00:17. The total infiltration time was 14 hours, 42 minutes and 59 seconds. The last part of the experiment began on February 2, 2012, at 12:28:40 and ended in the same day at 20:12:00. It lasted only 7 hours, 44 minutes and 20 seconds since degassed solution was used, thus obtaining a significant decrease in infiltration time.

Infiltration conditions for the three experimental part are the following:
Initial conditions:
Constant pressure:
- For the first experimental stage: - 10.2 bar;
- For the second experimental phase: - 10.0 bar;
- For the third experimental stage: -10.0 bars;

b) The variation of the initial content of water in the ground:
1) For the first experimental stage:

- tensiometer P1 = - 344.3 cm col. water;
- tensiometer P2 = - 351.2 cm col. water;
-tensiometer P3 = - 326.9 cm col. water;

2) For the second experimental stage:
- tensiometer P1 = - 24.5 cm col. water;
- tensiometer P2 = - 18.9 cm col. water;
- tensiometer P3 = - 11.8 cm col. water;

3) For the third experimental stage:
- tensiometer P1 = - 33.7 cm col. water;
- tensiometer P2 = - 26.7 cm col. water;
- tensiometer P3 = - 19.4 cm col. Water.

The following figures (v. 11, 12 and 13) show the variation of water pressure in tensiometers: P1 (blue), P2 (red) and P3 (green), inserted into the KH soil sample, at depths of -7.5 cm, -12.5 cm and -17.5 cm implicitly, for all the three experimental part.

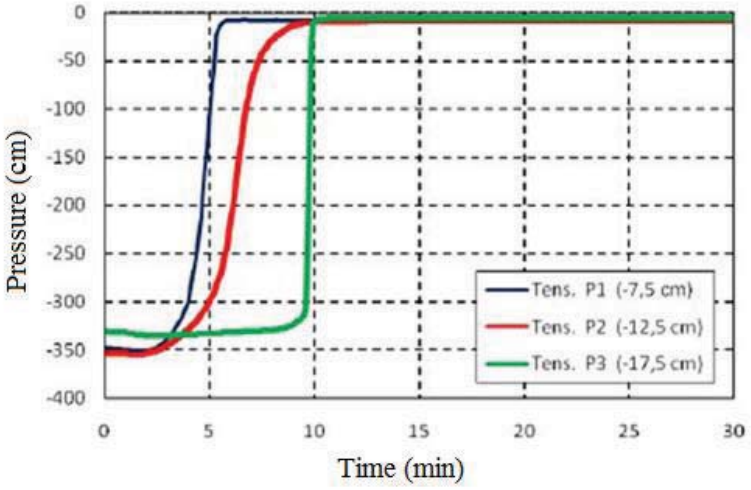

Figure 11. The pressure variation in the P1, P2, P3 tensiometer for the infiltration experiment phase 1

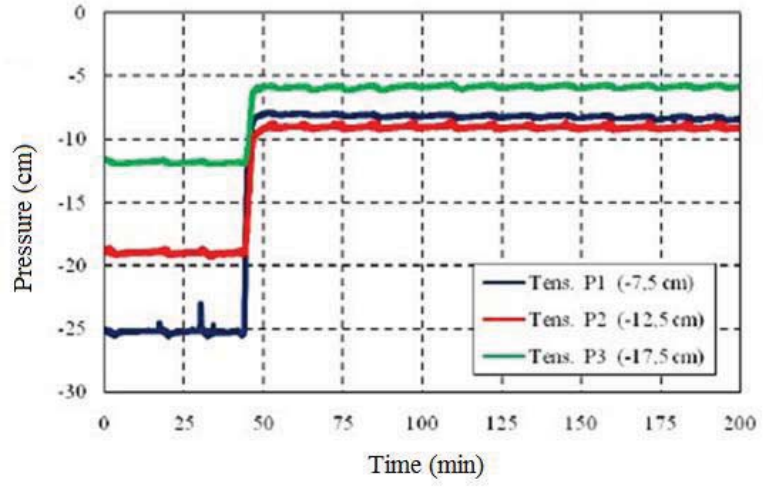

Figure 12. The pressure variation in the P1, P2, P3 tensiometer for the infiltration experiment phase 2

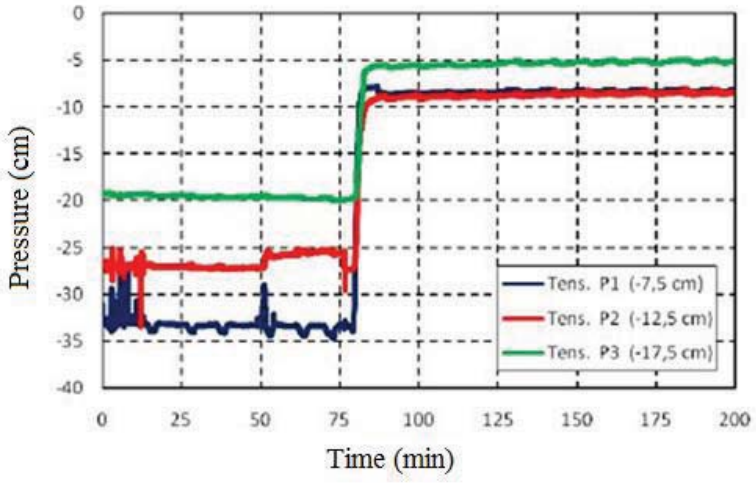

Figure 13. The pressure variation in the P1, P2, P3 tensiometer for the infiltration experiment phase 3

In Figure 11, it is observed that the initial values of P1, P2 and P3 tensiometer are close, but immediately after starting the infiltration experiments (after about 5-10 minutes) there is a spectacular increase of them towards 0 (which represents the reaching of maximum saturation level where suction value is null).

For the second round of infiltrations, highlighted in Figure 12, it can be noted that the initial values of the three tensiometer devices varies according to depth (P1 = - 24.5 cm. water col. at the depth of -7.5 cm P2 = -18.9 cm. water col. at the depth of -12.5 cm and P3 = -11.8 cm. water col. at the depth of -17.5 cm) which confirms the hypothesis that the soil is drying starting from surface towards depth and the suction values are higher at the surface and hence they decrease with depth. After about 45 minutes from the start of the experiment no. 2 a rapid increase of pressure values is signaled, towards a value close to 0, which in this case leads to supposition of not achieving the maximum level of saturation in the soil column.

It should be stressed that these charts were made for the time span of 200 minutes, which represents a detailing of the experimental process, needed for emphasize the variations of suction values for the three analysed tensiometers.

The determination of the effluent flow was possible due to repetitive recording the number of cups in Data logger, of the tilting device, where the effluent has been retained. It is the result of the three infiltration experiments conducted on the soil sample. Knowing the starting position and the volume of each cup, its intensity was calculated. Figure 14 shows the effluent flow (cm/min) for all the experimental parts of the infiltration.

Carefully analyzing this figure, an extension of the lower ends of the flow can be seen, which indicates the start of the drainage phenomenon after completing the experiments.

In the first experimental condition, "the effluent flow" 1 (blue color) has a slight instability of the linear path due to the occurrence of an air blockage leading to the decrease of the infiltration process. After a period of time of 120 minutes, the initial flow conditions are re-established.

For effluent flow 2 represented by color red, there is an initial increase of its intensity, followed shortly by a sharp decline, which remains constant throughout the experiment. This is explained by the fact that through the dry soil, the flow phenomenon and transport of liquids takes place in a lesser time, and in conditions of saturation, it becomes extremely slow.

In the last case, there is an accelerated growth of the effluent flow 3 defined by green colour mainly due to the effects of using degassed solution. The use of this innovative method

reveals that the reduction of the infiltration time is based on dissolution of macro-pores air from the soil, which leads to a considerable increase in its permeability property, of approximately 50-70%.

At the determination of the infiltration rate, the pumping rate of the solution was considered, of ISMATEC 1 (for the first and last experimental stage) and ISMATEC 2 (for the second experimental stage) pumps, expressed in ml/s, which was reported to the surface area of the infiltration plate fixed on top of the soil column. From Figure 15, it is found that infiltration rate for the first two experiments (infiltration 1 - blue and infiltration 2 - red) shows the same trajectory, the infiltration rate as 3, with green colour, has an increasing trend and hence its duration halved compared to the other two. The justifications of these differences are attributed to the use of degassed solution for the last experimental part.

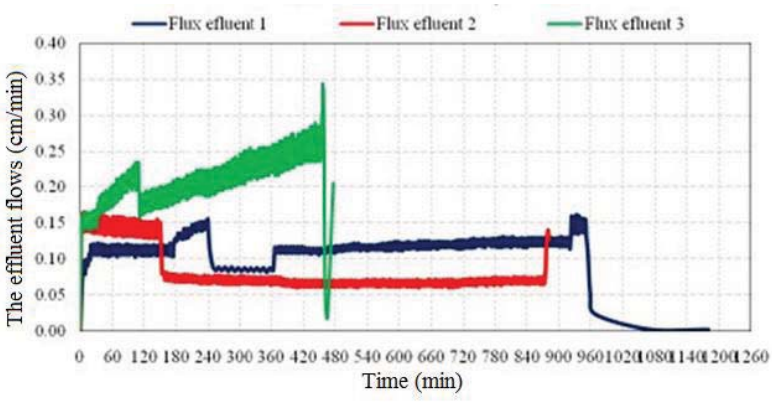

Figure 14. The effluent flows

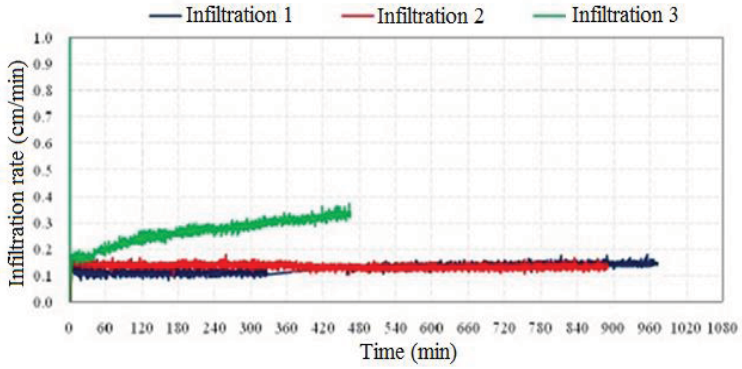

Figure 15. Infiltration rate

THE USE OF INFRA-RED SPECTROMETRY IN SOIL RESEARCH

1. Equipment presentation

Shimadzu spectrophotometer Iraffinity-1 (Figure 16), provides the best S/N ratio in its class, a maximum resolution and compact size. In addition, the high-performance software IrSolution, which focuses on interoperability and analysis of support programs, makes it easier to perform analyses and data processing.

The IR domain currently serves both for chemical analysis and qualitative recognition of

inorganic, organic and natural combinations as well as for determination of the chemical structure.
IR absorption is due to interactions of the incident electromagnetic radiation (the electric component thereof), with the electrical dipoles of a molecule.
It is assumed that the IR radiation energy causes an increase in vibration energy of the molecules because the corresponding dipole oscillates at a frequency close to the above mentioned electrical component.

Figure 16. IR spectrophotometer
Shimadzu IR Affinity 1

2. The method

The KBr pills method was used with IRAffinity-1 spectrophotometer. Soil samples and KBr (potassium bromide) were ground to a particle size <2μ mixed and homogenized in a ratio of 1: 100 (1 mg to 100 mg soil sample KBr) (Figures 17 and 18).
Both the soil used to make the pills and KBr, were each dried at 105ºC, then at 230°C and grinded.
Pills used to record spectra were obtained by molding the mixture sample with KBr in a stainless steel mold using a force of 10 to 12 tf/cm^2 (Figure 19).
Prior to and during the application of pressure using the hydraulic press shown in Figure 20, the air from the mold is removed, to avoid cracking.
Pills thus obtained should be transparent and slightly translucent. They had a diameter of 15 mm and a thickness of 0.3 mm.

Figure 17. Grinding of KBr (potassium bromide)

Figure 18. Grinding of the soil sample

Figure 19. Stainless steel mold

Then they were placed in the spectrometer and recording of spectra was performed automatically using KBr as blank, at a moisture content <10%.
The spectra of each analysed sample was obtained using a total of 20 scans (considered optimum number) at a resolution of 4.0 for wavelengths of 4000 cm^{-1}-400 cm^{-1}.

Figure 20. Hydraulic press

3. Obtained results

Obtaining a background spectrum (Figure 21) plays an important role in the analysis of the samples spectra. The background spectrum is obtained without any sample placed in the device, then the IR spectra of the KBr is done in order to be used in comparing the samples.
The spectra were obtained for samples dried at 105°C and 230°C, one for each drying temperature (Figure 21).
The studies aimed at analysing both water retention in the soil, and for the presence of clay and organic compounds. Since absorption peaks were low, the soil does not have high organic carbon content, which means that the soil is mineral, predominant in carbonates, phosphates and silicates. For this reason, the water present in the soil is mainly linked to its inorganic components.
Due to the influence on the physical and chemical properties of the soil, as well as to its substantial involvement in pedogenetic processes, clay remains the main factor in the analysis of soil texture. The colloidal inorganic matrix or clay, as it is commonly named, has a number of properties which are a result of the characteristics of its components. Identification and proportions of these components establish the quality of the clay. The clay minerals identified in studied clay soils are illite, smectite (montmorillonite), kaolinite and chlorite. In the addition, spectrometry revealed the presence of vermiculite elements or the presence of poorly expressed inter-stratifications.
The mineralogical composition of clay in Msdarjac and Visani soils was studied using IR spectra, and the results are shown in Table 1.

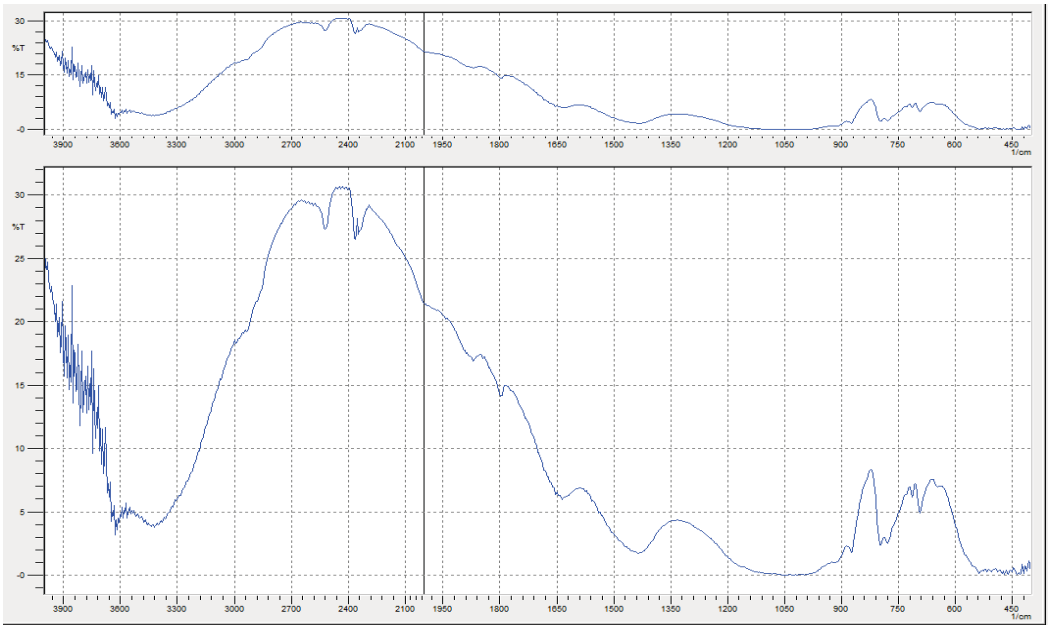

Figure 21. The IR spectrum of Visani soil sample, at 0-20 cm depth, dried at 105ºC

Table 1. The average mineralogical composition of the clay in the studied soils

Perimeter	Depth	Smectit	Illit	Caolinit	Other
Viș ani	0-20 cm	43	50	5	2
	20-40 cm	37	52	7	4
	40-60 cm	42	51	5	2
Mădârjac	0-20 cm	47	46	4	3
	20-40 cm	46	47	5	2
	40-60 cm	46	46	6	2

THE USE OF MATHEMATICAL MODELS IN RESEARCHING AERO-HYDRIC SOIL REGIME

The modelling is an attempt to describe the dynamic processes of soil in mathematical terms. Most models are simulation models, attempting to predict soil behaviour or performance. Mathematical models, on the other hand, uses empirical and observational data to provide quantitative values for gains, losses, substances transfer and their quantity contained in one or more tanks, as a function of time. Models can be local, regional or global as area of application.

1 Description of MOHID Land Software

MOHID Land is a basic executable program from the MOHID frame. So far, it was applied for studies in some river basins, but it is not as developed as the MOHID Water executable.
Within it was also integrated the MOHID Soil executable which simulates water flow through porous medium. It solves the Richards equation in saturated and unsaturated porous medium. This mode is used to simulate the flow of water from the porous medium. Currently, hydraulic properties are described using Van Genuchten function. However, the model is prepared, where appropriate, to include any model which describes the relationship between water content and hydrostatic pressure, and conductivity and the hydrostatic pressure.
Some modules developed in this software are related to specific processes that occur within river basins on a specific environment, creating a modular structure. These modules are:
Porous Media Module – calculates the infiltration, saturated and unsaturated water movement;
the transport and changes in the soil;
Porous Media Properties module - calculates transport and transformation in soil;
Sediment Quality module – calculates the soil transformations due to microorganisms (mineralization, nitrification, denitrification)
Preeqc module – calculates the soil transformations by chemical balance;
Runoff Module - calculates the surface water runoff;
Runoff Properties Module - calculates the transport property in runoff;
Drainage Network Module - which is investigating the conditions of movement, capture and water directing toward stream;
Vegetation Module - processing data on plant growth and agricultural practices;
Basin Module - correlating information between modules while determining flows between the atmosphere and soil.

2 Description of the modelling steps

The first step in developing applications with Mohid Land is setting the working directory and the title of the new project. The next step is to give a name to the application. Then is selected the research area, for this study PoduIloaiei, Iasi County. From the icon "Map" choose "Web Tiles" (Figure22). The program shares the same database with Google Maps.
Each Mohid Land project contains a file called "**General data**", which in turn contains additional 4 sub-files called "**Boundary conditions**", "**Digital Terrain**", "**Initial Conditions**" and "**TimeSeries Location**".
In the file called "**Boundary Conditions**" there

are data on humidity, rainfall, fertilization, temperature and radiation. The boundary conditions need to be introduced because we cannot run the modelling unless known these conditions. If they are wrong it will be a warning at the beginning of the simulation by error messages which will allow us to continue the simulation until they are corrected.

Figure 22. Choosing the study area Podu Iloaiei, Iasi County

In "**Digital Terrain**" data can be found, for instance those related to soil geography. In our case, the column is 3 meters high, is divided into four horizons and has 50 layers. After checking if these data have been set, the simulation can started.

Since it was intended to highlight the impact of porosity on the aero-hydric regime of the soil, the "Porous Media" module was used (Fig. 23). In this module there are data about soil horizons, and also data about the number of cells allocated to each horizon. Also, in this module, is needed to specify the soil hydraulic parameters for each horizon.

The soil hydraulic parameters are required for many studies, but most often they cannot be measured due to financial restrictions and practices. They can be measured directly or can be indirectly estimated using data about the soil texture and the bulk density. In this study Rosetta computer program was used. This program has 5 pedo-transfer functions for determining soil hydraulic properties: Theta_s – the water content at saturation (m^3/m^3); Theta_r - the residual content of water (m^3/m^3); Ks - saturated hydraulic conductivity (m/s); Alpha - the inverse of the pressure at the point of entry of the air (when the gas phase become continue) (m^{-1}); L - empirical index of pore conductivity (m); n - dimensionless index that refers to the pore size distribution.

The next module, called the "**Porous MediaProperties**" is one that controls the transport (depending on the calculated flow in PorousMedia) and the transformation process (Quality sediment and PreeqC which refers to the biological and chemical processes in the soil).

The "**PreeqC**" module performs several functions. The first is to read the structure of the simulation, a kind of frame that will be used to prepare the database and run the model. The second function is to convert the units of the properties that will be used in simulation to units that are required by the model PhreeqC and after the calculations, the conversion of results back to the units used by Mohid Land. Finally, the module runs a number of calculations required to use the database.

Among the features of PhreeqC implemented in the database, the most important is the ability to achieve the chemical equilibrium between the solution and the soil variables, i.e. to carry the process of cations exchange.

"**Sediment Quality**" module. By using this module, the intention was to approximate the simulation results to those in the field, and thus getting close to reality. This is a module dealing with the processes of biological sediment achieved by bacteria such as mineralization of organic matter, nitrification, de-nitrification and immobilization. This module allows the monitoring of the nutrient evolution NO_3^-, NH_4^+, P and CO_2 in the soil.

The next modules are "**RunOff**", "**RunOff Properties**" and "**Basin**". Runoff module calculates the surface runoff, RunOff Properties calculates the transport properties during flow and Basin module manages the information among modules.

Once the data entering is completed, the simulation is “Run”.

3. Obtained Results

Simulation results are structured on each individual module, representing the soil column

through graphs and maps, in the two-dimensional system, in vertical section, and in .hdf format.

The changes resulted in soil columns, depending on the boundary conditions, are represented by means of a colour palette, in video or pictures format.

Some results of simulations are presented below. Thus, in Figure 24 is represented relative humidity in the soil column. The program allows making a correlation between soil moisture and precipitation rate (Fig. 25). In Figure 26, notice the variation of the CO_2 content of the soil profile (the amount of CO_2 is higher in depth and lesser at the surface). The decrease of the percentage of oxygen in the soil air is accompanied by an increased amount of CO_2, which adversely affects the root growth and the water and nutrients penetration into the plant.

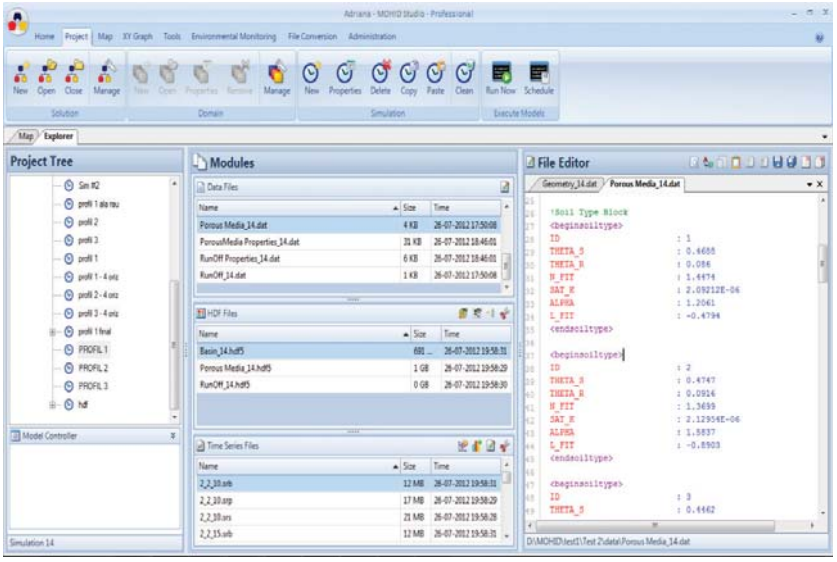

Figure 23. Definition of soil horizons

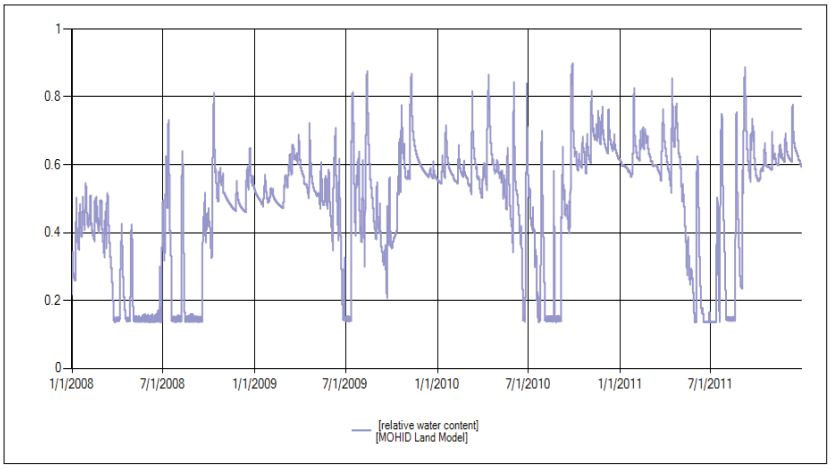

Figure 24. The relative humidity of the soil column

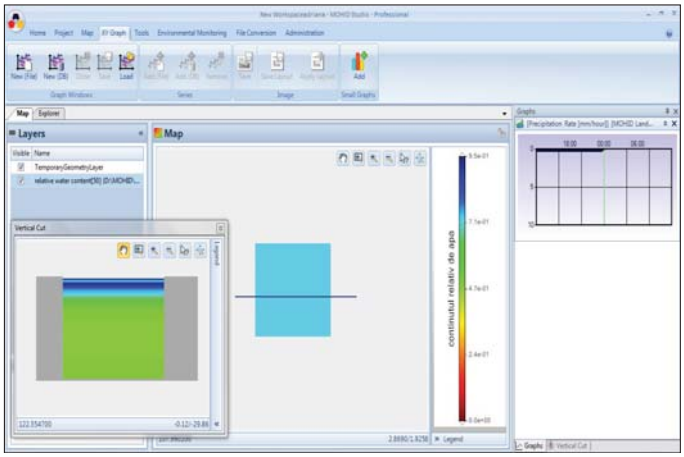

Figure 25. The relative humidity correlated with the precipitations rate

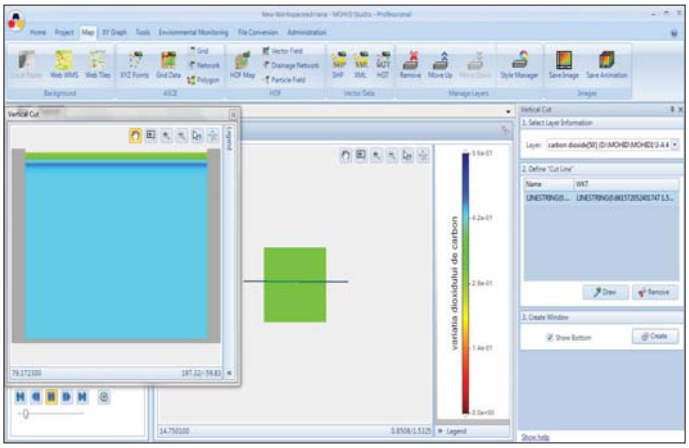

Figure 26. CO_2 Variation on soil profile

CONCLUSIONS

Modern research techniques regarding soil physical properties and the obtained results have a very wide range of applicability. Environmental engineering, land reclamation, hydrogeology, hydrology are just some of the areas where the topic of this article are of particular interest.

Accurate quantification of soil physical properties is a prerequisite in modelling the processes taking place in the soil. Infiltration, advection, diffusion, dispersion are just some of the many processes influenced by the physical properties of soil.

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REQUIRED EARLY WARNING SYSTEMS IN SUPPORT OF STRUCTURES BEHAVIOUR MONITORING SYSTEM

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Abstract

The Earthquake Early Warning Systems (EEWS) are currently in a number of countries with severe seismicity. They detect the initiation or development of earthquakes using the differences between the arrival of P and S waves and signals on-line of seismic sensors network and they emit a warning during the seismic wave will reach a site or another. This system can be used with a monitoring system of building structures behaviour "Structural Health Monitoring System" (SHMS) to improve pre-event and post-seismic event forecasts. EEWS can provide valuable information for civil structures and using information from both systems and SHMS and EEWS leading to a more accurate estimate of the loss and to an efficient safety alert. There are many countries where this correlation is permitted; in Romania also there are promising achievements in each of these areas. A system which can use all the capabilities and possibilities of these existing networks is shown.

Key words*: earthquakes, behaviour monitoring, early warning.*

INTRODUCTION

Background on early warning systems. Seismic warning or alert systems are implemented currently in severe seismic countries such as Japan, Turkey, Italy, China etc. These systems detect the initiation or development of earthquakes using the differences between the arrival of P and S waves and signals on-line from seismic sensors network and emit a warning during the seismic wave will reach at a site or another. This type of system requires the existence of a network of seismic sensors located in seismically active areas, acquisition, processing and signal transmission, some interfaces of warning and generating alarms.

Background on real-time monitoring by seismic instrumentation and the need for documentation of buildings seismic response measurements. Monitoring by seismic instrumentation can contribute directly mainly to identify and determine the temporal variation of modal characteristics, Fourier amplitude spectra, damping coefficients etc. It also plays an important role in verifying the maximum level of relative displacement, the torsional response (especially for asymmetric structures), identifying needs for building repairs and strengthening as the effectiveness of preceding intervention measures, the displacement measurement for evaluation the drifts from strong earthquakes (Borcia and Georgescu, 2005; Borcia, 2006; Georgescu and Borcia, 2005). The need for documentation of measurements of seismic response of buildings is real, so the implementation of strategies dedicated to these activities should include resource allocation, as a national priority; development of criteria for selecting some representative buildings and specific objectives of measurements; stimulation of progress in investigating technologies; encourage owners to invest in seismic monitoring, by providing by structural engineers of products that homeowners be able to understand and use;

plans and resources for data archiving and dissemination (Celebi et al., 2014).

MATERIALS AND METHODS

Rapid INFP alarm system in case of earthquake. Based on researches about 15 years, at the moment, in Romania, the National Institute for Earth Physics - INFP has installed an alarm system mainly to alert the important objectives in the area of Bucharest, Figure 1 (eg. Irradiator at the Institute of Atomic Physics at Magurele).

This early warning system was developed to provide a warning for 25 - 35 seconds for installations from Bucharest, in the event of earthquakes with magnitude greater than 6.5. INFP has developed a detection algorithm for calculating the Vrancea intermediate earthquakes magnitude using strong motion data field, a rapid assessment and scaling relationship between maximum acceleration of P wave amplitude measured in the epicentral area and the largest ground motion recorded in Bucharest or in other cities in the affected area of Vrancea.

The system can be used to: (I) - alarm and blocking nuclear installations of national interest; (II) - blocking the gas supply valve for housing or industrial installations; (III) - walking slowing or stopping passenger and goods trains; (IV) - blocking the water supply valves for industrial installations; (V) - enabled rescue facilities; (VI) - enabled backup systems and data bank rescue operations for interest (banks, police etc.); (VII) - alerting hospital operating rooms and emergency generators start automatically etc. (Marmureanu et al., 2012; Bose et al., 2007).

Seismic Warning System (SAS) was developed in 1999 and the investment was made possible by funds from the company "FOTON 2000 SELF" Ltd., Figure 2.

The system was designed and implemented to transmit by radio-paging seismic alarm about earthquakes in epicentral area Vrancea in 25-30 seconds before reaching wave "S" (destructive) in Bucharest.

Seismic monitoring network of structures INCD URBAN-INCERC is oriented to buildings monitoring and public works instrumentation. Records on in-situ and on buildings were and are extremely important for designers. National Seismic Network INCERC is the largest network in Romania, consisting of approx. 60 digital accelerographs distributed in Bucharest and in the country (Figure 3 and Figure 4).

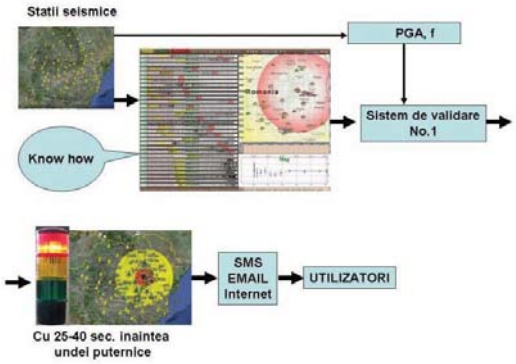

Figure 1. Rapid INFP alarm system in case of earthquake [http://ews.infp.ro/rews.php]

Figure 2. Seismic Warning System (SAS) [http://www.fotonsas.ro/]

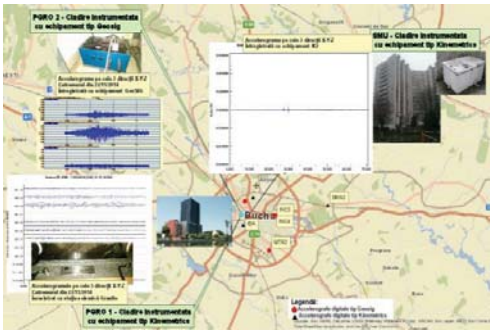

Figura 3. Distribution of Geosig and Kinemetrics digital accelerographs in Bucharest

Figure 4. Distribution of Geosig and Kinemetrics digital accelerographs in Romania

Method of seismic instrumentation. Possible schemes for the location of the triaxial sensors are shown in Figure 5 and 6. Recordings of dynamic parameters (structural spatial speed in three main directions NS, EW and vertical Z), Fourier spectra, fundamental period of vibration (corresponding to values for the two transverse and longitudinally directions of a building) are obtained.

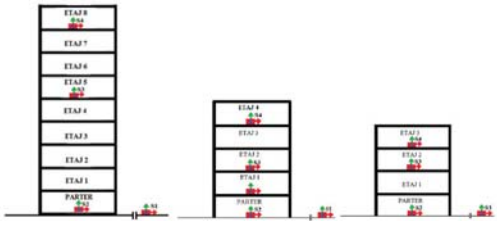

Figure 5. Location scheme with 4 triaxial sensors.

Combined method. Seismic warning systems or early warning "Earthquake Early Warning System" (EEWS) can be used together with a monitoring system of building structures behaviour "Structural Health Monitoring System" (SHMS) to improve pre-event and post-seismic seismic event forecasts (Figure 6). If it is a pre-seismic event forecast, EEW system information are used to determine the likelihood of some degree of damage to structures using a methodology for estimating the damage using the performance-based seismic engineering. These predictions can support those who make decisions on appropriate intervention enabled systems. Since the time between warning and recording earthquake is very short, probabilistic predictions must be readily determined and the decision is automatic for intervention actions.

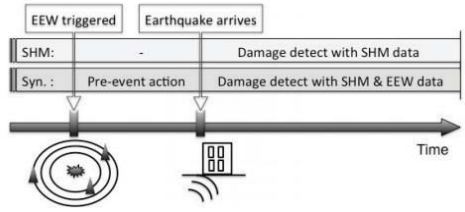

Figure 6. Combining the information received from the two systems (in time) [Wu and Beck, 2011]

In structural engineering software for SHM have developed or are in developing, with which to detect changes in the structural characteristics, changing local rigidities, evaluating the potential damage to the structure. Structural response received from the sensor network is used to determine the changed stiffness based on linear models/nonlinear, differences between modal parameters calculated for a finite element structural model and modal characteristics of dynamic tests using ambient vibrations. Accessing data from EW system by HM system can improve estimates related to failures and losses.

RESULTS AND DISCUSSIONS

Existing systems in which have been integrated early warnings or alert, and monitoring seismic behaviour of structures.

Japan - Real-time observation system for earthquake early warning and monitoring structures (Kuyuk and Motosaka, 2008, 2014). There are two complementary systems, Japan's national EEW system, which adopts the method of "network" and was inaugurated in 2007 by the Japanese Meteorological Agency (JMA), and seismic observation system in the Sendai area, based on the "front detection" which is one of observation in real time, not only seismic records (event mode, information before the arrival of seismic strong phase), but the response of buildings (normal mode provides real-time status of structural damage).

Ital y- Probabilistic Rapid Alert System and Evolution (Presto). An early warning procedure for predicting to regional scale, based on P waves arrive in an area with potential for

damage and loss, was implemented in Probabilistic System Early Warning and Evolution, which is a portable platform developed by the Laboratory of RISSC Department of Physics of the University of Naples "Frederico II" (Picozzi et al., 2014). The procedure uses the characteristic period P-wave and peak displacement primary wave signal measured at each station P values are then compared with empirical regression defaults. A warning level at each station correlated with the expected level of local damage will get. Thus, integrating the parameters measured on-site stations (between P waves and movement characteristic peak) and estimate the regional settings (hypocenter), Presto can identify the affected area a few seconds after the onset of the event, with a good agreement with the instrumental intensity map produced later.

Turkey. The earthquake rapid response and early warning system in Istanbul (IRREW), designed and used by Univ. in Bogazici with 100 sensors record seismic motion in the metropolitan area that require fast data on damages, 10 seismic stations very close to the Marmara fault for data collection in the early warning system and 60 critical sensors on buildings (Erdik, 2006). After the onset an earthquake, each station will process the seismic movement to lead the spectral accelerations at certain times and send these parameters as SMS messages to the main data centre through available GSM network services.

China. The national project on seismic alert has been initiated and will be conducted by the Institute of Mechanical Engineering IEM-Harbin, belonging to the China Earthquake Administration - CEA, under the State Council, in the next 5 years it will cover approx. 50% of the territory, with 8878 stations. Several projects are being funded by the National Foundation for Natural Science of China, among which key project "Study of damage characteristics of strong seismic actions and seismic simulation field."

A proposed system by INCD URBAN-INCERC. The National Network for Earthquake Engineering - RNSC of INCD URBAN-INCERC provides data on seismic response of buildings and about structural vulnerability, Figure 3, and INFP monitors the seismological conditions and it began the implementation of a regional early warning system, Figure 1. The system which can use all the capabilities and possibilities of these networks is shown in Figure 7.

CONCLUSIONS

The current trend in the estimation of seismic risk of buildings is to create wireless sensor network capable of providing the necessary information for analysis and evaluation of post-seismic vulnerability of buildings. In addition to monitoring and display the collected data in real time, also the opportunity for alert through alarms, email or SMS, of a certain category of users about potential risks to buildings is aimed.

Also, *regarding the capabilities of a monitoring system,* they must integrate also the needs of the owners of buildings so as to facilitate rapid assessment of the integrity of the building, data format shown to be in degrees of damage and to provide them in a relatively short time (a few minutes, if not seconds), if not in real time, in order to facilitate the decision making process having the necessary information.

Regarding integrated investigative methods of building performance after earthquakes, analysis of the current international stage (US, Japan, China, Mexico, Turkey, Italy etc.) and in Romania demonstrates that there are premises that allow the continuation and expansion of advanced concerns in this field.

The concept of integrating the two systems, EEWS (seismic early warning or alert) and SHMS (monitoring behaviour structures) will use their basic characteristics and the clear possibility, already adopted in some countries, of a data correlation supplied after an earthquake. Although now there are many countries where this correlation is permitted, in Romania there are promising achievements in each of these areas.

In this context, the National Network for Earthquake Engineering - RNSC of INCD URBAN-INCERC provides data about seismic response and structural vulnerability of buildings and INFP monitors seismological part and began the implementation of a regional early warning system.

INCD URBAN-INCERC has demonstrated that based on records of response of buildings to moderate intensity Vrancea earthquake, some processing which contributes to the understanding of structural response (Dragomir et al, 2012, 2013; 2014), such as absolute acceleration response spectra (spectra floor), Fourier spectra amplitude and amplification functions were obtained.

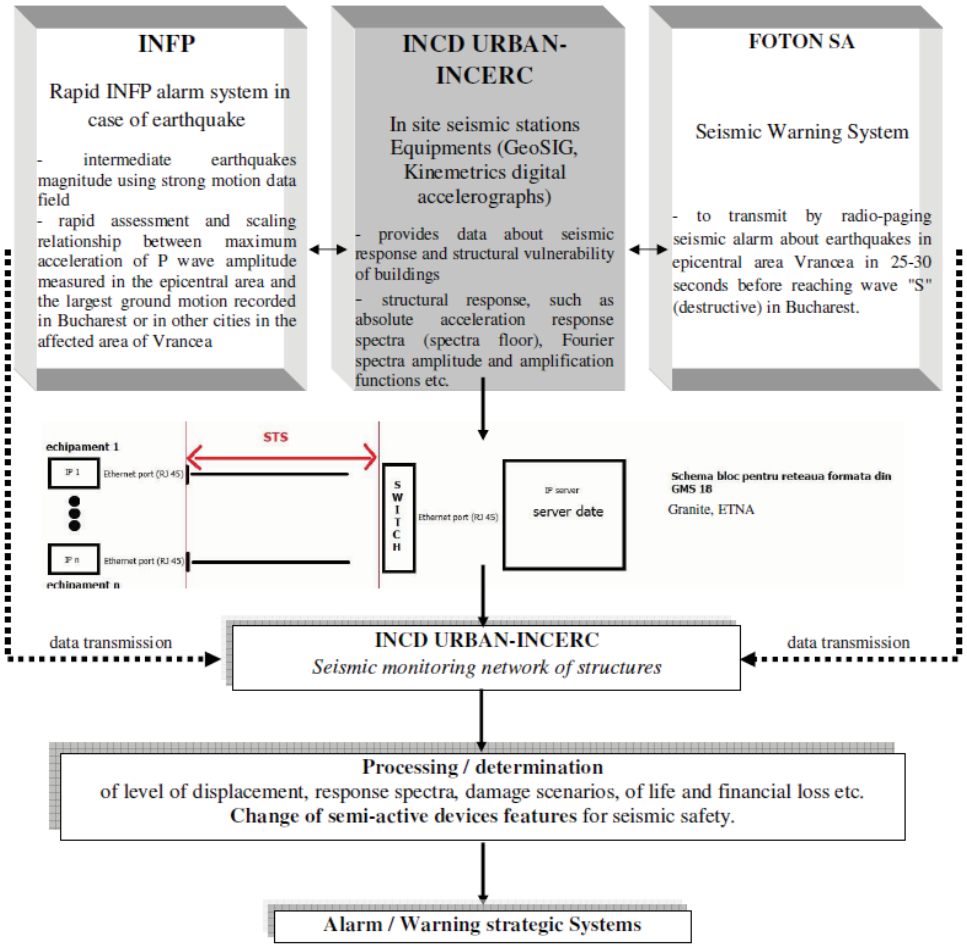

Figure 7. Seismic alert or early warning System and monitoring the behaviour of buildings

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Providing expertise in public policies related to RDI Strategy 2014-2010 for the design/ construction evaluation, the analysis and interpretation of seismic/non-seismic records in 2015 in the National Seismic Network for Constructions.

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IMPACT VIBRATIONS GENERATED BY NON-SEISMIC SOURCES ON STRUCTURAL SAFETY, FUNCTIONALITY AND COMFORT

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Abstract

In most cases, most of the vibration energy source with the dynamic flux propagation Rayleigh waves propagated near the surface of the ground may cause movement of the ground and a high level of efforts that transmit vibrations from underground to the supported structures and adjacent structures. The permanent negative effects of these major vibrations on foundations cause structural damage to adjacent buildings, especially those supported by deposits of soil/soft soil. This type of vibration can cause adverse effects in the nearby areas and inside buildings to sensitive electronic equipment and to devices/facilities measuring and alike can have a major impact on occupant comfort. The literature shows that the best assessing criterion is the maximum speed of oscillation of the particle soil - PPV (Peak Particle Velocity).
The paper aims to present a case study on determining the effects of vibration levels generated by non-seismic sources on structures. A criterion for assessing the vibration at internationally level is considered and also some existing solutions in the literature to reduce the level of vibration are presented. The proposed systems were evaluated and compared using particle displacements reductions obtained in soil through intensive study of parameters. All proposed filled barrier systems performed well in order to reduce surface waves and effectiveness shielding, but in most cases a variable protection in the presence of structure was provided.

Key words: *non-seismic sources, vibration, assessing criteria, structural safety, systems for vibrations mitigation.*

INTRODUCTION

In-situ vibration can be characterized in any point by the following seismic parameters: period or frequency, displacement, velocity or acceleration of the particle of soil at that point. From these parameters, secondary quantities as relative energy, the strength of vibration expressed in vibrating can be also estimated.
Evaluation criteria can be related to one of the dynamic parameters listed above. In terms of mediation in time of the kinematic quantities, they can be instantaneous maximum values, mean or RMS spectral values resulting from a third octave analysis.
Descriptions of allowable values for different types of kinematic values are specified in national technical rules and in the literature.
Technical standards referred to in this report are:
Romanian rules:
- SR 12025-2-Vibration effects on buildings or parts of buildings. Permissible limits;
- P 121 -89 - Technical instructions for the design of noise protection measures and anti-vibration to industrial buildings;

German norm:
- DIN 4150-3/1999 - Vibration in buildings - Effect on structures;

Swiss norm:
- Standard for the effect of explosions on buildings;

Norm in Washington - USA:
- WAC 266-52-67065 - Vibration and damage control

The literature shows that the best criterion for assessing is the maximum velocity of oscillation of the particle of soil - PPV (Peak

Particle Velocity). The following theoretical and experimental justification comes to support the choice of velocity criterion as the most reliable criterion for assessing the effects of vibration:

- the particle velocity take into account both frequency and displacement and give a valid indication for any frequency vibration;
- good statistical correlation of degradation data with velocity;
- the velocity of oscillation depends in large measure of soil properties, except those saturated with water, compared to displacement or acceleration.

Velocity criteria as defined in various standards or studies generally refer to buildings with structures designed according to the technical rules. Different thresholds with allowable limits are defined for structural types based on height, number of openings; constituting material for the structural elements, possible degradation of structural and non-structural elements; distance; vulnerable/non-vulnerable buildings (refer also to historical monuments).

Assessment criteria refer to the velocity of oscillation at ground level or structural oscillation velocity.

MATERIALS AND METHODS

Determining the level of vibrations produced by ambient vibration is in an area comprising an inside, outside and the perimeter of the industrial hall, the location of technological equipment (industrial presses), the driveway and the road surface limit, in the residential neighbourhood and in the subway station, Figure 1.

Figure 1. The area for which the vibration measurements are carried out

Materials-Equipment. In order to achieve the instrumental recordings, the following equipments were used: the digital triaxial accelerometers Kinemetrics (ETNA), triaxial accelerometer GSM-18 GEOSIG, broadband multichannel stations GeoDAS – Japan for vibration monitoring, Figure 2.

In accordance with STAS 12025/1-81, the level of vibration strength encountered in the literature that the relative intensity of the vibration is determined by the relationship:

Figure 2. Location of GEODAS 12USB stations (left) and ETNA (right)

$$S = 10 \lg \frac{A}{A_0}$$

in which:
A is the strength (intensity) of vibration, defined by the relation:

$$A = \frac{a^2}{f} \ [cm^2 / s^3]$$

a is the amplitude of vibration acceleration at frequency f, in [cm/s^2];
f considered frequency, in Hz;
A_0 – strength (intensity) of reference, with the given value:

$$A_0 = 0{,}1 \ [cm^2 / s^3]$$

SR 12025/2-94 sets allowable limits for normal operation of residential, social and cultural buildings subjected to vibration action produced by aggregates located in or outside the buildings and of road traffic vibration, after propagation through the structure of the path or road bed, acting on buildings or parts of buildings. For the comfort of the building, the limit values of the vibration are different in the case of vibrations acting in the longitudinal direction or transverse direction.
For a number of materials commonly used in construction, SR 12025/2-94 shows the material degradation curves. According Norms on acoustics in buildings and urban areas, indicative C 125 - 2013, Part IV - Protective measures against noise in urban areas, indicative C 125/4 - 2013 Annex 1 List of parameters and performance levels corresponding requirement "Protection against noise in urban ensembles, "published in official Gazette No. 812 bis., on 20/12/2013, parameter 9: allowable vibration level of specified velocities on structure in terms of the frequency is maximum 8mm / s.

RESULTS AND DISCUSSIONS

Results are acceleration, velocity fields, with the response spectra in the hazardous frequency domain for buildings (0÷40Hz). Description of allowable values for different types of kinematic values is specified in the national technical rules and in the literature presented mentioned above.
Processing records can led to determining the maximum instantaneous velocity and acceleration records and expressed in velocity and acceleration and getting the velocity and displacement through calculation (ETNA, GSM-18), determining the maximum instantaneous of records expressed in velocity (GEODAS stations), the spectral analysis of records in velocity and acceleration, Figure 3 and Figure 4.

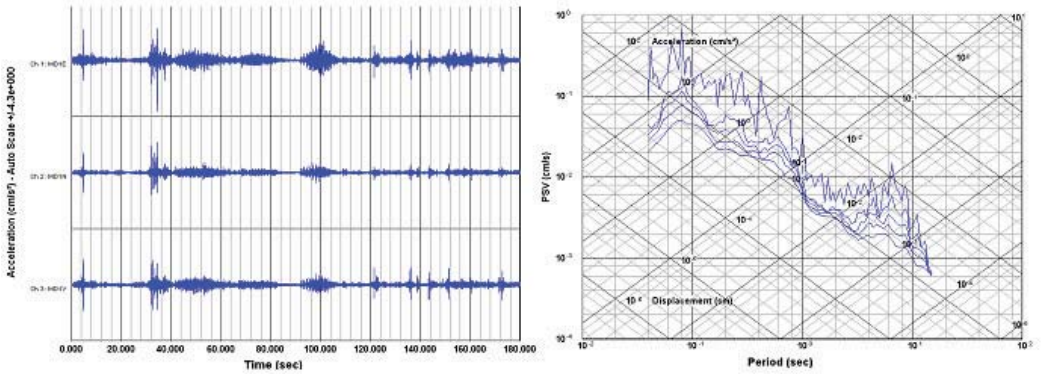

Figure 3. Example of registration in terms of acceleration (left) and results obtained after processing in form of tripartite spectra (right)

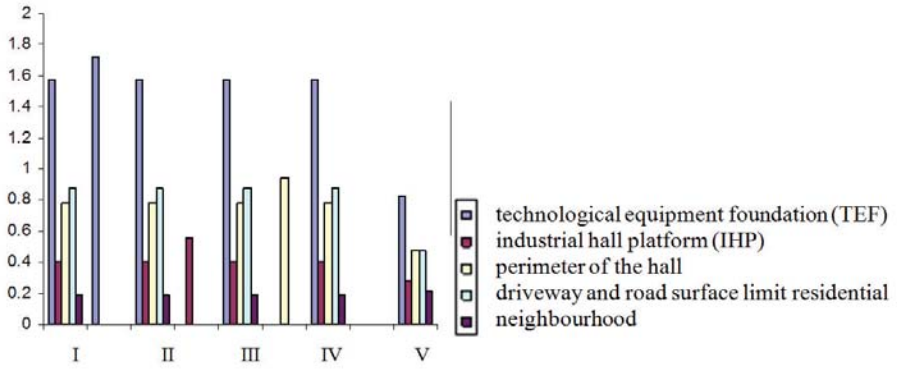

Figure 4. Graphical representation of the maximum velocity (mm/s) in the studied area (Dragomir et al., 2015)

Studies on mitigation/reduction of vibrations

For effective protection of buildings from structural failure due to dynamic loads generated by human activities such as drilling, blasting in construction of roads, foundations subjected to vibration in industrial, heavy and dense traffic caused by the development of interconnections residential areas etc., there are multiple possibilities for shielding the vibration caused by all these sources. In particular the development of rapid transport and increased of weight of fast trains have as effects vibration in soil and structures along transport routes and in the immediate vicinity of loads, especially in densely populated urban areas (Orehov et al, 2012).

Reducing the structural response can be achieved by: Adjusting the frequency content of the excitation; Change the location and direction of vibration sources; changing the dissipation of waves near the ground surface; Interrupt partial waves spread in structure or by providing a damping attenuation structure by various means such as additional damping systems or other base isolation systems. It is also possible to change the dynamic behaviour of transmitted locally underground waves by way of a complex mechanism of reflection waves and changing the source of vibration isolation by building a barrier between the waves and dynamic load affected structures such structures will be protected. When insulating barrier is positioned near the vibrating source, such application is known as "active isolation" (near field). If the barrier is located far from the source but around the structure to be protected from Rayleigh waves so far containment field is known as "passive isolation".

As an open trench and a solid barrier such as a ditch filled with suitable materials may be useful as anti-vibration measures. There is a wide range of types of construction that can be considered as the basic insulating barrier, ranging from concrete walls or piles arranged in series to the gas highly flexible mats or barrier which prevents the waves, when the latter is based on the cut-off frequency of a rigid layer soil on the bedrock. Due to effective shielding, easy and low-cost implementation, both open and the filled trenches are most commonly used in engineering as isolation measures.

Numerous studies have had as main objective the development of new numerical techniques as a tool to analyse the influence of different parameters in order to shield vibration through trench barriers compared with the few experimental studies in which tests are conducted at real scale and laboratory models only for particular cases.

The effect of stratification of soil on wave shielding efficiency by vibration isolation systems under plane deformation are also investigated using frequency domain formulation of numerical analysis.

Shielding effectiveness depends on accurate assessment of stiffness material used as a barrier. This requires a series of experiments to understand the characteristics of wave propagation.

For testing are required an excitatory, two concrete blocks, a wave barrier and two

measuring points. Electro-dynamic stirrer, which induces a sinusoidal motion, as shown in Figure 5, is used as a source of vibration to produce a stationary vertical harmonic force of 250 N maximum amplitude in a frequency range of practical importance of 10 Hz÷95 Hz. Adjacent accelerometers are used to obtain values generated that are stored on computer. Excitation frequency is increased gradually in steps of Δf = 5 Hz. The noise of the signals recorded during the test was removed by digital signal processing by filtering with a band pass filter (Orehov et al, 2012).

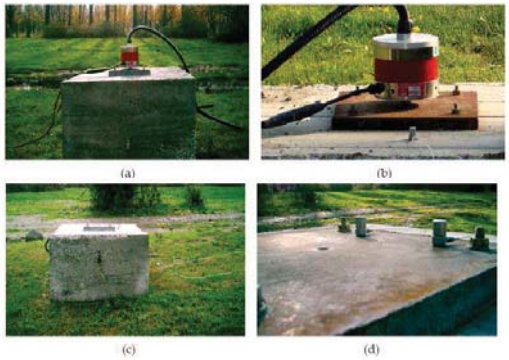

Figure 5. Electrodynamic shaker and accelerometer rests on a foundation: a) electrodynamic shaker placed on foundation; b) electrodynamic shaker and accelerator positioned on the foundation, c) Measurements made on the basis of the Foundation, d) Accelerometer rests on the foundation.

The vibrator is mounted on a thin metal plate and located above the central square shock rigid concrete, in order to cause only vertical vibrations. Two surface concrete foundations size 1.0 m×1.0 m×0.5 m, at a distance from one another by LF = 25 m are used. For research purposes, is built a long rectangular trench (an open channel) with Δt = 3 m, symmetrical about the centre line of these foundations. The first foundation is used to produce a harmonic load accelerometers and one for recording and vice versa. Source measurement on concrete pedestal is at a distance of 4 m from the gutter to isolate active research at a distance Lt = 20 m for measuring passive isolation. Vertical components of harmonic vibrations are recorded with accelerometers placed on these foundations and corresponding to a time interval Dt = 0.0005 sec.

Shielding performance of trench material stiffness in relation to soil and excitation frequency range is investigated by performing a series of field tests on transmitter and receiver isolation barriers, namely active and passive.

In order to achieve the best results in vibration control, are using four types of ditch barriers. For trenches filled with water as shown in Figure 6, the backfill material compared to soil is considered as water, bentonite as a material softer and the concrete as more rigid material instead of open trenches. For stability reasons the trench/ditch walls slope has been reinforced with 0.15 m thick reinforced concrete.

Figure 6. Trench-type insulating barriers: a) open trench, b) pre-filled trench with water, c) trench filled with bentonite, d) concrete ditch

CONCLUSIONS

Measurements to determine the level of vibration were non-seismic sequence and were made with type Geodas stations, Japan, broadband and high sensitivity (10-6 m/s) with 12 channels equipped with four triaxial transducers, and that 3-channel transmitter equipped with one triaxial, ETNA accelerographs GeoSIG Kinemetrics and GSM-18, triaxial, with automatic and manual release.

The analysis of all data recorded in the industrial equipment, and in its vicinity, during the recordings were made, there were no vibrations that exceed permissible levels set by

the standards and regulations, which are almost ten times below their limits.

According Norms on acoustics in buildings and urban areas allowable vibration level specified for structures is up to 8 mm/s.

Regarding the study of active and passive insulation against vibration was put to demonstrate the effectiveness of different system configurations barrier protection as ditches filled. Proposed systems were evaluated and compared using particle displacements reductions obtained in soil through intensive study of parameters. Following previous discussions and analysis results, we can draw the following conclusions: All filled barrier proposed systems perform well to reduce surface waves and shielding effectiveness. Moreover, in most cases provide protection in the presence of variable structure. Continuous monolithic wall system is an economical solution as a passive isolation system, since it requires less material.

In the presence of structure, where open ditches and some filled, the barrier acting normal and the movement of the particle behind the barrier went up, but if no structure was observed that the measurements are expected trend in terms of amplitude versus distance for all distances. This may be due to two reasons: first, the vibration of the structure under dynamic loading can affect the vibration of the ground surface particles. Waves produced by the structure to the ground, passing through the soil-structure interface, in-phase or out of phase are; The second reason, the amplitude of vibration is negligible even without barrier, and any variation of the response rate is a major change.

It is noted that in many instances it is necessary to conduct a more thorough investigation on the structure of soil-insulating barrier (ditch/ channel) used simultaneously, as performed in this study.

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This paper is based on results obtained in the PN 09-14.01.07 Project: Studies and experimental research on the vibration generated by nonseismic sources with impact on constructions (essential functions, national heritage etc.) in terms of the consequences associated with collapse or severe damages. Assessment of structural safety, functionality and comfort. Phase 18/2015. Providing expertise in public policies related to RDI Strategy 2014-2010 for the design/construction evaluation, the analysis and interpretation of seismic/non-seismic records in 2015 in the National Seismic Network for Constructions.

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EVALUATION OF SEISMIC RESPONSE - FACULTY OF LAND RECLAMATION AND ENVIRONMENTAL ENGINEERING -BUCHAREST

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Abstract

*Predicting seismic response of structures to future earthquakes contains a large dose of uncertainty. This is primarily due to inability to know exactly the characteristics of future earthquakes, and in the second simplifying assumptions used to calculate the structural response. One of these simplifications is that current design methods used elastic calculation, while the response of several structures under the action of an earthquake is inelastic***.**

Key words*: calculation method, evaluation, earthquake, seismic response.*

INTRODUCTION

Evaluation of seismic response using static calculation methods (method of lateral forces) in a local dynamic analysis is another major simplification. Uncertainty of determining the seismic response of a structure is amplified by other issues, including the inability to accurately predict the value and distribution especially of gravitational loads, structural elements contribution to stiffness, strength and damping resistance of the main structure.

In these analysis procedures, the maximum earthquake-induced base shear and deformation for an uplifting structure are computed directly from the earthquake response spectrum. It is demonstrated that the simplified analysis procedures provide results for the maximum base shear and deformation to a useful degree of accuracy for practical structural design (Chopra, 2000).

Therefore the conceptual design of structures located in seismic areas is very important, in order to have a proper seismic behaviour.

Basic conceptual issues are related to:

- Simplicity of structure
- Uniformity, symmetry and redundancy
- Strength and lateral stiffness in any direction
- Strength and torsion stiffness
- The realization that the diaphragm floors
- Proper foundations

P100-3/2008 - the new code provides 3 seismic evaluation methodologies for evaluation of construction, defined by the conceptual level of refinement of calculation methods and the level of checking operations detail:

A. Methodology Level 1 is a simplified methodology;

Level 2 methodology is the methodology commonly used type current ordinary construction;

Level 3 methodology using calculation methods applied to nonlinear and complex construction or of particular importance when data require. Level 3 is recommended methodology for current type construction due to higher confidence provided by the method of investigation or the classification in a risk group based on R3 coefficient is not obvious.

The calculus has been making for the body A of the Faculty of Land Reclamation and Environmental Engineering at the University of Agronomic Sciences and Veterinary Medicine of Bucharest.

The building is executed between 1968-1970, and has a resistance structure made of the reinforced concrete frame, designed according to design standards at the time, so that does not meet many of the requirements of the current seismic design codes. Bucharest area according P100-1 / 2006 is characterized by a peak acceleration ag = 0.24 g and a control period (corner) response of the spectrum Tc = 1.6 sec.

The following is a part of an assessment methodology based on Level 2. In this methodology the earthquake effects are

approximated by a set of forces applied to conventional construction. Size of lateral forces must be choose as the movements obtained from a linear structure calculation under those forces approximate the structure deformations imposed by seismic loads.

MATERIALS AND METHODS

If the fundamental building period is greater than the corner period Tc of the spectrum is applied the so-called rule of "equal displacement" which states that displacement elastic response represents an upper limit of the nonlinear seismic displacement. Consequently, the lateral forces applied to these situations corresponds to the elastic seismic response of the structure, assessed using the response spectrum by the non-reduce factor q.

The building subject to review has a capacity of over 200 people in total area exposed; it requires its classification in to importance class II, characterized by an importance factor of 1.20.

But when the fundamental building period is less that the corner period the effective inelastic displacement exceeds the elastic response and their assessment needs corrections. Thus, for Vrancea earthquakes recorded in the Romanian Plain whit Tc = 1.6 sec, most existing buildings fall in the range 0 - Tc. Therefore, to assess the ultimate limit state displacements it must to correct the offset values by elastic seismic loads (unabated) amplification coefficient "c" (P100-1/2006, Appendix E).

The level 2 methodology, checking structural elements is made for the ultimate limit state and the service limit state under similar conditions as in P100-1/2006 for new structures design. For the service limit state is imposed to check only lateral displacements, while for ultimate limit state is imposed to check also the structural resistance. In order to determine the displacements and sectional efforts into structural elements of reinforced concrete is has been developed a three-dimensional model of the building resistance structure. For a short presentation, in the case study is presented only the analyzes results that consider seismic effects in transverse direction of the building. The program used is SAP 2000.

The modal analysis revealed the following modes of vibration, according Table 1.

Table 1. Periods of vibration modes on the transverse direction

Mod of vibration	Period (s)	Modal participation factor (λ)	Amount of participation factors $\sum \lambda$
1	0.888	0.775	0.775
2	0.300	0.131	0.907
3	0.164	0.050	0.957
4	0.109	0.026	0.983
5	0.081	0.017	1.000

Unlike the level 1 methodology, when the total mass of the building was evaluated at approximately 3800 t, the level 2 methodology provided a value of 3620 t for the total mass of the building. Consequently, the resulting base shear elastic seismic response found is:

$$F_b = \gamma_1 S_d(T_1) m\lambda = \gamma_1 \frac{a_g \beta(T_1)}{gq} \lambda(mg) = 1{,}2 \frac{0{,}24g}{g} \frac{2{,}75}{2{,}5} 0{,}85G \quad (1)$$

$$F_b = 0{,}67G = 0{,}67 \times 3620 \times 9{,}81 \Rightarrow F_b = 23790 \quad (2)$$

The lateral force was distributed vertically according to the fundamental shape of vibration mode on transverse direction.

Checking relative level displacements According to P100-1/2006 code, relative displacements associated to the service limit state are obtained by multiplying the corresponding elastic response with a reduction factor taking into account the seismic recurrence interval associated to the verification in the service limit state. For buildings classified in Class II, this factor has the value of v = 0.4. Similarly, the ultimate limit state elastic displacements are amplified by a gain factor which takes into account the building fundamental period of vibration with site corner period lower and the inelastic displacements are higher than those corresponding to the elastic seismic response (P 100-3/2008).

This coefficient is equal to:

$$l \leq c = 3 - 2,5\frac{T}{T_c} \leq 2 \Rightarrow c = 3 - 2,5\frac{0,88}{1,60} = 1,625 \quad (3)$$

The level relative movements are, present in Table 2

The acceptable values of relative level displacements are of 0.5% to 2.5% for limit state service (LSS),, equation (4) and ultimate state service (ULS), equation (5) and follows:

$$R_3^{d,SLS} = \frac{d_{r,adm}^{SLS}}{d_{r,max}^{SLS}} = \frac{0,5}{1,15} \Rightarrow R_3^{d,SLS} = 0,43 \quad (4)$$

$$R_3^{d,SLU} = \frac{d_{r,adm}^{SLU}}{d_{r,max}^{SLU}} = \frac{2,5}{4,69} \Rightarrow R_3^{d,SLS} = 0,53 \quad (5)$$

Table 2. Level relative movements associated limit state service (LSS) and ultimate state service (ULS)

Level	Elastic dispalcemnts c (m)	Level hight (m)	Drift as elastic displacements (%)	Drift as LSS (%)	Drift as ULS (%)
4 Floor	0.435	3.80	1.68	0.67	2.73
3Floor	0.371	3.80	2.60	1.04	4.23
2Floor	0.272	3.80	2.89	1.15	4.69
1floor	0.162	3.80	2.71	1.09	4.41
Ground floor	0.059	3.73	1.59	0.63	2.58

RESULTS AND DISCUSSIONS

Verification of reinforced concrete structural elements. Carrying out resistance for Ultimate Limit State depends on the ductile or brittle failure of the structural element s under the considered effort. Failure modes of reinforced concrete elements are defined in P100-3/2008 - Appendix B (P 100-3/2008).

Sectional efforts computed for elements of inelastic behaviour are assessed under the new code seismic evaluation based on the principle relationship: Ed = (E * $_E$ / q) + Eg, where E * $_E$ is the effort of seismic load considering the elastic response spectrum (non - reduce), Eg is the effort resulted from associated non-seismic loads combination including seismic load, and q is the behaviour factor function the element analyzed, yielding the of the type of effort.

For ductile failure elements capacity is determined by dividing it by the partial average resistance safety coefficients and confidence factor CF = 1.20 level of knowledge associated with "normal" KL2.

For fragile failure the verification represents a comparison of efforts resulted under lateral and gravitational forces associated with the plastic state of ductile elements of the structure, with the value calculated with the minimum load capacity of materials resistance (typical values divided by CF and partial safety factors).

According to P100-3/2008 - Appendix B - factor values for reinforced concrete beams of such behaviour are depending on the behaviour (ductile or inductile), the reinforcement ratio at the top and bottom of beam and shear strength of calculation (P 100-3/2008).

Because the critical areas at the beams edges:

(1) the upper edge has not at least two bars shaped surface 14 mm diameter;

(2) there is at least one quarter of the maximum reinforcement from the top provided continuously along the beam length;

(3) the compressed area is provided with at least half of the large reinforcement section

(4) distance between stirrups in critical areas violates the condition of s≤ min {hw / 4, 150 mm, 7 d_{bl}} (where hw is the height of the beam cross section and d_{bL} is the minimum diameter of longitudinal bars), it was considered that the composition and the reinforcement of existing beams partially fulfils the conditions of new design standards. Consequently, the behaviour factor values were obtained by interpolation of the corresponding q values respectively non ductile behaviour.

The following is an example of how to conduct inspections of resistance to a floor beam over

transverse current frame. In the spread sheet calculation presented below we used the following values and formulas, this are presents in Table 3 (Slave, 2010).

Values of the structural seismic assurance degree of the transverse beam show that the beam is less reinforced that the earthquake design claims. The minimum value of the indicator is recorded in the central opening in the traffic corridor between the axes B and C, where reinforcement of the bottom edge of the beam is about 10 times lower than that associated computing moment When the seismic load is oriented on transverse direction in the positive direction of axis OY, we have, Table 6 (Slave, 2010).

Table 3 – Values and formulas

f_{cd}	=13.9 MPa (10.5 MPa) – concrete C12/15 class - compression resistance under ductil failure/ fragile failure
Fctd	=1.1 MPa (0.76 MPa) – concerte C12/15 class -tensile resistance under ductil g=failure/ fragile failure;
fyd	=236 MPa (175 MPa) yield strength steel OL38 brand for ductile type failure (or weak);
p_{max}	$=\zeta B(f_{yd} / f_{cd})$ maximum reinforcement ratio (corresponding balance point);
p, p', p_e	- reinforcement ratios (tensile efforts in bars, compressive efforts in bars, stirrups;
V_{Ed}	design shear force;
M_E^* ,V_E^*	bending moment, shear force that generated the seismic action considering the elastic response spectrum;
M_g ,V_g	bending moment, sheer force of the actions that non seismic associated load combinations including seismic action;
M_{Ed}	- (M_E^* /q) + M_g - bending moment calculation of the inelastic behavior associated with that section of the beam
M_{Rd}	- $A_{s1}f_{yd}(d-a)$ - Bending moment capacity in this section
R_3^M	- M_{Rd}/ M_{Ed} - degree of assurance in structural seismic bending moment;
$q_M^{plastif.}$	- behavior factor associated to the plastic state of beam cross section;
$V_{Ed}^{plastif.}$	- calculation shear force associated to the plastic state of beam cross section under bending moment
$S_{i,cr}$	- normalized horizontal projection of inclined crack critical, according STAS10107-0/90
V_{cb}	shear force capable no dimension according STAS10107-0/90
R_3^V	- V_{Rd}/ V_{Ed} – degree of assurance in structural seismic shear

Table 4 Geometry and reinforcement transverse beam over the 1st floor

Level	Ax	b (mm)	H (mm)	A_a^{jos} (mm^2)	A_a^{sus} (mm^2)	n_e	A_{ae} (mm^2)	a_e (mm)	P (%)	p' (%)	p_e (%)
1 st floor	A	250	650	1119 (2ϕ20 + 1ϕ25)	245 (5ϕ25)	2	50.3	200	0.73	1.60	0.20
1 st floor	B_{dr}	250	500	402 (2ϕ16)	1473 (3ϕ25)	2	50.3	200	0.35	1.27	0.20
1 st floor	C_{dr}	250	650	982 (2ϕ25)	1473 (3ϕ25)	2	50.3	200	0.64	0.96	0.20
1 st floor	B_{stg}	250	650	628 (2ϕ20)	1473 (3ϕ25)	2	50.3	200	0.41	0.96	0.20
1 st floor	C_{stg}	250	500	402 (2ϕ16)	1473 (2ϕ25)	2	50.3	200	0.35	1.27	0.20
1 st floor	D	250	650	1473 (3ϕ25)	2454 (5ϕ25)	2	50.3	200	0.96	1.92	0.20

Table 5. Sectional efforts – transverse beam over the 1st floor

Level	Ax	M^*_E (kNm)	V^*_E (kN)	M_g (kNm)	V_g (kN)
1 st floor	A	2891.9	-100.5	882.3	-88.7
1 st floor	B_{dr}	1786.3	-27.2	1388.9	-17.5
1 st floor	C_{dr}	2116.5	-100.0	678.4	-93.7
1 st floor	B_{stg}	-2335.6	-65.5	882.3	74.4
1 st floor	C_{stg}	-1824.8	-31.9	1388.9	21.0
1 st floor	D	-2581	678	-132	104

Table 6. Structural seismic assurance degree of transverse beam over the 1st floor under the moment bending - Earthquake in the transversal direction (+OY)

Level	Ax	$\frac{p-p'}{p_{max}}$	$\frac{V_{Ed}}{bdf_{ctd}}$	Degree of compliance to provide the seismic structure	q	M_{Ed}	M_{Rd}	R_3^M
1 st floor	A	0.295	0.246	60 %	5.80	398.1	184.0	0.46
1 st floor	B_{dr}	0.313	1.458	70 %	3.55	475.9	49.0	0.10
1 st floor	C_{dr}	0.109	0.040	60%	5.80	264.9	161.5	0.61
1 st floor	B_{stg}	0.187	1.201	60%	3.40	-752.4	-242.2	0.32
1 st floor	C_{stg}	0.313	1.756	70%	3.55	-546.0	-179.6	0.33
1 st floor	D	0.217	1.219	60%	3.40	-898.9	-403.5	0.45
Average 0.38								

Table 7 Structural seismic assurance degree of beam above a floor under moment bending - Earthquake in the transversal direction (+OY)

Level	Ax	$\frac{p-p'}{p_{max}}$	$\frac{V_{Ed}}{bdf_{ctd}}$	Degree of compliance to provide the seismic structure	q	M_{Ed}	M_{Rd}	R_3^M
1 st floor	A	0.295	1.284	50 %	2.95	-1079.2	-503.5	0.37
1 st floor	B_{right}	0.313	1.728	50 %	2.94	-635.5	179.6	0.28
1 st floor	C_{right}	0.109	1.137	50%	3.14	-773.8	-242.2	0.31
1 st floor	B_{left}	0.187	0.329	50%	4.50	453.3	103.3	0.23
1 st floor	C_{left}	0.313	1.430	50%	2.94	589.5	49	0.08
1 st floor	D	0.217	0.043	50%	4.38	449.4	242.2	0.54
Average 0.30								

Table 8. Structural seismic assurance degree of the 1st floor beam under shear force - Earthquake in the transversal direction (-OY)

Level	Ax	$q_M^{plastif}$	$V_{Ed}^{plastif}$	$\overline{S_{i.cr}}$	$\overline{V_{eb}}$	V_{Rd} (kN)	R_3^V	$R_3^M \leq R_3^V$
1 st floor	A	9.5	-181.1	1.69	1.49	175.9	0.97	Yes
1 st floor	B_{right}	11.7	-135.9	1.66	1.36	121.2	0.89	Yes
1 st floor	C_{righ}	14.9	-139.3	1.54	1.27	149.5	1.07	Yes
1 st floor	B_{left}	13.8	10.7	1.54	1.27	149.5	4.50	Yes
1 st floor	C_{left}	22.5	-40.6	1.66	1.36	121.2	2.94	Yes
1 st floor	D	6.8	7.4	1.75	1.44	169.8	4.38	Yes
							Average	2.46

Summarizing the average grade of all structural beams transverse the current frame, we have, table:

Table 9. Structural seismic assurance degree of the beams transversal the current frame

Level	Earthquake on the (+ OY)		Earthquake on the (-OY)	
	R_3^M	R_3^V	R_3^M	R_3^V
4 Floor	1.41	2.32	1.54	2.45
3Floor	0.70	2.48	0.49	2.52
2Floor	0.38	2.70	0.30	2.46
1floor	0.38	2.75	0.30	2.46
Ground floor	0.44	2.76	0.33	2.42

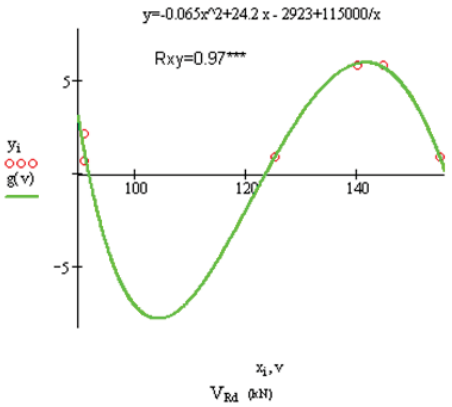
CONCLUSIONS

A Excepting beams from the higher level, the transverse frame beams are substantially under reinforced to bending moment, highlighting the a more pronounced sensitivity to stress when the seismic action is oriented in the negative sense of the axis OY.

B. Seismic evaluation shows also a positive aspect: consistently the values of the seismic structural assurance degree under shear force are superior to those associated with bending moment, suggesting that the fragile failure is inhibited by the flowing of longitudinal reinforcement.

C. The relationship between the degree of structural seismic insurance over 1 floor beam shear - Earthquake in the transverse direction (+ OY)) according to the table 8 is a polynomial regression function, degree III ratio R_{XY} = 0.97 the correlation is very significant.

The graph obtained is done using successive trials with PROFESSIONAL MATHCAD Software.



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FORESTS AND WATER VULNERABILITY UNDER CLIMATE CHANGE IMPACT IN THE PUTNA RIVER BASIN -VRANCEA

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Abstract

Located in a temperate – continental area the Romania's mainland is influenced in the last period by the worldwide climate changes: extreme weather conditions (high temperatures and prolonged dryness, rainfall accompanied by storm) what have as effects: increasing the risk of desertification, floods, forest fires, erosion, landslides, flash floods, snow squall etc. As precipitation effects have resulted leakage liquid and solid, in particular on slopes without forests, which led to the submission of material eroded in river beds. Concentrating leaks have resulted in an increase in flows of the volume and speed both water on slopes as well as the network of sinks and intensify torrential erosion processes. Floods have been accompanied by intense processes of erosion of the banks causing subsidences or land slides. The other vessel types were excessive transport have clogged hydrological collecting network and as a result, have diminished the ability of transit of liquid flows, increasing frequency and flood, with negative implications for water quality and social and economic activity. The paper, address an integrated approaches cause-effect by analysing river Putna's basin following aspects: analysis of risks and their main causes of, any effects on the ecosystems, vulnerability of water resources, measures to reduce their impact on water resources.

Key words: *climate change, ecosystem, forest, water.*

INTRODUCTION

The current Climate Changes in Romania have imposed a close monitoring of environmental factors and assessments of the causes leading to their appearance.

Romania has faced in the past decades with extreme weather events, which generated great calamities. Floods increasingly common since 1970, caused extensive damages, including the loss of lifes. They were accompanied by torrential phenomena evident watercourses, erosion and landslides, with devastating effects on communities, transportation routes, land and agricultural crops (Panaitescu and Onutu, 2013, Panaitescu and Bucuroiu, 2014). Also, at short intervals, in the plain areas an excessive record dry years of drought, the agricultural crops represent only 10-30% of the corresponding normal years.

The need to evaluate the current status of environmental factors and analysis climate changes influences on the latter can only be achieved by addressing system in an integrated manner cause-effect (Panaitescu at al., 2008). So within this framework of this study, has been taken in view of a European legislation and its implementation at the national level. European legislation direct and related governing quality of surface water is supplied by the main Directive as follows: 60/2000/EC, 2008/105/EC, 2000/60/EC.

National legislation which contribute to the implementation of the Directives is given by: HG (EC) No 964/2000, the law 310/2004, the law on protection of the environment (EC) No 137/1995, amendments to the law on environment No 294/2003. From the point of view of legal rules which are involved in the management of emergency situations in the case of floods and drought normative acts are oriented in two directions: for prevention and intervention in the case of urgent situations. Of these we mention: HG 1489 of 9 September 2004, HG 1490 of 9 September 2004, government decree 21/2004, government decree 15/2004, A88/2001.

River Putna basin represents an area of interest from the point of view of ecosystem changes due to climate change. The Vrancea County is

congruency of factors which may cause human casualties and damage to the human communities, in particular where the manifestation of one hazard produces congruent effects, thus amplifing their effects. Only hidrographic water network inside of Vrancea county measured 1756 km water courses, of total surface area of the catchment area of the river Putna is 274200 ha (approx. 70% of the county surface area). Difference in altitude is one of the most semnificative parametres - max. altitude is 1777 m (vf. Lacauti, the mountain Goru), and spill in Siret, altitude is 12 m. Of the features may basin may be mentioned:

- litology substrate highly varied, fragmented and diverse in composition;
- continental climate with truer excesivitate
- annual average temperature: between 6 - 8 degrees C, up to 10 degrees at the bottom of the basin;
- precipitation: average 600 l/m^2 (between 300 and 1000 l/m^2) of which, rainfall frequencies (40-80 l/m^2/24hours), indicates raised aggressivity; maximum quantity of precipitation in 24 hours was 199.5 l/m^2 and 220 l/m^2 in 2005.

The drainage of the water produces erosion, as a result of which land eroded lose capacity retention and storage of water at the rate of 20 - 90% (Clinciu, 2006; Untaru et al., 2006). Such lands represent segments of the most powerful altered environment: they promote and enhance environmental disturbances, being the main outbreaks of other vessel types were supply during floods, adversely affecting considerably biological diversity and habitats

In Romania, water erosion affects about 47% of the agricultural area of the country, over 6 million acres (and only 2.3% of forest area) and landslides over 700 000 ha (and only 1.5% of the forests - approx. 100.000 ha). Out of these, about 2-3 million hectares are excessively strong degraded, unsuitable for agriculture (Giurgiu, 2010).

Among the factors having a significant impact on forests and waters are mentioned:

- landslides and ruptures of banks are strictly local phenomena, even so they have increased by 10 times in the past decade as a result of torrential rainfall. Affected lands represent segments of the most powerful altered environment: they promotes and enhances environmental disturbances, are the main outbreaks of other vessel types were supply during floods, they affect powerful biological diversity and habitats;
-reducing consistency of forests, either because drying in areas exposed to drought, either because injuries due to wind, storm, snow - in areas of hill and mountain, in particular to resinous. Although reduced weight of the total surface area, forests affected have become unfit from the point of view of operational efficiency. Reducing consistency, lead to proportional reduction in the retention capacity and in this way to increase in the volume of leakage and superficial processes are resumed by erosion.

MATERIALS AND METHODS

The recent Climate Changes lead to increase the risk of injury to forests and degradation of the environment through concerted action of dangerous factors, leading to the necessity of monitoring of forest ecosystems and quantifying environmental impact on the environment, with the view to substantiation methods of sustainable forest management to reduce negative effects of these changes.

Climate change influences studied in the paper, have been determined through the evaluation of status of forests, vulnerability of water resources in the area being studied and flood risk analysis and slides (Table 1).

Evolution of the health of the forests is evaluated since 1990 in the national network of national monitoring surveys of the forest vegetation. Followed characteristics, setting mode, collection and processing of data are consistent with the methodology used by the ICP Forests of UN / ECE and the EU, and data recording is performed annually.

Continuous monitoring of air pollution effects on forests and soil acidification are tracked in the forest monitoring.

Further information on injuries forest ecosystems are provided by the administrative structures of forest department.

Landslides and floods are natural hazards in close liaison with torrential floods, that is with water leakage on hillsides not protected by forest vegetation shield (Constandache et al., 2012).

Table 1. Studied climate changes influences, recorded phenomena and main causes

Climate changes influences	Recorded phenomena	Main Causes
Floods	- accelerate flood frequency and intensity, as a result of rapid leak water from precipitation and soil erosion, with negative implications on the goals were intercepted (towns, roads, etc.); - drop in potential hydro power plant and resources of drinking water; - instability agricultural production, by disturbance of hydro balance and emphasize this phenomenon of drought; - reducing economic and tourist potential of affected areas.	-abundant precipitation or long duration precipitation unsecured or undersized dams, obstacles in the waterbed or blocking irregular water courses -wide variety of climatic conditions, strain reliefs, undercoat lithological and vegetation, give rise to an configurable high potential to natural risks
Natural risks	Storms, floods, drought, freezing and destructive phenomena of geological origin: landslides and earthquakes.	Dangerous meteorological phenomena

Putna river basin's water resources vulnerability estimation was done with water quality indices.The quality indicators that may help to estimate the vulnerability of surface waters from Putna river area were chosen WQI (the Water Quality Index) (equation 1, Table 1) (Adriano et al. 2006, Panaitescu et al., 2014).

$$WQI = (\sum_{i=1}^{n} q_i w_i)^2 \quad (1)$$

where: WQI is the Water Quality Index
i– the quality parameter
q_i– the registered value
w_i – the rank of implication of the parameter in the computation formula.

RESULTS AND DISCUSSIONS

1. Forests status evolution

In Putna basin, in addition to the anthropic factor, in the outbreak of torrential phenomena, an important role has the climate factor as a result of climate changes caused by global warming.

Most of the forests are located in mountainous and hilly areas with steep slopes, substrate lithology predominantly sedimentary nature, which increases the vulnerability of land to erosion, landslide, etc. clogging. It is estimated that more than 75 - 80% of the forest area is vulnerable to various forms and intensity of degradation. Maximum leakage may reach 80-90% of the annual average leakage in the mountains and this value may exceed 1.5-4.0 times in the hills, during the heavy rains, when

floods occur. By erosion of upper' horizons soil, water circulation on slopes is amended essential, reducing speed and capacity of the water infiltration into the soil and, by default, the availability of water which runs out on slopes. It also reduces resistance and soil and to the impact of the rain drops. On hillsides libelled soils remain at low level of humidity, similar to those of the steppe.

2. Water resources vulnerability

Water is one of the most important natural resources that come from the mountains, mostly wooded. Considering that drains water from precipitation and erosion occurs on any sloping ground, it can be inferred that, depending on the surface characteristics that fall precipitation and rainfall characteristics, hydrological balance is very different.

With climate change, the frequency and intensity of heavy rains have increased. These phenomena are accompanied by torrential evident watercourses, erosion and landslides, with devastating effects on communities, transportation routes, land and agricultural crops. Phenomena rains and land degradation, exerts negative effects on a much wider area than that they occur, as a result of disruption of the hydrological regime of watercourses, resulting in periods of excess rainfall, flooding in downstream areas clogging with silt reservoirs, ascension beds of watercourses etc.

Flash floods are floods which occur very rapidly in watersheds with relatively small area, being typically caused by high intensity rainfall.
Putna River has a high torrentiality indicated by:
- 275 torrential basins, 764 km degraded bed of the torrent representing about 60% of hydrographic network, located in the mountains and high hills;
- over 1/3 of the agricultural lands in the hilly region affected by erosion, gullying or sliding;
- the report between the maximum discharge (1323 cm/sec) and middle discharge (15.4 $cm.sec^{-1}$);
- annual average flow of sediments transported (16.4 $t.ha^{-1}.year^{-1}$).
Specific conditions of degraded lands imposed the performance of special works to strengthen the ravines, torrential river beds and planning / consolidation of the slopes for planting and use of specific procedures for afforestation (Constandache et al., 2010). Hydro technical works (Table 2) are decisive on their turn, for stabilising (fixation) of core levels for silt retention, creating reservoirs for flood mitigation, for providing the necessary balance for installing vegetation.
Hydro technical works are located on the most neuralgic segments of hydrographical network, on the basins that whites "alluvial sources" marked by excessive erosion and subsidence and landslides sides and consist of cross work (rails, sills and dams) and longitudinal (groynes, defences the sides, whites regularization channels).
Pluviograph records made by ICAS notes that the decisive factor in producing shower leakage is represented, in particular the size and intensity of the rains. The most aggressive proved to be rains greater than 40 mm in 24 hours, especially when they fell on the ground saturated with water from previous rainfall.

Table 2. Clasification of transversal hydrotechnical works

Useful height (measured on the upstream - Y_e)	The construction material the running	After discharge silt mode through the body work	After sizing assumptions and methods
- barages, Y_e>1,5 m; - aprons, 0 m <Y_e<1,5 m; - traverse, $Y_e \approx$ 0 m.	- Wood; - Dry stone masonry (wrapped in wire mesh or not); - Stone masonry mortar cement; - Plain concrete; - Reinforced concrete; - Earth; - Mixed;	- monolithic; - filter.	- free admission of streaching efforts on the parameter upstream ($\sigma_B = 0$); -on admission of streaching efforts on the parameter upstream ($\sigma_B < 0$).

Critical season lays between May 1 and August 15, during which over 75 % of the heavy rains fell, often accompanied by thunderstorms and hail (Untaru et al., 2006). In the last few years, critical periods are different to a temperature rise in the area concerned with approximately 1.15°C went to the variation in quantity of precipitation with - 4.2%, which shows alternate periods will take vengeance with those abundant in precipitation has stopped.
Such water quality varied greatly deteriorates substantially over continuously.
Water quality index registered in Putna basin area indicate a moderate water quality (Table 3).

3. Flood and landslides risks analysis

Global climate change have as result in an increase in frequency and intensity of torrential floods and boosting their negative effects. Relief has a dominant role in the outbreak and development of processes of erosion and mass movement of land. Erosion intensity is directly proportional to the slope of land, the energy relief, relief or fragmentation density hydrographic network. In mountain area density varies between 1.7 and 2.9 km/km^2, and in the Subcharpatians between 1.4 and 3.0 km/km^2 - above 1 km/km^2 = configurable stronger in erosion.
The lithological substrate consisting of soft rocks has a high predispozition to erosion and semi-hard rock alternations causes high predisposition to sliding, while substrate composed of hard rocks show a lower predisposition.
The obtained results led to the finding that rain under 30 mm, with a weight of 50 ... 55 % of

the total amount of rainfall that caused leaks, generates more than 15% of the amount of erosion, and the highest of 30 mm, 85 % of the eroded material. Average turbidity (loading suspended silt) of drained water was 84 g/l in the case of very strongly and excessively eroded lands, without trees, 7...13 g/l for degraded forest, while in mature beech forest this indicator was 2.6 g/l.

Table 3. Water quality index registered in Putna river basin

River/Tributary	WQI, %	Status
Putna	67	moderate
Naruja	58	moderate
Zabala	55	moderate
Milcov	62	moderate

Accordingly, the average specific erosion was 57.5 $t.ha^{-1}.year^{-1}$for fields with active erosion practically treeless, and only 0.41 $t.ha^{-1}.year^{-1}$in pine forest cultures, aged between 15 and 20 years (Untaru et al., 2008). However, it must specify that if excessively eroded land with slopes greater than 30 degrees, totally devoid of vegetation, the average specific erosion determined by measures of observation reached values of 300 $t.ha^{-1}.year^{-1}$ approximately.

For an efficient management of all categories of risks, the responsible authorities should have an integrated vision and innovative one. Dealing with each risk, in the current context, is one of the simplistic method without dramatic changes in practice. Modern vision should include an algorithm of work which in principle has to comply with following steps:

- to establish specific hazards;
- to determine specific vulnerabilities of each hazard;
- to determine specific risks of the established area and draw up The Community Risks Scheme;
- to establish a hierarchy of risks, in relation with the levels of values (levels of break down), the parameters and the effects on the communities: loss of life; the value of damages on property; any effects on utilities, works of defence; critical infrastructure;
- to establish combined effects (composed) risk scenarios: earthquake + flood + chemical accident + number of fires + cut-off of electricity, gas, water, sewage. These scenarios and their effects should be studied and implemented in specialized software in order to generate the following step – Plans so next step to be;
- generation of the intervention plans - plans that may be generated on the basis of the value of the parameters to which they are studying scenarios, depending on the existing response capabilities and needs, plans which may be used in the case of the outbreak of any type of disaster (ex: plans with the expanding capabilities of hospitalization, transport, wounded, triage);
- publication of plans;
- education of citizens and economic operators;
-practicing plans through exercises and correcting them.

CONCLUSIONS

Climate changes influence on the fauna of pelvis area Putna-Vrancea monitored in the work can be reversible and difficult to control.

Forest ecosystems properly maintained play an important role in retention, water filtration and regulation of surface watercourses, reducing the soil erosion and transport of sediments, all of which result in maintaining water quality and ensure a permanent water flow.

The size, structure and health of forest ecosystems are vital for ensuring water resources and water purification. The interaction between population growth, urbanization and development of water requirements, between the flood control/flood and operating mode/change of utility, requires restoration of degraded land and planning of hydrographic basins in a manner that provides ecosystem services becoming more sustainable. Moreover, these engineering activities closely related to forestry, have been and are accepted worldwide as an effective tool to maximize

ecological services and ensure clean and stable water resources.

Low percentages of forest areas in the lowlands is correlated with frequent and prolonged dryness, as well as deforestationsof the hillsor massive cuts of forest in certain mountain is correlated with torrential, degradation of land and landslides phenomena.

On the basis of the data submitted and taking into account the fact, that losses caused in the case of floods 2005 of river Putna, amounted to over 30 mil EUR (of which about 7.35 mil EUR in forestry fund) measures should be taken for the protection and rehabilitation of the ecosystem such as:

-defense strategy adaptation to floods and land slides from the current challenges of climate change, including the harmonization with modern operating systems environmental management;

- passing on the first plan of activities involving the prevention, minimise risk of producing flood or landslides and to minimise the negative impact of them. Will be worked out in full construction of the hydrographic basins, extensive afforestation programs and to promote good agricultural practice in the context of sustainable use of these resources, Improving legislative and institutional framework;

- promotion of training activities, awareness-raising and education of the authorities and the population, on line effects of floods, landslides, including the measures which may be taken at a local level to mitigate socio-economic consequences of their.

A good risk management is a result of intersectoral, interdisciplinary activities which may include: inclusion of research in the framework of the evaluation process of the risk, integrated water management, regional planning and urban development, nature protection, agricultural and forestry development, as well as protection of the transport infrastructure, masonry preservation and protection of tourist areas, community and individual protection, each sector being responsible for in carrying out specific activities.

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THE VIABILITY OF *E. COLI* IN SEA WATER AT DIFFERENT TEMPERATURES

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Abstract

The accidental multiplication of conditional pathogen bacteria such as E.coli in the territorial sea waters of Romania has an important impact on human health and requires a continuous evaluation of its risks. This study is focused on the effect of some physical factors (temperature, salinity, nutrient concentration) on the viability of Escherichia coli cells. In our experiments, we analysed the response of E.coli grown in normal conditions (LB at 37 ^{0}C) when subjected to a nutritional, saline and osmotic shock by introducing sub-samples of the culture in three (4°C, 15°C, 37°C) separate sterile sea water (sea water filtered through a Millipore filter- pores of 0.22 µm) microcosms. The samples were collected at different times (ranging from minutes to days) and analysed with respect to total cell densities (cells permeable to Syber green), dead cells (cells permeable to propidium iodide) densities and colony forming units. The results showed that the stress conditions determined by osmotic shock, saline shock and nutrients deprivation cannot suppress the resistance and multiplication capacity of E.coli after two days, even though the stress conditions diminished them. Although the temperature of the sea water is an important factor regarding the resistance of E.coli, a rather large proportion of cells continue to remain alive at 4°C, and able to multiply when transferred to LB at 37°C.

Key words: *E.coli, starvation, microcosm, Black Sea, SYBER Green, propidium iodide, colony forming units.*

INTRODUCTION

Due to the impact on human health and marine life the multiplication of conditional pathogen bacteria such as *E.coli* in the territorial waters of the Black Sea is and will be a continuous risk that needs permanent evaluation. Worldwide researchers try to evaluate the risk of exposing *E.coli* in the sea waters; risk that implicate not only the human populations but also the marine macroorganisms and microorganisms. (Greenberg, 1956; Carlucci and Pramer, 1960; Lessard and Sieburth, 1983; Gonzales et al., 1992; Davies, et al., 1995). Based on literature (Carlucci and Pramer, 1960; Carlucci et al., 1961; Gameson and Gould, 1975; Anderson et al., 1979, 1983; Fujioka et al., 1981; Welch et al., 1993; Ingraham and Marr, 1996; Troussellier, 1998; Ghita and Ardelean, 2011) it is well known that physical factors like temperature, salinity, pH, light radiation and nutrient availability play a key role in the survival of sea water bacteria, in particular potential pathogen bacteria. Nutrient depravation and light radiation associated with oxidative stress are belived to be most the most hostile stress factors of shallow costal sea waters.

This paper is focused on the time evolution of *E coli* alive cells, dead cells and cells able to grow and divide following their passage from LB medium (37° C) to sea-water kept at different temperatures (4°, 15° and 37° C).

MATERIALS AND METHODS

Strain

E.coli (non pathogenic strain) was grown in LB 37°C on a orbital shaker (150 rpm) and collected after 18 hours of growth. The cells were aseptically washed two times in sterile phosphate buffer saline to eliminate organic substrate, and further quickly introduced in indoor microcosms.

Sampling

The sea water used in this experiments was collected from the territorial waters of the Black Sea at 1 m depth (Constanta). The

water filtrated into sterile bottles by using 0.22 μm Millipore to avoid the inclusion of bacteriovorus microorganism and also other bacterial competitors. Many studies show that protozoa represent the main predators of *E.coli* populations in sea waters. (Gonzales, 1992; Barcina et al., 1992; Enzinger and Cooper, 1976; Sherr and Sherr, 2002).

Microcosms

We constructed three microcosms that each consisted of 1 L filtered see water in which it was added 0.5 mL *E. coli* sub-culture. The microcosms were kept in the dark at 4°C, 15°C and 37°C for 48 hours. The samples were collected immediately after inoculation and at 1h, 3 h, 22 h, 28 h and 48 h.

Total cell count

SYBER Green was used a fluorochrome to label all cells, both alive and dead (Figure 1) as it permeates both cells with intact and functional plasma membrane (living cells) and cells with altered plasma membrane (so called dead cells) (Lunau et al., 2005) The samples were filtered through polycarbonate Nuclepore filters with Millipore funnel as previously shown (Lunau et al., 2005; Manini and Danovaro, 2006; Ghita and Ardelean, 2011). In order to count bacteria, 300-600 cells were counted on each filter (usually 10-20 microscopic fields) and special attention was accorded to the filtration process in order to achieve an as uniform as possible distribution of bacterial cells all over the filtration surface (Sherr and Sherr, 2002). The average density of cells was converted to cell densities following appropriate equation (Cell density/mL = { [3,14 x (75000x75000)] :[3,14x(11,5x11,5)] }x number of counted cell/field).

Dead cell count

The same samples were stained with propidium iodide (Figure 2), a commonly dye used to differentiate necrotic/apoptotic, cells. Propidium iodide is membrane impermeant and is excluded from viable, non-apoptotic cells. (Moore et al., 1998; Manini and Danovarro, 2006).

Cells able to grow and multiply

The determination of cells able to grow and multiply was done by quantification of the colonies formed on LB agar at 37 C using droplet method (Neblett, 1976; Hoben and Somasegaran, 1982). Fresh subsamples of 10 μl each were collected and inoculated letting the colony forming units to grow for 12-24 hours at 37°C. For a better view of the colonies they were stained with basic fuchsine (0,004% w/w) before counting (Figure 3).

Figure 1. *E.coli* stained with SYBER-green

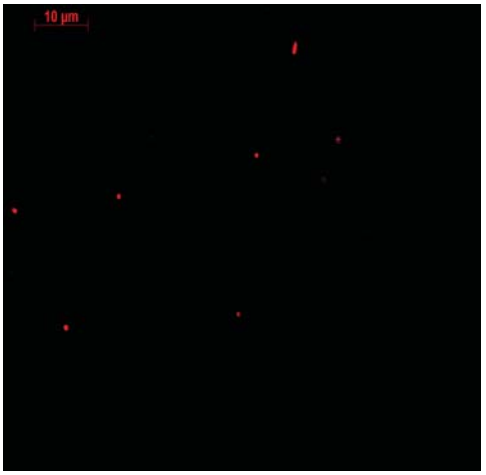

Figure 2. E.coli stained with propidium iodide

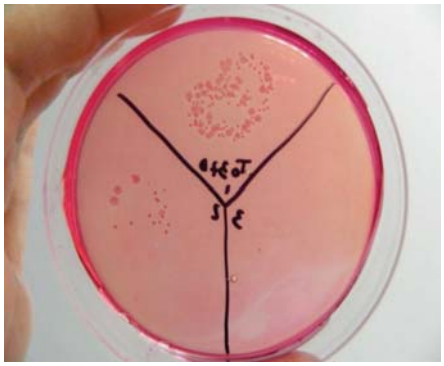

Figure 3. E.coli colonies stained with basic fuchsin 02004%.

RESULTS AND DISCUSSIONS

In figures 4,5 and 6 there are presented the results concerning the time evolution of alive E coli cells (SYBER green permeable cells minus propidium iodide permeable cells), dead cells (propidium iodide permeable cells) and cells able to grow and multiply (colony forming units) respectively. As it is mentioned in the literature, temperature plays a key role in the survivability of *E.coli* and also on its capability of forming colonies. Various studies claim that the optimal temperature for survival of *E.coli* is different and notable lower than the temperature optimal for its growth (Carlucci and Pramer 1960; Carlucci et al., 1961; Vasconcelos and Swartz, 1976; Lessard and Sieburth, 1983).

Although there was a similar tendency between the samples collected from the 4°C microcosm and the one held at 15°C, there was no substantial difference. As shown in the first graphic the number of live cells kept at 4°C seems to be slightly higher. Regarding cells able to grow and multiply, on the other hand, the difference between these two temperatures, was significant with respect to the 4°C. The population of *E.coli* kept at this temperature contains a lower number of cells able to grow and multiply than the population kept at 15°C (Figure 6).

The state of viable but nonculturable cells was proven to be, in different studies, a state in which cells preserve metabolically active though being unable to divide on nutritional media specific for theirs growth (Roszakt and Colwell, 1987; Pommepuy et al., 1996).

Nevertheless, as seen in the figures 4, 5 and 6 even after only a few hours, although the density of viable cells in not radically diminished, the density of cells able to grow and multiply is rather largely affected at lower temperature (4°C).

Taking into account these results, one must assume that in the summer period, when the temperature is higher, an outbreak of potential pathogen bacteria in the territorial waters of the Black Sea is indeed possible. Though it's true that *in situ* there are other factors such as UV radiation, hydrostatic pressure and other concurrent bacteria, bacteriovores and microorganisms of the sea to be taken into account in further studies.

Also it is notable that as mention in different studies (Anderson et al., 1983) the temperature of 4°C, even after 48 hours can not totally suppress the ability of *E.coli* populations that can survive at this temperature; in agreement with the results presented in this paper, a small fraction of cells continue to remain viable, and able to multiply when transferred to LB at 37°C.

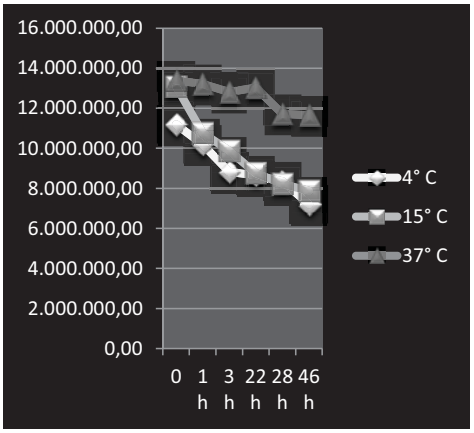

Figure 4. Time evolution of alive/live E coli cells densities (total cell -SYBER Green positive- minus dead cells -propidium iodide positive) in filtered sea water, at different temperatures.

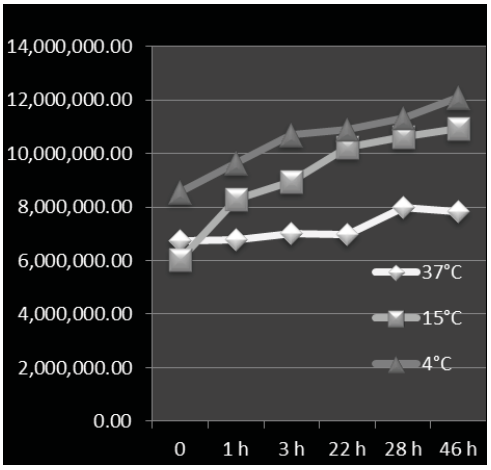

Figure 5. Time evolution of dead cells densities (propidium iodide positive) in filtered sea water, at different temperatures.

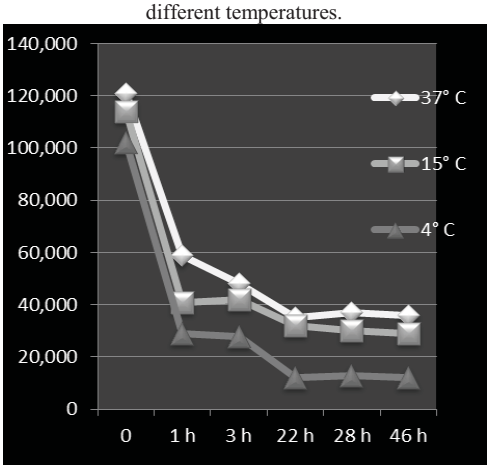

Figure 6. Number of cells able to grow and multiply in LB medium after the cells have been kept in filtered sea water at different temperatures.

CONCLUSIONS

1. In time, there is a linear decrease in the density of living cells total cell (SYBER-green positive) minus dead cells (propidium iodide positive) and a corresponding increase in the density of dead cells (propidium iodide positive).
2. The densities of cells able to grow and multiply (colony forming units) decrease very sharply (orders of magnitude) in the first hours after the beginning of the experiment, the decrease being higher at lower temperatures.
3. Total cell count (SYBER- green labelled cells) of *Escherichia coli* in filtered sea water remain constant all over this short term experiment (48 hours), suggesting that, in these experimental conditions, cell multiplication or physical dissolution do not occur.

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FLOODPLAIN DELINEATION FOR CALNAU RIVER USING HEC-RAS SOFTWARE

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Abstract

1-D mathematical hydraulic models are the most commonly used for floodplain mapping. Based on detailed topographic and structural surveys, they provide a description of the river channel, structures and floodplains. The paper aimed to present the development of flood boundary map for Calnau River section between Costomiru and Potarnichesti gauging stations by running the Hydrologic Engineering Centre's River Analysis System (HEC-RAS). It was created the 1-D hydrodynamic modeling of the river using different flow values for the probability of exceedance– 0,1%, 1%, 5% and 10%. The simulations were for both steady and unsteady flow.

Key words*: 1-D modeling, boundary, flood, HEC-RAS.*

INTRODUCTION

A numerical model which is used to represent the hydraulic behaviour of a water body is called a hydraulic model. Hydraulic models may be broadly categorised into one-dimensional (1-D), two-dimensional (2-D) and three-dimensional (3-D) schemes.

1-D mathematical models are the most commonly used for floodplain mapping and use the Saint Venant equations, and therefore rely on many high resolution morphological parameters (cross sections) (Saleh al., 2013).

This study utilises 1-D numerical models to simulate the flow of water through a section of Calnau River based on detailed topographic survey and it provides a description of the river channel with its floodplains.

The development of effective floodplain management plans requires that engineers understand the hydraulics of open channel flow, which depend upon the flow classification, flow and conveyance, and the energy equation.

HEC-RAS is a hydraulic model developed by the Hydrologic Engineering Center (HEC) of the U.S. Army Corps of Engineers. The software is a one-dimensional steady flow model, intended for computation of water surface profile. Modules for unsteady flow simulation and movable-boundary sediment transport calculations are scheduled to be included (USACE, 2010).

Updates to HEC-RAS have been periodically released and the product is still being actively developed. Among the many improvements since the initial version of HEC-RAS have been geographic information system (GIS) integration capabilities (Yang al., 2006).

By using topographic datasets (LiDAR) and the 1-D model (HEC-RAS) on the case study, the sensitivity of hydraulic model and flood mapping to terrain data, geometric configuration and model type are analyzed (Merwade, 2012).

MATERIALS AND METHODS

The Calnau River is part of the Buzau Catchment with a length of 113 km. The analyzed sector crosses a relatively populated area, the most important villages being Posta Calnau and Fundeni (Figure 1).

The analysis started with the ESRI GRID digital terrain model – pixel size in plan of 5 m. This model resulted from the combination of LiDAR data performed on the bank lines of the stream and digitized maps 1:100000.

Hydrological data were considered the water level and average daily flow series (Correia al., 1999) from Costomiru and Potarnichesti gauging stations, considering four flood events measured in both gauging stations (1975, 1984,

1991, 2005 events) and different probabilities of exceedance (0,1%, 1%, 5% and 10%).

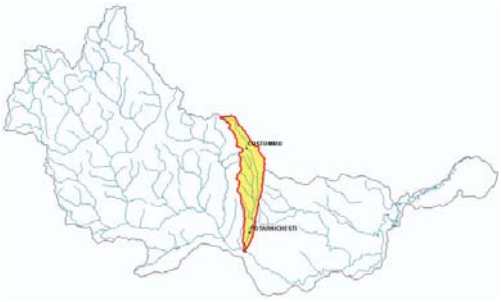

Figure 1. Location of Calnau River in Buzau Catchment Area

First processing were performed in ArcHydro Tools, then in HEC-GeoRAS; it provides specific access to GIS procedures that assists the hydraulic engineer in the creation and evaluation of hydraulic models using digital terrain data (Ackerman C.T., 2001).
HEC-GeoRAS was used to create a geometric import file for HEC-RAS. The import file is containing head, stream network, and cross-sectional information (Williamson T., 2004).
Hydraulic models were developed for existing conditions and alternative condition scenarios, for both steady and unsteady flow.

RESULTS AND DISCUSSIONS

The simulation of flow direction turned into the raster below, with a legend of colours, each color corresponds to a number and each number indicates the flow direction between the gauging stations considered.

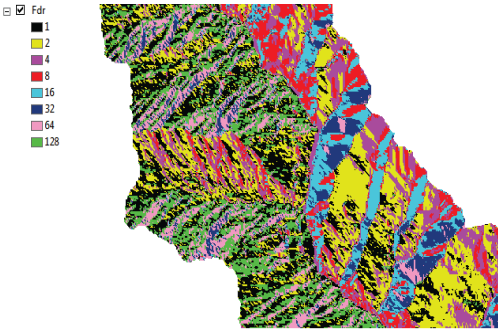

Figure 2. A closer view of flow direction raster with its legend

In HEC-GeoRAS each attribute is stored separately in a feature class. Using RAS Geometry was created a layer for stream centerline (Figure 3), banks, flow paths and cross sections (Abbas A., 2011).

For the simulations in HEC-RAS for steady flow were considered as upstream boundary conditions the maximum flows measured (Yuan Y., Qaiser K., 2011) at Potarnichesti gauging station (with the probability of exceedance 0,1%, 1%, 5%, 10%) and as downstream boundary condition the rating curve (Figure 8).

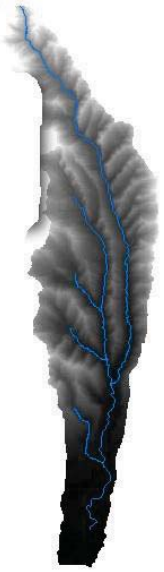

Figure 3. Stream centerline for Calnau River between Costomiru and Potarnichesti gauging stations

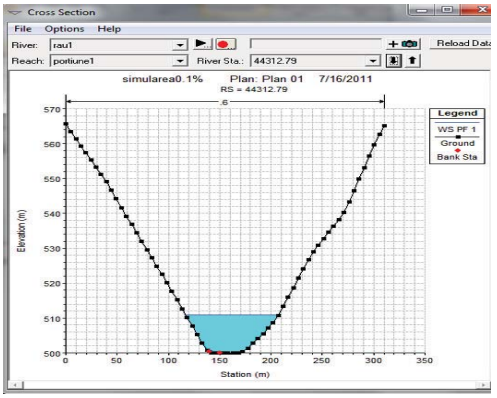

Figure 4. Graphical result of cross-section in HEC-RAS

Finally, the simulation results were exported to ArcGIS, where the flood maps were generated (Figures 5 and 6) (Tate E.C., 1999).

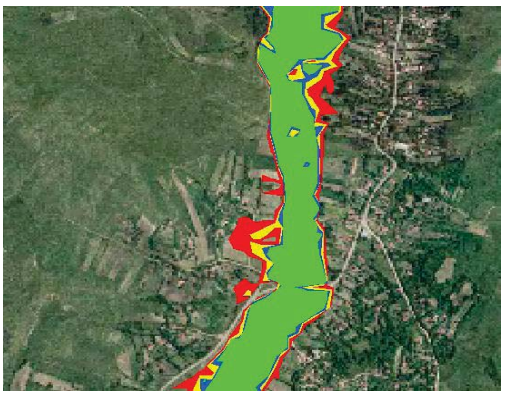

Figure 5. Detail of floodplain delineation where Q 10% - green, Q 5% - blue, Q 1% - yellow, Q 0,1% - red

Figure 6. Another close view of floodplain delineation where Q 10% - green, Q 5% - blue, Q 1% - yellow, Q 0,1% - red

Simulations on unsteady flow were used on the same geometric model and required as upstream boundary the flood hydrographs recorded at Costomiru gauging station from flood events in 1975, 1984, 1991 and 2005 (Figures 7 and 9). For downstream boundary condition was kept the rating curve from steady flow simulations (Figure 8). Ultimately the simulation results were exported again to ArcGIS for generating the floodplain maps (Ionita F., 2011).

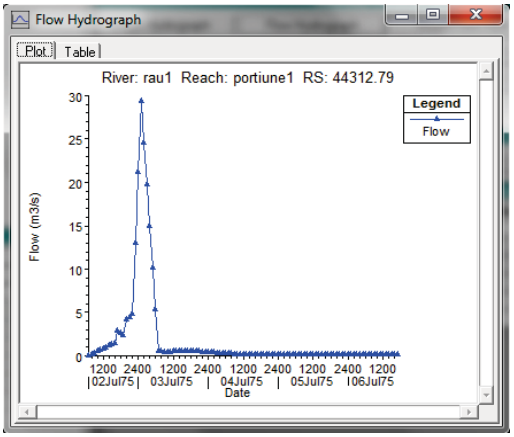

Figure 7. Flow hydrograph for flood event 1975

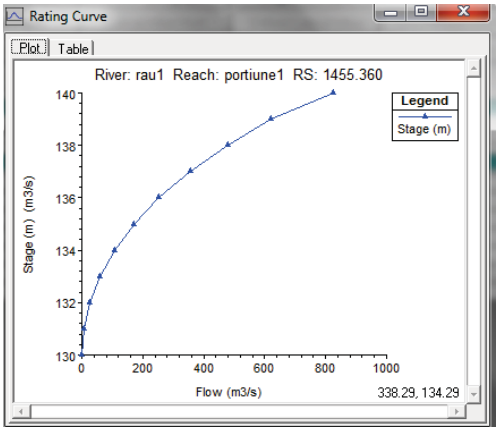

Figure 8. Rating curve used as downstream boundary condition

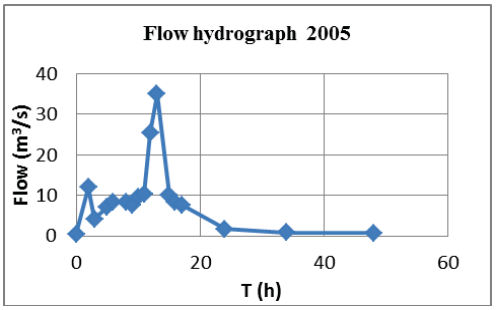

Figure 9. Flow hydrograph for flood event in 2005

Figure 10. Floodplain delineation for the flood event in 2005

CONCLUSIONS

A study for automated floodplain mapping and terrain modeling was presented. The paper provides a link between hydraulic modeling using HEC-RAS, and spatial display and analysis of floodplain data in ArcGIS.

As inputs, the study requires a completed HEC-RAS model simulation and a GIS stream centerline representation.

The procedure consists of several steps: data import from HEC-RAS, stream centerline representation (Figure 3), cross-section georeferencing, terrain modeling, and floodplain mapping. The outputs are a digital floodplain map that shows extent of flood. (Figure 10).

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THE RELATIONSHIP BETWEEN FLOW RATES AND LAND USE AT PLOT SCALE IN THE VOINESTI EXPERIMENTAL BASIN (ROMANIA)

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Abstract

The aim of this study is to investigate the role of land use in the dynamics of the water resources on a plot scale (water balance plot), following natural spring rainfalls and land use (grassland vs. bare soil). The study was primarily based on hydrometeorological data (e.g.: rainfall depths, rainfall intensities and flows), measured in the spring (IV-V) of 2014 at Voinesti Experimental Basin, part of the National Institute of Hydrology and Water Management - Romania. The water balance plots are situated at an altitude of 500 m a.s.l. in the Curvature Subcarpathians and have the following characteristics: 300 sq m area; type of soil: eutricambisol; average slope of 13% and N-S orientation; land use: a plot "grassland"(P1) and another plot "bare soil"(P2).
During the analyzed period, rainfall events, corroborated with previous conditions of soil humidity, have been quantitatively reflected in the flow parameters (depths, discharges) thus: the processed soil plot created heterogeneous conditions for the runoff surface, such as microdepressions, and thus flow rates have been reduced compared to those recorded on the grass plot; The interception of vegetation, in cases of previous humidity (last 3 days) caused by small depths (e.g. 0.6 and 19 mm), has been low and highlighted by high rates of overland flow (0.144 l/s on vs. 0.092 l/s on P1), and when antecedent conditions are marked by rainfalls, the interception has been reduced and thus the volumes of overland flows were amplified (4996 l on P2 vs. 2800 l on P1); soil infiltration rates were elevated in cases of previous rains and low when previous conditions were dry for both land use types; this is also confirmed by the partition of average flows volumes: 15% overland flow, 27% subsurface flow, 58% base flow.

Key words*: plot scale, land use, flow, water balance plot, rainfall, Voinesti Experimental Basin.*

INTRODUCTION

Getting to know the anthropogenic effect on the liquid phase of water transport in its circuit plays a significant role in studying water balance. Vörösmarty & Sahagian (2000), Fohrer et al. (2001), Foley et al. (2005) have shown the consequences of land use on water resources at global, continental and regional scale.
Quantifying the hydrological consequences associated with land use represents a research method which directly contributes to our understanding of the spatial and temporal dynamics of water resources and indirectly helps in the process of choosing the right size of hydraulic works (e.g. dams, bridges, canals), managing extreme hydrological phenomena (e.g. floods). A useful scientific way of quickly assessing the influence of land use is the study of water balance at micro-scale (Hudson, 1993; Jencso et al., 2009; Sánchez, et al., 2012; Maetens et al., 2012; Popa et al., 2015).
Plot-scale experimental studies are designed to help understand interrelationships between the processes involving geomorphologic, hydrological and ecological factors (Bosch et al., 1982; Linsley, 2009; Zhang et al., 2015) and providing a basic description of the most relevant aspects, such as the influence of the land use on the water discharge (Joel et al., 2002).
Thus, many research studies on surface runoff have been made on experimental plots, which are easier to control and are better indicators of the factors that contribute to water balance, through rainfall spectrum, its timing, the surface and subsurface flow characteristics, and atmospheric processes (Bloschl et al., 1995). Furthermore, rainfall-runoff relationship in experimental plots is analysed at the centre of hydrologic research in studies concerning soil

macroporosity and erosion under different land use and land covers in northeast India (Shougrakpam et al., 2010).

The process of adopting different land uses is known to exhibit a significant effect on the rainfall - runoff responses that come from these watersheds' hydrological reaction to changes in the climatic system (Jakeman et al., 1993), macromodelling of the rivers (Bobinski et al., 1993), post-fire runoff and erosion (Benavides-Solorio & MacDonald, 2001), monitoring the obstructions emerging from the relationship land use - hydrological dynamics (Stanciu & Zlate-Podani, 1987; Brocca et al., 2004; Ionita et al., 2006; Dodocioiu et al., 2011), nutrient management in orchard productivity (Andrews, 2002; Durran-Zuazo et al., 2005). In this context, this paper present the results of a *hydrological investigation into the effects of land use on the dynamics of water resources at plot scale, following natural spring rainfalls and land use (grassland vs. bare), measured in spring (IV-V) of 2014 in the Voinesti Experimental Basin (Romania).*

MATERIALS AND METHODS

This study was conducted under field experiments on water balance plots from Voinesti Experimental Basin (VEB). This basin belongs to the National Institute of Hydrology and Water Management (NIHWM).

The main data types used in the current experimental investigation (e.g.: rainfalls depths; volumes of overland flow, subsurface flow called intermediate or hypodermic flow and base flow; soil moisture) have been measured, processed and corrected in the Experimental Hydrology Section of NIHWM. Rainfalls measurements have been carried out continuously with a pluviograph, and runoff rates on the tow water balance plot (300 sq m) were determined with the help of devices that continuously measure and record (Valdai limnigraph) attached to the collector tanks.

The conversion of the water volumes (V) collected in the tanks was achieved through the volumetric method V=f(H) and/or the spillway method Q=f(H).

Data on flows on subsurface flow were collected from a depth of 40 cm and base flow was measured at a depth of 1.20 m.

Soil moisture was measured daily, by probing soil profiles next to the water balance plots at 6 depths 0-10, 20, 30, 40, 60 and 100 cm, with a capacity sensor.

The volumetric water content expressed in terms of the volume of water per volume of soil (m^3 of water/m^3 of soil) was converted in a mean equivalent water depth.

The main method used when investigating the effects associated with land use was based on the water balance equation. Lvovich (1965, 1980) formulated the general expression of a mean water balance equation, and Sokolov & Chapman (1974) particularized and detailed this equation depending on the time interval and water bodies (e.g. river basins; forest and forested basins, drained land etc).

Among the forms of these equations for investigations on a micro-scale of water balance plots, we adopted and adapted the following form (Eq. 1):

$$P - Q - E - \Delta S - \Delta M - \eta = 0 \quad (1)$$

where:

P = precipitation;

Q = total flow (overland flow, subsurface flow and base flow);

E = evaporation (incorporates evaporation; precipitation intercepted by the grasses;

ΔS = water storage on the soil surface in endorheic micro- depression;

ΔM = water storage in the upper 1 m soil layer;

η = water balance discrepancy.

All statistical analysis and graphical of hydro-meteorological data were performed using OriginPro version 8.5, and mapping was made with ArcGIS Version 9.3.

Geographical background

The Voinesti Experimental Basin is located in the Curvature Subcarpathians, on the left bank of Dambovita River, at 28 kilometers away from the Targoviste city (Figure 1).

VEB was created in 1963, though the first material on the research of runoff formation processes started in 1964.

The goal of its creation was to establish relations between runoff and its genetic and conditional factors, to design rainfall-runoff mathematical models, to quantify the way different topographical and cultivated surfaces

participate in the flow processes and to study the water balance in the soil (Minea & Morosanu, 2014).

The climate of the region is moderate temperate-continental and the area of the VEB was characterized in the 1980-2014 period by an average multiannual rainfall depth of 806 mm. Most rainfalls occurred in the warm semester (63%), and the highest number of rainfalls was recorded in June (12.6%) and July (12.4%).

The lowest amount of precipitation was registered in the cold semester (October-March), with the fewest precipitations measured in January (5.21%) and February (5.7%).

The average air temperature was 9.7 °C, and July was the month of the maximum temperature (17.9 °C, with absolute maximum of 37.3 °C in 2000 - a dry year) and January, the month of the minimum temperature (-2.2 °C, with the absolute minimum of -22.6 °C in 1979).

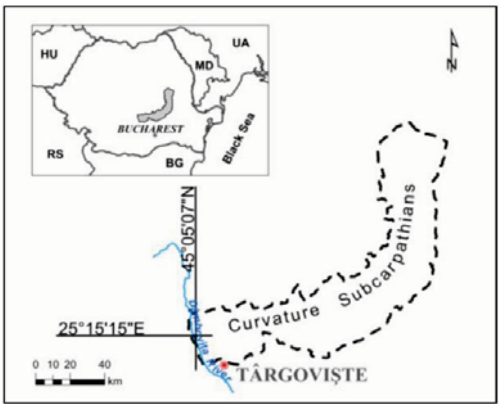

Figure 1. Geographical location of the experimental site

Water balance plots design

The water balance plots (Figure 1) are situated at an altitude of 500 m a.s.l. (45°05'07.27"N latitude and 25°15'15.43"E longitude - cartographic projections Stereo 70) and have the following characteristics:

- 300 sq m area (10x30 m);
- eutricambisol a type of soil with *"28% clay, 21% silt, 51% sand"* (Maftei et al., 2002);
- average slope of 13%;
- N-S aspect;
- land use: a plot covered by permanent *"grassland"* (P1) and second plot (P2) *"bare soil"* had its soil processed through the digging of the first horizon (20 cm), without crops or natural vegetation (Figure 2).

Figure 2. Water balance plot *"bare soil"* (P2)

In this sense, the technical equipment of the balance plot allowed a wide range of hydrological (tank collectors, water-level recorder) and meteorological (e.g.: recording rain gauge) measurements.

RESULTS AND DISCUSSIONS

Hydrological investigation of genetic (natural rainfalls) and control (initial soil humidity; land use; soil texture; slope) factors of the elements that make up the water balance allowed us to identify the following particularities:

i.) Rainfall events:

- depths > 15 mm and durations >3 ÷ 13 h (e.g.: 180 min. on 25.V.2014; 680 min. on 18.IV.2014; 650 min. on 19.IV.2014; 790 min. on 24.IV.2014 - Figure 3) and have produced abundant flows;
- the maximum intensities of rainfalls have been low, such as: 0.190 mm/min. – 18.IV.2014; 0.100 mm/min. on 19.IV.2014; 0.140 mm/min. on 24.IV.2014 (Figure 3) and a maximum of 0.280 mm/min. on 25.V.2014;
- rainfalls with small depths and low intensities, after periods without any precipitations, even if they are not capable of producing overland flows and/or significant events, have contributed to restoring the soil's humidity reserve.

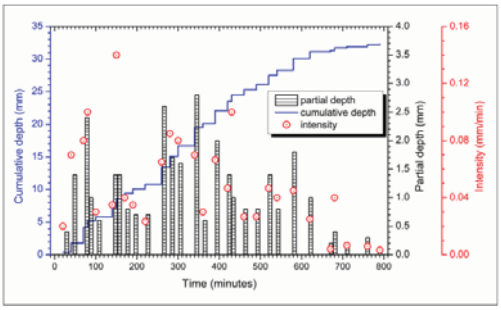

Figure 3. Elements of the rainfall event of 24.IV.2014

ii.) Previous soil humidity conditions, in strong correlation with precipitations, represent a factor that has a variable influence on flow rates;

- in terms of the soil's moisture regime, it is of a percolation type - rates of infiltration have exceeded those of evapotranspiration and a gravitational water current was formed, which ensured a strong supply of groundwater; previous mean values of soil water content (3 days) underwent a growing trend; in the 17-18.IV.2014 interval, the average stored water volume was the equivalent of a 4.79 mm depth and for the 22-24.V.2014 interval, it was the equivalent of a depth 4.10 mm thick (Figure 4);

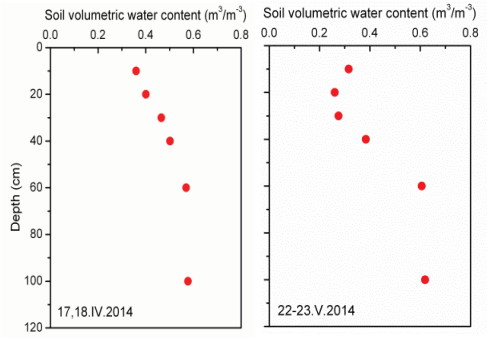

Figure 4. Antecedent soil water contents (depths of 10, 20, 30, 40, 60 and 100 cm) near plots

iii.) Hydrologic investigation at micro-scale on the relation between the genetic factor rain (hp) and the main control factor of flow - land use highlighted differences between flow parameters in the two plots (Table 1):

- maximum discharges of overland flow were influenced by the land use in conjunction with the antecedent moisture; in terms of insignificant previous rainfall (Table 1), maximum discharges were high on P1 (e.g. 0.144 l/s) and low on P2 (0.091 l/s), (Figure 5);
- significant depths of water have been involved in overland flow (5.47 mm/sq m on P2 and 6.88 mm/sq m on P1) and base flow (6.5 mm/sq m on P1 and 18.6 mm/sq m on P2), and the lowest of subsurface flow (1.7 mm/sq m on P2 and 2.37 mm/sq m on P1);

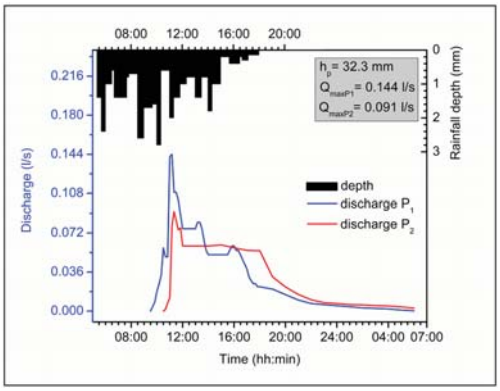

Figure 5. Hydrograph of overland flow from water balance plots grass covered (P1) and bare soil (P2) from 24/25.IV. 2014

- previous rainfalls, which have not generated rich overland flow rates, have significantly raised the soil's moisture and thus, they have also raised base flow rates (e.g. 10.4 mm/sq m. on P1 and P2 - 19.IV.2014), compared to overland flow rates (1.64 mm/sq m. on P1 and 3.60 mm/sq m on P2 – 19.IV.2014);
- water infiltration in the upper soil horizons (40 cm), plays an important role in subsurface flow rates dynamics:
  - high infiltration: 5.91 mm/sq m. on P1 - 19.IV.2014 and 4.4 mm/sq m. on P1 - 18.IV.2014,
  - low infiltration: 1.70 mm/sq m. on P2 - 24.IV.2014 and 1.75 mm/sq m. on P2 25.V.2014);
- in case of rainfalls with reduced depth (hp = 15.6 mm), overland flow depths have been substantially reduced on the processed plot, which has no plant retention (e.g. 2.94 mm/sq m. on P2 - 25.V.2014);

Table 1. Flow characteristics on the water balance plots with different land use

Data	hp (mm)	hs_1 (mm)	$q_{max.hs1*}$ (l/s. km^2)	hs_2 (mm)	$q_{max.hs2*}$ (l/s. km^2)	α_{P1}	α_{P2}	S (mm)	A_{hp} (mm)
18.IV.2014	32.3	9.3	295	16.7	250	0.29	0.52	4.79	26
19.IV.2014	25.8	10.4	273	18	117	0.40	0.70		57
24.IV.2014	32.3	15.7	480	25.8	306	0.49	0.80	4.50	0.6
25.V.2014	15.6	6.9	3556	11.7	64	0.44	0.75	4.10	19

hp = rainfall depth (mm); hs_1 = flow depth on the grassland plot; $q_{max.hs1}$ = specific maximum discharge of the grassland plot; hs_2 = flow depth on the bare soil plot; $q_{max.hs2}$ = specific maximum discharge of the bare soil plot; α_{P1} = discharge coefficient for the grassland plot; α_{P2} = discharge coefficient for the bare soil plot; S = average previous depth (3 days) of the equivalent amount of water in the soil (0 - 100 cm depth); A_{hp} = total rainfall depth for 3 days.

- runoff coefficients (Table 1), for grass plot (α_{P1}) have average values reduced by 0.28 compared to processed plots (α_{P2});
- total water volumes that have passed through the three types of runoff have varied both between each runoff type and between each plot, e.g. 2063 l on P1 vs. 1642 l on P2, in case of overland flow; 712 l on P1 vs. 508 l on P2 on subsurface flow; 1590 l on P1 vs. 5590 l on P2, in case of base flow on 24.IV.2014 (Figure 6); at the total runoff volume level per rainfall event (18.IV.2014), the effect of land use was best exhibited: 4996 l on P2 vs. 2800 l on P1.

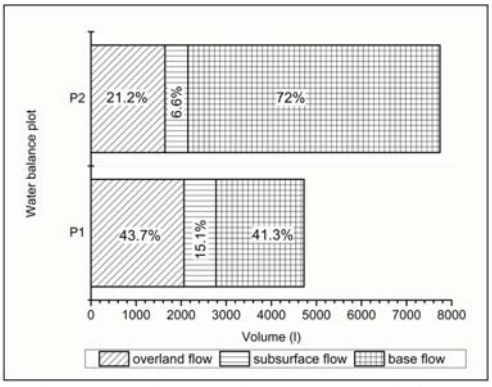

Figure 6. Total water volumes from water balance plots of grass covered (P1) and bare soil (P2) from 24/25.IV.2014

CONCLUSIONS

Investigations of flow from different land use (grassland vs. bare soil), under natural rainfall allowed us to determine the following particularities:

a) rainfall events, corroborated with previous conditions of soil humidity, have been quantitatively reflected in the flow parameters (discharges, depths, volumes);
b) the water balance plot with processed soil *"bare soil"* creates heterogeneous conditions for the runoff surface, such as micro-depressions, and thus flow rates have been reduced compared to those recorded on the grassland water balance plot;
c) the interception of vegetation, in cases of previous humidity (last 3 days) caused by small depths (e.g. 0.6 and 19 mm), has been low and highlighted by high rates of overland flow, and when antecedent conditions are marked by rainfalls, the interception has been reduced and thus the volumes of overland flows were amplified;
d) soil infiltration rates were elevated in cases of previous rainfalls and low when previous conditions were dry for both land use types; this is also confirmed by the repartition of average water flows volumes:

- overland flow (15%),
- subsurface flow (27%);
- base flow (58%).

Future Research Directions

For a correct calculation of water balance, it will be necessary to explore water residence time from natural rainfall in areas covered by vegetation (grassland) by using lysimeter method and the hydraulic properties of soil.

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THE ASSESSMENT OF THE ECO-TOXICITY IN THE WATERS OF SOMESUL MIC RIVER BY USING SCENEDESMUS OPOLIENSIS ALGAE CULTURES

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Abstract

The algae population is the key factor in determining the biological productivity of the river basins. The fish production depends a great deal on the quantity and quality of the phytoplankton, as well as on the benthic macrophyte, shelters and ideal spawning places for numerous species of fish.
The ecotoxicological analyses carried out on algae and certain small sized spineless species have a very high precision. The algae and the spineless species make up biological indicators of polluted waters.
The bioindication can be regarded as an anthropogenically induced biochemical and molecular response displayed by the modification of the physiological parameters and the effects are seen at one or more levels of the biological system.

Key words*: green algae, ecotoxicology,bioindicators.*

INTRODUCTION

The algae constitute in the immensity of the plant kingdom a special group with numerous species, most of which microscopic and unicellular, most of the time invisible for the eye of the passer-by and so they often remain unknown and ignored. It is only on the summer days we spend at the beach that they surface from within the sea carried by the waves as if to be seen, allowing us to see them on the sand where they find their demise (Dragos, 1997).
At the same time, the ecotoxicology analyses carried out on algae and some very small species of invertebrates have a very high accuracy. The algae and the species of invertebrates represent biological indicators of polluted waters.
The level of water pollution has increased impermissibly over the last decades, especially in those parts of the world where the population and the industry developed intensively and rapidly without any measures concerning the protection of the water quality being taken. It is important to point out that the areas from which the contaminated waters were sampled, the municipalities of Gherla and Dej, Somesul Mic Basin respectively, are known as excessively industrialized areas with very polluting industries, especially around Gherla and Dej, which spill their polluting substances in Somes and of course its tributaries.
The need for a larger and larger quantity of water and mineral substances for the algae cultures has lead in the last few decades to thorough research on the possibility of using natural fresh water or residual water for algae cultivation.
Experiments with the culture of microscopic algae have begun to spread rapidly in all highly developed countries interested in preserving the biodiversity. Microscopic algae multiply and grow very fast and that allows for a larger assimilation surface to be obtained in a matter of a few days (Momeu, 2008).

MATERIALS AND METHODS

The present paper aims at identifying and demonstrating the action of the risk factors on freshwater algae (*Scenedesmus opliensis)* tested in different concentrations of the contaminated waters in Somesului Basin by observing their physiological growth inhibition response depending on the action of the risk factors and nutrients.

The algae species originate from pure cultures and are inoculated in a well-defined environment obtained by combining different quantities of the utilized growing environment with various concentrations of the contaminated water. The used recipients are then incubated in constant temperature and luminosity with the purpose of determining the cellular density in each recipient at a certain time span.
The purpose is to observe the way in which every concentration of contaminated water affects the exponential growth of the algae within 72 hours in comparison with the control samples. The inhibition is measured as a decrease in the growing rate as compared to the witness samples.
The tested organism used is the Scenedesmus Opoliensis freshwater planktonic algae.
Classification: phylum Chlorophyta, class Chlorophyceae, order Chlorococcales, family Scenedesmaceae (Peterfi, 1979; Parvu, 2003).
Scenedesmus species are associated in coenobia which normally contain 2 to 5 individuals. They can have two cytoplasmic extensions at their ends. Scenedesmus opoliensis belongs to a four individual coenobium having two cytoplasmic extensions at each end (Ionescu, 1972).

Figure 1. Scenedesmus opoliensis

The growing environment used for the incubation of the algae is a standard environment containing a wide range of nutrients to ensure the natural growing conditions of the organism.
I prepared 4 stock solutions for the preparation of the growing environment according to the recommendations of the European Standard ISO 8692 concerning water quality.

The following table displays the macronutrients and micronutrients used in the preparation of the stock solutions (Table 1).

Table 1. Micro and macronutrients

Stock Solution	Nutrients	The mass concen. in the stock solution	Final mass concen. in the test solution
Stock Solution 1: macronutrients	NH_4Cl	1.5 g/l	15 mg/l
	$MgCl_2*6H_2O$	1.2 g/l	12 mg/l
	$MgCl_2*2H_2O$	1.8 g/l	18 mg/l
	$MgSO_4*7H_2O$	1.5 g/l	15 mg/l
	KH_2PO_4	0.16 g/l	1.6 mg/l
Stock Solution 2: Fe-EDTA	$FeCl_3*6H_2O$	64 mg/l	64 µg/l
	$Na_2EDTA*2H_2O$	100 mg/l	100 µg/l
Stock Solution 3: trace elements	H_3BO_3	185 mg/l	185 µg/l
	$MnCl_2*2H_2O$	415 mg/l	415 µg/l
	$ZnCl_2$	3 mg/l	3 µg/l
	$CoCl2*6H_2O$	1.5 mg/l	1.5 µg/l
	$CuCl_2*2H_2O$	0.01 mg/l	0.01 µg/l
	$Na_2MoO_4*2H_2O$	7 mg/l	7 µg/l
Stock Solution 4	Na HCO_3	50 g/l	50 mg/l

European standard ISO 8696-water quality

All recipients used in the test are made of glass because this material is well known for being inert.
Used laboratory equipment: modern incubator insuring a white fluorescent light, providing a constant and uniform illumination in accordance with the requirements of the test. The Thoma chamber used for calculating the cellular density has a 0.1 mm depth and the area of the smallest square is 0.05 mm. Erlenmeyer flasks which can store up to 250 ml of liquid, pH meter and a conductivity meter. Other instruments used: Berzelius beakers, graduated cylinder, adjustable mechanic pipettes with plastic or glass tips (1 ml, 5 and 10 ml), razor blade, disks and of course an optical microscope with 20x, 40x, 100x objective and 10x ocular, oven.
The preparation of the four stock solutions was followed by the preparation of the growing environment.
For 500 ml of growing environment 10 ml from the stock solution 1 and 1 ml from each the stock solutions 2, 3 and 4 were used.
After the preparation of the growing environment the concentrations of the contaminated water to which the algae would be exposed was chosen.

Two contaminated waters were used: one concentration of 50% from the tested volume and one from 100% in which the algae would be tested. According to these concentrations the reaction of the algae will be observed.
The test was carried out in four weeks during which two types of residual water from two different areas where toxic substances are said to exist were tested.
The preparation of the test samples was carried out by mixing the volumes set by the nutritive environment with the volumes of residual water necessary for each recipient of the volume indicated by the algae culture so that the cellular density in each recipient did not exceed 10^4cells/ml.
After the inoculation the pH in each recipient was calculated in order for it to be compared with the pH at the end of the test.
The recipients were incubated after the preparation of the solutions.
Each recipient was covered with aluminum foil in order to avoid the evaporation; a small hole was made in the foil with a pin so that the CO_2 can enter the recipient during the incubation.
In order for the algae to grow optimally a certain amount of CO_2 is needed. Atmospheric CO_2 can provide a concentration of CO_2 in an open test, but this is not possible in a closed space. That is why it is recommended that in closed systems a small hole should be made so that the concentration of CO_2 is maintained constant.
The recipients were incubated at the temperature of 23°C under continuous white light and agitation. The intensity of the light ranged between 60 µmol/(m^2*s) and 100 µmol/(m^2*s).
For the inoculation, a necessary quantity for obtaining an initial cellular density of 10^4 cells/ml was calculated and used and it proved to be the best for the growing of the cultures experimented on.
During the 72 hour test the daily density of the algae suspensions in each recipient was measured using the Thoma chamber and the microscope. The results then underwent the statistical analysis.
The residual water from Somesul Mic River originates from two different possibly polluted locations.

RESULTS AND DISCUSSIONS

Municipality of Gherla

The water collected in the municipality of Gherla has pH 7.20 and conductivity 512 µs/cm.
The pH had an increase from the beginning to the end of the test. The pH was measured both on the inoculation day and at the end of the test.

Table 2. Variations of the algae densities – Gherla

Days	Witness	Conc. 50%	Conc. 100%
Day Inoculation	10^4	10^4	10^4
Day 1-24h	$2.3*10^6$	$2.2*10^6$	$0.32*10^6$
Day 2-48h	$3*10^6$	$2.9*10^6$	$0.9*10^6$
Day 3-72h	$4*10^6$	$3*10^6$	$1.5*10^6$

There was a significant increase in the samples up to 3 and 4 cel/ml.
At the 100% concentration which contains only residual water from the Gherla region downstream the algae grew at a normal rate reaching 1.5 cel/ml. However, in comparison with the previous concentrations a decrease can be observed.

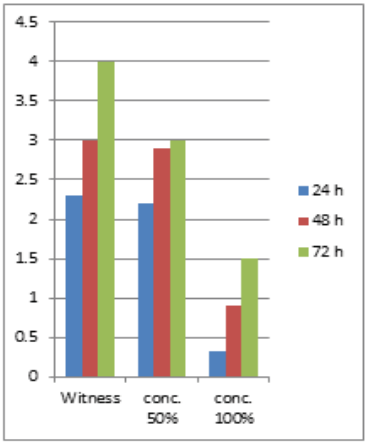

Figure 2. The variations of the algae densities – Gherla

Municipality of Dej

The water in this region is characterized by a high degree of pollution. After the measurements the results were the following: 6.66 pH and 942 µs/cm conductivity.

The pH value increased from the beginning to the end of the test and it was measured on the inoculation day as well as at the end of the test.

Table 3. Variations of the algae densities – Dej

Days	Witness	Conc. 50%	Conc. 100%
Day Inoculation	10^4	10^4	10^4
Day 1-24h	$2.42*10^6$	$0.2*10^6$	$0.3*10^6$
Day 2-48h	$3*10^6$	$0.7*10^6$	$0.9*10^6$
Day 3-72h	$3.6*10^6$	$1.7*10^6$	$1.3*10^6$

In samples of different concentrations (50% and 100%) the density increased. However, the increase was lower than in that in the previous region. The yellowish colour of the water and the specific smell are two notable characteristics of this water.

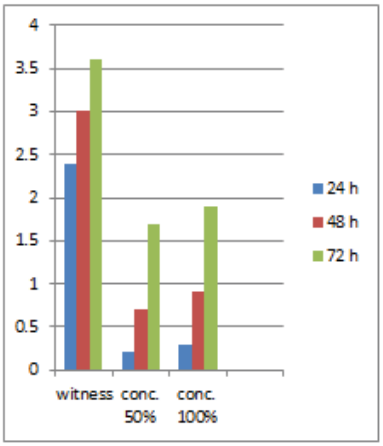

Figure 3. The variations of the algae densities – Dej

CONCLUSIONS

Bio-indicators can give accurate information regarding the quality of the water.

The degree of pollution of the water as well as the type of pollution can be analysed and identified by analysing the algae species from the perspective of the biological and physiological reactions.

The preservation of the water quality is something permanent and each member of the society has to bring his own contribution to it in a very conscious and responsible way.

The toxicity tests involve using certain algae cultures, carefully chosen, in which the tested organism is exposed to various concentrations of the toxic agent.

It would be ideal that the tested organism does not produce elements which could influence the structure of the metal ions, but it is well known that microscopic algae eliminate such chemical compounds altering the speciation of the metals, their accessibility and their reaction to algae.

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HEAVY METAL POLLUTION OF SOILS FROM BAIA-MARE – CASE STUDY: CUPROM INDUSTRIAL AREA

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Abstract

Industrialization of Baia-Mare area has had a major effect on the environment. Many contaminants were released and accumulated in soils causing important heavy metal pollution. This study presents a historical approach of the reasons that led to the contamination of soils and the present situation of industrial areas in Baia-Mare. The pollution of soils with heavy metals is a worldwide problem and the state of the environment should be improved in each case study. Former CUPROM industrial area requires remediation measures because of the historical soil contamination with heavy metals, mainly Cu, Pb and Zn. The revitalization of the case study area is necessary and further studies on the remediation possibilities must be carried out. The aim of this study is to characterize this industrial zone and to identify the soil pollution.

Key words*: environment, industrial sites, heavy metals, soil pollution.*

INTRODUCTION

Activities like mining, smelting or petrochemical refining are the main sources of pollution at global scale. Studies proved the harmful effects that heavy metals and other elements have on the environment quality and human health. In order to protect the life of citizens, many governments established the limits of different elements in soils and sediments for residential and industrial zones (Paulette et al., 2015).

Pollution of soils and the problems generated by it, interest more and more researchers. For the environment, the historical pollution caused by industry has deleterious consequences on the ecosystem, the quality of life and human health. Heavy metals can contaminate the soils through different pathways: solid waste disposal, industrial applications, sludge, vehicular exhaust, wastewater irrigation or agricultural production (Cioruta et al., 2013).

Soil is "the surface layer of the earth shell and it is formed from mineral particles, organic matters, water, air and living organisms". It is very important for the survival of the ecosystem and for the human needs. Pollution of soil affects it from both qualitative and quantitative sides. It is a resource that is non-renewable and a connection between air, water and earth having the following functions:

- Origin of raw materials;
- Biomass production and nutriments;
- Filter, transform and deposit different substances;
- Physical environment for humans;
- Platform for biodiversity, species, genes and habitats;
- Geological and archaeological patrimony (National Report on the State of Environment, 2011).

Because of its structure and properties, soil acts as a filter and can retain and deposit toxic substances. In Europe, the most common

pollutants are mineral oils and heavy metals like: copper, lead, cadmium, arsenic, chromium, nickel, zinc, mercury. These have a great impact on the environment and human health (Panagos et al., 2013; EEA, 2014; Liedekerke et al., 2014; Moldoveanu, 2014).

Situated in the north-west part of Romania, Maramures County is well known for the metallurgical industry and non-ferrous mining. The environment has been polluted with the gas emissions and dust that contained Zn and Cu. So many years of mining activities in the Maramures County led to a historical pollution that affect citizens' health. Zn exposure can cause diseases like hypertension, arteriosclerosis, heart disease while Cu can determine lung cancer, nasal septum perforation, pulmonary interstitial fibrosis and interstitial fibrosis. After the closing of the copper smelter in 2008 and the lead smelter in 2012, it was reported an improvement in the air quality, but soil still has a high level of heavy metals (Oros, 2010; Butean et al., 2014).

The main sources of pollution in Baia Mare area are SC Cuprom SA, SC Romplumb SA and CNMPN Remin SA. After reducing or stopping the activities, the dumps that formed due to metal extraction and processing of ores, are considered "hot spots". These hot spots exist even inside the city of Baia Mare. Microorganisms are capable of making heavy metals soluble and the pollutants can be absorbed by plants' roots and transported in the upper parts entering the food chain and causing different maladies to animals and humans (Coman et al., 2010; Cociorhan, 2011; Big et al., 2012).

There are several hot spots of soil pollution in the Maramures County (Figure 1).

This study will analyse the Cuprom industrial area (Table 1) with its characteristics and historical pollution.

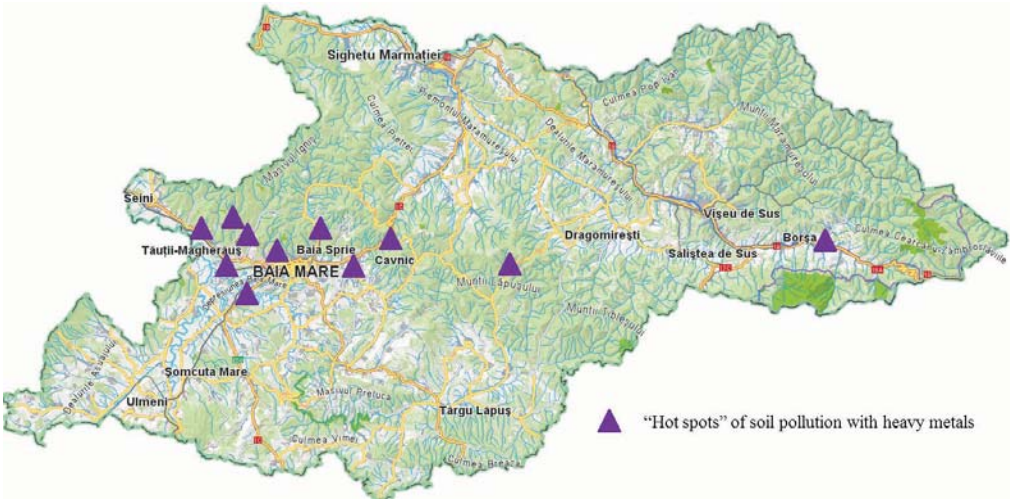

Figure 1. Mining zones where soil pollution reaches the highest level from the Maramures County (map realized according to the data provided by ANPM at http://apmmm.anpm.ro/sol-subsol)

Table 1. Case study overview (http://apmmm.anpm.ro/sol-subsol)

Name of owner of the site	Location of contaminated site	Type of polluting activity	Nature of pollution source	Nature of pollutants	Contaminated area (ha)
CUPROM SA Bucharest Subsidiary Baia Mare	Baia Mare	Metallurgical industry, copper production	Suspension smelting installations of copper concentrates	Heavy metals, sewage, sludge, acidic solutions, petroleum products	58,0

Description of the studied area

Baia Mare is located in the Maramures County, in the Baia Mare depression and on the banks of Sasar River. Its coordinates are 47°20'00" and 48°00'15" North latitude and 22°52'30" and 25°07'30" East longitude, at 228 meters above sea level. It is a town situated almost entirely at the north peaks of Eastern Carpathians. The location of the Baia Mare depression is at the contact of Someseana platform and the Eastern Carpathians. The region was part of a marine basin at the end of Pliocene and during Neogene there was an intense volcanic activity. So mountain massifs of 50 km called Varatec - Gutai - Oas developed, containing gold and silver ores and non-ferrous metals like zinc, lead, copper (Maramures County Environmental Profile, 2013).

The area of Baia Mare is a typical area of hydrographic convergence that resulted from merging of valleys and the confluence of rivers Lapus and Somes (Muntean et al., 2012).

Baia Mare is an urban settlement dating from the XIV century, well known because of the mining activities in the area and as a result of operating non-ferrous ores. The first reliable informations are from the fourteenth century, although medieval beginnings of such activities are much earlier, the second half of the thirteenth century (http://www.baiamare.ro/ro/Descopera-Baia-Mare/Orasul-Baia-Mare/Istoria-orasului/Istoria-orasului/).

The city of Baia Mare is first specified by Charles I of Hungary in the written papers from 1328 as "*Rivulus Dominarum"* which means the Ladies' River because of the image of the wives of miners that were involved in the gold sand washing operation in riverbeds of the region (Constantinescu et al., 2015).

For most of the Baia Mare citizens, mining was the main source of subsistence and it was a traditional profession since ancient times (Modoi et al., 2010).

After mining become unprofitable and the fall of the communist regime, mines were closed and conserved due to European Union terms.

MATERIALS AND METHODS

The present study analyses the data collected fromfield documentation and it represents a theoretical approach. It focuses on the data that is related to contamination of soils with heavy metals from the Baia Mare region as a consequence of mining activities and on the information on how industrial activities from the SC Cuprom SA affected the environment. The collected data was processed and the characterization of Baia Mare and Cuprom were obtained.

RESULTS AND DISCUSSIONS

Context

Romania is well known for the mining activities for centuries. The impact on the environment of the long-term extraction and mining is huge and the features of the affected zones are: destruction of soil quality, fertile soil layer, agricultural terrains, forests, noise pollution, radioactive pollution, air pollution, deterioration of landscape, changes in the flow of groundwater, residual water, mine wastes disposal with great effect on flora and fauna, erosion of soils. There is a need of pollution reduction to limit the risks of pollution spreading (Coman et al., 2009; Berar et al., 2010).

Maramures Environmental Protection Agency compiled a list of contaminated and partially contaminated sites that counts 30 sites polluted with heavy metals due to the activities of mining and metallurgy on an area of 602.42 ha (Table 2) (Maramures County Environmental Profile, 2013).

Table 2. Surface areas of contaminated sites in Maramures County (Maramures County Environmental Profile, 2013)

Tailing ponds (ha)	Arsenious pyrites deposits (ha)	Metallurgic industry (ha)	Mine sterile dumps (ha)	Total (ha)
428.94	12.29	67.74	93.4	602.42

One of the major environmental problems in Baia Mare city are the waste mine deposits that are very close to the residential areas, agricultural lands and surface water. These deposits occupy large areas and have big volumes. They deteriorate the landscape and affect the ecosystem, flora, fauna, people and also affect the ground and surface waters. The heavy metals and metalloids that pollute the

areas for long term are: Zn, Cu, Pb, Cd, As and Ni (Damian[2], 2008; Modoi et al., 2014).
The minerals that can be found in the soils of Baia Mare are the following:

- Native elements: Cu, Ag, Au, As, S;
- Sulphide minerals: arsenopyrite, galena, pyrite, stibnite, chalcopyrite, sphalerite;
- Tungstates: scheelite, wolframite;
- Sulphosalts: jamesonite, pyrargyrite, tetrahedrite, semseyite;
- Gangue minerals: quartz, barite, adularia, clay minerals, rhodonite, carbonates (Oprea et al., 2010).

The Romanian Ministry of the Forest, Waters, and Environment establishes in the Order no. 756/1997 for approving the Regulations regarding the evaluation of environment pollution, the normal, alert and intervention limits for soils elements. It also defines terms like maximum level of pollution (sensitive and less sensitive soils), environmental impact, threshold alert and intervention, types of land uses etc.

History

Ferrous steel industry and non-ferrous metallurgy are components of metallurgical industry. Steel industry provides raw material for manufacturing a wide spectrum of products. In Romania, this branch of industry has a long tradition in history, witnesses of the evolution are the bronze weapons and products of iron coming from workshops and kilns. There were several metallurgical centres: Galati, Targoviste, Hunedoara, Otelul Rosu, Baia Mare, Zlatna, Copsa Mica, Severin, Focsani, Resita, Slatina, Braila, Brasov, Nadrag, Campia Turzii, Drobeta Turnu Severin that proved how important was the industrial sector for the country economy. Most of them lowered or closed production after 1999 (Martinescu and Capusneanu, 2010).
The plant from Baia Mare was built in 1907 near Baia Mare, in a place called Ferneziu (Figure 2). At the beginning, it was a private company that produced sulphuric acid. The Phoenix owners bought the glass factory and the surroundings, which was the same place where the plant was located. Later, between 1927 and 1942, the plant extended and started the electrolytic copper production and precious metals business – gold and silver. In the years of 2003 – 2004, Cuprom bought the Phoenix Baia Mare plant and the Company of Laminated Electric Cable that was founded in 1972. Because of the modernization process and the new technologies that were implemented and also because of the financial investments, it became the biggest copper production company from Romania and one of the largest from Eastern Europe. This lasted until September 2008 when the company faced bankruptcy after the price of copper collapsed suddenly (Cuprom SA, Reorganization plan, 2010).

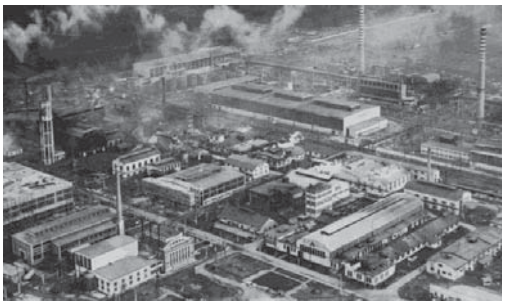

Figure 2. Phoenix plant (http://dorinstef.blog.com/files/2010/06/Combinatul-Phoenix.jpg)

Cuprom SA was a leading company in recycling, refining and transforming copper. It was the unique company that produced electrolytic copper, continuous cast copper rod and enamelled wire in Romania. It also had applications in secondary smelting, casting, refining, bunching, drawing and enamelling facilities (http://www.cuprom.ro/lang_en/cuprom.html).
The geographical coordinates of the Cuprom Company are 47°39'17" N, 23°36'12" E.

Soil pollution

Because of the emissions in the air from the Romplumb that was processing lead and Cuprom (Figure 3) that was processing copper, the soil from Baia Mare is polluted in high concentrations with Pb, Cu, Zn, Cd and As (Sustainable Development Strategy of Baia Mare, 2009, Oprea et al., 2011).
Baia Mare Municipality identifyed the main polluting sources and the major pollutants in the city. The man-made sources of pollution that affected the quality of soils in the area

were non-ferrous metallurgy and extraction of non-ferrous ore. RBG Phoenix SA and SC Romplumb were the companies that contaminated the environment with the levigation ponds, mine rock dumps and mine waters from the galleries that were discharged. High concentrations of heavy metals were found in the perimeter of these plants, values that exceed the admissible limits (Baia Mare Municipality, Local Agenda 21, 2002).

In 2002, former Cuprom SA (Figure 3), RGB Phoenix Baia Mare was on the hot spot list of Greenpeace for water pollution. The causes of pollution stated by the organization were wastewater discharges loaded with heavy metals. Greenpeace asked for an effective operation of waste water treatment plant (Greenpeace, 2002).

Figure 3. Satellite view of Cuprom area (https://www.google.ro/maps/@47.6545769,23.601314,1415m/data=!3m1!1e3?hl=en)

The distribution of the total surfaces of 58 ha that SC Cuprom SA Bucharest Subsidiary Baia Mare had in its patrimony was:

- Built area – 106417 m^2;
- Surface of interior roads and concrete platforms – 164777 m^2;
- Surface of transport routes – 103467 m^2;
- Networks and platforms area – 36689 m^2;
- Surfaces covered by dumps (landfills) – 47200 m^2;
- Green areas – 168652 m^2 (Regional Environmental Protection Agency Cluj-Napoca, Integrated environmental permit no. 79 - NV 6 from 29.10. 2007).

Damian et al. (2008) investigated the soil pollution with Pb, Cd, Cu and Zn of Cuprom area in the upper horizon and up to 1.2 meters depth. The results showed a Pb concentration of 904 – 995 ppm, a Cu concentration between 400 – 5823 ppm, Cd has values between 80 – 39 ppm, while Zn values range between 536 – 252 ppm. In the organic horizon, the total content of Cu is important in the aluviosols and luvosols that are specific for this area and the highest values are in area of gaseous emissions. Soil pH varies between 3.54 – 4.98.

The Cuprom chimney (Figure 4), with a height of 351.5 metres, is the tallest artificial building in Romania and the 3rd in Europe (http://skyscraperpage.com/cities/?buildingID=56681). This makes it very valuable for a future redevelopment of the area.

Figure 4. Cuprom chimney, a landmark of Baia Mare (http://www.panoramio.com/photo/76619862)

Nowadays, all the buildings that used to have specific functions are neglected or damaged. The whole scenery looks terrifying. Important surfaces of soils that belong to Cuprom area are degraded and vegetation does not develop in this type of land (Figure 5). Invasive species have started to grow and populate the soil.

According to national press, Cuprom area is in the interest of the Municipality of Baia Mare to be rehabilitated and integrated in the community. The price of 3 million euros seems to be affordable for the investors and the location of this area is great for future development.

Baban (2012) proposed the rehabilitation of the industrial platform Cuprom by keeping some of the old elements and converting them into new attractions and functions (Figure 6). The chimney would be kept for touristic purposes while the rest of the area would be converted in an eco-industrial park and a platform for waste management.

Figure 5. The current status of the Cuprom site

The most important step in the reconversion of the area is the decontamination and greening of the land.

Best techniques for the treatment of the polluted soil must be applied and a combination of different techniques might be very effective in this case.

There are not only environmental problems caused by pollution, but also social and economic effects. Most affected by pollution seems to be the forests from the vicinity of the pollution sources.

The agricultural land on a surface of 7 – 8 km round is less fertile or even infertile.

The drinking water is contaminated by the heavy metals and organic substances. If compared with other places, the life of humans and animals is shorter with 2 to 12 years.

The constructions in the surrounding areas are more dirty and rusty than others from clean regions (Pop, 2014).

Figure 6. Example of proposed situation for area rehabilitation (designed by arh. Alexandru Baban, 2012)

CONCLUSIONS

For Baia Mare, a city with a population of more than 100000 citizens, the remediation of the contaminated areas is an important issue. The serious environmental pollution caused by mining activities lead to health problems for the population. Dangerous types of contaminants like Pb, Cu, Zn, Cd require finding good solutions for decontamination of these zones. After closing the mines and plants, thus reducing the specific activities, the air became less polluted, but the soil remained highly contaminated. The area of former plant Cuprom needs urgent measures of reconversion because of its valuable location and due to the fact that

is part of the city and must be integrated, not rejected. The industrialization and urbanization of Baia Mare had negative effects on the environment due to the pollution of important areas in the surroundings. Nowadays, the city must recover from the historical pollution and there are a lot of investments to be made in cleaning the polluted environment.

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AN INTEGRATED APPROACH TOWARDS THE DEPOLLUTION OF THE APUSENI MOUNTAINS

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Abstract

Romania has a long-standing tradition of mining, particularly within the Apuseni mountains area. Unfortunately, there are various negative consequences which occur as a direct and indirect result of this process, such as acid mine drainage and heavy metal pollution of air, soils, surface and underground waters. This paper proposes an integrative and interdisciplinary strategy for the depollution of acid mine drainage and heavy metal contaminated areas in the Apuseni Mountains, Romania. We aim to view the reported problems within the designated area, which occur as a result of ore exploitation, from various perspectives (environmental science and engineering, medicine, veterinary medicine). Secondly we aim to provide a plan of action for depollution. Specifically we will focus on: the treatment of tailing ponds and surface waters, soil remediation, greening of heaps of debris, mine closure, stabilization and rehabilitation. We wish to focus on efficient, technologically easy to implement solutions, which preferably use natural, indigenous materials.

Key words*: heavy-metals; acid mine drainage; toxicity, bioremediation, natural materials.*

INTRODUCTION

Acid mine drainage (AMD) is recognized as the foremost significant problem associated with mining worldwide. Romania is a country with a long history of mining. A study estimates that more than half of the total assessed ore deposits of Romania occur in the East Carpathians and the Apuseni Mountains. Currently, Romania is still struggling with mine-related pollution, namely AMD, heavy metal and SO_2 pollution of air, soil and waters, which in turn are toxic for plants, animals and people (Toth and Quiquerez, 2006; Sima et al., 2011; European Commision, 2014).

This study focused on one of Romania's most polluted areas by the mining industry, the Apuseni Mountain range, with particular emphasis on Zlatna. The area affected by mine related pollution around Zlatna alone is around 55660 hectares (Lacatusu et al., 2009). Zlatna soils were found to be highly acidic as they are watered by acidic leachates (pH=3.7-4), and have a high heavy metal concentration (Williamson et al., 1998).

The mean annual emissions of SO_2 are 150450 tonnes and almost 3500 tonnes of heavy metal filled dust (Lacatusu et al., 2009).

OBJECTIVES

The purpose of this review paper is to provide an integrative approach to the problem of AMD in Zlatna, and is divided as follows: short description of AMD, sulphur dioxide and heavy metal effects on soils, plants, animals and people, species that can be used for biomonitoring in order to assess the pollution levels over time, potential ways to treat AMD problems.

INTRODUCTION TO AMD

AMD is formed when material containing sulphide (generally FeS_2 containing rocks) is exposed to oxygen and water. Sulphur is released as sulphate (SO_4^{2-}) which can dissolve to produce weak sulphuric acid, which in turn solubilizes heavy metals. This gives usually acidic, sulphur rich waters that greatly increase the solubility of heavy metals. Acidic water with heavy metal contaminates has serious negative effects on the plants, animals and soils in the contaminated

areas, which shall be discussed in the subsequent sections.

MAIN AMD POLLUTANTS

This section aims to introduce the main pollutants associated with AMD, namely SO_2 and heavy metals. General characteristics, the source of occurrence and the movement of these elements through the environment will be addressed, as well as how they are toxic to soils, plants, animals and people.

Anthropic SO_2 is produced as a result of ore mining, alongside heavy metals. Many species of plants are very sensitive to SO_2 concentrations. The main effect of the compound is the interference with the process of photosynthesis; it destroys the chlorophyll in the leaves (Malschi, 2014).

SO_2 particles combine with particles which are in suspension in the atmosphere, and form complexes which can transform this compound in H_2SO_4 and as such can contribute to the formation of acid rain. When inhaled, a significant part remains in the respiratory system and is excreted or absorbed in the organism very slowly.

In people, in the case of short term exposure, the compound produces irritation of the respiratory system, blocking of the bronchi, increases the secretion of mucous and determines the constriction of the airways.

A high incidence of chronic bronchitis as a result of SO_2 has been noticed (Bartók and Crisan, 2007).

The increased mucus as well as the constriction phenomenon prevents the elimination of the solid particles from the lungs, which in turn determines chronic bronchitis. In the case of long term exposure, this compound has been linked to lung cancer (Ludusan, 2002).

Heavy metals naturally exist within the environment and are redistributed following various biological and geological cycles.

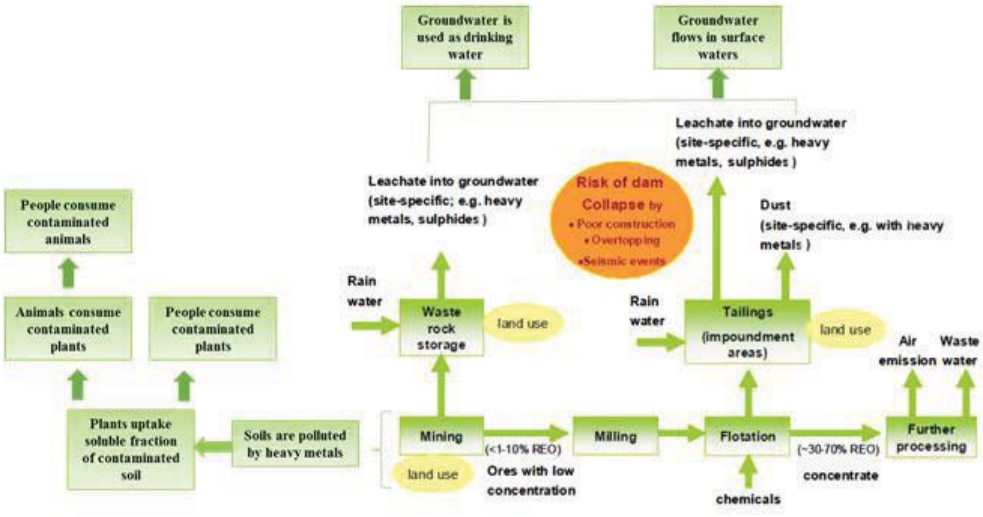

Figure 1. Heavy metals and sulphide movement within the environment in the context of mine exploitation (reproduced and altered from Massachusetts Institute of Technology, 2013)

One of the main anthropogenic sources for heavy metal pollution is mining. The accumulation of heavy metals in plants is influenced by the type of plant, soil conditions as well as the microorganisms present in the soil. These last two elements can shield the plants from the polluting agents, and thus be biological neutralization agents. The most crucial soil characteristics that are relevant in this context are: the thickness of the soil layer, the cationic and anionic exchange capacity (present especially in soils with high quantities of clay and organic matter), the biological activity of the soil, the precipitation of the ions from the soil solution

Some of the most commonly occurring heavy metals in the study area are presented in table 1.

Table 1

Table 1. Selected heavy metals from area of interest, their most common form in the environment and the Romanian maximum admitted limits

Heavy metal	Maximum admitted limits in Romania (HG 325/2005 NTPA 001)	Almasu Mare surface river samples	U.M.
Al	5.0	57	mg/L
Pb	200	15	µg/L
Cd	200	65	µg/L
Cu	100	190	µg/L
Fe	5.0	127	mg/L
Mn	1.0	106	mg/L
Zn	0.5	47	mg/L

* The samples were collected by the author of this paper in June 2013.

Lead (Pb) is toxic to the soil as it inhibits the enzymatic processes, it reduces the intensity of eliminating the carbon dioxide and it decreases the number of microorganisms as well as their metabolism (Ludusan, 2002). Lead's phytotoxicity consists of diminishing the uptake of micro and macronutrients, decreasing the transpiration rate and water content of the tissues and inducing oxidative stress in growing plant tissues (Sharma and Dubey, 2005). No biological need for Pb was found. In mammals, the most significant risk is posed to the nervous system. Lead can accumulate both in bones and in soft tissues. Within the soft tissue, Pb tends to mostly accumulate in the liver and kidneys. Lead's main excretion pathway is through the kidney. Pb can also cross the placenta, hence can be transmitted from the mother to the foetus. Effects of exposure include peripheral or chronic neuropathy, hypertension, lead-induced anaemia, lead nephropathy (Goyer and Clarkson, 1996).

Cadmium (Cd) is a particularly dangerous heavy metal as it has high mobility and affects plants even when present in small amounts. Cd toxicity in plants is generally shown by a decreased growth and chlorosis (loss of the normal green leaf colour), due to its interference with Fe uptake interferes with the uptake, transport and use of Ca, Mg, P and K. Physiological and genetic damage were observed in onions, beans, peas and barely (Das et al., 1997). In people, chronic toxicity gives chronic obstructive pulmonary disease and emphysema as well as chronic renal tubular disease. Calcium metabolism is affected by Cd toxicity, thus inducing skeletal effects. These may include bone pain, osteoporosis and osteomalacia. Studies also linked Cd toxicity to essential hypertension, lung cancer and possibly prostate cancer (Goyer and Clarkson, 1996). Cd is excreted in urine.

Copper (Cu) polluted soils have a smaller aggregate number and a lower hydraulic stability which leads to increasing susceptibility to erosion and compaction. The biological activity from the soil is also weakened because an increased Cu concentration in the soil increases the mobile fraction of the humus, which in turn increases the hydrolytic acidity and decreases from the concentration of the basic cations. In plants, a high Cu concentration reduces the intensity of the respiration and slows down the process of producing chlorophyll. Plants which present high uptakes of Cu are herbaceous plants, vegetables, grape vines, trees and shrubs (Ludusan, 2002). Cu is an essential element for the body. Homeostatic mechanisms rule its gastrointestinal absorption. Ingestion of drinking water which has more than 3mg/L Cu produce gastrointestinal symptoms such as abdominal pain, diarrhoea, nausea and vomiting.

Symptoms of iron (Fe) toxicity in plants are brown roots and the appearance of brown spots on the surface of leaves. In the human body, Fe is regulated by homeostatic mechanisms, with 2-15% being absorbed from the GI tract. The greatest concentration of iron in the body, which occurs from chronic exposure, accumulates in cells of the liver and pancreas, in addition to the heart and the endocrine organs (Goyer and Clarkson, 1996).

In plants, symptoms of manganese (Mn) toxicity include brown spotting of a necrotic nature which occurs on stems, petioles and leaves (Reichman, 2002). In people, gastrointestinal absorption is less than 5% and occurs in the small intestine. Mn is mostly contained in the kidneys, liver, blood and fat. Chronic exposure gives high uric acid levels in urine and serum, slow growth, anaemia and diarrhoea (Goyer and Clarkson, 1996).

Zinc (Zn) reduces biological activity in the soil and tempers with the enzymatic activity of the microorganisms in the soil. It is easily absorbed by plants and mostly accumulates in the green parts of the plant. Symptoms of zinc toxicity are chlorosis and the reddening of young leaves (Reichman, 2002). Zn has relatively low toxicity to animals. Zn is an essential metal for biological systems. Acute zinc toxicity due to ingestion is not common and there is no hepatic, renal or hematologic toxicity that was found (Goyer and Clarkson, 1996).

In plants, aluminium (Al) interferes with the uptake as well as transport and efficiency of the utilisation of essential minerals (Rout et al., 2001). Very sensitive species to Al include beet, lettuce, mustard, cucumber, medium-sensitive species include pea, sunflower, potato, oat and less sensitive species are turnip, currant, cranberry, tea, corn and rye. Al from acidified waters is especially toxic for invertebrates as it replaces Ca ions from their bodies. In humans, chronic exposure to Al targets the lungs, the bones and the nervous system. Al competes with Ca metabolism in the body (Goyer and Clarkson, 1996). Its toxicity results mainly from replacing Mg^{2+} and Fe^{3+} by Al^{3+}, hence the afflictions have a cellular basis; cellular growth, intercellular communication and secretory functions are affected. Al is neurotoxic, inducing lesions in neurones. Intoxication with Al is reflected in the osseous system by an unusual softness of the bones and a predisposition to bone fractures, while in the blood system anaemia appears (Barabasz et al., 2002.).

BIOACCUMULATION AND BIOMONITORING

Bioaccumulation is defined as “the biological sequestering of a substance at a higher concentration than that at which it occurs in the surrounding environment or medium” (US Geological Survey, 2007). Understanding this dynamic process of bioaccumulation is imperative for identifying and using biomonitors for pollutant assessment. There are several species which have been identified as biomonitors for a long time and are well adapted to a wide range of geographical conditions. Identifying these in the Zlatna area is of particular importance as they provide a means of comparing our levels of pollution to other countries’.

Biomonitoring uses biological responses to determine the changes in the environment. This process can use indicator species, such as macro invertebrates, fish, algae, protozoa, lichens, plants (Bailey and Stokes, 1985; Berkman et al., 1986; Caçadora et al., 2012). In the context of our study area, we are concerned mainly with fish, benthic macro invertebrates lichens and plants. Fish are good indicators of chronic effects spread over several years. Fish communities are indicative of a number of trophic levels, and are consumed by humans (North Carolina State University, 1995). They are easy to raise, have a long life cycle and are easy to handle. Biomonitoring using fish can be done in different ways; the most common one several decades ago was lethal testing of fish to measure the pollutants they contains, however studies are now shifting towards observing the behaviour response of fish, growth, metabolism, reproduction and fertility (Zhou et al., 2008). In Romania, the fish species *Chondrostoma nasus, Leucisus cephalus* and *Phoxinus phoxinu* were used to monitor heavy metal pollution the Mures, Crisul Negru and Crisul Repede rivers respectively. Various pathologies and elevated levels of a number of heavy metals were found (Triebskorn et al., 2008; Petrovici and Pacioglu, 2010). Benthic

macro invertebrates have also been used as biomonitors for pollution, in various environments and geographical locations, producing a significant number of papers since the mid 1900's (Cairns Jr and Pratt, 1993). A study used insects, beetle larvae, and amphipods along with sediment samples to determine the heavy metal concentration in streams within the Abrud river catchments (Mates). Various plants which are susceptible to significant metal ion uptake can be used as biomonitors. In Romania, a study used four moss types to assess heavy metal pollution on more than 60% of the country's territory; target metals included Cd, Cu, Fe and Zn. The study found that Romania's median values were greater than most of the other European regions which had also done similar studies and that all the collection points showed concentration ranges above toxic level for humans. Various studies used lichens as biomonitors (Richardson et al., 1982; Haas et al., 1998). Lichens have also been used as monitors in the area of Zlatna, for SO_2, Pb, Zn, Cu and Cd levels. To be noted is that Zlatna was found to be so polluted that only some very resilient species of lichens were able to survive in that environment.

WATER TREATMENT

There are several methods to water treatment, which do not use a water treatment plant. For low quantities of water, a biosand filter can be used. These filters are cheap and technologically easy to build, and as such they are a viable solution for small, rural communities to procure the water they need for each day. Biosand filters reduce turbidity and colour of the wastewater and remove chemical contaminants and microorganisms through a single filtration process (Muhammad, 1997). The downside is that this process cannot clean up an entire river; a typical flow rate is limited to 15-20 L hr^{-1} but can be slower depending on the height of the water column on the filter top and the size and type of the filter components. Treatment usually involves diverting a part of the river to the filter, or manually pouring water on the filter top, which is why this treatment is more suitable for individual households. A South African study has developed a cost-effective biosand filter (total cost of < USD 20) using the natural zeolite clinoptilolite (usually found in volcanic ash). The filter was comprised of four areas which played a part in filtration; the first layer after the standing water zone was the biological layer (sediments, slime and micro-organisms), the second one was the biological zone, which occurred in a fine sand layer (5-10 cm from the surface of sand and removed Fe and microbial contaminants), the third one was the zeolite layer which removed the majority of the heavy metals and the last one was the gravel zone which prevented the zeolite layer from being washed down (Figure 2). Results obtained after 1 hour of filtration showed a removal of 80% Ca, 89% Mg, 99% Fe, 56% As (Mahlangu et al., 2011).

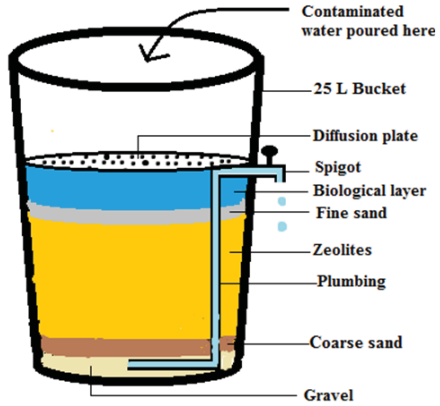

Figure 2. General sketch of bucket zeolite-enriched biosand filter (Mahlangu et al., 2011)

Other studies using simple biosand filters (no added zeolites) confirmed its potential of heavy metal removal (Tang et al., 2010).

Various other low-cost materials have been explored for the purpose of AMD remediation. Zeolites are naturally occurring alumina-silicates with a cage-like structure which contains loosely bound non-toxic metallic cations (usually Na^+, K^+ and Ca^{2+}) which can be exchanged with heavy metal ions from the environment and as such have been successfully used for the treatment of acid mine drainage.

Romania has important natural volcanic tuff resources. (Bedelean, 2010). Extensive research has been done on various heavy metal removals with natural zeolite; tests included various pH,

zeolite type, experimental procedures (mostly batch or columns) and all of them proved the efficiency of the material in this context (Ouki and Kavannagh, 1999; Erdem et al., 2004; Al-Anber and Al-Anber, 2008). Betonies clay is a type of aluminium phyllosilicate which is an adsorbent. It has a similar sorption capacity to zeolites, it attract metals because it has various cations and anions on its surface and as such can ion-exchange them with the metal ions or adsorbs the ions onto its structure, and as such has been used in the context of AMD remediation.

Biomass fly ash is a ferro-alumino silicate with a variable fraction of oxides; for AMD treatment, calcareous FA (10%CaO) is needed, which has a typical pH=9-12.

Biomass ash represents about 19% of Romania's primary energetic potential hence biomass ash is a cheap, readily available resource Romania. Numerous authors have studied coal ash as an adsorbent for heavy metals, in various types of contaminated water, at a range of different pH, temperature and contact time (Panday et al., 1984; Barakat, 2011; Vadapalli et al., 2012).

For accumulation ponds, biosorption by various plants can also be used. Types of brown marine algae, fungi, biomass of order Mucorales fungi, chitin and chitosan (from fishery wastes) represent good biosorbents (Volesky and Holan, 1995; Ng et al., 2002).

SOIL TREATMENT

Soil treatment is more difficult to achieve than water treatment and more difficult to implement technologically. In the case of the Zlatna area, the best approach would probably be a passive type of treatment, using a combination of biosorption and phytoremediation methods, especially designed for the geophysical conditions of the area, as opposed to active treatments. Phytoremediation is a long-term way of remediation, but represents a more sturdy and technologically easily to implement and to maintain way of soil treatment. Phytoremediation involves the usage of plants, algae, microorganisms from the soil as well as biomass for the remediation process; this includes phytostabilisation and phytoextraction. Phytostabilisation involves decreasing from the mobility or immobilising the contaminants from the soil by using plants for hydraulic control. Addition of high zeolite content volcanic ash has also been used (Damian and Damian, 2007; Malschi, 2014). Phytoextraction involves the accumulation of heavy metals within plants or algae which have a high tolerance to these pollutants.

Plants with high potential that have been studied are: forest products (wood, logging, shrubs and wood residues, sawdust etc.), energy crops (grasses, starch, forage, herbaceous woody or oilseed crops), aquatic plants (water weeds or hyacinth, algae, reed and rushes), wetland plants (brass buttons, duckweed, umbrella plant, smartweed, water lettuce) (Goodrich-Mahoney, 2001; Ciubota-Rosie et al., 2008).

There are also certain types of metal-binding algae and lichens which effectively accumulate heavy metals and which have been addressed in the bioaccumulation and biomonitors section.

Biosorption of heavy metals can also be done on various types of waste by-products from agricultural production and processing, crop residues, urban wood and organic wastes. Phytoremediation is usually done by constructing a wetland (Brenner, 2001).

TREATMENT FOR PEOPLE

In people, blood, urine and hair are used as indicator tissues for the measurement of heavy metal exposure. Urine and blood show recent exposure. For certain metals, such as Hg, hair analysis can provide a good long term indication of exposure by comparing samples from different portions of the hair segment. The valence state and the ligand binding of the metals are also very important factors which relate to toxicity. In terms of chemical bonding, organometallic and inorganic forms of the metals behave very differently. The most popular method of chronic exposure to heavy metals' treatment in people and animals is chelation therapy.

Chelators are agents which bind to toxic metal ions, thus forming metal complexes which can be excreted by the body from intra or extracellular spaces, primarily through urine.

In terms of the characteristics it exhibits, a good chelator should have a high affinity for

the toxic metal ions, low toxicity, a high capacity to compete with endogenous chelating agents, the capacity to penetrate cell membranes, high solubility in aqueous media, the capability of forming non-toxic complex and it should have the same distribution as the metals it is aimed for. Another aspect of chelating agents that should be regarded is the type of complexes they form.

The structure of the ligand may reduce toxicity in the local *in vivo* environment by forming a closed complex, thus shielding biological targets. Similarly, there are certain chelators that can expose the metal more to the biological environment, thus increasing its toxicity. Care should be taken when administering chelating ligands since they can bind to useful metals in the body as well and as such can have very serious side effects such as kidney damage, stomach and intestinal bleeding, cardiac problems, seizures and can even result in death (Lowry, 2010; Medline Plus, 2010).

An alternative to chelating agents, with significantly less adverse effects are zeolites.

Several studies have shown their efficiency in the removal of heavy metals from the body through urinary excretion (Papaioannou et al., 2005; Karampahtsis, 2012).

CONCLUSIONS

Zlatna is still a particularly AMD affected area of Romania with very severe levels of SO_2 and heavy metal pollution. Of even more concern is the fact that it is an example of many former or current mining sites in Romania, particularly in the Apuseni Mountains. Even though there have been some attempts at mine closures over the years, as well as a multitude of both national and international fundamental research and even pilot studies, action has not been taken to treat the affected soils and water and alleviate people and animals which have been affected by chronic exposure to these pollutants. The author recognizes the limitations imposed by government spending and funding allocation on these types of environmental issues and by the large surface area and number of geographic locations which need to be treated, and as such the author proposes that the Zlatna area treatment strategy should focus on low-cost, technologically easy to implement, long-term, *in situ* treatments of river and creek waters, tailings ponds and soils.

Regarding the people living in pollution hot-zones, a medical examination should be given to each resident and a database should be constructed with the assessment of each patient. Seeing as conventional therapies which involve chelating ligands are costly and can be dangerous for the patients, a decision should be made for each patient regarding the severity of the heavy metal intoxication. Domestic animals, particularly animals which are consumed or which give products which are consumed by people should be tested for heavy metal contamination. Even if there aren't a high number of studies attesting the efficiency of zeolites in treating heavy metal, there is enough evidence to suggest that it represents a feasible treatment, and as such a pilot study concerning heavy metal treatment with zeolites should be conducted in Zlatna as well.

Treatment of water and soils should be done simultaneously with the above-mentioned treatments in order to prevent further exposure of people and animals to the same high pollutant levels.

The author proposes an environmental assessment study be done in the Zlatna area, and preferably include updates of previous studies in order to potentially find a pattern of pollution evolution with time or cross-reference the results with previous data. Based on the particularities of the surveyed area, small scale *in situ* treatment facilities should be designed and implemented along AMD affected creeks, rivers and in tailings ponds, based on low-cost, indigenous materials such as zeolites, fly ash, clay, waste biomass.

Based on literature studies, plant species with a high potential of heavy metal uptake should be identified in the area and a wetland containing those indigenous species should be designed and constructed.

A pilot study should be done by using zeolites volcanic tuff, betonies and other natural absorbing materials and mixing it with soil on patches of land which can be used for agricultural purposes.

Biomonitoring species, including fish, lichens and benthic macro invertebrates should be collected from the affected area in order to build a database for the assessment of pollutant

levels. This is essential for monitoring the efficiency of the treatments, both on a short term and a long term.

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LABORATORY STUDIES ON THE SIMULATION OF ACCIDENTAL POLLUTION OF SOILS

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Abstract

This paper is part of a comprehensive study on soil pollution with liquid petroleum products. An experimental model to simulate the natural state of soil horizons was imitated in the laboratory. By cracking underground or aboveground pipes, which carry liquid petroleum products, the ground - underground – groundwater system undergoes changes. If immediate action is taken, the system is less affected and remediation does not require costly techniques. If the accident is found after a long time, the oil stain can seriously affect the soil and remediation methods do not provide good efficiency. Pollutant migration, in the proposed arrangement, has been studied for several soil types. For each soil type there were determined: capillarity, permeability and retention capacity, size distribution and density. Pollutant migration, a petroleum product, was studied both on horizontal and vertical direction. There were calculated the travel speeds of pollutant in the two directions and it was measured the width of the oil spill. Future research aims the remediation of these soils through methods that can be applied in the laboratory.

Key words*: soil, contaminated, oil products, migration.*

INTRODUCTION

It is observed that in the world, and also in Romania, deliberate discharges of oil to soil or water, which leads to economic, social and environmental issues, are reported every year. Ensuring protection of soil quality provides, among other things, the use of remediation processes and technologies designed to neutralize or block the flow of pollutants and ensure the effectiveness and enforcement of legislation on the protection desired soil quality.
There are concerns on this issue and this paper is part of a large study in this direction.

MATERIALS AND METHODS

In the laboratory it was simulated an experimental model to imitate the natural state of soil horizons. The experimental setup on which the measurements were made is shown in Figure 1. By breaking underground or above-ground pipes, which carry liquid petroleum products, ground - basement – groundwater system suffers transformation. If immediate action is taken, that system is less affected and remediation does not require costly techniques. If the accident is found after a long time, the oil stain can seriously affect the soil and remediation methods do not provide good efficiency. Pollutant migration in the proposed arrangement has been studied for several types of soils. For each type of soil there were determined the following properties: capillarity, permeability, retention capacity, size distribution and density.
Before performing the experimental scheme, the pipe was cracked. Pollutant migration, a petroleum product, was intended both on the horizontal and vertical direction. There were calculated moving speeds on the two-way directions and it was measured the width of the oil stain. Future research directions pursue the remediation of these soils through methods that can be applicable in the laboratory.

Figure 1. The experimental scheme

RESULTS AND DISCUSSIONS

Each soil type was analyzed in the laboratory and there were determined properties whose values are presented in Table 1.
Soil capillarity is the phenomenon of rise of possible pollutants in soil structure, in this case a liquid petroleum product.
Permeability is the property of soil to allow flow of a liquid product through its structure.
Retention capacity is the amount of liquid product embedded in saturated soil structure analysis.
Retention capacity varies inversely with the soil permeability.
Size distribution is the percentage distribution of the size of soil particles.
The particle size conditions the physical properties of the soil and their filtration capacity.
The determination of size distribution was made by sifting method.
Figures 2 and 3 shows the properties values. variations.

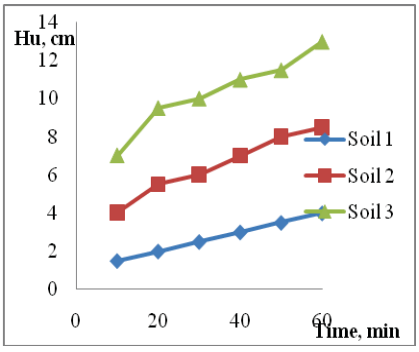

Figure 2 Variation of capillarity

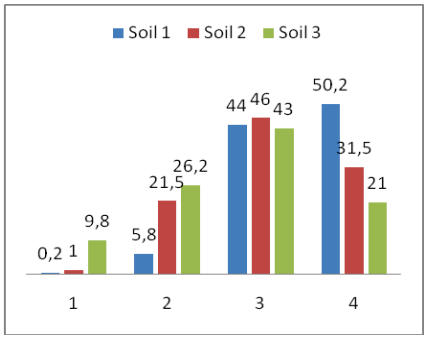

Figure 3. Variation of granulometry

Table 1. The soil test results

Analysis	Soil 1	Soil 2	Soil 3
Capillarity, cm liquid			
10 min	1,5	4	7
20 min	2	5,5	9,5
30 min	2,5	6	10
40 min	3	7	11
50 min	3,5	8	11,5
60 min	4	8,5	13
Permeability, cm/h			
P 15 min,	21	312	456
P 30 min,	22	116	112
P 45 min,	18,67	55	80
P 60 min,	18	26	58
P_{medium}	19,92	127	177
Retention capacity, kg/m^3	290,18	96	358
Size distribution, g/sieve (S)			
S 1 d=0,06mm	0,2	1	9,8
S 2 d=0,12mm	5,8	21,5	26,2
S 3 d=1,5mm	44	46	43
S 4 d=2,5mm	50,2	31,5	21
Real density kg/m^3	1,54	2,05	2,43

The dimensions of the pipe and the tank are shown in Table 2.

Table 2. Pipe and tank size

Pipe	Thickness, mm	1
	Diameter, mm	18
Tank	Height, cm	19
	Width, cm	31,5
	Length, cm	50

In order to express the speed of the pollutant on vertical direction in a soil based on the nature of the pollutant, the type and structure of the soil, it was studied the ascendent and desscenent speed of oil in the soil.
Tables 3-5 present the measured values in h_a and h_d of the pollutant front, both ascendant and descendant (Patrascu, 2005).

Table 3. Variation in height and pollutant fronts up and down for 1 h soil 1

Time, min / h, mm	15	30	45	60
h_a	15	30	43	50
h_d	11	23	35	45

Tabelul 4. Variation in height and pollutant fronts up and down for 1 h soil 2

Time, min / h, mm	15	30	45	60
h_a	15	18	22	28
h_d	14	16	19	24

Tabelul 5. Variation in height and pollutant fronts up and down for 1 h soil 3

Time, min / h, mm	15	30	45	60
h_a	23	27	33	45
h_d	26	34	40	48

Since ascending and descending speeds are variable over time, calculation is made incrementally for each time interval between two consecutive measurements.
The obtained values will be used to calculate the average speed in each range time. Ascendant and descendant speeds (w_a and w_d) are calculated based on h_a and h_d at different times from the start of the experiment.

$$w_a = \frac{\Delta h_a}{\tau_m}, \quad \text{mm/min} \qquad (1)$$

$$w_d = \frac{\Delta h_d}{\tau_m}, \quad \text{mm/min} \qquad (2)$$

Table 6. The variation Δh_a şi Δh_d for soil 1

τ_m, minute	7,5	7,5	7,5	7,5
Δh_a, mm	15	15	13	13
Δh_d, mm	11	12	12	10

Tabele 7. The variation Δh_a şi Δh_d for soil 2

τ_m, minute	7,5	7,5	7,5	7,5
Δh_a, mm	15	3	6	6
Δh_d, mm	14	2	3	5

Table 8. The variation Δh_a şi Δh_d for soil 3

τ_m, minute	7,5	7,5	7,5	7,5
Δh_a, mm	23	4	6	12
Δh_d, mm	26	8	14	4

Table 9. Variation of ascendant and descendant speeds

Type soil	Ascendent speed, w_a, mm/min	Descendent speed, w_d, mm/min
Soil 1	2	1.46
	2	1.6
	1.73	1.6
	1.73	1.33
Soil 2	2	1.87
	0.4	0.27
	0.8	0.4
	0.8	0.67
Soil 3	3.06	3.47
	0.53	1.06
	0.8	1.87
	1.6	0.53

CONCLUSIONS

The penetration of oil residues at a certain depth in the soil is influenced by humidity, particle size and density, pollution intensity, viscosity and density of the pollutant.

Soil samples were analysed using laboratory methods already described in the literature, a constant concern for this area already existing (Patrascu, 2005; Popa, 2014).

The direction and speed of the pollutant depend mainly on the viscosity and permeability of the soil.

The main acting force over the pollutant is gravity. Therefore, if the soil is permeable pollutant infiltrates in the soil predominantly in vertical component. Also, there is a lateral pollutant impregnation due to dispersion, which is controlled by the porosity of the soil.

Whatever the size of the crack of a pipe, the evolution of the pollutant in soil is influenced by soil properties and discharged pollutant.

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THE PERFORMANCE OF BACTERIAL CONSORTIUM IN VARIOUS CARRIERS ON THE BIOREMEDIATION OF RIVER WATER POLLUTED BY DOMESTIC SEWAGE

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Abstract

This study aims to obtain raw materials as an effective carrier for starter inoculum consortium of Bacillus coagulans B. licheniformis, B. subtilis, and Pseudomonas sp. and contact time for bioremediation of polluted water from the river Cimuka. The study was conducted by using the experimental method with completely randomized design (CRD) with two-factor factorial 9x9. The first factor is the carrier material (P) consisting of 9 level and the second factor is the contact time (W) consisting of 9 level. Parameters measured were BOD, COD, TSS, and ammonia. The results showed that bioremediation by a consortium of bacteria Bacillus coagulans, B. licheniformis, B. subtilis, and Pseudomonas sp. the carrier material alginate-starch with a concentration of 1% at the time bioremediation 14 days can reduce levels of BOD by 81.49%, 81.44% COD, TSS 75%, and 35.82% ammonia by bacteria populations reach 2,89x10^{13} CFU/ml. The results also show that the encapsulation can maintain the viability of bacteria and is able to improve the bioremediation of organic matter compared to treatment without encapsulation.

Key words: *Encapsulation, bioremediation, Alginate, Bacillus, Starch, Nitrosomonas, BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand).*

INTRODUCTION

Currently the waste disposal in the waters increased, which resulted in pollution of water bodies such as rivers by organic matter and chemicals from industry and households. One is Cimuka River in West Java, river pollution levels are high enough, where industrial dispose of waste waste into waters without being treated and become domestic waste effluent streams. One of the efforts to minimize the volume of waste that the bioremediation technique that utilizes living organisms to break down harmful substances into harmless (Sheehan, 1997 in Wignyanto, et al., 2009).

Bioremediation can be done by adding certain microbes in the water that will be remediated (Munir, 2006). According Ishartanto (2009), the success of bioremediation depends on the amount of organic pollutant load and duration of contact (retention).

The longer the time degradation and the higher the degrading bacteria population, the more effective is bioremediation.

In this study, bioremediation in rivers Cimuka using indigenous bacteria isolated from the river Cimuka, namely Bacillus coagulants and B. subtilis. In addition, the bacteria Bacillus licheniformis and Pseudomonas sp. added to support the process of bioremediation. Bacillus coagulants are able to decompose lipid known as produce lipase that can reduce levels of BOD and COD simultaneously (Hidayat, et al., 2010). Bacillus subtilis is known to produce the enzyme but it also can form endospores that are able to tolerate extreme circumstances (Amrah, 2002). Bacillus licheniformis, produce amylase enzymes that are tolerant to alkaline pH and high temperature (Jamilah, 2011). Whereas Pseudomonas sp. known to degrade aromatic hydrocarbons (Munir, 2006). According Sastrawidana (2008) Bioremediation in waters by a consortium of bacteria indigenous and non-indigenous is very effective due to decomposition of organic matter such as cellulose, lipids, and proteins according to their ability.

Viability of bacteria in bioremediation processes can be improved by adding a consortium of bacteria in nutrient broth and mix of bacteria that have grown into the carrier material. Nutrient broth chosen because it can provide a source of nutrients and energy such as carbon, nitrogen, minerals, and vitamins that are appropriate for testing bacterial metabolic activity. In addition, the mixing of bacteria in the carrier material can stabilize emulsions and maximize the active material protection against environmental conditions (Mosilhey, 2003). Materials commonly used carrier is alginate and starch, talcum powder and gelatin, as well as rice flour, skim milk, corn starch, and dextrose. Bacteria in the carrier material alginate and starch through the encapsulation process can produce good quality capsules, with a high number of bacteria, consistent, strong and not easily destroyable (Wijayanti, 2010). Carrier material such as talcum powder and gelatin contains elements rich in protein and minerals, capable both in forming the membrane, is biocompatibility and non-toxic (Li, et al., 2009). Arifurrahman (2012) using rice flour carrier is added skim milk and glucose are capable of producing endurance during storage because rice flour is a source of carbohydrates, skim milk as a source of protein, while glucose is functioning as a protective nutrients and microbial cells. This study aims to obtain raw materials as an effective carrier for starter inoculum consortium of *Bacillus coagulans, B.licheniformis B. subtilis* and *Pseudomonas* sp. and contact time for bioremediation of polluted water from the river Cimuka.

MATERIALS AND METHODS

MATERIALS: Strain *Bacillus coagulans B. licheniformis, B. subtilis,* and *Pseudomonas* sp. alginate, calcium chloride, starch, talc powder, gelatin, rice flour, skim milk, corn starch, dextrose, nutrient agar, Cimuka river water.

Method

Preparation of inoculum consortium of strains of bacteria encapsulated in alginate.

Alginate 2 grams dissolved in 90 ml of distilled water was stirred slowly, and added 1 starch flour until is well blended and sterilized. Suspension alginate-starch which has been sterilized and inoculated by as much as 10% bacterial consortium consortium inoculum aseptically. Furthermore, the consortium inoculum in alginate-starch carrier material is inserted into the dropper tool to shed a solution of 0.1 M $CaCl_2.2H_2O$ formed Ca-alginate capsules. Furthermore capsules filtered using Whatman filter paper. Ca-alginate capsules are then put into a nutrient broth medium (Bashan et al., 2002 in Wijayanti, 2010) and incubated for 24-30 h in a rotary shaker speed 150 rpm at room temperature, to regrow consortium of bacteria contained in the capsule alginate-starch.

Preparation of inoculum in Gelatin and talc

Gelatin as much as 1% (1g) was dissolved in 100 ml of distilled water until well blended and sterilized in an autoclave at a temperature of 121^{o}C for 15 minutes at a pressure of 2 atm, after cold Gelatin-talc is inoculated by inoculum of consortium to be used with density cell is proportional to the turbidity of Mc Farland 3 Furthermore, a consortium of bacteria inoculated on the carrier material, by mixing 10% inoculum consortium to 100% (100 grams) of sterile talc powder until blended aseptically. The starter then incubated for 72 hours.

Preparation of Inoculum Starter

Medium starter consisted of 80% (80 grams) of rice flour, 10% (10 grams) of skim milk, 5% (5 grams) of corn flour and 5% (5 grams) of dextrose for the manufacture of inoculum (starter) solid as much as 100 grams. Rice flour, skim milk, corn starch, and dextrose put in clear plastic heat resistant size 15 x 25 cm. Then added to water at a ratio of 1: 1 and steamed for 1 hour, then cooled. A total of 10 ml of a bacterial suspension with a cell density comparable to McFarland 3 was inoculated into 100 grams of medium starter that has been sterilized. Plastic tied, given the holes and wrapped in aluminum foil, and then incubated at 30 ° C For 3 days and counted the population every 6 hours until the population reaches exponential phase. Upon reaching the phase of exponentially growing. The next starter dried and milled to form a powder.

Stages of Bioremediation

Starter inoculum bacterial consortium in the carrier material was inoculated into the waste water as much as 1% of the volume of waste,

while the starter inoculum in nutrient broth was inoculated as much as 10% of the volume of waste water. Then, the test parameters were measured on day 0, day 1, day 2, day 4, day 6, day 8, day 10, day 12, and day 14. Observed parameter is BOD, COD, TSS, and the concentration of ammonia.

Data Analysis.

Research using experimental methods with completely randomized design (CRD) factorial design with two factors, namely 9 x 9. The first factor is the carrier material (P) consisting of 9 level and the second factor is the contact time (W) consisting of 9 level. If found significant differences, then followed by Duncan's Multiple Range Test at 5% significance level.

RESULTS AND DISCUSSIONS

Effect of inoculum Starter In carrier material, Against BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand) during the bioremediation process Wastewater from Cimuka River.

Biochemical Oxygen Demand (BOD) is a measure of the amount of oxygen required microorganisms to decompose organic matter contained in waste water. Results Analysis of Variance (ANOVA) showed levels of BOD and COD carrier material effect on the percentage removal of BOD and COD (Table 1 and Table 2).

Table 1. Duncan's Multiple Range Test Percentage decrease in BOD (Biochemical Oxygen demand) In The remediation of waste water by a consortium inoculum of bacteria on various carrier materials.

Contact Time (H)	Material Carrier (P)			
	Nutrient Broth	Alginate -Starch	Talc-Gelatin	Rice Skim Milk-Corn Flour-Dextrose
Day 0 (mg/l)	1000	1582	1374	2430
Day -8(mg/l)	5243	4672	4741	5000
Day- 14 (mg/l)	500	335	434	538
Persentage of Reduction (%)				
Day 0-14	50,00 cd	**78,90 a**	66,26 abc	75,86 ab
Day 8-14	90,45 bc	**92,82 a**	90,86 bc	89,25 c

From Duncan's Multiple Range test results, it can be seen that the inoculum carrier material effect on the reduction of BOD and COD (Table 1 and Table 2). The percentage decrease in time from day 8 to 14 in order to be higher than decrease from the first day until day 14, this was due to the inoculum starter requires adaptation to the origin of the waste water stream before entering the phase exponential ie on days 8-14 and at the same time able to decompose organic matter and pollutants in wastewater resulting in lower levels of BOD and COD.

Table 2. Duncan's Multiple Range Test Percentage decrease in COD (Chemical Oxygen demand) in the remediation of waste water by a consortium inoculum of bacteria on various carrier materials.

Contact Time (H)	Material Carrier (P)			
	Nutrient Broth	Alginate-Starch	Talc-Gelatin	Rice Skim Milk-Corn Flour-Dextrose
Day 0 (mg/l)	1583	2476	2122	3834
Day -8(mg/l)	8171	7445	7435	7871
Day- 14 (mg/l)	807	525	686	847
Persentage of Reduction (%)				
Day 0-14	48,97 cd	**78,83 a**	65,4 abc	75,76 ab
Day 8-14	90,10 bc	**92,94 a**	90,7 bc	89,24 c

Inoculum starter in the carrier material alginate-starch resulted in removal of BOD and COD highest on days 8-14 in the amount of 92.94% with a bacterial population reaches 2.89 x10^{13} CFU/ml, indicating that the carrier material alginate and tapioca can maintain viability and activity of bacteria.

In microencapsulated probiotics by using calcium alginate and corn starch as a prebiotic improve the encapsulation of living bacteria than encapsulation without starch (Sultana, etal. 2000. Dried culture bacterial consortium in carrier-skimmed milk powder bares- corn starch and dextrose may also decrease BOD and COD by 89.25% 89.24%. Dried cultures are easily dispersed in water, the viability of bacteria in skim-milk-rice powder-starch-dextrose can be maintained, and however, the results lower than alginate-starch. In probiotics alginate-starch mixture showed effective encapsulation, also in various other bacteria (Mortazavian et al. 2007).

Encapsulation is trapping or closing the cells of microorganisms by means of a coating or

wrapping the bacteria with hydrocolloid right, and separates the cell from the surrounding environment, such as changes in pH, heat, enzyme activity, chemical compounds. Encapsulation is an efficient way to maintain the viability of bacterial cells because they have permeable membrane that keeps the bacteria that gets nutrients from prebiotic mixed. Permeable membrane that allows the bacteria to be able to come out slowly and minimize the contamination in the capsule (Kitamikado, et al., 1990 in Wijayanti, 2010). In this case, the bacteria in the encapsulation will be higher viability than the viability of bacteria in Nutrient Broth. Encapsulation produce beads containing cells are metabolically active bacteria.

Based on Figure 1 and 2 can be seen, removal of BOD and COD Cimuka river water polluted industrial and domestic waste is also generated by the consortium strain encapsulated bacteria by alginate and starch in the amount of 81.49% with a decrease of 1 810 mg/l to 335 mg/l and 81.44% with a COD content of 2829.7 mg/l to 525 mg/l for 14 days, and the result is higher than strain consortium of bacteria in nutrient broth, gelatin and mix talcum powder bares-skim- milk powder corn - dextrose. This means, the use of a carrier material with the encapsulation process is more effective in reducing the COD and BOD levels of polluted waste water.

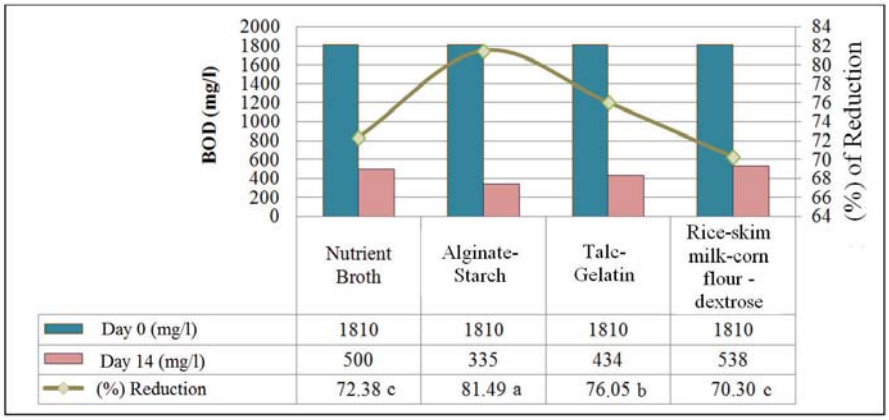

Figure 1. Graph of BOD (Biological Oxygen Demand) of water from the river Cimuka were inoculated by a consortium of bacteria in a variety of carrier materials.

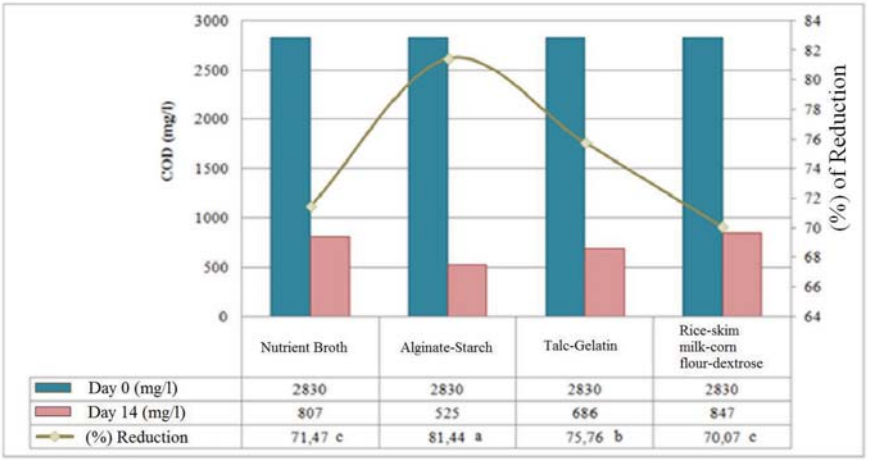

Figure 2. Graph of COD (Chemical Oxygen Demand) of water from the river Cimuka were inoculated by a consortium of bacteria in a variety of carrier materials

According Banu et al. (2001) encapsulated bacterial conditions will be better than the bacteria-free or without encapsulation of the efficiency of removal of harmful content in the waste. Viability of bacteria and bacterial strains in the consortium affect the removal of BOD and COD. According Eweis (1998) that the consortium of microorganisms will help the process of bioremediation quickly and more efficient or it can be said that stren synergistic bacterial consortium was instrumental in the process of bioremediation. In this study used Strain *Bacillus coagulans B. licheniformis, B. subtilis,* and *Pseudomonas* sp. Dwipayana (2010) using Bacillus sp., Pseudomonas sp. and Pseudomonas luteola in industrial wastewater treatment, and can reduce levels of COD by 57.5% within 12 days. Pseudomonas assessed as having ability to decompose pollutants and available from wastewater. However, the average BOD and COD results obtained in this study do not meet water quality criteria for maximum levels of class III in Government Regulation No. 82 of 2001, that each of 6 mg/l and 50 mg/l.

Effect of Bacterial Consortium in Various Materials Carrier to Decrease Levels TSS (Total Suspended Solid) during bioremediation Contaminated Waste Water from the River Cimuka

Total suspended solid or total suspended solids (TSS) is a residue of total solids that can block the sunlight thereby blocking photosynthesis. Results of analysis of variance, followed by Duncan test at the level of the TSS (Table 3.) shows that the inoculum consortium in a variety of carrier materials, with a bioremediation for 14 days, is able to reduce levels of TSS.

Inoculum consortium of bacteria in nutrient broth medium and alginate- starch produces TSS levels for 14 days is 133.33 mg/l with the bacterial population reaches 4.6 $x10^5$ CFU/ml and 2.89 $x10^{13}$ CFU/ml. Inoculum of the bacterial consortium in Nutrient Broth medium and in alginate and starch resulted in decreased levels of TSS for each 75% of the initial TSS 533.33 mg/l to 133.33 mg/at the end of bioremediation. Nutrient broth is a liquid medium for growing microorganisms that do not affect the levels of TSS than solid medium.

Table 3. Duncan's Multiple Range Test of carrier material containing a starter inoculum of bacterial strains consortium and Time on levels of TSS (mg/l) of water from the River Cimuka

The carrier Material (P)	Contact Time								
	0	**1**	**2**	**4**	**6**	**8**	**10**	**12**	**14**
Control	533.33 bc A	466.67 abc A	400 abc A	466.67 abc A	333.33 abc A	666.67 c A	266.67 ab A	200 ab A	**133.33 a A**
Nutrient Broth	533.33 b A	466.67 b A	333.33 b A	466.67 b A	533.33 b A	600 b A	333.33 b A	267.67 ab A	**133.33 a A**
Alginate-Starch	600 b A	533.33 b A	466.67 b A	533.33 b A	600 b A	666.67 b A	533.33 b AB	400 ab A	**133.33 a A**
Talc-Gelatin	1733.33 b B	3866.67 c B	1200 b B	4800 cd B	5866.67 d B	6133.33 d C	3266.67 bc C	3133.33 bc B	1066.67 a B
Rice-Skim Milk-Corn-Dextrose	600 bc A	666.67 bc A	666.67 bc A	600 bc A	733.33 c A	800 c A	666.67 bc B	466.67 ab A	**333.33 a A**

Note: The same letter indicates no difference

Talc is a mineral that TSS levels are higher when compared to other carrier materials. Gelatin is a protein derived from denatured collagen of the skin, connective tissue, bone and cartilage that contains Hydroxyproline, proline, and glycine were high (Li, et al., 2009), thus becoming a source of nutrients for the bacteria. Gelatin is used as a stabilizer, gelling agent, a binder, thickener, emulsifiers and adhesive. The use of alginate and starch as carrier material through encapsulation technique is still the material and the best way compared to other carrier materials.

Decreased levels of TSS, besides resulting carrier material capable of maintaining viability, also strains of bacteria in the consortium work synergistically with biodegradation properties of each strain of bacteria. Research conducted by Jamilah, et al (2009) stated that the Bacillus believed to produce proteolytic enzymes and amylolytic and capable lower levels of up to 30.4% TSS. B. coagulans is also

able to remodel lipid bacteria being able to produce the enzyme lipase (Hidayat, et al., 2010). Bacillus subtilis form endospores that can live in extreme environmental conditions and can decompose organic matter as the treatment of waste water quality (Amrah, 2002). B. licheniformis α-amylase produces enzymes that are thermostable and can hydrolyze α-1,4 bond-glycoside polysaccharides by producing oligosaccharides, dextrin, and glucose (Hasan, et al., 2006). Sandri (2011) explains that Pseudomonas sp. have the ability to degrade hydrocarbons and proteins in organic solvents. Fourth bacteria are considered to be synergistically remediate organic content in wastewater is more effective. In the carrier material alginate and starch decreased levels of TSS reached 87.31% with initial TSS concentration of 533.33 mg/l to 66.67 mg/l. The TSS levels are included in the maximum levels in the water quality criteria of class III according to the Government Regulation No. 82 of 2001 of 400 mg/l.

Effect of starter inoculum of the Consortium in the carrier material against ammonia Levels for Bioremediation of Polluted Water Treatment Origin Cimuka River

Ammonium nitrogen compounds are toxic at high levels, so as to reduce the quality of water which is the source of life for living things, especially aquatic biota. Results of analysis of variance (ANOVA), there is an interaction between the consortiums with a carrier material to reduced levels of ammonia waste from contaminated water Cimuka River. Based on this, the Duncan's Multiple Range Test performed as a follow-up test. Duncan test results in Table 4 show that the bacterial inoculum strain consortium in carrier material alginate and starch able to reduce levels of ammonia by 35, 82% with initial ammonia concentration of 6.49 mg/l to 4.17 mg/l on day 14.with the bacterial population reaches 2.89 x10^{13} CFU/ml. These results did not differ with ammonia reduction by a consortium inoculum in Nutrient Broth medium and rice flour corn-flour-milk skim-dextrose on day 12 and day 14.

Table 4. Duncan's Multiple Range Test of carrier material containing a starter inoculum of bacterial strains consortium and Time on levels of Ammonium (mg/l) of water from the River Cimuka

The carrier Material (P)	Contact Time								
	0	**1**	**2**	**4**	**6**	**8**	**10**	**12**	**14**
Control	6.50 bcd C	6.36 bc C	6.63 d B	6.41 bcd B	6.46 bcd A	6.59 cd A	6.43 bcd B	6.06 a C	6.31 b C
Nutrient Broth	5.53 bc A	5.54 bc AB	5.33 bc A	5.73 cd AB	5.96 d A	6.45 e A	5.20 b A	4.30 a A	4.20 a A
Alginate-starch	5.56 b A	5.02 b A	5.24 b A	5.10 b A	5.50 b A	7.58 c B	5.66 b AB	5.26 b B	**4.17 a A**
Talc-Gelatin	6.16 bc B	6.21 bc BC	5.46 ab A	6.42 c B	8.48 d B	8.10 d B	7.93 d C	5.16 a B	4.69 a B
Rice-Skim milk-corn-dextrose	5.60 b A	5.21 b A	4.86 b A	5.26 b AB	7.58 d B	6.30 c A	6.37 c B	4.37 a A	4.23 a A

Note: The same letter indicates no difference

The decrease ammonia indicates that the descending levels of ammonia, the lower the concentration of ammonia toxicity and improve water quality. It is also supported by the high viability and growth of bacteria in the carrier material.

According Ishartanto (2009) the success of bioremediation processes (aerobic) is highly dependent on the amount of organic pollutant load, the length of contact time (retention) between contaminants and bacteria and bacterial populations effectively.

CONCLUSIONS

Based on the results, it can be concluded as follows: Consortium Bacillus coagulans, Bacillus licheniformis Bacillus subtilis, and Pseudomonas sp encapsulated with a carrier material alginate and starch effective in bioremediation of polluted waste water of Cimuka river with lower levels of BOD by 81.49%, COD: 81.44% COD, 75%, and ammonia 35.82% with bacterial population

reaches $2.89x10^{13}$ CFU/ml in the bioremediation of contaminated waste water origin Cimuka River in 14 days

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STUDY ON BUILDING OF PLANIMETRIC NETWORK STAKEOUT FOR A COMMERCIAL SPACE USING COMBINED TECHNOLOGY GPS-TOTAL STATION

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Abstract

This paper presents a case study on the establishment of a support network using modern and high performance technology GPS - Total Station, in which objective was to highlight all the advantages and accuracies results from its implementation on the ground.
In the first stage is presented achieving of the support network points using Trimble R6 GPS GNSS, which can reach an accuracy of less than 2 cm, the one he recommends for use in such work. After collecting field data, processing was performed using www.topo-online.ro program, and Trimble Business Center, which led to obtaining a very high efficiency and a high accuracy, which is recorded in tables 5,6,7. For linking to the national coordinate system, points coordinates in the ETRS89 were transformed using software TRANSDAT in Stereographic 1970 coordinate system. Thus network built fully comply all the requirements of accuracy, visibility, accessibility and control, requiring such construction work.

Key words: *accuracy, coordinates, GPS, total station, support network.*

INTRODUCTION

Stakeout as the main topographical execution works, intended to implement on the land the characteristic points of construction in plan and height, according to the project. Effectively operation involves preparation of project stakeout respectively calculation of necessary elements and drawing on the field of the axis, contours and details of the project.
Building support networks using artificial satellites represented from the beginning a technical and scientific progress, but over time has undergone a number of improvements, which finally led to increased productivity and increase accuracy absolute position determination points.
The Global Positioning System consists of the following major components (subsystems):

- spatial system (after Paunescu C., 2001, 2012);
- the control system;
- the users system.

The control system consists of several ground located stations for tracking and continuous monitoring satellites. In it is included Operational Control System (OCS), consisting of the main control station, monitor stations and ground control stations.
Orbital elements and ephemeris parameters monitoring and control of this system are:
- $\sqrt{A}$ - square root of the large semi-axis of the orbit; - orbit eccentricity; - t_{OE} - ephemeris time reference; - Io- tilt reference time - I- rate of change of inclination; - Ω_o -Right Ascension to reference time; - φ - change –interest of right ascension; - ω - argument of perigee; - M_o - mean anomaly at reference time; Δ_n - average movement changing; ;- Cuc, Cus argument corrections latitude; - Crc, crs- orbital radii corrections; - Cic, Cis - tilt corrections (J. Neuner, 2000 Paunescu C., 2012).
The users include all users of GPS equipment that receives signals for positioning. Ground equipment includes receiver units and auxiliary tools: weather sensors, tribrach, tripods and auxiliary equipment.

MATERIALS AND METHODS

In the work carried out was used combined method to build support network using GPS

technology (GPS Trimble R6) and stakeout the points of detail with very high precision total stations (Leica TCRP 1201 R300, Leica TCR 407 Power). The methods of stakeout the characteristic pints of the building are (Onose D., 2004 and Calina A. et al., 2014): 1 - method of points on alignment; 2 - polar coordinates method; 3- rectangular coordinates method or perpendiculars; 4 - intersection method; 5 - repeated intersection method.

Measurements with GPS receivers are different from those classical because their outcome is either Cartesian coordinates (X, Y, Z) or geographic coordinates - altitude, latitude and longitude. Reference surface is uniform for all those coordinates, which is ellipsoid WGS-84 - World Geodetic System (Calina A., 2013 and Calina Jenica 2012 and 2014). GPS measurements derives from measurements of code (pseudodistances) or phase measurements. The results of these measurements can be processed in real time or post - processing. Measurement is performed in real time when the coordinates are obtained on land from processing a single epoch of measurements or even several epochs. The accuracy of these measurements is small - of meters, so this type of measurement should not be used to determine support networks (J. Neuner, 2000 and Paunescu C. et al., 2012).

The process of determining by post - processing requires observations on magnetic media storage and further processing with an appropriate program. The accuracy of this method depends heavily on the residence time and the distance between points. The residence time is longer, and the distance between points is less, the accuracy of the coordinates increases. The Global Positioning System (GPS) technology has revolutionized terrestrial measurements, leading to radical change in the known criteria design of classical stakeout networks (after Badea Gh. et al., 2001, quoted by Calina A., 2014)

The cause of this development is the advantages offered by GPS technology:

- Points should not have visibility, so that geodetic signals are useless;
- Millimeter instrument precision plus a error range from 1 to 2ppm of the distance between points;
- Increased productivity, resulting lower costs;
- Measurements in all weather conditions (fog, rain, cloudy, day/night);
- Capable of three-dimensional measurements.

The current stage of development for geodetic purposes can be summarized under the following considerations: pretentious requirements of precision ($\sigma \leq \pm 1$cm) can be achieved with ease not only to the specific network stakeout distances (0.3 ... 5km) but for much greater distances. One of the great advantages of this technology is the fact that can design networks very well adapted to the stakeout requirements, whose configuration need not comply classical criteria of the design. Since GPS measurements depend to a very small measure by distance support networks can be achieved with fewer points (distance between points 3-5km), a higher density of points is required into area of the stake objective. After completing the project, following the recognition of land network points will be arranged to ensure:

- measurements favorable conditions (in case of GPS measurement technique)
- free sky for elevation angle 15°;
- not be closer than 200m from broadcasters and 50m high voltage pylons;
- sight between points, which allows operation of stakeout in either method of points construction stake;
- auto transport accessibility to nearby points;
- stability points in time (points to be placed in stable land outside protected areas or pipe networks).

Expected relative accuracy in determining the measured base b can be estimated using the empirical formula (Beutler 1989, 1990)

$$\frac{db}{b} = \sqrt{\frac{1}{2b}}\ mm/km$$

RESULTS AND DISCUSSIONS

Based on data gathered from the field, later was performed processing of the stakeout network using the program (www.topo-online.ro). It processes data through indirect measurements. In the program has been loaded a text file with a specific form (Figure 1).

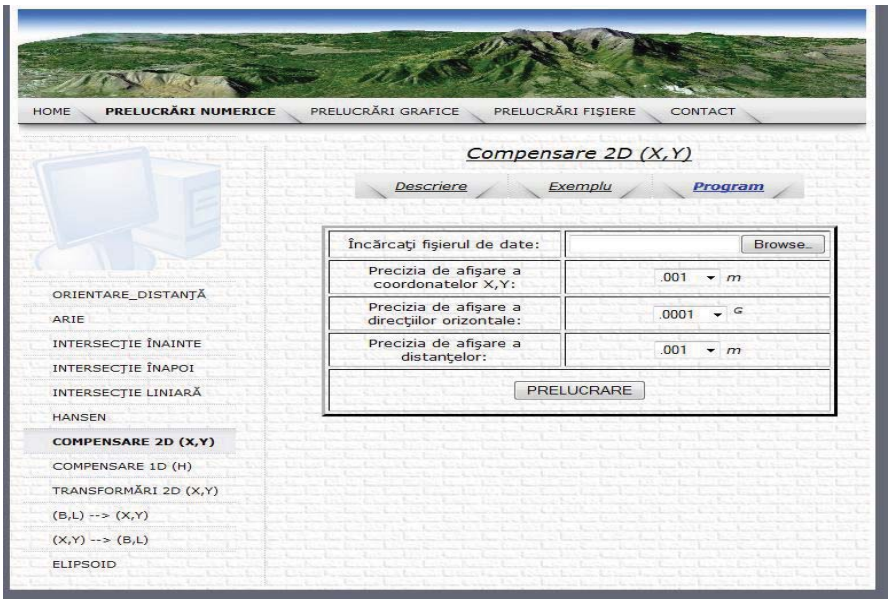

Figure 1. Text file

In order to elaborate the functional model were used provisional values for the unknowns that occur in the model, which refers to the approximate coordinates of the points of the network and also to the provisional values of the orientation angles for the stations at which angular observations were made.

These values must be sufficiently close to the values most likely to be able to waive the terms of second order and higher, from Taylor series expansion. Temporary coordinates chosen for the network points were obtained using GPS technology. The devices used are of the type Trimble R6 GNSS.

Table 1.Technical specifications of the Trimble R6 GPS

MEASUREMENTS	GPS: L1 C/A CODE, L2C, L2E (TRIMBLE METHOD FOR TRACKING SIGNAL L2P) GLONASS L1 C/A CODE, L1 CODE P, L2 C/A (ONLY GLONASS-M), L2 CODE P		
DIFFERENTIAL GPS POSITIONING ON CODE	ACCURACY	HORIZONTAL	$\pm(0.25m+1ppm)^2$ RMS
		VERTICAL	$\pm(0.5m+1ppm)^2$ RMS
STATIC MEASUREM.		HORIZONTAL	$\pm(5mm+0.5ppm)^2$ RMS
		VERTICAL	$\pm(5mm+1ppm)^2$ RMS
KINEMATIC MEASUREMENT		HORIZONTAL	$\pm(10mm+1ppm)^2$ RMS
		VERTICAL	$\pm(20mm+1ppm)^2$ RMS
AREA OF OPERATION		TEMPERAT.	from -40^0C to $+65^0$C
		MOISTURE	condensation 100%
		IMPERMEABILITY	IP67 for dip depth of 1m

It was also used data from ROMPOS system, which is based on a National Network permanent GNSS Stations (GPS + GLONASS). Reference stations operate permanent providing data in real time and at predetermined intervals (1h, 24h).

ROMPOS is a position determination system based on GNSS technologies and includes the following services:

- ROMPOS DGNSS - Service for applications in real-time kinematic (positioning accuracy between 3m and 0.5m);
- ROMPOS RTK - service for accurate real-time kinematic applications (up to 2cm accuracy);
- ROMPOS GEO (Geodetic) for postprocessing applications (less than 2cm accuracy).

At work under study was used the method **GPS RTK (Real Time Kinematic)** - Real-time kinematic applications to give an accuracy of up to 2 cm. The measuring range was 1 second, and measurement epochs 300. It states that during measurements was a favorable weather with little wind and temperatures between 15-22°C.

Calculations were performed using Trimble Business Center. Field measurements have been downloaded from the device as a job, then it was loaded into the program.

Stages of work with Trimble Business Center were:

1. Creation of a project in which to save the results;

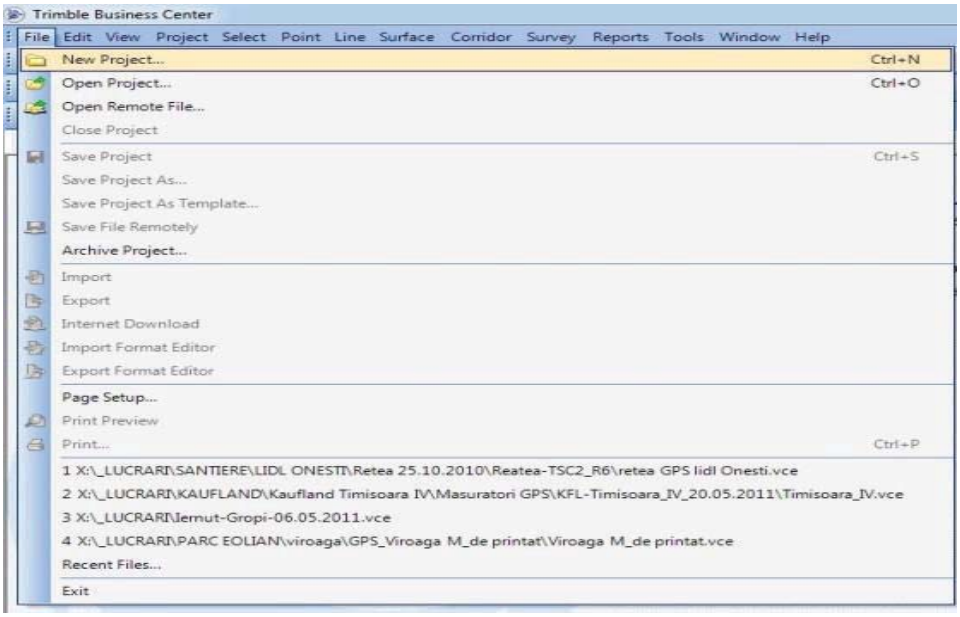

Figure 2. Creation of the project.

2. Importing the job downloaded from the device;

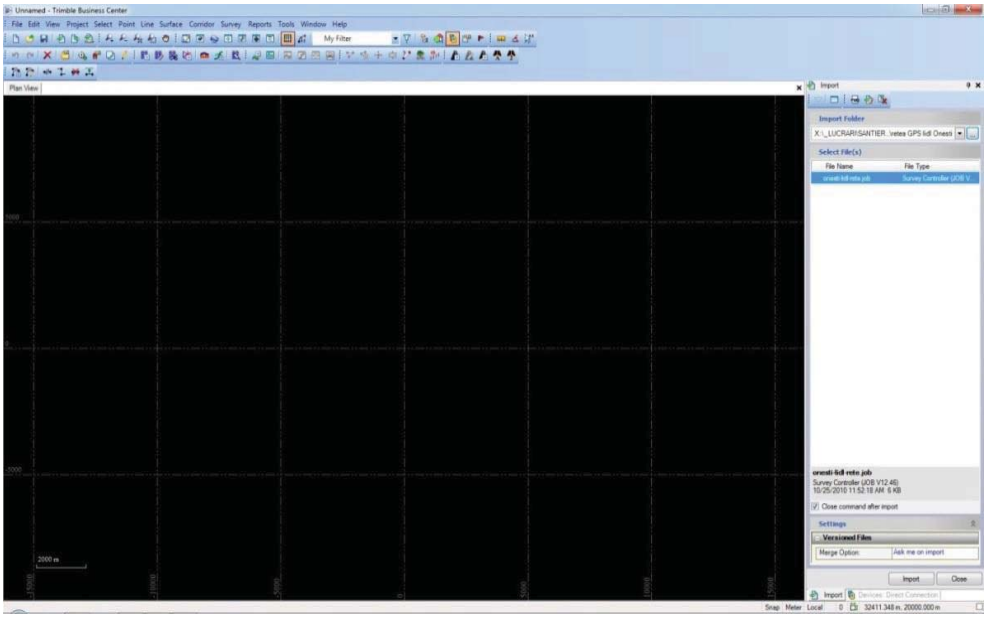

Figure 3. Importing the job

3. Obtaining GPS network

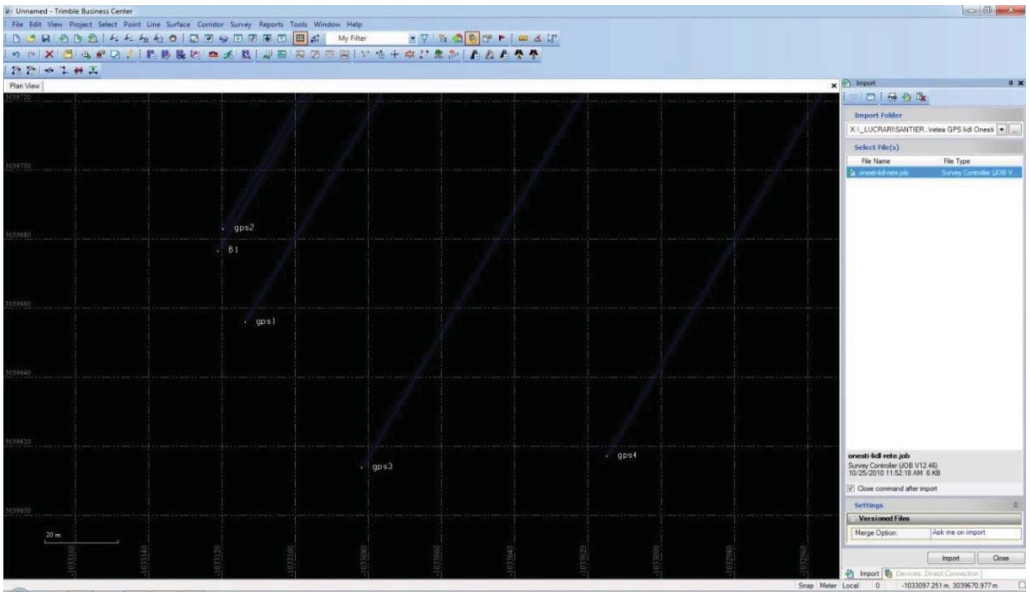

Figure 4. GPS network

4. Exporting data.

They will be saved as a file (.txt). It here will find the coordinates of points in the system ETRS89 in the form: Name point, Latitude (B) Longitude (L) and Ellipsoidal height (He). Then using software TRANSDAT were transformed point coordinates from ETRS89 in 1970 stereographic coordinate system (system used in Romania).

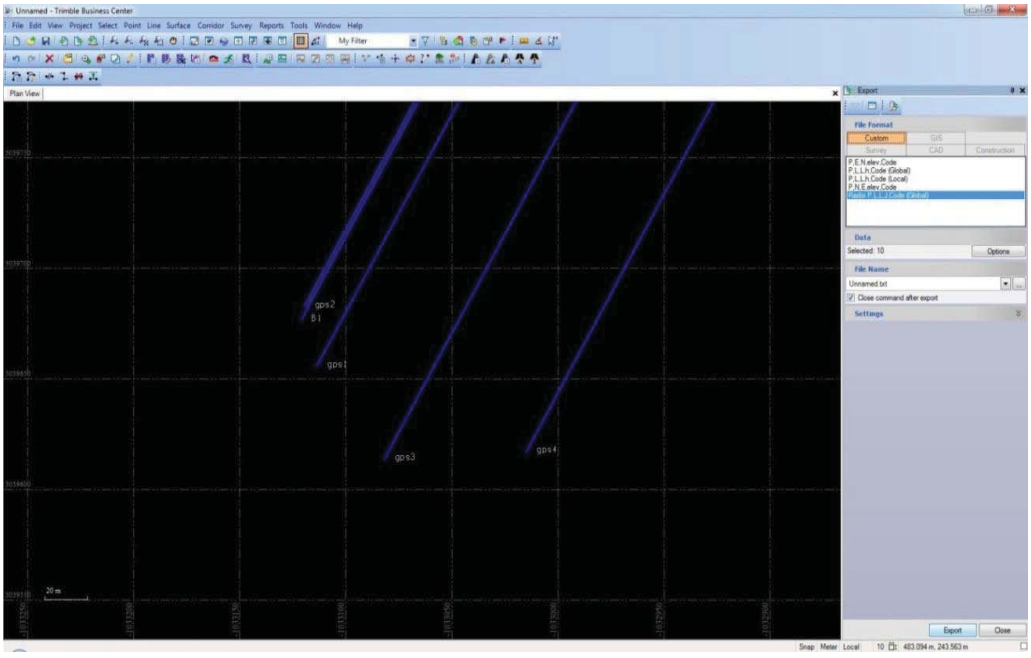

Figure 5. Exporting data to obtain coordinates

The temporary coordinates of the new points are presented in Table 4.

Data processing for stakeout network of the Commercial Complex

1. Initial data

Coordinates of the old points

Table 2. Inventory of coordinates old points

Name	X [m]	Y [m]
1000	530383.459	636668.591
1001	530597.792	636595.661

Directions measured values reduced to the projection plane

Table 3. Horizontal directions

Station point	Sight point	Direction [G]
1000	1001	377.3579
	GPS1	162.2631
	GPS3	148.5953
GPS3	1000	348.5954
	GPS1	342.9416
	GPS2	352.3331
	GPS4	80.8325
GPS1	GPS2	370.3966
	1001	376.0957
	GPS3	142.9483
	1000	362.2564

2. The temporary coordinates of the new thickening points

Table 4. The temporary coordinates of the new thickening points

Name	X [m]	Y [m]
GPS1	530365.739	636679.873
GPS2	530389.593	636668.697
GPS3	530333.371	636718.183
GPS4	530350.560	636779.573

3. The result of the processing

Table 5. Horizontal angular directions offset and their accuracies

Station point	Sight point	Measured direction [G]	Corection [cc]	Offset direction [G]	Standard deviation [cc]
1000	**1001**	377.3579	19.4	377.3598	± 12.47
	GPS1	162.2631	-37.27	162.2594	± 51.39
	GPS3	148.5953	17.87	148.5971	± 18.88
GPS3	**1000**	348.5954	-3.82	348.595	± 18.88
	GPS1	342.9416	18.2	342.9434	± 23.95
	GPS2	352.3331	-12.26	352.3319	± 18.19
	GPS4	80.8325	-2.12	80.8323	± 20.15
GPS1	**GPS2**	370.3966	0.59	370.3967	± 41.57
	1001	376.0957	-16.01	376.0941	± 12.33
	GPS3	142.9483	-21.2	142.9462	± 23.95
	1000	362.2564	36.63	362.2601	± 51.39

Table 6. Offset distances and their accuracies

Station point	Sight point	Measured distance [m]	Corection [mm]	Offset distance [m]	Standard deviation [mm]
1000	**GPS1**	20.89	-0.77	20.889	± 3.37
1000	**GPS3**	70.392	-0.89	70.391	± 3.54
1000	**GPS2**	6.218	1.15	6.219	± 3.33
GPS3	**1000**	70.392	-0.89	70.391	± 3.54
GPS3	**GPS1**	50.178	0.68	50.179	± 3.47
GPS3	**GPS2**	74.921	-0.13	74.921	± 3.55
GPS3	**GPS4**	63.878	0	63.878	± 3.52
GPS1	**GPS2**	26.34	-0.12	26.34	± 3.39
GPS1	**1001**	246.745	9.25	246.754	± 4.12
GPS1	**GPS3**	50.178	0.68	50.179	± 3.47
GPS1	**1000**	20.892	-2.77	20.889	± 3.37

Table 7. Offset coordinates of new points and their accuracies

Point name		Temporary coordinates [m]	Corections [mm]	Offset coordinates [m]	Standard deviation [mm]	Total standard deviation [mm]
GPS1	**X**	530365.739	81.0	530365.820	± 1.48	± 2.01
	Y	636679.873	-96.0	636679.777	± 1.37	
GPS2	**X**	530389.593	92.0	530389.685	± 2.06	± 2.89
	Y	636668.697	-78.0	636668.619	± 2.03	
GPS3	**X**	530333.371	36.0	530333.407	± 1.83	± 2.63
	Y	636718.183	-99.0	636718.084	± 1.88	
GPS4	**X**	530350.56	93.0	530350.653	± 3.98	± 5.51
	Y	636779.573	18.0	636779.591	± 3.80	

Table 8. Elements of error ellipses

Point name	a – semi-major axis [mm]	b – semi-minor axis [mm]	Semi-major axis orientation [G]
GPS1	1.7	1.08	155.63
GPS2	2.38	1.64	151.64
GPS3	1.88	1.83	95.38
GPS4	4.22	3.54	41.62

Table 9. Final points coordinates

Point name	X(North) [m]	Y(East) [m]	S_x [mm]	S_y [mm]	S_p [mm]
1000	530383.459	636668.591	---	---	---
1001	530597.792	636595.661	---	---	---
GPS1	530365.820	636679.777	± 1.48	± 1.37	± 2.01
GPS2	530389.685	636668.619	± 2.06	± 2.03	± 2.89
GPS3	530333.407	636718.084	± 1.83	± 1.88	± 2.63
GPS4	530350.653	636779.591	± 3.98	± 3.80	± 5.51

CONCLUSIONS

Based on studies in the field and in the office, it was concluded that the network support for stakeout axes and the characteristic points of the building must be executed using GPS modern technology and data processing using www.topo-online.ro program, which use as basis for calculation the indirect measurements.
Data collected on the ground had to be compensated, primarily were offset horizontal directions, where corrections are between 2.12^{cc} and 37^{cc}, and the standard deviation of 12.33^{cc} and 51.39^{cc}, then distances were corrections are between 0.12 mm and 9.25mm, standard deviation of 3.33 to 4.12mm.
According to the data processed and calculated was found that the accuracy of determining support network points is high because all the topographic elements have values of standard deviations much smaller than the tolerance allowed in the work of stakeout, for civil and industrial buildings.
In the first phase of the field were determined temporary coordinates of the points of support network after they have been processed and compensated, observing that the standard deviations of X and Y are reduced and total standard deviation does not exceed 5.51mm.
All final coordinates of support network points have been checked and compensated rigorously, which gives us the certainty that their use in stakeout the axes and characteristic points of future construction, will be transmitted without any errors or pressure.
A particularly important phenomenon observed is that surveying and stakeout work efficiency is very high, due to the use of modern and advanced technologies and also staffing costs and decreased significantly compared with the classical method.

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THE USE OF METADATA FOR COMPLETING THE GENERAL CADASTRE IN ROMANIA

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Abstract

Romania's integration into EU requires respecting the regulations established by the institutions of this community. One of the regulations is DIRECTIVE 2007/2/CE establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). Basing our opinion on the definition of general cadastre, we consider as opportune the use of metadata in completing its objectives, due to the data sets offered by metadata to potential users. Metadata are information describing sets and services of spatial data, permitting the search, the inventory and the usage by field specialists and other interested persons. Starting from the current situation in Romania, the present paper aims to describe the role and the importance of using metadata in the context of completing the general cadastre in Romania.

Key words: *metadata, cadastre, spatial data, INSPIRE.*

INTRODUCTION

The modernisation of the Romanian society due to the passing to a democratic economy required a series of projects of ample spread for the design and creation of competitive structures, adapted to the EU requirements. After 1989, a first important step was the revitalization of the right to property, leading to the breaking-up of the land, new pieces that need to be registered in the Romanian general cadastre. Based on this aspect, modern, efficient and economical solutions are necessary so the evidence of landlords and of the Romanian territorial fund to respond to the global contemporary requirements.

Once Romania adhered to EU, the state had to adopt a new legislation, including Directive 2007/2/CE of The European Parliament and Council, from the 14 of March 2007, for the creation of a spatial information infrastructure inside the European community (INSPIRE). INSPIRE as "spatial information infrastructure" means: metadata, spatial data sets and spatial data services, network services and technologies, sharing, access and usage agreements, coordinating and monitoring processes and procedures, established, exploited or available in conformity with the above mentioned directive.

Starting from the definition given by the 2007/2/CE Directive for the creation of a infrastructure for the spatial information in EC, (INSPIRE), that statues that "metadata" means information describing spatial data sets and services and permit their search, inventory and usage", the benefits in the contemporary world of spatial data represent a huge change in creating, storing, using and developing an entire assemble of interconnected data in everything that is linked to the monitoring in all the domains to a global level. INSPIRE is based on an spatial data infrastructure created and under maintenance of each 27 member states of European Union, destined to cover 34 themes of spatial data necessary for the support of the politics of environmental protection, each theme being defined by key components and implementation norms.

The global interest for the metadata standards and practices are consequence of the electronic publishing, the increase of individual or organizational websites and also of the vast non differential data available online. The metadata represents the totality of information used to characterize and describe the data and data sets

in a clear and intelligible way, including information upon the following aspects:

- A good conformity of spatial data sets;
- Applicability conditions for the access and usage of spatial data sets and services;
- The quality and validity of spatial data sets;
- The public authorities responsible with the establishing, administration, maintenance and distribution of spatial data sets and services;
- The limitation of the public access and its reasons.

The metadata classification according to the INSPIRE Directive contains 10 elements according to Figure 1.

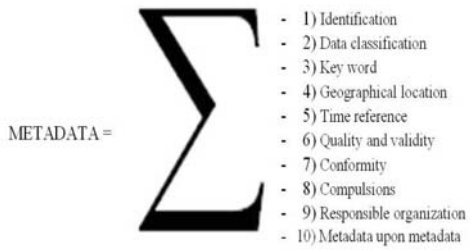

Figure 1. INSPIRE profile for metadata

Determining the spatial data types and the specification of requirements for them is an essential priority of INSPIRE Directive.

Among the main principle of INSPIRE Directive are:

- A single collection and storage of spatial data for the most efficient way of maintenance;
- The possibility of combination without problems of spatial information from various European sources and the sharing between users through a various range of applications
- The collected information to a certain scale must be available for sharing at other scales
- The identification of geographical data must be convenient, also the usage manner for a specific necessity and the acquisition and usage conditions.

The Romanian institution that deals with the creation of the national spatial data infrastructure is ANCPI (The National Agency for Cadastre and Real Estate Publicity), which is presently working to a spatial data base, its results being the geoportal INSPIRE. The INSPIRE geoportal of ANCPI offers the necessary means for the search of spatial data and data services, under the national legal restriction for access, visualization and download. This way of applying the INSPIRE Directive has the purpose of permitting the access of relevant geographical information, in an actual and qualitative form, supporting the formulation, implementation, monitoring and evaluation of policies and activities with a direct or indirect impact upon the environment.

Figure 2. ANCPI running projects

Figure 3. INSPIRE geoportal to ANCPI

STANDARDS OF THE INSPIRE DIRECTIVE

Implementing the national spatial data infrastructure respects the technical specifications emitted by The European Commission, under the name of INSPIRE profiles, based on national and international standards (ISO 19115, Dublin Core, Open Geospatial Consortium, Comité Européen de Normalisation, CDS etc.). Following CEN (Comité Européen de Normalisation) were adopted the following OGC (Open Geospatial Consortium)

standards: ISO19115/ ISO19119 Application profile for CSW (Catalog Service) 2.0 (CAT2 AP ISO19115/19)2, enhanced with a number of supplementary fields explicitly required in the initial INSPIRE proposal) usage rights, compliancy etc.), Figure 3.

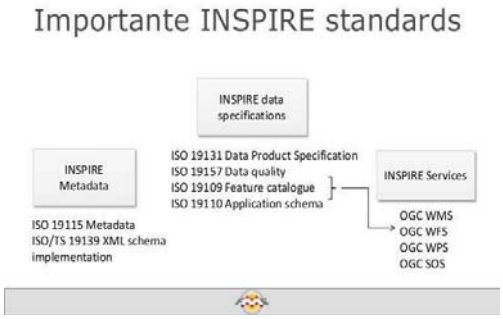

Figure 4. International standards for metadata creation

For the creation and update of metadata it is necessary to quantify the necessary resources, to adapt the existing metadata and to create metadata for the data sets that will be created. An ample example is the EuroMapFinder4 catalogue for services, launched on the 25th of January 2006, a catalogue based on ISO 19115. This catalogue includes descriptions for the data provided by 18 members of EuroGeographics.
The access to the catalogue is based on the discovery service, Figure 5.

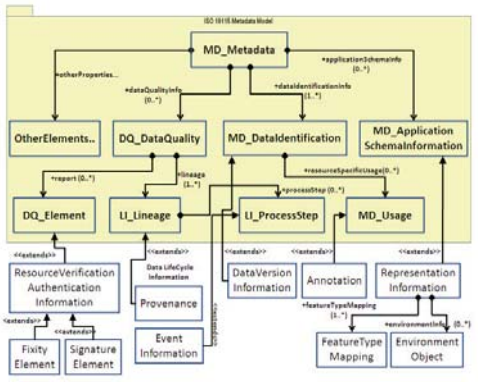

Figure 5. Metadata model according to the European standard ISO 19115.

Among the main aims of the INSPIRE directive is that of determining the specific data types required by European SDI.
INSPIRE Data Specification Drafting Team works with ISO 19131; ISO includes descriptions of the function schemes, catalogues of elements, spatial and temporal reference systems and the quality of the information. Figure 6.

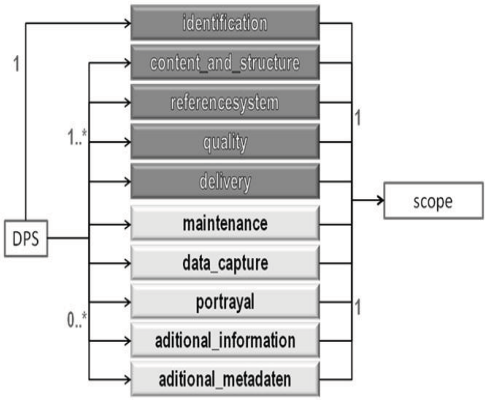

Figure 6. Data content for ISO 19131 standard. UML simple model for DPS.

It is well-known that all the information content group are linked to a domain that describes the geographical area of availability, thus, beside the identification content group, each group may present more than an entry, so the data from various geographical regions may have different entrances in DPS.
In case the information is stocked according to ISO 19131, DPS may be used in the spatial time of the data production process to support the working flow and to automatically generate metadata for the produced data.
Thus, there are three possibilities of applying DPS:
- The direct mapping of the DPS content for the metadata of the produced data;
- guiding and supporting the user and the working flow during the production process;
- The support of manual introduction of metadata.

SDI TECHNOLOGIC CONCEPT

Spatial Data Infrastructures – SDI represent the technology, the politics, the standards and the human resources necessary for the acquisition, distribution and the usage of spatial data.
This technology has the as main objective the maximum usage of geographical information in the possession of various operators from the private and public domain.
Spatial Data Infrastructures are continuously developing on national and international levels.
Among the states that exclusively contributed to the implementation of the spatial data infrastructure are: **The United States of America** that founded The Federal Geographic Data Committee (FGDC) in 1990, **Canada**, implementing GeoConenections, an important component of CGDI (Canadian Geospatial Data Infrastructure), **Australia** and **New Zeeland**, implementing The Australian Spatial Data Infrastructure.

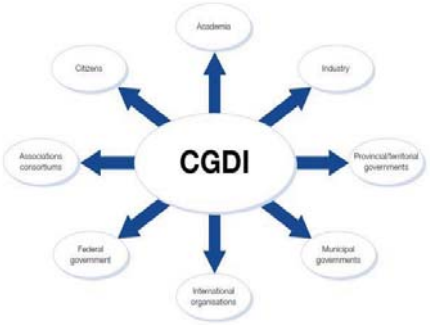

Figure 7. Providers for the Canadian spatial data infrastructure.

In our country, three types of metadata were developed:
a) ".xls" format metadata –colour orto foto plan, scale 1:5000

Figure 8. ".xls" metadata model – colour ortofotoplan scale 1:5000.

b) ".xml" format metadata – colour ortofotoplan, scale 1:5000.

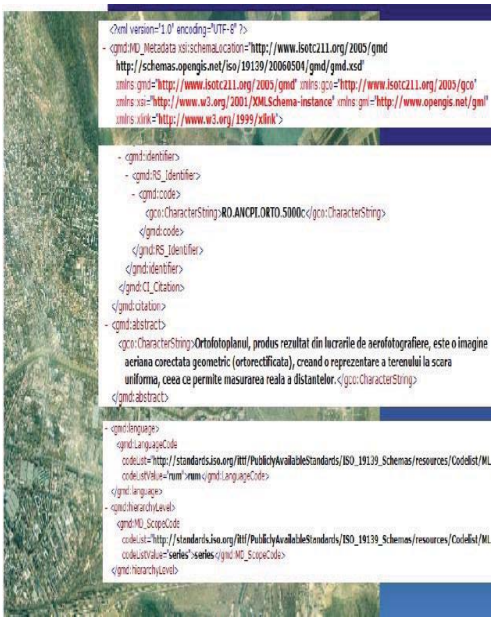

Figure 9. ".xml" format metadata –colour ortofotoplan, scale 1:5000.

c) ".xml" format metadata – on the A.N.C.P.I. Geoportal– TOPRO5

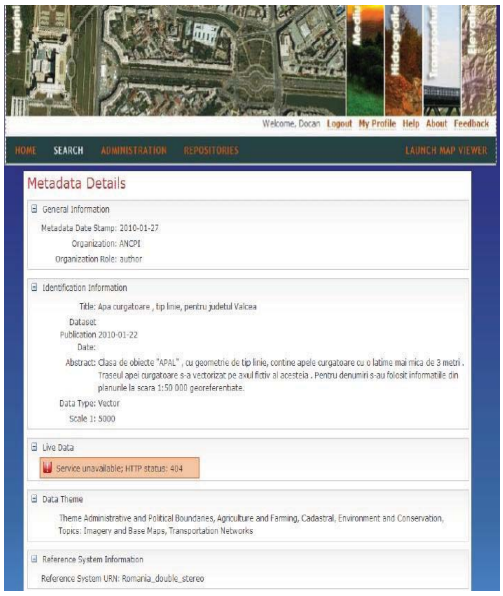

Figure 10. ".xml" format metadata –
on the A.N.C.P.I. Geoportal– TOPRO5

It results that the aim of creating a national spatial data infrastructure is to create a network of valid spatial data resources, which will constitute an important support in taking any type of decisions.

CONCLUSIONS

Due to the fact that the spatial data structures are becoming more and more elaborate and new sets of data are created, the provision and the control of spatial data quality has an important role in the scientific development.

The continuous evolution and the dynamics of spatial data structures and sources have direct consequences upon the entire mechanism of creating geographical informational systems and the general cadastre works.

The spatial data infrastructure is meant to act like a deposit for data and spatial data services, helping the exchange of spatial data between the participants of its creation.

The real value of spatial data is visible only when solving global and local problems.

The benefices offered by the usage of spatial data include:

- The enhancement of the informational quality necessary to the territorial development and to the cooperation with the local authorities (rural and urban);
- Increasing the interoperability in the information system necessary for the projects developed by the central and local authorities;
- Reducing the associated costs for the creation of spatial data;
- Increasing the degree of awareness for the local and global environmental problems.

Creating the spatial data infrastructure has a major role in ensuring the availability of spatial data. For an efficient implementation process of the Government Edict 4/2010 and the development of the national spatial data infrastructure, it is necessary to translate into action a number of measures, the following being considered as priority:

- Publishing reference data sets in order to permit the harmonization on spatial criteria of the existing data and new data;
- signing agreements between institutions for the Exchange and common usage of data in order to develop INIS;
- Adopting at the beginning of each year the plan of activity for the INIS Council and the attribution of the participant organisations, so they may plan the necessary resources;
- Organising events on the theme of spatial data infrastructure, where may be discussed a series of technical aspects related to the development of INIS.

The time, the effort and the resources consumed for collecting similar spatial information may be used to collect new information that will be the starting point for future spatial data sets.

Applying the INSPIRE Directive will contribute to the enhancement of the national spatial data infrastructure, especially in the domain of inter operability of spatial data and services and will represent a common effort of cooperation upon the technical implementation of the directive.

Starting from the definition "the general cadastre is a unitary and compulsory system of technical, economic and juridical evidence of all the real estate on the territory of the state" and based on our study, we consider as necessary a much more consistent approach of metadata in the creation of the general cadastre on the territory of our country.

PROPOSALS

Analysing the above presented aspects and based on the large usage of spatial data infrastructure, we consider useful, practical and economical the usage of spatial data sets for the elaboration of the national cadastre and cadastral register creation.

We propose for this purpose a spatial data model we consider useful for the creation of the national general cadastre programme.

Thus, we propose that all the three functions of the general cadastre to be implemented in spatial data sets:

- The real estate identified with I.E. 50000, registered in C.F. Bocsa, is in the property of Voina Ioan with the cote 1/1, the area of 2877 square meters, the category of arable usage, situated in the unincorporated area of Pohanca, Caras-Severin County.
- The owner obtained the right through a bill of sale, authenticated under the number 1/2015 on the 10th of January 2015 by the attorney Ionescu Marius.
- The real estate is identified from a plan metric point of view through the rectangular coordinates (X and Y), Figure 11.

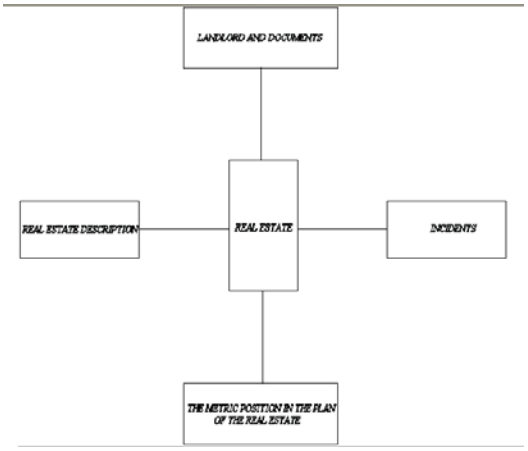

Figure 11. Model for metadata structure, with applicability in the national program for the general cadaster.

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THE NEGATIVE IMPACT OF SINKHOLES IN AGRICULTURE LAND: THE CASE OF KONYA

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Abstract

Sinkholes, one of the carstic geographical formations, come into existence as meltable rocks underground, such as limestone create holes in time and as ceilings of those holes collapse. Sinkhole formations have occurred with convenient lithological and ground water effect in Konya area for a long time. Dry or wet, there are almost 100 sinkholes in Konya, which they are called as sinkholes. As a result of overuse of groundwater in the district of Konya, existence of sinkhole has been increased recently. Since appearances of aforementioned sinkholes are located in agriculture land has been carried issues because those aforementioned sinkholes are covered unproperly and used as a farm area by property owners. The covered process is extremely dangerous and it sometimes causes the sinkhole area to collapse again. In this study, it is aimed to discuss some sample of aforementioned sinkholes in the agriculture lands in Konya.

Key words*: Sinkholes, Konya, agriculture land, Turkey.*

INTRODUCTION

Formations of sinkhole have occured in Konya area for a long time with the effect of convenient lithologic structure and groundwater. However, there has recently been an increase in formation of sinkhole with the effect of the change in level of groundwater, chemical features of groundwater, lithologic structure, climate features and human beings. That's why, sinkhole formations can be categoriezed as old-occuring and new-occuring. As new-occuring sinkholes have begun to occur in settlements and agrucultural lands, they've begun to directly affect humanity. Many people have begun to fulfill some plains with excavation in order to prevent aforementioned impacts. This situation, in fact, presents vital danger for people, because the fulfilled plains attract attention as a potential to harm people by collapsing again.

Researchers who studied around Konya suggested many ideas (*Lahn 1940, Güldalı and Şaroğlu 1983, Erol 1990, Selçukbiricik 1992, Çörekçioğlu 1994, Canik 1997, Pekkan 2004, Törk et 2010, Göçmez 2011)* about description, formation and features of sinkholes.

MATERIALS AND METHODS

In this study, the formation of sinkholes in and around Konya, it is aimed to present the effects of the sinkholes that have formed in past and present on human activities. In order to achieve this goal, firstly field studies take an important place. Through the field studies both the areas in which there are sinkholes and the settlements around the sinkholes in the determined land will be examined on the spot. In order to document the studies in the field, it will be photographed on the spot. It will be tried to measure the wide and depth of the sinkholes. The heights and the relationships of sinkholes with each other will be examined. By being evaluatet of both data that will gathered through study of field (photographs, statistical information and the notes of interview with local people) and related literature, the formation of sinkholes and the evolutian of sinkholes their effects on activities of the people living around will be evaluated.

SINKHOLES IN KONYA

Sinkholes in Konya exist in middle and southern parts of Central Anatolia.

These sinkholes can be particularly found in Karapınar, Çumra, Karatay, Akören, and Ereğli and Kadınhanı districts. We separate the sinkholes in Konya into two groups, as old and newly formed (Figure 1).

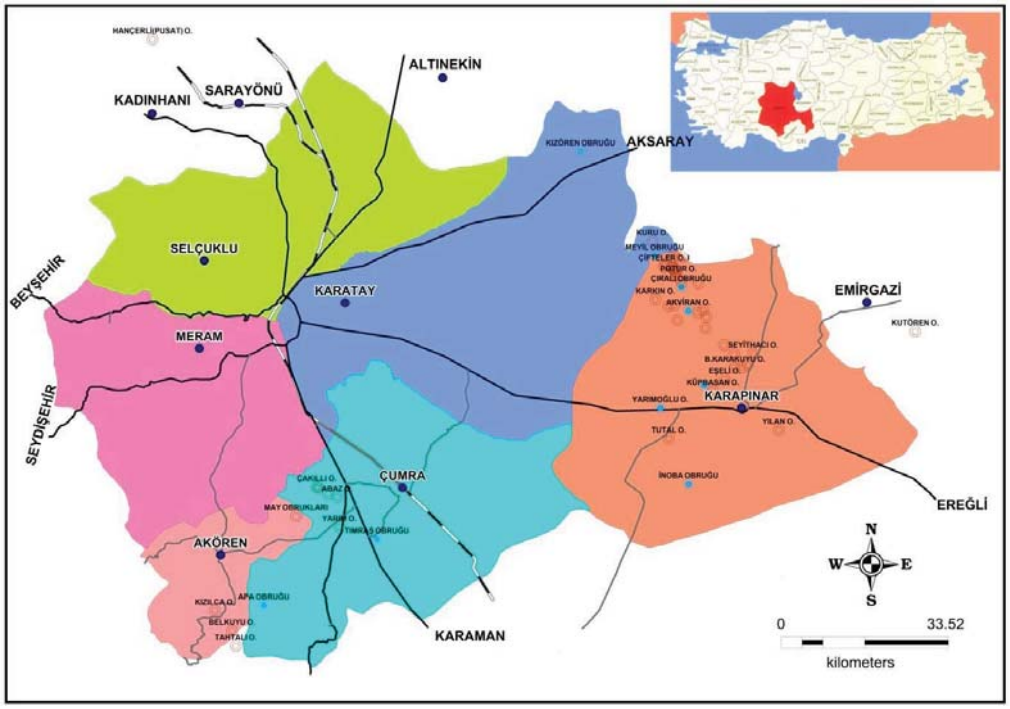

Figure 1. Distribution of the sinkholes in Konya

SINKHOLES IN TERMS OF FORMATION

In Konya, there are sinkholes that were formed in old era and attract attention in terms of morphologic and their formation characterristics. In view of place and depth, the sinkholes which are old formed such as Kızören, Meyil, Çıralı, Timraş and Apa, Zincancı, Akobruk, Fincan, Yarımobruk, Potur, Karain, Hamam, Çifteler, Derinobruk, Kızılobruk, Celal, Kurk, Cehennem, Yeniopan, Karkın, Niğdeboğazı, Kuruobruk, Küpbasan, Meke, Bereketini, Belkuyu are the ones which mostly attract attention.

Kızören Sinkhole: It exists in the east of Konya centrum, on the highway between Konya and Aksaray, in the 4 kilometers north of Kızören Town (Figure 2). The sinkhole had emerged in Upper Paleozoic old crystalized limestones and Upper Miocene-Pliocene old lacustrine formations. Upper elevation of the sinkhole seen in circular shape is 1004 meters in average; its water surface elevation is 973 meters. Long axis of the sinkhole in east-west direction was determined as 341 meters, and its short axis in north-south direction was determined as 182 meters. Although Selçukbiricik (1992:103) remarked the lake depth of the sinkhole as 145 meters, today, this depth has slightly decreased due to the ebbing of underground water. Kızören Sinkhole and the area of 127 hectares around it were involved in contract list as Ramsar Convention in 2005.

Meyil Sinkhole: It's located in the Meyil Plateau in the 40 kilometers northwest of Karapınar (Figure 3).The sinkhole had emerged Upper Miocene-Baventian old different layers. The elliptic sinkhole's upper elevation is 1044 meters; its water surface elevation is 980 meters. Long axis of the sinkhole in east-west direction is 660 meters, and its short axis in north-south direction is 590 meters. The measurement in September, 2014 shows that

various fish live in the sinkhole whose lake depth is 40 meters.

Çıralı Sinkhole: It's located in the Çıralı Plateau in the northwest of Karapınar (Figure 4). The sinkhole had emerged in Upper Miocene-Pliocene old limestone, clayey limestone, marl, travertine limestones. Circular shaped sinkhole's upper surface axis is 354 meters, short one is 303 meters, its lake surface's long axis is 135 meters and short one is 120 meters. Its upper elevation is 1070 meters, its lake surface elevation is 966 meters and there's a range of about 90 meters between upper surface and Lake Surface. Today (October, 2013), the depth of the lake has decreased so much that the branches of an old tree has appeared. It was seen that it decreased up to 12 meters as of the date of October, 2013. Cave habitations' existence spaces of 10 to 12 meters emerging on the slopes in the north, east and southwest parts of the sinkhole. The fact that the tools and coins found in these caves were dated to Rome and early Christian eras proves that this place had been used with aim of locating since old ages.

Figure 2. Kızören Sinkhole from south

Figure 3. Meyil Sinkhole from North

Figure 4. Çıralı Sinkhole Lake from north

Figure 5. Timraş Sinkhole Lake from South

Timraş Sinkhole: It's in the southeast of Village Gökhüyük in Çumra (Figure 5). The ellipse sinkhole's upper surface long axis' caliber in north-south direction is sketchy 325 meters, its short axis in east-west direction is 245 meters, lake surface's long axis is 242 meters, its short axis is 197 meters. Its upper elevation is 1035 meters, its lake surface elevation is 1005 meters and there's a range of about 25 meters between upper surface and Lake Surface. Water depth of the sinkhole is 40 meters. The sinkhole had emerged in Upper Miocene-Pliocene old limestone, marl and sandy-clayey formations. There are horizontal limestone cornices on its slopes and melting spaces between the cornic and marly surface. As the water of the lake is fresh, various fish kinds exist.

RECENTLY FORMED SINKHOLES

There are many sinkholes in Konya province which has recently emerged and are going on emerging today. Significant amount of recently formed sinkholes have emerged in Karapınar district (Figure 1). While sinkholes today sometimes slightly show indications, sometimes they collapse without any indications.

İnoba Sinkhole: It's located in the southwest of Karapınar district center and 40 meters west of İnoba plateau habitation (Figure 6).The sinkhole emerged in 2008 in limestone, clay and marly formations. Its upper elevation is 1010 meters. While the sinkhole was in 25 meters caliber and 33 meters depth when it first emerged, today (October, 2013), it has a caliber of 29 meters and depth of 42 meters. The fact that the sinkhole is close to plateau habitation presents a great danger. Families around here stated that they had immigrated to Karapınar district center. The sinkhole formation is regarded as a significant danger for people who make a living from sheep-goat farming.

Yarımoğlu Sinkhole: It's located in the Akkuyu Plateau in the west of Karapınar district center. Sinkhole is occured in the agriculture lands. When sinkhole was occured corn was field land. The sinkhole emerged in 2009 in soil, clay and marly alluvion formations. Its upper elevation is 1010 meters. While the sinkhole had a caliber of 25 meters when it first emerged, the caliber has raised up to 28 meters in present day. Water exists at the part after almost 49 meters of sinkhole (Figure 7). Yarımoğlu Sinkhole attracts tourists as it is highly close to Konya-Adana highway. Edge of the sinkhole has been covered with simple barb wires. There's a serious danger for people visiting the sinkhole. Currently 350 m^2 there agriculture land were destroyed by sinkhole.

Figure 6. İnoba Sinkhole

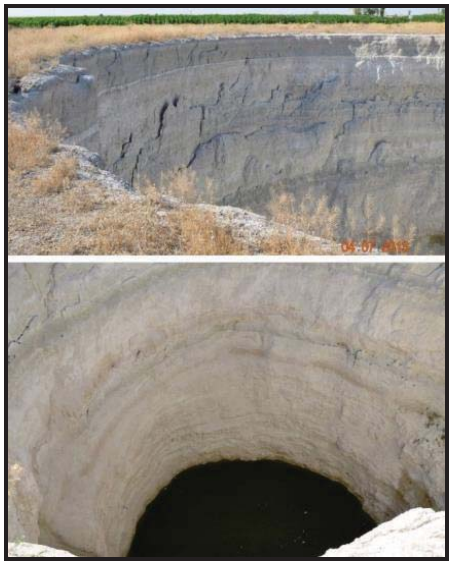

Figure 7. Yarımoğlu Sinkhole

Yavşançukuru Sinkhole: It's located in the northwest of Karapınar, 1 kilometer east of Yavşançukuru Plateau. In the measurement performed in December, 2000, it was determined that the northeast-southwest section of sinkhole's caliber increased to 17.5 meters and northwest-southeast section increased 16.5 meters (Göçmez et al, 2001). According to the measurement performed in October, 2013, the caliber of the sinkhole is 21 meters, its girth is 70 meters and its depth is 56 meters.

Nebili Sinkhole: It's located in the north of Büyükkarakuyu Plateau. Its upper elevation is 1092 meters; its depth is 70 meters. The sinkhole which had been wet since its emerging has become a dry sinkhole as underground water level went deeper 21. Sketchy ellipse shaped sinkhole's long axis is 18 meters, short axis is 16 meters (Figure 8).This makes it possible for pigeons to house.

Akviran Sinkhole: It's located in the northwest of Karapınar and north of Akviran Plateau. The sinkhole emerged in May, 1977 in Upper Miocene-Pliocene formations (Figure 9). Its upper elevation is 1046 meters, its depth is 80 meters and its calibre is 24 meters. There's 26 meters of range of ridge between the sinkhole's

upper surface and water level. It's observed that the shielless sinkhole presents a danger for living beings. Currently 190 m^2 there agriculture land were destroyed by sinkhole.

Figure 8. Nebili Sinkhole

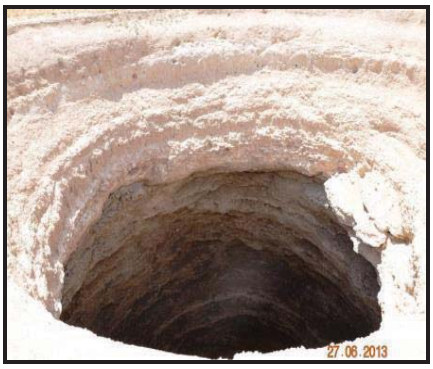

Figure 9. Akviran Sinkhole

Içeriçumra Çakillar Sinkholes: 3 sinkholes emerged in different dates in İçeriçumra Çakıllar Location. First of them emerged in 2005, the second one emerged in 2008, and the third one emerged in 2009. Each one of these sinkholes was plugged by landowners. First of them emerged in November, 2005 in İçeriçumra Çakıllar Location. In our measurement in 2008, the caliber of circular sinkhole was determined as 5 meters, its depth was determined as 9 meters. During that period, limestone, clay and marley layers on the slopes of the sinkhole could be prominently seen (Figure 10). Moreover, although the sinkhole hadn't been named yet, we stated that it would be proper to name it Çakıllı Sinkhole as the location where it had emerged was Çakıllar (Bozyiğit-Tapur, 2009:149). However, when we went there to make a more detailed research, it was observed that the sinkhole had totally been plugged.

Figure 10. İçeriçumra Çakillar Sinkhole-I plugged in present day (Photo taken in 2008)

Figure 11. İçeriçumra Abaz Sinkhole plugged following its emergence

The other two sinkholes emerged in the south of 8^{th} kilometer of İçeriçumra-Seçme highway on the same. For information about the sinkholes, research was made on the location shown by Hasan Görmez, who plows the farm. Hasan Görmez stated that they had made measurements themselves when the sinkholes had occured, the sinkhole emerging in 2008 had had a caliber of 4 meters and depth of 7 meters, and the one emerging in 2009 had had a caliber of 2 meters and depth of 4 meters. He stated that they had plugged the sinkholes in order to cultivate the farm (Tapur-Bozyiğit, 2013). However, little signs of collapsing and cracks can be observed on one of the plugged sinkholes.

İçeriçumra Abaz Sinkhole: It's located in the borehole fields in the west of İçeriçumra Town (Abaz Road). The sinkhole emerged in Quaternary old alluvion layers. Its upper elevation is 1027 meters; its depth is 8 meters. The calibre of sketchy circular sinkhole was measured as 10 meters. The sinkhole emerging in July, 2012 has been plugged with excavation materials (Figure 11).

Kadınhanı Hançerli Sinkhole: It emerged in Pusat Village in Kadınhanı district. The sinkhole emerged in Upper Miocene-Pliocene old lacustrine cover formation (Figure 12). Its elevation is 1004 meters; its depth is 7 meters. Its long axis in the direction of east-west is 18 meters; its short axis in the direction of north-south is 13 meters. The escarpments are more in the north and east slopes of the sinkhole. There are block collapses and deep cracks in the west slope and piles of debris in the south slope. As the sinkhole is highly new, its process of formation is going on.

Figure 12. Kadınhanı Hançerli Sinkhole

Later on, found out that the sinkhole had been plugged with excavation by the farm owner 4 months after its emergence, it was seen that the sinkhole had been plugged when we performed a research on the sinkhole field in April, 2014. It can be seen that the sinkhole had collapsed about 1 meter and cracks occured on the edges of the sinkhole although we researched 2 months after it was plugged (Figure 13). Plugging it increases the possibility of a bigger collapse as the sinkhole hasn't totally collapsed. Although the owner of the farm where sinkhole emerged was informed about this danger, he didn't give up his insistence. He carries on his agricultural activities by plugging the sinkhole emerging on his farm.

Figure 13. The closed display of Kadınhanı Hançerli Sinkhole after 6 months

CONCLUSIONS

The sinkholes in Konya province emerged in Miocene-Pliocene and Quaternary old formations. These formations consist of rocks such as limestone convenient to karstification, marl, claystone. It can be seen that sinkhole emerging frequency has recently increased in and around Konya. The fact that people overuse underground water is effective in that increase. The rapid decrease of underground water in recent years can be detected from change of levels in Akgöl, Meke Tuzlası, Kızören, Meyil, Çıralı, Timraş and Apa sinkhole lakes. During underground water movement from Konya Plain toward Lake Tuz, underground water abstracts the carstic rocks it engages and this creates underground spaces. These spaces collapses due to both decrease in underground water level and false landuse of humanity and carstic formations which we call sinkholes emerge.

Recently emerging sinkholes affect both habitation areas and agricultural activities in and around Karapınar, Çumra, and Kadınhanı. Either plateaus are deserted or agricultural activities are interrupted in farming fields because of danger of collapsing on the locations where sinkholes have emerged. However, it's been observed that some of the recently emerging sinkholes were immediately plugged by landowners. However, the plugged sinkholes transform into covered traps, this might cause lose of priorities and lives. That's why, the public should be informed about not plugging newly emerging sinkhole areas and plugging sinkhole formations should be prevented.

The sinkhole fields should be evaluated in economic activity branches mainly in tourism different from utilizing in agricultural land, because the old and newly formed sinkholes in Konya could become ecological attraction centres by putting under protection because of their morphological figure, climatic features and aquatic value. Sinkholes forming habitats of species such as hawks, falcons, eagles, partridges and pigeons and existence of living beings in wet sinkholes having lake characteristics are important ecotourism destinations.

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COMPARISON OF PIXEL-BASED AND OBJECT-BASED CLASSIFICATION METHODS FOR SEPARATION OF CROP PATTERNS

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Abstract

Determination and classification of plant patterns with satellite images is most suitable method for preparation of source inventory. The use of high resolution satellite imagery is quite widespread for separation of land use types. Pixel based classification methods are widely used to classify images. The choice of classification methods in satellite images directly affects the success of the research. In recent years, the use of object-based classification method to determine the plant pattern as parcels is being investigated. In this study, we present an example to determine the crop pattern as parcels using pixel and object based classification methods.
The study was conducted in Isparta-Turkey. Quickbird-2 satellite image, ERDAS and e-Cognition Developer Trial 8.8 software were used. Maximum likelihood and Isodata algorithms of Pixel-based classification methods and, multiresolution segmentation operator of object-based classification methods were used to classify satellite imagery. Object-based classification method was determined to be more successful than pixel-based classification method, based our analyses.

Key words*: Quickbird, land use types, image classification, object based classification.*

INTRODUCTION

The range of resolutions available for satellite imagery lends itself to the mapping of land cover at a number of scales. High-resolution images obviously contain more information than low-resolution images. Therefore, it is reasonable to suggest that coarser resolution data can be used to create small-scale land cover maps, whereas higher resolution data can map land cover in greater detail (Colombo et al., 2004; Whiteside, XXX). High spatial resolution images have been increasingly used for the classification of urban land use/plant patterns. Classification methods used to determine the land cover/plant patterns are pixel and object based. The high spectral variations within the same land cover, spectral confusion among different land covers and the shadow problem often lead to poor classification performance by the traditional per-pixel spectral-based classification methods (Moran, 2010). However, the interest in object-based classification has increased because it has been shown that there exists a relationship between the pixel and object sizes, which was not a factor in pixel-based classification methods (Blaschke, 2010).

The object-based classification method is a combination of separation into segments and contextual classification. The first step that is based on the object-based image analysis was image segmentation (Castilla and Hay, 2008). The segmentation process separates the image into segments that are arranged according to the classification of spectral, geometric, textural and other characteristics of the objects (Veljanovski et al., 2011). The selection of appropriate parameters is an important step in the image segmentation process. Multi-resolution segmentation is based on the selection of optimal parameters to study the result of a series of segmentation that is based on trial and error. The choice of optimum parameters depends on the user's experience and observation capabilities. This trial and error segmentation processes take a long time (Tong et al., 2012).

The sizes and shapes of the objects can be further distinguished with object-based classification methods that allow many new applications in the data received by the very high spatial resolution satellite.

Multi-resolution segmentation of object-based image analysis, on the other hand, results in objects with different sizes and shapes, which are meaningful and better represent the real size and shape of land cover types (Salehi et al., 2011). The land use types (LUTs) and plant patterns can be determined and classified by this software and classification algorithms. In this study, we compared the pixel- and object-based classification methods for determining land use types and plant patterns.

MATERIALS AND METHODS

The study was carried out within the boundaries of Güneykent municipality on Gönen district in Isparta (Figure 1). The climate conditions of the study area are mixed types of the Central Anatolia Region and Mediterranean, and the altitude is 1250 m.

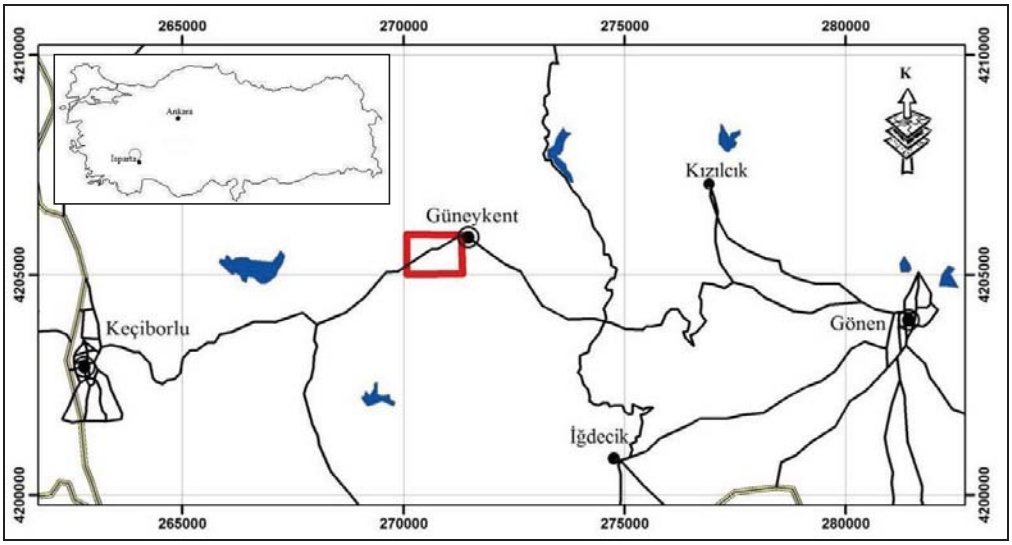


Figure 1. The location of the study area

Quickbird-2 satellite data dated 06.08.2006 is used with a 0.61-m panchromatic and 2.44-m multispectral bands. ERDAS IMAGINE 9.1, ArcGIS 9.1 and eCognition Developer Trial 8.8 softwares were used. Geometric correction, image sharpening and image enhancement were performed for photo interpretation using 4, 3, 2 band combinations. The first step of photo interpretation was determining the characteristics of land use types and plant patterns in the image. Second, the image object and land use types/plants were compared. The image was interpreted based on the information obtained from these parameters. Land surveys were performed in parcels at the test area. In the land survey, data about the morphological properties of land use and plant patterns were collected. The digital land use parcel map was produced using ArcGIS software and a database of this map was set up. ERDAS software was used in pixel-based classification of satellite images (Erdas, 2002). eCognition software was used to classify the satellite image according to the object-based method. In this method, the multi-resolution segmentation algorithm was selected. The image segmentation algorithm was grouped into pixels as homogeneous parts in close proximity according to the spectral and spatial extent. For selection of optimal parameters, segmentation operations were performed by testing different shapes, compactness and scale parameters using 4, 3, 2 band combinations on the Quickbird-2 satellite image of the study area.

The shape factor and compactness factor were chosen as 0.1 and 0.5, respectively in the multi-resolution segmentation process. The satellite image of the study area was separated into

segments by testing different scale parameters. Training classes were created using the standard nearest neighbour method. After classification of the Quickbird image using this algorithm, control points were selected randomly in the image. The plant patterns obtained from the LUT map were assigned as class value of the control points. After entering, all the points were checked for accuracy by the software. The accuracy of the data generated from the object-based method was determined according to the interpretation of the object-based classification and parcel maps.

RESULTS AND DISCUSSIONS

LUTs in the study area

The study area consisted of stubble, quince, almond, settlements, walnut, bare soil, apple, nursery, nut, broad-leaved *Rosa damascena* Mil., mixed garden, poplar, cherry, forest, reeds, vegetable, fodder crops, poor vegetation cover LUTs and plant patterns. The distribution according to LUTS and plant patterns of the study area are given in Table 1. The view of the field work is shown in Figure 2. In the study area, quince cover is the least 2.03 (0.22%) and bare soil cover is the most, 258.71 (27.43%).

Figure 2. A view of the field work

Visual image properties of LUTs/Plant pattern parcels

Fruit trees have regular inter-row and intra-row spacing. Therefore, it is seen in a regular manner on satellite images. Crown-width and planting pattern, as well as inter-row and intra-row spacing are important criteria in the separation of fruit types. Rose damascena areas can be separated because of the planting pattern, while they show similarity to perennial plants in hue. Planting pattern is seen in longitudinal, parallel rows in the north-south direction in the flat terrain and as the perpendicular direction to the slope in the sloping terrain. Pixel reflection shows heterogeneous-appearing parcels where the higher plants consist of mixtures of soil, vegetation and perennial crops.

Table 1. LUTs distribution and plant patterns of the study area

LUTs/Plant Patterns	Total area (da)	%
Stubble	13.98	1.48
Quince	2.03	0.22
Almonds	16.30	1.73
Settlements	72.3	7.67
Walnut	12.62	1.34
Bare soil	258.71	27.43
Apple	33.01	3.50
Nursery	45.50	4.83
Nut	3.45	0.37
Broad-leaved	65.76	6.97
Rose damascena	103.90	11.02
Mixed Garden	29.08	3.08
Poplar	45.88	4.86
Cherry	47.10	4.99
Forest	29.33	3.11
Reeds	18.31	1.94
Vegetable	62.46	6.62
Fodder Crops	21.86	2.32
Poor Vegetation cover	61.55	6.53
Total	943.13	100.00

Annual plants such as crop and fodder crops cover the soil surface. LUTs such as bare soil, dry grass or fallow show a homogeneous appearance. These can be clearly distinguished from the other factors. Poplar has a thin, longitudinal crown-width perpendicular to the pattern. It is typically planted in a single row on the road and parcel edge. Shadow on the parcels is masked by spectral reflectance in the satellite image. Thus, the accuracy of visual interpretation was reduced. These events show the classification method, which is based on spectral, geometric, textural and other features of the objects. Morphological appearance and interpretation of LUTs and plant patterns that are located in the study area are given in Figure 3.

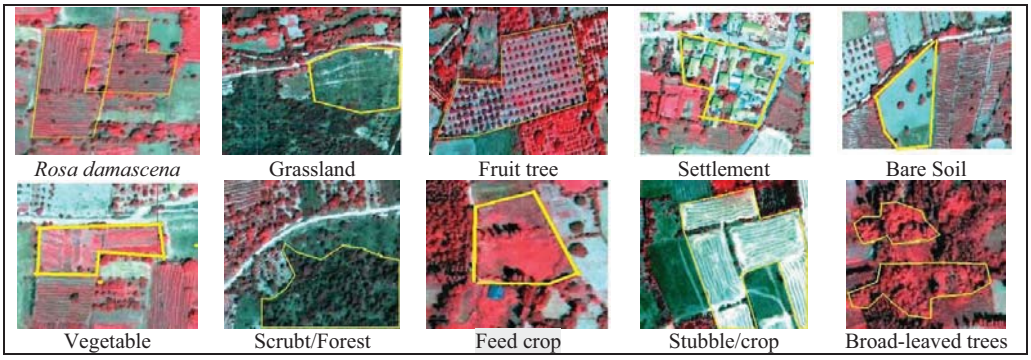
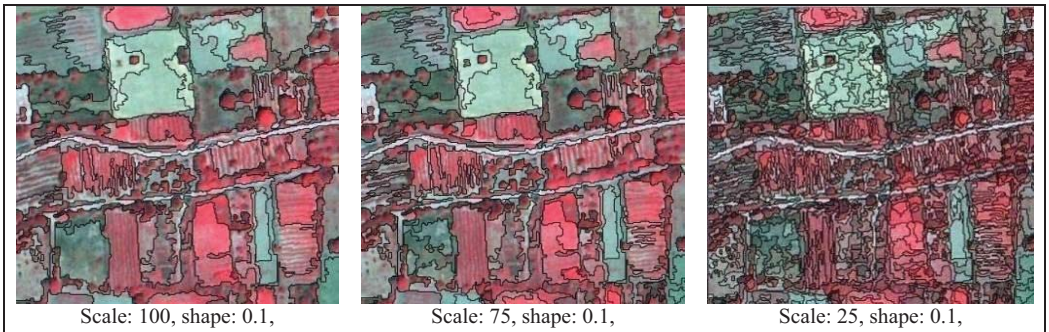


Figure 3. Morphological appearance and interpretation of LUTs and plant patterns that are located in the study area

Pixels and object-based classification

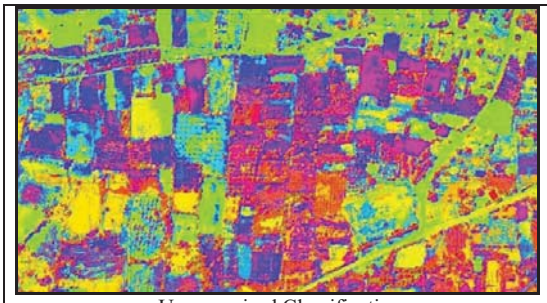
Scale parameters were taken as 100, 75 and 25. The most appropriate scale parameters for separating segments were determined to be 100. A comparison of the scale parameter is given in Figure 4. The Maximum Likelihood Decision Rule (19 classes) of the supervised classification and the ISODATA method (20 classes) of the unsupervised classification revealed the most appropriate methods. Eight land use types/crop pattern classes were grouped by combining the classes.

Land use types/crop patterns that were separated with the highest accuracy using object-based classification were determined to be rose damascena parcels (67.16%), stubble/crop parcels (58.93%), settlements (78.40%), scrub areas (56.13%) and fruit plants (37.02%). Land use types/crop pattern that was separated with the highest accuracy using supervised classification were vegetable parcels (100%), feed crop parcels (85.71%) and bare soil areas (76.51%). Land use types/crop pattern that were determined using unsupervised classification showed lower accuracy than other classification methods (Figure 5).



Scale: 100, shape: 0.1, compactness:0.5 | Scale: 75, shape: 0.1, compactness: 0.5 | Scale: 25, shape: 0.1, compactness: 0.5

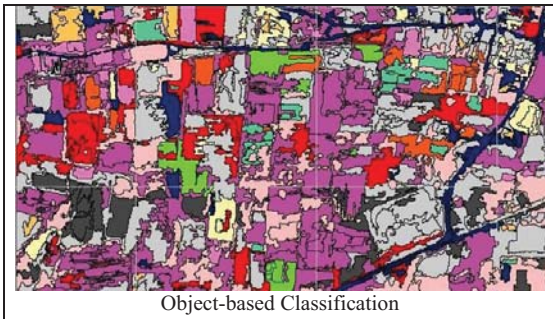
Figure 4. Comparing of segmentation parameters in the object-based classification



Unsupervised Classification

Legent

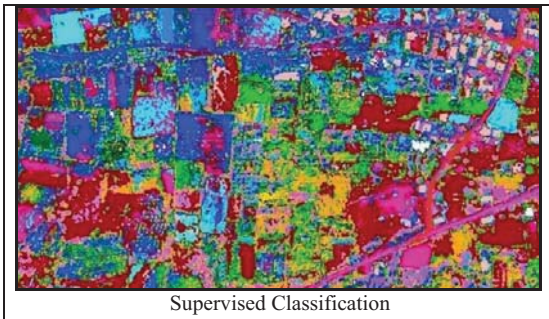
	Rosa d.		Scrub
	Stubble/crop		Fruit tree
	Bare Soil		Feed crop
	Vegetable		Settlement



Object-based Classification

Legent

	Rosa d. 1		Fruit tree
	Rosa d. 2		Vegetable
	Rosa d. 3		Feed crop
	Road		Barel Soil
	Stubble/crop		Barel Soil
	Stubble/crop2		Scrubt



Supervised Classification

Legent

	Rosa d.		Scrubt
	Stubble/crop		Fruit tree
	Barel soil		Feed crop
	Vegetable		Settlement

Figure 5. Pixel-and object-based classification of LUTS and plant patterns that are located in the study area

CONCLUSIONS

In the study, the multi-resolution segmentation process using scale factor 100, shape factor 0.1 and compactness factor 0.5 in object-based classification was determined to be the most successful method for separating of land use types/plant patterns. The unsupervised classification method showed the least accuracy.

The success of the classification decreases if classifications were only made based on the spectral information of the image when the high-resolution data were used to determine land use types/plant patterns (Salehi et al., 2011).

Selecting the most appropriate scale parameters according to size of the objects is very important for the success of the classification in the multi-resolution segmentation algorithm (Smith, 2010). In general, small-scale parameter values are suitable in classifications that were made on images with the aim of uncovering small objects. Uses of large-scale parameter values are suitable to separate large objects (Duro et al., 2012). In this method, precisely correct segmentation options do not exist. Thus, numerous attempts were made until optimal segments appropriate for the purpose of this study were determined. It is important to establish appropriate structures from pixels to objects by providing the appropriate homogeneity.

In conclusion, the object-based classification method gives the highest accuracy in higher plants and perennial crops that consist of a mixture of soil and vegetation. For homogenous patterns such as bare soil, vegetables and feed crops, the supervised classification method was found to be more successful than the object-based method. Therefore, elimination of the soil reflections is an essential factor in studies that are proposed for the classification of vegetation patterns. The accuracy of separation is believed to increase by combining with the vegetation index of the object-based classification method.

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DATABASE ROLE IN A GIS PROJECT FOR AGRICULTURAL MANAGEMENT ON SOILS SUBJECT TO EROSION

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Abstract

The work hereby describes the setting up of database and its role within a GIS project. As already known, monitoring and management activities for a certain territory imply a significant amount of data as well as related processing and analysis means. In such context, it is particularly important for both farming landowners and agricultural management decision-makers to determine the quality of soils and especially those affected by erosion decay processes. Availability of a descriptive database is critical for a GIS to work well. An attribute value (descriptive) database is connected to the spatial database to enable query. It is well known that the cultures structure and culture anti-erosion systems are two of the main factors on which agricultural management approach for slope land plots depends. The study hereby presents the many advantages of a GIS system for territorial management, and particularly for potentially erosive land. It is important to set up a database as complete as possible, that users can easily manage in order to be able to take the best decisions regarding "eco-friendly agricultural policy".

Key words*: GIS, database, SQL query.*

INTRODUCTION

In our country, erosion represents one of the biggest problems of agriculture, besides the drought phenomenon. Despite some anti-erosion improvements that covered 2.2 million ha (by 1990), currently we can confirm that erosion is a phenomenon that should be a warning signal for the society, especially that the investments in the field are on hold, agricultural properties are excessively divided, and the former sites are re-exploited, which is less in compliance with requirements of slope soil protection and conservation (Motoc al., 1988). Such decay process (pollution in modern ecological terms) is extended to almost half (47 %) of the country's agricultural area, namely on 7 million ha representing land affected by decay, of which 6.75 million ha of eroded land (including 0.25 million ha of active landslides and 0.25 million of land subject to wind erosion). On yearly basis, 150 million tons of soil are lost, including 1.5 million tons of humus, 0.45 million tons of soil with nitrogen, as well as significant quantities of phosphorous, potassium etc. (Statescu al. 2013). Specific annual losses of soil caused by erosion vary between 3.2 and 51.5 t/ha; the country weighted average is 16.28 t/ha·per year, much higher than maximum tolerable / acceptable losses of 3...6 t/ha·per year.

Monitoring and management activities for a certain territory imply a significant amount of data as well as related processing and analysis means. In such context, it is particularly important for both farming landowners and agricultural management decision-makers, to determine the quality of soils and especially of those affected by erosional decay processes. A few years ago, such activities were actually impossible to perform on extended areas. Currently however, the extraordinary progress of information technology and data acquisition techniques for data specific to a certain territory (including remote detection and aerial photography) have enabled radical changes in the area (Biali al., 2013).

The database containing alphanumeric (descriptive) and graphical georeferenced data for a certain territory, can be considered the most important component of the system, as the quality of such data is a key factor on which the performance of the future information system and future results depend.

In the case hereby of slope land plots affected by hydro-erosion, such data should synthetically define as close as possible the main factors causing erosion processes. One key factor is the manner of using slope agricultural land.

MATERIALS AND METHODS

Geographic Information Systems (GIS) were first developed in USA, in view of knowing better the soils quality and assessing agricultural land plots. Starting 1993, the US Natural Resources Conservation Service began to use Geographic Information Systems (GIS) for georeferenced data storage and processing in view of updating soil maps (Biali, 2003). That enabled to highlight extended options of geographic information systems in the study of soils production potential trend.

Considering the above, the GIS project (presented briefly in this work) covers the use of GIS technique in the study of soils affected by decay processes.

In view of knowing better the current state of the erosion process and to forecast the related consequences by using the Geographic Information Systems technique, the watershed of Antohesti reservoir (on 3963 ha area) of Berheci Hydrographic Basin (tributary stream of Barlad river), Bacau county, was considered for this research.

The losses by surface erosion of agricultural land in such watershed were estimated by USLE equation resulting from the relation below (Wischmeier al.,1978):

$$A = R \cdot K \cdot L \cdot S \cdot C \cdot P$$

where:

A – annual average specific soil losses, (t/acre -year) or (t/ha-year);

R – annual index of rain water erosion added to the erosion caused by snow melt drainage, where such melt drainage is significant (ft·t·in/acre·hour·year);

K – soil erodibility factor (t/acre·hour/acre·tf·t·în);

L – factor of slope length on the drainage direction (ft) or (m);

S – factor of slope gradient on the drainage direction (%);

C – impact factor consisting in the use of cultures and soil works (dimensionless);

P –impact (dimensionless) factor including the influence of current measures and works against soil erosion (works along land contour lines, strip farming, grass filter strips, terrace farming etc.).

RESULTS AND DISCUSSIONS

In view of implementing GIS techniques, for developing the application hereby the GEO – GRAPH geographic information system was used, a GIS type software developed by the Information Services Company in Suceava city, based on an in-house developed software.

Raster procedure was used in order to set up the georeferenced database and an attribute-based database, as necessary for storage and processing according to the above mentioned equation. That consists in developing a raster type graphical database with each pixel (cell) of 25 x 25 m (details on figure 4 and 5).

According to the work hereby, GIS application covers the last two factors **C** and **P** with a critical role in simulating erosion and agricultural management processes (Renard al., 1996).

The first phase included vectorization of site layout plans on a scale of 1:10.000 with data related to land coverage/uses (figure 1) and types of land improvement coverage (figure 2).

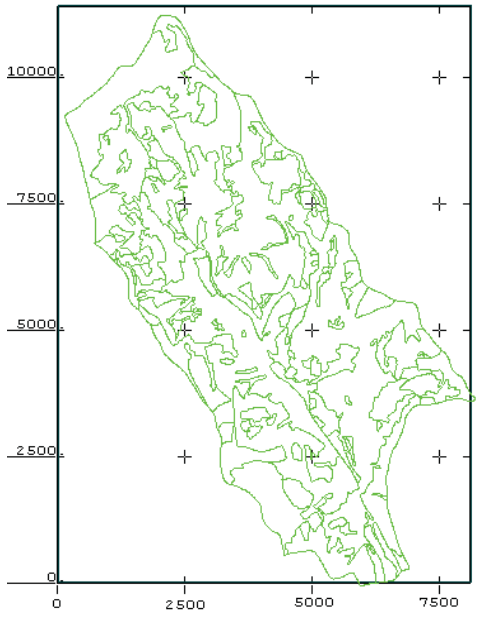


Figure 1. Vector data models of uses outline in Antohesti Hydrographic Basin

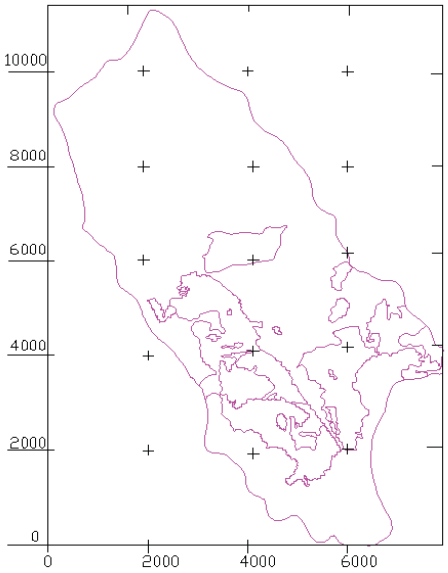


Figure 2. Vector data models of anti-erosion improvements in Antohesti Hydrographic Basin

The next phase consisted in setting up a polygon topology (figure 3) for each graphical object, which is represented as a use outline or an improvement type. The topology structure (to ensure vector data storage model) is based on proximity properties and spatial relations between elements (objects) defining a vector data model. That will enable developing the structure of spatial data base files, which are mandatory to ensure operation of the information system: updating, zones overlapping, entity outline by overlapping intermediate boundaries, generalizing boundaries outline etc.

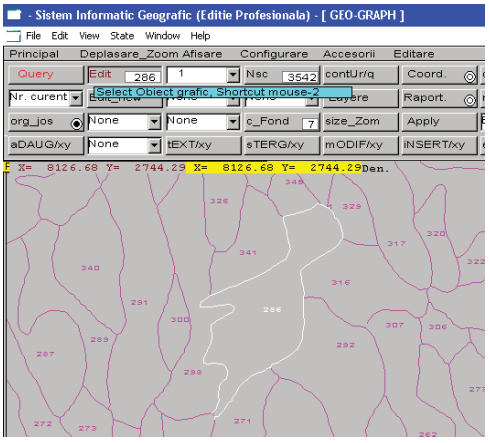


Figure 3. Selecting a graphical object in view of setting up related topology

Upon data processing, information layers are obtained regarding the distribution of C and P coefficients, which are integral part of a GIS project database, mainly enabling to assess soil losses caused by erosion.

Information layers of land coverage in Antohesti Hydrographic Basin are represented in figure 4 (with details on cells). Cultural C Factor – land coverage / culture management reflects the beneficial effect of vegetation (farming cultures) on the erosion process. This factor helps to adjust the most reasonable culture management strategies to fight against slope land erosion.

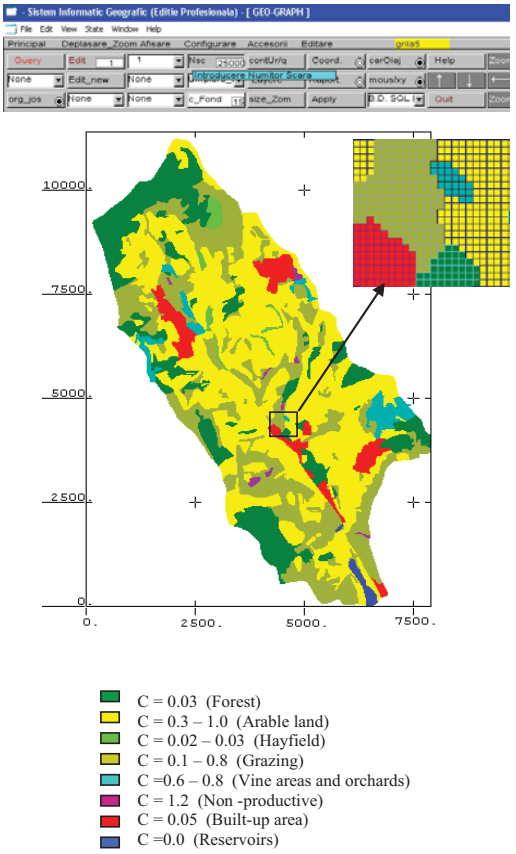
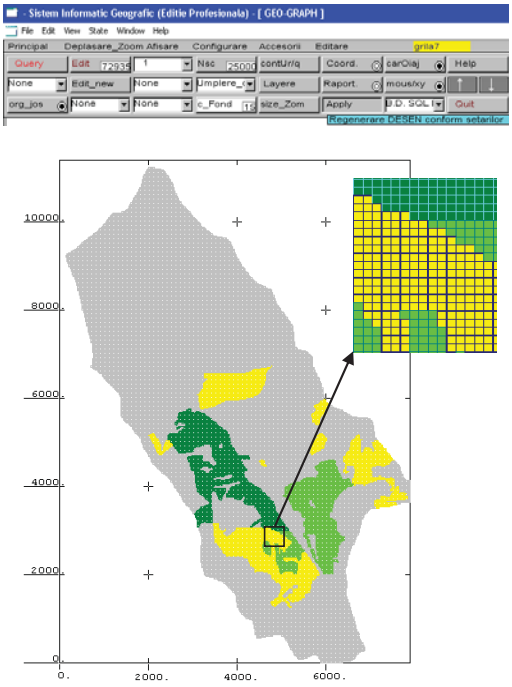


Figure 4. Spatial distribution of C coefficients. Information layers of land coverage / uses in Antohești Hydrographic Basin.

Information layers of anti-erosion measures in Antohesti Hydrographic Basin are represented in figure 5 (with details on cells). P Factor reflects the soil protection and preservation measures. It is a relative value factor due to extended variation range, implementation quality level and long term maintenance of anti-erosion measures.



- P = 0.15 → terrace farming on arable land or terraces in vine areas and orchards
- P = 0.30 – 0.60 → strip farming or grass filter strips on arable land
- P = 0.50 – 0.90 → works along the land contour lines overall directionarabile

Figure 5. Spatial distribution of P coefficients. Information layers of anti-erosion measures in Antoheşti Hydrographic Basin.

CONCLUSIONS

1. Acquisition and storage of alphanumeric (digitized) data, computer-based processing, analysis and display of information obtained under various information layers (thematic maps, diagrams, analyses reports etc.) ensures a few significant benefits, such as:

- possibility to handle large multi-layer heterogeneous databases of spatial reference;
- extended flexibility for placing queries or interactively using the system;
- larger flexibility in configuring the information system in order to adjust it to a wide range of applications and users;
- diversified presentation (display) of information.

2. By implementing such techniques, GIS can also enable integrated ecological monitoring, which competent authorities may use in order to perform ongoing monitoring of environmental factors and anthropic impact.

3. Setting up a database based on spatial and time coverage parameters and indices, provides the information framework necessary to draft the strategy for preventing the impact of environmental factors and human activities.

4. GIS-enabled complex analyses help to make forecasts of erosion processes and exercise operational control of environmental restoration (improvement) measures.

5. Using Geographic Information Systems for analyzing and forecasting land erosion in our country is a topical issue, however in view of meeting such requirement continuous research is necessary; in order to pinpoint the specificities that should enable large scale implementation of such modern techniques.

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THE ACCURACY OF LiDAR MEASUREMENTS FOR THE DIFFERENT LAND COVER CATEGORIES

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Abstract

The paper aimed to present, for the different land cover categories, the accuracy of LiDAR measurements obtained with a light detection and ranging dataset from a test area of the hydrographical basin Somes-Tisa in Romania. It is presented the geometric geolocation accuracy of LiDAR footprint for few land cover categories, utilizing an UAV configuration that supports a sensor designed to scan the surface of the Earth, a DGPS and INS/IMU system. There are presented the geometric accuracies, for LiDAR footprints on the ground, as a relationship between the input parameters, which include errors of the orbital state, attitude information of the UAV and the look vector errors of the active sensor (LiDAR scanner), that give us the coordinates of the point of intersection of the line of sight scanning system and the Earth's surface as a function of: terrestrial ellipsoid surface, UAV position, UAV attitude (spatial situation) and the orientation of the LiDAR scanner. As a conclusion, the paper proposes the vertical accuracy requirements that are recommended when analyzing elevation data generated using airborne light detection and ranging or laser technology, because vertical accuracy is the principal criterion in specifying the quality of elevation data, and vertical accuracy requirements depending upon the intended users applications.

Key words*: Geomatics, LiDAR, Remote sensing, UAV.*

INTRODUCTION

As is well known, LiDAR (Light Detection and Ranging) is a remote sensing instrument that measures distance to an object by emitting timed pulses of light and measuring the time between emission and reception of reflected pulses. The measured time interval is converted to a distance. LiDAR scanner emits rapid streams of laser pulses and distance (range) between object and scanner is measured by computing the time to travel of the laser pulse from the scanner to the object and back. Coordinates of each reflected laser pulse is computed combining: distance or range, scan angle, sensor location and sensor orientation.

Studies have shown that LiDAR errors are significantly affected by various ground cover categories. Because natural vegetation or crops can limit ground detection, tall dense forests, tall grass or agricultural crops tend to cause greater elevation errors than unobstructed terrain. Errors measured in areas of different ground cover also tend to be distributed differently from errors in unobstructed terrain.

For these reasons, international standard requires open terrain to be tested separately from other ground cover types. Testing over any other ground cover category is required only if that category constitutes a significant portion of the project area deemed critical to the customer.

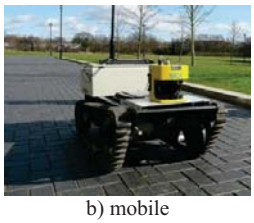
Varying types of topography (such as mountainous, rolling, or flat terrain) within a project may affect the accuracy at which the elevation surface can be modeled. Also, for many applications, the accuracy requirement in high-relief terrain may be less than that for flat terrain. In such situations, it may be preferable to specify different accuracy requirements for the various terrain types and to design separate tests for each (ASPRS LiDAR Committee, 2004).

The fundamental vertical accuracy is the value by which vertical accuracy can be equitably assessed and compared among datasets. The fundamental vertical accuracy of a dataset must be determined with check points located only in open terrain where there is a very high probability that the sensor will have detected the ground surface. It is obtained utilizing

standard tests for Root Mean Square Error (RMSE).

LiDAR platforms, shown below in Figure 1, can be: fixed position (Fig.1a), mobile (Fig.1b) and airborne (Fig.1c, the most popular: helicopters, airplanes, UAVs).

a) fixed position



b) mobile

c_1) helicopter c_2) airplane c_3) UAVs

Figure 1. Types of LiDAR platforms

A typical LiDAR system, presented in Figure 2, consists of three main components: a GNSS system to provide position information, an INS/IMU for attitude determination, and a laser unit to provide range (distance) information from the laser beam firing point to the ground point. In addition to range data, modern LiDAR systems can capture intensity images over the mapped area.

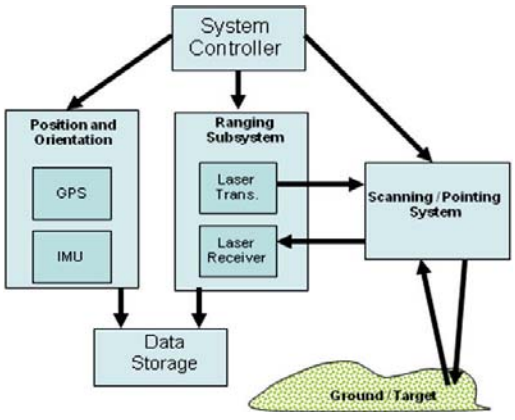


Figure 2. Diagram of a typical LiDAR system (NGA Standard, 2009).

Below, in Figure 3, is presented a simplified diagram of the processes LiDAR data pass through before reaching the end user.

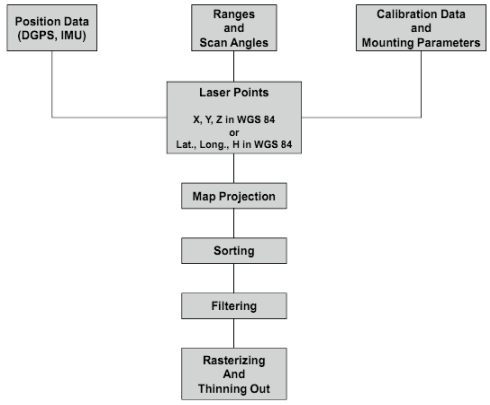


Figure 3. Diagram of the processes LiDAR data pass through before reaching the end user (ASPRS 2004)

The transformation between the footprint on the image and the ECEF footprint is expressed in terms of a series of consecutive matrix transformations applied to the line of sight vector of LiDAR. Finally, for any scan footprint, we obtain ECEF coordinates (by intersection of the scanner's view line with the ellipsoid used to model Earth) and then geodetic coordinates (geodetic longitude and latitude).

Recently, improvements in small scale positioning technology have enabled the use of Unmanned Aerial Vehicles (UAVs) as a close range sensing platform offering a distinctive combination of very high resolution data capture at a significantly lower survey cost to traditional platforms.

Current research into the use of UAVs, as a 3D data-capture platform, includes application specific use in a variety of different fields ranging including for agriculture crop monitoring and forests monitoring.

There are many factors that affect the accuracy of coordinates derived from a LiDAR system. These errors which can be summarised into 17 error components which will occur in every system were modeled by Luke Wallace et.al. in 2011. These error components can be described as:

– 3 errors existing in the measurement of the absolute position;

– 3 errors existing in the measurement of UAV orientation;
– 6 errors caused by the inaccurate calibration of the system affecting the bore sight angles and lever arm offset;
– 3 Internal LiDAR system errors occur in measurements of range and the two L encoder angles measured from the UAV;
– 2 errors due to divergence of the laser beam which propagate in the horizontal direction and elevation angle measurements within the laser scanner reference frame.

These error components can be propagated through the functional model of the LiDAR system equation enabling the magnitude of the error in the final coordinates of a point to be determined.

The notations of all parameters n (known and unknown) from mathematical relation below are shown in the Figure 4 (Ki In Bang, Ayman F. Habib, 2008).

$$\vec{X}_G = \vec{X}_O + R_{yaw,\ pitch,\ roll}\ R_{\Delta\omega,\ \Delta\phi,\ \Delta\kappa}\ \vec{P}_G + R_{yaw,\ pitch,\ roll}\ R_{\Delta\omega,\ \Delta\phi,\ \Delta\kappa}\ R_{\alpha,\ \beta} \begin{bmatrix} 0 \\ 0 \\ -\rho \end{bmatrix}$$

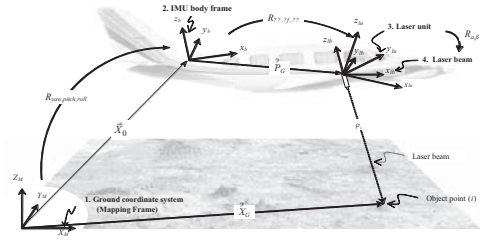


Figure 4. Relationship between LiDAR scanner, INS/IMU, GPS and their reference systems

Commercial vendors have fostered development of multiple-return systems to penetrate vegetation canopies in order to receive and identify more bare earth returns in vegetated areas. To derive bare earth models, LiDAR returns representing vegetation and human made features are identified and eliminated using bare earth filtering techniques. In many cases, this ancillary vegetation information is simply discarded. However, for many ecological applications, 3D vegetation information or interactions between vegetation and topography are most important. LiDAR has been used in several studies involving the 3D vegetation structure including estimation of stand height, total above ground biomass, foliage biomass, basal area, tree density, canopy base height, and canopy bulk density and at resolutions where even individual tree characteristics can be measured (Stoker J.M., Greenlee S.K. et. al., 2006).

MATERIALS AND METHODS

In order to obtain the accuracy of LiDAR measurements for the different land cover categories were used airborne LIDAR data which were collected for an area of 100 km², comprising the northwest zone of Somes-Tisa hydrographic basin, where in terms of land use the sub-basin Crasna is dominated by agricultural land.

The data were collected in 2013 and have been processed and interpreted in 2014, based on author's doctoral thesis entitled "Application of laser technologies in topo-graphical survey of Somes-Tisa hydrographic basin" (Iordan D., 2014).

UAV used for data collection in studied area is classified as a micro UAV also known as hexacopter. This UAV is categorized as micro UAV because it has weight below than 5 kilograms and endurance hour less than one hour. Unmanned aerial hexacopter used has six blades where three blades rotate in clockwise direction while the other three blades rotate in counter-clockwise direction.

RESULTS AND DISCUSSIONS

LiDAR accuracy is generally stated in vertical direction as the horizontal accuracy is indirectly controlled by the vertical accuracy. This is also due to the fact that determination of horizontal accuracy for LiDAR data is difficult due to the difficulty in locating Ground Control Points (GCPs) corresponding to the LiDAR coordinates.

Prior to calculating the data accuracy, few steps should be taken, as follows:

– Separate checkpoint datasets according to important variations in expected error such as by land cover class;
– Edit collected checkpoints to identify, remove or minimize errors and blunders;
– Interpolate the elevation surface for each checkpoint location;

– Identify and eliminate LiDAR sensor systematic errors and blunders in the LiDAR data processing.

The vertical accuracy is determined by comparing the Z coordinates of data with the truth elevations of a reference (which is generally a flat surface).

The vertical accuracy is stated as $RMSE_z$ (root mean square error) and given by:

$$RMSE_z = \sqrt{[\Sigma (z_{data,i} - z_{check,i})^2 / n]} \quad (1)$$

It is assumed that systematic errors have been eliminated as best as possible. If vertical error is normally distributed, the factor 1.9600 is applied to compute linear error at the 95% confidence level (Andre Samberg 2005).

Therefore, vertical accuracy, noted A_z, reported according to the American standard NSSDA (National Standard for Spatial Data Accuracy) shall be computed by the following formula:

$$A_z = 1.96 \cdot RMSE_z \quad (2)$$

(This accuracy is called fundamental vertical accuracy when the $RMSE_z$ is determined for a flat, non-obtrusive and good reflecting surface).

According with NSSDA, horizontal accuracy for $RMSE_{xy}$:

$$\mathbf{RMSE_x} = \sqrt{[\Sigma (x_{data,i} - x_{check,i})^2 / n]} \quad (3)$$

$$\mathbf{RMSE_y} = \sqrt{[\Sigma (y_{data,i} - y_{check,i})^2 / n]} \quad (4)$$

where:

– $\mathbf{x}_{data,i}$, $\mathbf{y}_{data,I}$ are the coordinates of the $\mathbf{i}^{th}$ check point in the dataset data;
– $\mathbf{x}_{check,i}$, $\mathbf{y}_{check,I}$ are the coordinates of the $\mathbf{i}^{th}$ check point in the independent source of higher accuracy;
– **n** is the number of check points tested;
– **i** is an integer ranging from 1 to n.

Horizontal error of a point **i** is defined as $RMSE_{xy}$ with formula:

$$RMSE_{xy} = \cdot\sqrt{RMSE_x^2 + RMSE_y^2} \quad (5)$$

It is assumed that systematic errors have been eliminated as best as possible. If error is normally distributed and independent in each the x- and y-component and error, the factor 2.4477 is used to compute horizontal accuracy at the 95% confidence level (Andre Samberg, 2005).

If we consider the measurements of the same accuracy in plan xy, than $RMSE_x$=$RMSE_y$, and the $Accuracy_{xy}$, noted A_{xy}, shall be computed according to NSSDA, by the formula:

$$A_{2D} = A_{xy} = 1.73 \cdot RMSE_{xy} \quad (6)$$

The various sensor components fitted in the LiDAR instrument possess different precision. For example, in a typical sensor the range accuracy is 1-5 cm, the GPS accuracy is 2-5 cm, scan angle measuring accuracy is 0.01rad, IMU accuracy for pitch/roll is < 0.005° and for heading is < 0.008° with the beam divergence being 0.25 to 5 mrad. However, the final vertical and horizontal accuracies that are achieved in the data is of order of 5 to 15 cm and 15-50 cm at one sigma.

The total spatial accuracy of a LiDAR footprint is given by the formula:

$$A_{3D} = A_{xyz} = \cdot\sqrt{A_{xy}^2 + A_z^2} =$$

$$= \cdot\sqrt{(1.73 \cdot RMSE_{xy})^2 + (1.96 \cdot RMSE_z)^2} \quad (7)$$

The accuracy of LiDAR measurements discussed in this paper refers to absolute vertical accuracy, which accounts for all effects of systematic and random errors. For some applications of LiDAR elevation data, the point-to-point (or relative) vertical accuracy is more important than the absolute vertical accuracy.

Relative vertical accuracy is controlled by the random errors in a dataset. The relative vertical accuracy of a dataset is especially important for derivative products that make use of the local differences among adjacent elevation values, such as slope and aspect calculations. Relative vertical accuracy can be difficult to measure unless a very dense set of reference points is available.

There may be error in the laser range measured due to time measurement error, wrong atmospheric correction and ambiguities in target surface which results in range walk.

Error is also introduced in LiDAR data due to complexity in object space (e.g., sloping surfaces leads to more uncertainty in X, Y and Z coordinates). Further, the accuracy of laser

range varies with different types of terrain covers.

One of the paper's results was to estimate the error associated with the LiDAR system elevation, where one of the main objectives in specifying parameters for data collection (flight height, the travel speed, footprint) is to achieve an appropriate density of LiDAR impulses. After the labelling category of land cover, and if it was done correctly, we observed that the error altitude varies according to the category of land cover (Table 1).

The variation of the vertical accuracy was evaluated for nine categories of land cover.

The values of root mean square error ($RMSE_z$) has varied from minimum 4.5cm (for straw) to a maximum of 23.4cm (for canopy). The differences values from Table 1 are graphically represented below in Figure 5.

Table 1. Characteristic values of $RMSE_z$ and A_z for 5646 points of Land Cover Categories

Crt. No.	Land cover type	Total number of points tested	Differences (m) (Hp_{LiDAR}-Hp_{ground}) Value Min.	Value Max.	The average value (m)	$RMSE_z$ (cm)	Vertical Accuracy (cm)
1	Canopy	858	-0.600	0.598	-0.013	23.4	45.8
2	Road of asphalt	16	-0.161	0.562	0.070	21.5	42.1
3	Road of land	108	-0.460	0.588	-0.009	13.3	26.0
4	Road of stone	16	-0.355	0.130	-0.071	12.4	24.4
5	Gardens, vegetables	15	-0.246	0.047	0.004	9.5	18.6
6	Nonproductive and uncultivated	867	-0.595	0.528	0.004	9.5	18.6
7	Wheat, straw	321	-0.204	0.336	-0.004	4.5	8.9
8	Corn	2053	-0.520	0.580	0.001	5.2	10.1
9	Slopes	1392	-0.582	0.593	-0.007	14.8	29.0
Total		5646	-0.600	0.598			

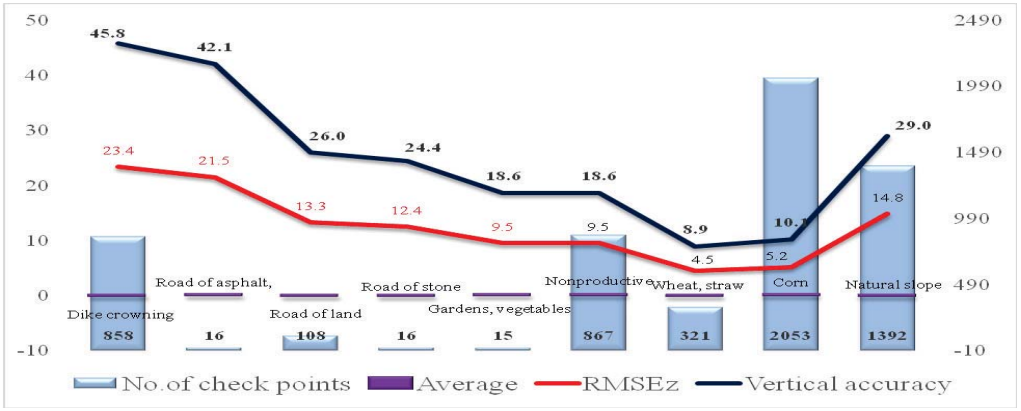


Figure 5. The graph of $RMSE_z$ and vertical accuracy in centimetres, depending on the Land Cover Category

CONCLUSIONS

LiDAR-based elevation surveys are a cost-effective means for mapping topography over large areas. Post-processing techniques are applied to remove vegetation and reveal the bare-earth elevations. In the recent years, LiDAR hardware and processing technologies have improved greatly. LiDAR surveys are now cost-competitive with traditional aerial topographic surveys and offer the capability to produce very high resolutions (potentially over 50 points / m, with vertical accuracy for airborne systems <10 cm).

LiDAR survey data may not replace traditional ground-based survey for applications that require centimeter or sub-centimeter accuracy, but the data available from these surveys, using an UAV, may be perfect for many engineering applications.

We have used a set of four accuracy standards and guidelines, as follows:

- Guidelines for digital elevation data;
- ASPRS guidelines – Vertical accuracy reporting for LiDAR data;
- Guidelines and specifications for flood hazards mapping;
- Geospatial positioning accuracy standards.

Accuracy typically assessed is for 5 different land cover classes: bare-earth, weeds and crops, scrub/shrub, forest and urban, and the results are graphically presented in Figure 6.

Fundamental vertical accuracy was commonly reported at 95% confidence level of root mean square error (i.e., RMSE = standard error).

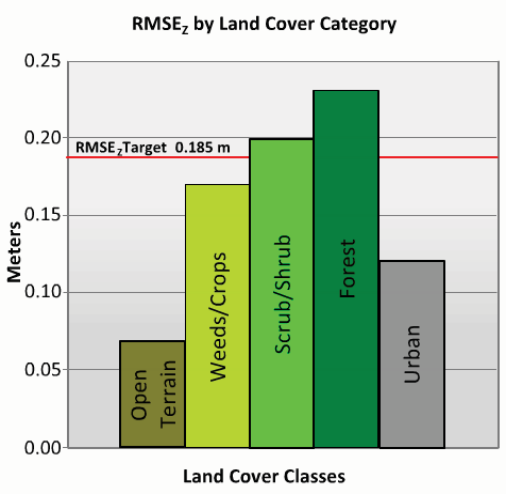


Figure 6. The graph of $RMSE_z$ depending by the Land Cover Category

LiDAR pulses can hit several objects before being reflected and cannot penetrate opaque objects (such as stems, branches, leaves) but can go between the leaves and hit the ground or other points with lower elevation than the first hit surface (first return)

Current LiDAR systems can detect secondary targets and record multiple elevations for each pulse and the last object recorded for a pulse is called last return.

The feature that allows recording multiple returns allows for determination of trees or crops height, presented in Figure 7.

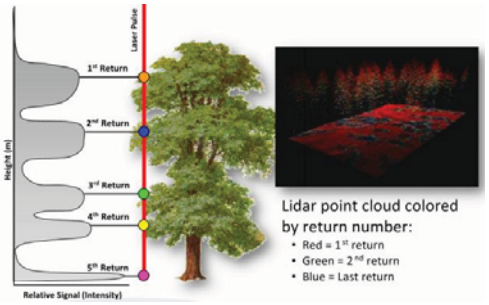


Figure 7. Multiple returns LIDAR pulses for determination of trees or crops height.

Multiple returns LiDAR pulses are based on relative signal strength/intensity recorded by the sensor.

Vertical accuracy is assessed by selection and measurements of checkpoints using survey grade GPS and/or conventional survey equipment. Vertical error is the difference between the elevation determined using LiDAR and using DGPS of the same checkpoint.

Checkpoints must be distributed across investigated area, and includes as many flight lines as possible and characterize the dominant land cover categories within the area.

It is preferable to have at least 20 checkpoints / land cover category, located on flat areas for minimizing horizontal errors.

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ASPECTS REGARDING THE OBSERVATIONS OF VERTICAL DISPLACEMENTS OF ROCKFILL (RIPRAP) DAMS

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Abstract

The paper refers to the monitoring of vertical displacements of rockfill (riprap) dams, displacements caused by the process of material compaction of dams. In order to monitor the vertical displacement, on the weir crest and berms situated on the downstream-side were placed tracking markers. To determine the vertical displacements was used a DNA 03 level and DNA levelling invar staff. Measurements processing was done rigorously through the method of conditional measurements and indirect measurements. The case study was conducted on the Belis Fantanele dam using the measurement periods of May to October 2013, respectively from March to November 2014. The maximum recorded value of compaction is 312 mm on the RN10 landmark located on the dam weir crest.

Key words*: compaction, geometric levelling, rigorous processing.*

INTRODUCTION

In the case of hydrotechnical planning, an important component is the upstream dams that form the lake basin which constitutes the driving force (Li and Wang, 2011).
Dam stability is very important considering that if it succumbs, great materials and sometimes life losses occurs downstream (Kalkan et al., 2010).
Considering this fact, dam stability is monitored through topographic measurements regarding their vertical and horizontal movements (Manea, 2013; Onose et al., 2014).
In the case of concrete arch dams, horizontal displacements predominates, and in the case of rockfill dams, vertical displacement predominates (Ortelecan et al., 2014; Sails et al., 2014).

MATERIALS AND METHODS

To determine the vertical displacements on the weir crest and downstream face, tracking landmarks are placed to observe vertical displacements.
Considering the small values of displacements, to record these displacements is used high precision geometric levelling and the measurement processing is performed by rigorous methods using functional models from conditioned measurements and from indirect measurements (Dima, 2005; Onose et al., 2009).
For a levelling traverse with known height points at the ends, a correction equation can be written as presented:

$$a_1 v_1 + a_2 v_2 + \cdots + a_n v_n + w_1 = 0; \quad (1)$$

where:
a_i – correction coefficients;
v_i – measured elements corrections;

w_1 – non-closure on height datum;
p_i – ponderous different levels of measurement.

$$w_1 = [v_{ij}]_A^B - (H_B - H_A) \quad (2)$$

where:
H_A – landmark height datum for surveying;
H_B – landmark height datum for closure.

$$p_i = \frac{1}{\Delta h_{ij}} \quad (3)$$

where:
Δh_{ij} – measured level differences.

Solving the correction equation is made in the condition of minimum: [pvv]→ minim, thus reaching the normal equation of correlation presented as:

$$\left[\frac{aa}{p}\right] k_1 + w_1 = 0 \quad (4)$$

where:
k_1 – undetermined coefficient of Lagrange (correlated).

$$\left[\frac{aa}{p}\right] = \frac{a_1 a_1}{\frac{1}{p_1}} + \frac{a_2 a_2}{\frac{1}{p_2}} + \cdots + \frac{a_n a_n}{\frac{1}{p_n}} = \Delta h_{A,1} + \Delta h_{1,2} + \cdots + \Delta h_{n-1,B} = [\Delta h_{ij}]_A^B \quad (5)$$

Considering the relationship (4) and (5), we can write:

$$k_1 = -\frac{w_1}{[\Delta h_{ij}]_A^B} \quad (6)$$

The corrections v_i are calculated using the equation:

$$v_{ij} = \frac{1}{p_{ij}} a_i k_1 \quad (7)$$

From relationship (6) and (7) results:

$$v_{A,1} = -\Delta h_{A,1} \frac{w_1}{[\Delta h_{ij}]_A^B}$$
$$v_{1,2} = -\Delta h_{1,2} \frac{w_1}{[\Delta h_{ij}]_A^B} \quad (8)$$
$$\cdots\cdots\cdots\cdots\cdots\cdots$$
$$v_{n-1,B} = -\Delta h_{n-1,B} \frac{w_1}{[\Delta h_{ij}]_A^B}$$

The standard deviation of the observations in the traverse of geometric leveling is calculated using the equation:

$$m_0 = \pm\sqrt{\frac{[pvv]}{r}} \quad (9)$$

where:
r – number of geometric conditions.

Non-closure tolerance on the traverse leveling is calculated using the equation:

$$T_h = 0.5mm\sqrt{n}$$

where:
T_h – non-closure tolerance on height datum;
0.5 mm – admissible non-closure on the distance between surveying stations and levelling staffs;
n – number of distances between surveying stations and levelling staffs.

The most probable value of measured level differences will be equal to the measured level differences plus correction determined by the relationship (8).

$$(\Delta h_{A,1}) = \Delta h_{A,1} + v_{A,1}$$
$$(\Delta h_{1,2}) = \Delta h_{1,2} + v_{1,2} \quad (10)$$
$$\cdots\cdots\cdots\cdots\cdots\cdots$$
$$(\Delta h_{n-1,B}) = \Delta h_{n-1,B} + v_{n-1,B}$$

where:
(Δh_{ij}) – the most probable value of the level difference;
Δh_{ij} – the measured level differences.

Absolute height datum marks will be calculated based on the most probable value of level differences shown in equation (9). Absolute height datums are calculated using the equation:

$$H_1 = H_A + (\Delta h_{A,1})$$
$$H_2 = H_1 + (\Delta h_{1,2}) \quad (11)$$
$$\cdots\cdots\cdots\cdots\cdots\cdots$$
$$H_B = H_{n-1} + (\Delta h_{n-1,B})$$

Depending on the absolute height datums of markers determined in the current era (period) of measurement and absolute height datums determined on the base measurement will determine the compaction of landmarks in the current era (period) with the relations:

$$T_i^j = H_i^j - H_i^0 \quad (12)$$

where:
T_i^j – compaction of landmark i at era j;

H_i^j – absolute height datum of landmark i at era j;
H_i^0 – absolute height datum of landmark i at base era (period).

In the case of indirect measurements, each measured quantity will have a corresponding correction equation.
The correction equation system is written as matrix:

$$AX + l = V \quad (13)$$

where:
A –unknowns coefficient matrix;
X – column vector of unknown corrections;
l – column vector of free terms;
V – column vector of measured elements corrections.

Unknown corrections matrix is calculated using the equation:

$$X = (A^T PA)^{-1} A^T Pl \quad (14)$$

where:
A^T – transposed matrix A;
P – ponderous matrix;

The standard deviation of ponderous unit is calculated using the equation:

$$m_0 = \pm\sqrt{\frac{V^T PV}{n-k}} \quad (15)$$

where:
V^T – transposed column vector of measured elements corrections;
n – number of equations;
k – number of unknowns.

The most probable value of the absolute height datums are calculated using the relationship:

$$(H_i) = H_i + x_i \quad (16)$$

where:
(H_i) – the most probable value of absolute height datums;
H_i – provisional value of absolute height datums;
x_i – corection of provisional height datums.

$$(\Delta h_{i,j}) = \Delta h_{i,j} + v_{i,j} \quad (17)$$

where:
$(\Delta h_{i,j})$ – the most probable value of level differences;
$\Delta h_{i,j}$ – measured value of level differences;
$v_{i,j}$ – corections of measured elements.

To check the compensated level differences, the relationship applies:

$$[\,(\Delta h_{i,j})\,]_A^B \quad (18)$$

The landmark compaction is calculated with the same relationship as in the case of conditional measurements (relationship 12).

RESULTS AND DISCUSSIONS

The case study was conducted on the Fantanele Belis dam, Cluj County, constructed in 1974 with height of 92 m.
Fantanele dam is part of the Somes River hydropower planning scheme on the Fantanele – CHE Floresti II dam sector and the first hydrotechnical construction of the Somes Mic River management plan.
Fantanele dam is located on the Somes Cald River, downstream from Belis, upstream of the confluence of Somesului Cald River with Batrana on the left side and Valea Rea on the right side.
Fantanele hydrotechnical planning include:
- Fantanele reservoir lake and the slopes;
- Fantanele rockfill (riprap) dam.

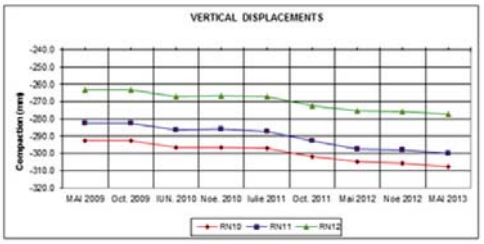
Fantanele dam is a rockfill (riprap) dam with concrete mask placed on the upstream, with the mask preventing water infiltration into the dam body. Dam height is 92 m and weir crest height is 996 m. Normal retention level is 991 m.
Altimetric monitoring network for the vertical displacements is formed of 16 tracking markers, located on the dam weir crest and 8 tracking markers located on the dam berms. Initial leveling landmarks located near the weir crest on the two sides have been destroyed, and now fixed points are considered, landmarks located on pilasters I, PII and PIII.
Measurements made at Fantanele dam consist of:
- Measurements for the determination of dam stress factors (water level in the lake, air temperature and atmospheric precipitations in site).

- Measurements made to determine the dam displacements using topogeodezical landmarks placed on weir crest, upstream mask and downstream berms;
- Measurements to determine infiltration through the dam and foundation conducted at drainage wells, outlet drainage spillways and downstream toe of the dam;
- Measurements for determining the piezometric levels in hydrogeological drilling;
- Measurements to determine the specific pressures and strains in the upstream cut-off of the dam;
- Measurements to determine deformations in the rock foundation of the upstream cut-off.

As a result of measurements in May 2013 and their processing were obtained:
- Maximum displacements from the base measurement era (period) are:
  - -307.5 mm (compaction) at landmark RN10 – on weir crest (Figure 1b)
  - -41.6 mm (compaction) at landmark B6 – on berms (Figure 1d)
- Maximum displacements from the previous measurement era (period) are:
  - -3.2 mm (compaction) at landmark RN14 – on weir crest (Figure 1a)
  - -1.7 mm (compaction) at landmark B3 – on berms (Figure 1c)

As a result of measurements in October 2013 and their processing were obtained:
- Maximum displacements from the base measurement era (period) are:
  - -308.3 mm (compaction) at landmark RN10 – on weir crest (Figure 2a)
  - -41.8 mm (compaction) at landmark B3 – on berms (Figure 2c)
- Maximum displacements from the previous measurement era (period) are:
  - +2.5 mm (swelling) at landmark RN14 – on weir crest (Figure 2b)
  - -2.8 mm (compaction) at landmark B6 – on berms (Figure 2d)

a



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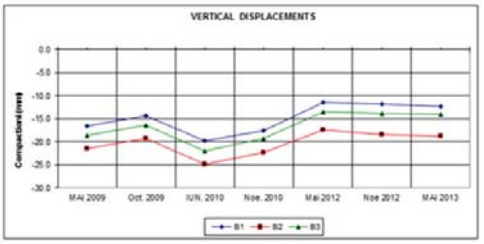

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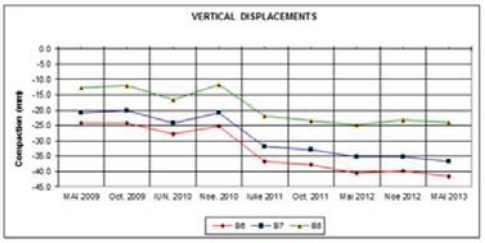

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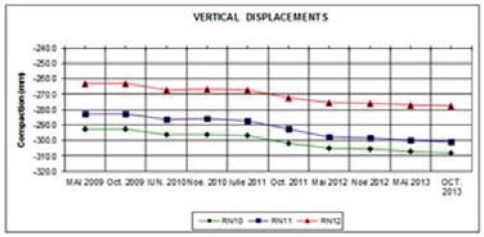
Figure 1. Vertical displacements (May 2013)



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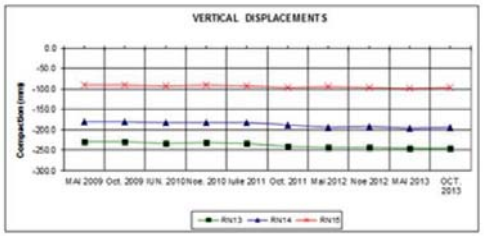

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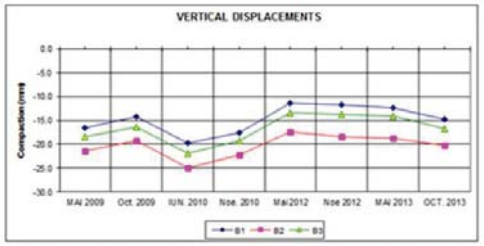

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Figure 2. Vertical displacements (October 2013)

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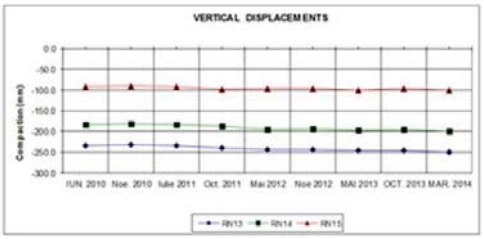

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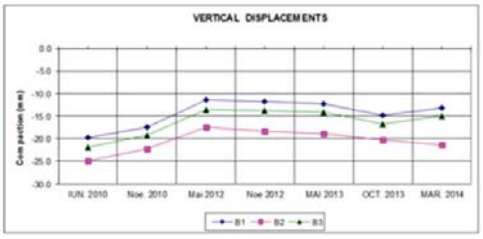


d

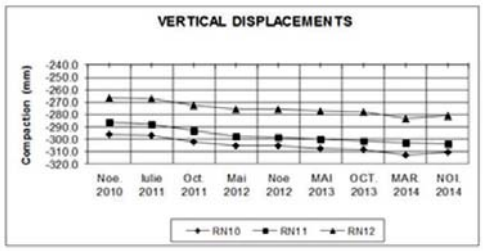
Figure 3. Vertical displacements (March 2014)

As a result of measurements in March 2014 and their processing were obtained:

- Maximum displacements from the base measurement era (period) are:
  - -312.6 mm (compaction) at landmark RN10 – on weir crest (Figure 3a)
  - -44.0 mm (compaction) at landmark B6 – on berms (Figure 3c)
- Maximum displacements from the previous measurement era (period) are:
  - +5.4 mm (compaction) at landmark RN14 – on weir crest (Figure 3b)
  - +1.8 mm (swelling) at landmark B3 – on berms (Figure 3d)

As a result of measurements in November 2014 and their processing were obtained:

- Maximum displacements from the base measurement era (period) are:
  - -310.6 mm (compaction) at landmark RN10 – on weir crest (Figure 4a)
  - -43.5 mm (compaction) at landmark B6 – on berms (Figure 4c)
- Maximum displacements from the previous measurement era (period) are:
  - +2.0mm (swelling) at landmark RN6 – on weir crest (Figure 4b)
  - +2.5 mm (swelling) at landmark B 2– on berms (Figure 4d)



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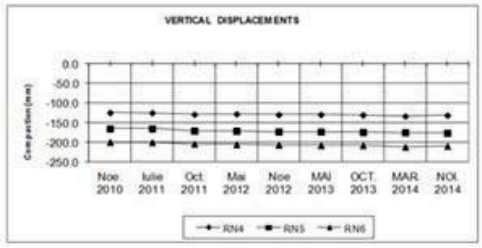

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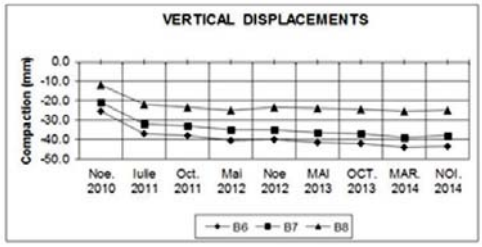

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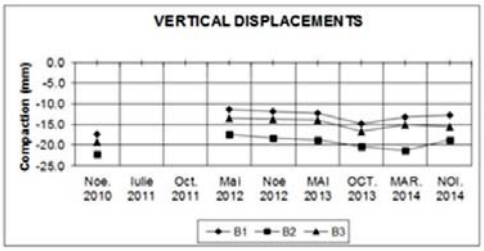

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Figure 4. Vertical displacements (November 2014)

CONCLUSIONS

Considering the situation on the ground, projects which establish how to monitor construction behaviour, construction industry norms in order to achieve real results which ensures reliable interpretation of the complex phenomenon of construction displacement in time, the topographic activity to determine landmark points displacements, respectively building constructions in good condition and efficiency, the following are required:

- Ensuring an adequate visibility from the downstream pilasters of the dam to the landmarks on the dam berms.
- Rebuilding fundamental landmarks of RNS and RND levelling.
- Marking the landmarks for a proper identification.
- Ensure a minimum protection at the PD pilaster by installing a railing around it, thus avoiding the danger of falling from height. This pillar is located on the side wall of the water overflow.

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PARTICULARITIES OF THE MANAGEMENT OF CONFLICTS IN INDUSTRIAL RELATIONS

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Abstract

We believe that labor conflict management is a crucial issue in the current socio-political reality of Romanian society, which unfortunately is not based on a culture of dialogue par excellence. So we realized this study in triple perspective: theoretical, practical and legal framework. We maintain that the industrial relations conflict management should involve a strategic level, targeting the correct choice of the goal on the one hand and a tactical level, on the other hand, which consists in the suitable settlement method. Regardless of the method chosen concrete, consider the three essential preliminary actions that could increase the chances of success, namely: the precise definition of the subject of the dispute; reducing space and increasing spectrum opportunities dispute resolution. Narrowing the field of dispute resolution and widen the spectrum of possibilities are practically in a relationship interrelation. Segregation disputed topic more items and limit divergences spectrum by identifying those specific issues that can be resolved more easily create prerequisites for the achievement of agreements on some specific issues in the dispute and ensure the transition from total war situation, the only alternative solving are victory or defeat in a dispute with a wider range of possibilities to solve, from which both sides can benefit.

Key words: *industrial relations, labour disputes, the management of conflicts.*

INTRODUCTION

History. In this region of Europe, changing industrial relations differ from country to country, depending on the socio-historical conditions. This led the development times and different solutions to national institutional model. Regardless of the ways, means and solutions promoted all countries in Central and Eastern Europe have built their own systems, inspired by one or more similar systems in developed countries on the continent (Government of Romania, Ministry of Labour, Family, Social Protection and Elderly, Directorate for Social Dialogue, , 2013).

In our country on conflict management institutions and structures industrial, institutional terms were not elaborated unit. The restructuring of the state sector, mainly strong economy contributed to boosting the institutional establishment of tripartite social dialogue processes. Tripartism in the 1990s was essentially bipartitism, given the dual role of the state in this dialogue both by government and by business organizations at the time, expression of the state capital, the only significant economy. Changing Labour Code (Law no. 53/2003, 2011) and the Law on Social Dialogue (Law no. 62/2011, 2012) led to profound changes in labor relations. Lately, especially at the beginning of the global economic crisis, the trend of flexible labor relations was felt stressed (The European social dialogue, Guide for Legislative Information in European dialogue, Government of Romania, Ministry of Labour, Family, Social Protection and Elderly, Directorate for Social Dialogue, 2012).

Acquiring. The term conflict concerns all forms of intolerance and attempts to influence resulting from incompatible between individuals and within groups and organizations and is used to describe conflict situations, emotional states of individuals, states cognitive, behavioral states. Richard H. Hall said about the conflict that "it is an organizational process inherent" (Hall, 1982).

Practicing successful management requires at the outset to identify the sources of conflict and factors favoring their orientation towards reducing management performance.

Labour disputes occurring between workers and employers regarding the interests of economic, social or professional or rights

arising from employment relationships or service. Labour disputes may be collective or individual.

MATERIALS AND METHODS

In this paper we used bibliographical sources in the field and references to specific legislation.
The methodology used during the research was conceptualisation, identification of management elements applicable in conflict situations from the perspective of the central public administration at the institutional level where the conflict breaks out, with the necessary adaptation thereof. The research undertaken had a determining and experimental-formative character. Analysis – as a tool for applied research – was performed through statements and statistics made at central government level, according to government data. Good results were yielded by the use models, the study of official documents or legislation governing this area in Romania, European norms, and documents issued by various institutions, subject to transparency. Data and information gained through the application of research instruments were processed using software applications.
I combined the *theory* reflecting, in a generalised form, the ideas, objectives, elements, concepts, principles defining the area of conflict management, the *methodology* approaching the methods, procedures of knowledge, research of the field, as well as specific action, *managerial technology* – which expresses, in essence, knowing how to do a concrete action rationally, efficiently, using theory and methodology, and *practice* – adapting above-mentioned elements to actual conditions.
The research required the study of specialised literature – economic, management, legal, sociological, psycho-sociological and pedagogical – which approached the issue of staff or human resources management, conflict management, labour law, as show in bibliographic references, with a direct impact in tackling the content pursued in the paper.
The research work consisted of: documentation, the study of organisational culture, the study of legal and practical aspects on labor legislation, the social dialogue and industrial relations legislation, mediation, statistic data processing and interpretation methods.
The involvement of the Social Dialogue Department within the Ministry of Labour, Family, Social Protection and Elderly, where I have been working for over two years, in such projects is opportune for conducting a program to develop alternative labour dispute resolutions, in order to decrease their negative effects.

RESULTS AND DISCUSSIONS

Individual labor disputes may relate to the exercise of rights or fulfillment of obligations under individual contracts and collective bargaining and in laws or other regulations; payment of compensation to cover damages caused by the failure of parts or improper fulfillment of obligations under the individual employment contract; nullity individual employment contracts or clauses thereof; finding termination of service or clauses thereof. Individual labor disputes are settled by the court of first instance. Applications for the settlement of individual labor conflicts are addressed court (tribunal) in whose jurisdiction the domicile or place of work the applicant (Ticlea, 2014).
Collective labor conflict occurs between employers and employees which aims commencement, conduct or completion of negotiations on contracts or collective agreements; employees' right to collective bargaining trigger conflicts in connection with commencement, conduct and conclude the negotiation of collective labor contracts is guaranteed by law. Collective labor conflicts may occur to defend the collective interests of economic, professional or social collective labor conflicts at the unit are represented by unions representing employees in the unit (Ticlea, 2013). At the school level are not established representative trade unions and employees have elected people to represent them in negotiations, the same people they represent and in the case of labor disputes (Law no. 62/2011, 2012). Collective labor conflict is

the main type of organizational conflict (inter-group), (Braica, 2009).

In terms of the effects they may generate conflicts as destructive or beneficial. If distructive - effects of personal and organizational resources are consumed in hostile conditions without great benefits, there is a constant state of dissatisfaction. Such conflicts can escalate and can lead to impaired strong organizations. The ability of each party to take into account the arguments of the other is reduced. Any communication between the parties is almost inexistent. On the other hand the effects are beneficial - when conflicts are recognized early and addressed properly can contribute to the process of change. In any organization, a degree of conflict is absolutely necessary, because the dynamic development of the organization to be better. Within such a conflict, the parties are able to communicate properly and sit at the negotiating table, and the results strengthen the organization (Braica, 2009).

The causes of collective conflicts. Among the most important causes that generate collective conflicts as those you listed below: a) lack of communication or miscommunication between parties. Providing sufficient information, truncated or contradictory use of methods, inadequate means and channels is generated by the inability of decision-making groups in ensuring "transparency" managerial and organizational culture; b) value system - especially ethical disagreement concerns the limits and the ways in which power should be exercised. Each party tries to enforce other, usually by force, its own set of values.One solution is for the parties involved to come to recognize and accept differences, adopting solutions that action to avoid "hot spots"; c) the existence of different purposes - not always parties agree on what should be done. Sometimes problems arise in compiling the list of priorities for other purposes can be totally different. It becomes dangerous when a party or individuals within a party have a "hidden agenda" undeclared purposes, often different from those of the organization and they follow its detriment; d) the limited amount of resources. Limiting resources can give rise to any conflict: time, money, material resources, the human and information. Resources should not and can't be unlimited and available to all, but must seek to achieve the objectives and tasks. Often, the problem is not lack of resources but their planning and allocation; e) the ratios between different categories of staff (production/support; land/premises, underground/surface, etc.). This source of conflict is amplified amid a precarious economic situation (Tripon, 2013).

Regarding collective labor conflicts effects on relations between the conflicting parties, mutual perception of the positions are "enemy", decrease the interaction and communication between the parties, ignoring their weaknesses, and the strengths of the other party. In general the opposition group appears less worthy of respect, the hostile attitude is easier to maintain and are less chances of reconciliation (Government of Romania, Ministry of Labour, Family, Social Protection and Elderly, Directorate for Social Dialogue, 2012).

In essence, the nature of the relationship between employers and employees is influenced by values, power and environment in which they operate and the type of dispute that they are trying to solve. In our opinion, the main factors that can influence the conflict are power system and environmental values.

Power means the ability to influence others, mainly because of the position of a person or institution has the technical competence and capacity of the person or institution, and the personal characteristics of the people who interact. In short, power is a combination of position, technical competence and personality. Interactions between employers and employees are influenced not only by the power that each party possesses, but also understand how to use this power. If the power is used to dominate the other party or to impose its own point of view, inevitably conflict will manifest itself in one way or another, sooner or later.

Employees and employers can have different sets of values. If employers and employees are fundamental values opposite, the conflict can't be avoided, and the results will depend on the strength of the parties. If the employee and employer values are close or similar to, the possibility of a conflict states will still exist, but will be more than principles related

standards. Integrity, good faith and respect for values other part is helping the parties reach a consensus.

Regarding the environment, relationships between employees and employers take place in a framework that includes several factors with a key role in determining the outcome of these interactions. Environmental factors change over time, leading to changing relations between employers and employees. The most important factors in this group are: the legal, economic and technological environment, political, social and cultural. We argue that cultural norms, rules and procedures governing negotiations between the parties, the attitude of the partners in the observance of the organizational structure of an enterprise, personal behavioral factors including personality, job satisfaction, social and professional status and goals may promote or mitigate, also the appearance of conflict. Through the gradual accumulation of collective conflicts escalate tension states.

There are all the conditions triggering the tense conflict without them to be noticed. Latent conflict is determined by the consequences of previous conflict episodes. The external environment also influences him latent conflict. For example, a company is facing more stressful conditions than another in the same sector. Divergent goals or objectives do not lead to conflict as long as the differences go unnoticed.

Recognition of the state of conflict by those involved in the conflict or by others outside parties. First you get the feeling of oppression. The threats are perceived, but they are not considered sufficiently important. Once focused attention on these states, the conflict situation is felt, recognized and begins to preoccupy all those involved in the conflict. Conflict remains in a latent state; those involved by not granting them significant importance and openly unreacted. Emphasizing state of conflict lies in the accumulation of tensional state. At this stage the conflict is inevitable, but he has not yet started.

Triggering the conflict inherent conflict does become visible even to those not involved directly. Manifest conflict is expressed through forms provided for by law (Law no. 62/2011, 2012). The most common reactions are apathy, dramatic attitude outright hostility or aggression. The end of the conflict is achieved by changing the initial conditions that led to its outbreak. The way resolving conflicts manifest consequences is essential. The consequences of conflict situations become an environmental factor for the next episode conflict. If a conflict has been resolved, the parties can move toward cooperation; otherwise, the conflict increases in intensity, comprising parts or issues that were not initially concerned.

Management strategies for resolving conflicts are considering two main dimensions: the perseverance of each party involved in the conflict in imposing their own point of view and their interests and how cooperative or uncooperative is each party to the conflict in needs or interests of the other party.

Regarding managers is important that they, knowing the nature, type, causes, extent and intensity of conflicts, to identify and adopt the most appropriate strategies for resolving organizational conflicts, such as: strategy oriented bypass (avoidance) strategy accommodation oriented, competition-oriented strategy, compromise-oriented strategy, strategy-oriented collaboration.

Other conflict resolution, according to the literature would be settling, forcing.

But the most effective managers deal with conflict by confrontation, first, and then trying settlement, compromise, forcing and only eventually, retirement (Lefter et al., 2012).

According to the legislation of our country (Law no. 62/2011, 2012) collective labor conflict can be triggered only under the following circumstances: a) employer or employers' organization refuses to start negotiating a contract or collective agreement, while not having signed such a contract or Agreement or the previous one has ended; b) the employer or employers' organization does not accept claims made by employees; c) the parties do not reach an agreement on a contract or collective agreement until the date agreed to complete negotiations.

During the validity of a contract or collective agreement, but employees may not trigger collective labor conflict, this is still cause for debate between unions and the government.

Collective labor conflict at the unit is triggered only after prior registration thereof by the union representative by notifying the employer of the start collective labor conflict and written notification to the territorial labor inspectorate, to effect conciliation procedure.

Steps triggering a collective labor dispute are:

1. Preparatory phase triggering - in all premises where there is an outbreak of collective labor conflict, the union will inform the employer in writing about the situation, stating the claims of employees, their motivation and the proposed settlement. The employer is obliged to receive, register and answer such notification in writing to the union, within two working days of receiving the notification, stating the view for each of the claims made. If the employer did not respond to all claims made or answered although union disagrees with the view stated collective labor conflict can be triggered. This first phase is a preparatory includes employer's obligation to respond to the union in a notification within two working days. It is an important step because the notification content analysis, especially settlement proposals made by the union and the speed with which, after receiving the views of the employer, the union shall notify the employer about the decision to trigger collective conflict written work and notify local labor inspectorate, the reconciliation, we have a picture of determination and union expectations eyes to further conduct of the events.

2. Nuisance collective labor conflict - a collective labor conflict triggered after his registration is considered collective labor inspectorate. Collective labor conflict can‘t trigger as long as there is a collective agreement in force.

3. Reconciliation of collective labor conflict is a mandatory procedure for amicable settlement of a collective labor conflict, which occurs between the warring parties. It is triggered in response to a referral to conciliation, filed by the union and to the territorial labor inspectorate. The conciliation process is led by a delegate of the territorial labor inspectorate who is authorized representatives of the parties, to work towards for reconciling their positions, to reaching an agreement and to signing an accord regarding collective labor conflict. The results of conciliation will be brought to the attention of employees by those who made the referral for conducting conciliation.

According to ILO regulations (Labour Dispute Systems, Guidelines for improved performance, Social Dialogue, Labour Law and Labour Administration Programme- ITC, Turin, Italy, 2013), but also those in our country (Law no. 62/2011, 2012), (Law no. 192/2006) after exhausting the steps above are considered forms of alternative amicable settlement of labor disputes mediation and arbitration (Book IV of L.134/2010 Code of Civil Procedure) which are voluntary procedures. Throughout the duration of a collective labor conflict, warring parties may decide by consensus to resort to mediation or arbitration. Mediation or arbitration of collective labor conflict is mandatory/compulsory if both parties jointly decided this before or during its strike. In practice, however, as a rule, to which the procedure is not used. Moreover, there is no body dedicated and specialized in labor disputes, which can call on the services and labor. Law no.62/2011 governing Social Dialogue establishing in the labor ministry official establishment of mediation and arbitration of labor disputes, but the reasoning that objective could not be operationalized so far.

Below is dynamic conciliation of labor disputes in Romania, where it shows a success rate of 50% (conflicts enclosed or semi-enclosed) as reported by labor inspectorates.

Table.1 Summary statement of collective labor conflicts in Romania during 2007 – 2014

	Year							
	2007	2008	2009	2010	2011	2012	2013	2014
Declared conflicts	85	116	93	73	35	27	22	16
Closed conflicts	35	34	33	24	11	9	10	4
Open conflicts	37	60	45	45	24	14	10	8
Partially closed conflicts	13	22	15	4	0	4	2	4

Source: ITM, Own calculation.

What we notice here is the potential alternative settlement of labor disputes. It is relevant also

individual labor conflicts and developments that affect settlement mechanisms and their prevention, where we see an increasing trend of individual labor conflicts with two distinct peaks in 2008 and 2010. While in 2008 the increase was due to individual labor conflicts of restructuring measures by employers as a result of the onset of the economic crisis (usually redundancies and wage cuts), measures challenged in court employees, growth in 2010 is the consequence of reducing the impact of legislative action wages in the budgetary measures affecting over a million employees, many of them addressing the courts to contest those measures.

According to the latest statistical data published in the Statistical Bulletin of the National Institute of Statistics of Romania in 2014, we processed the following graph for visualization of the number of complaints of labor disputes in court during 2000-2013.

The analysis of these data we can say that the effects of the global crisis are still being felt in Romania, and the measures taken by employers to reduce the effects of the crisis by restructuring jobs and reducing wages still generates a huge number of individual labor disputes. It is however difficult to predict at this time the dynamics of individual labor conflicts, as the economic situation is not yet stabilized, even if efforts are made in this regard by the government.

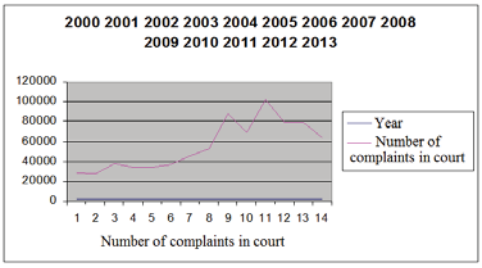

Figure 1. Evolution of the number of complaints of labor disputes in court during 2000-2013

On the other hand experience shows that there is a golden rule, namely interventions that are not supported by one or both parties that are not reinforced by expertise, friendship or third party authority (power sources thereof), can be received hostility or even hatred, whatever the motives or intentions of the third party.

The most expressive form of conflict manifests defined by fundamental law (The Romanian Constitution, 2003) is strike. The strike is any form of collective and voluntary cessation of work in a unit, when the crisis of the conflict. Strikes can be a warning, solidarity and themselves. Warning strike may not last for more than two hours when dealing with cessation of work, and must in all cases precede at least two working days strike itself. The strike can be declared solidarity to support the claims made by employees in other units in the same group or sector units. Solidarity strike can't take longer than one working day and must be announced in writing management unit at least two working days before the date of termination of operation (Law no. 62/2011, 2012).

Decision declaring the strike is taken by the trade union organizations participating in collective labor conflict with the written consent of at least half of the members of that union. The units are not representative unions organized the judgment declaring the strike is taken by employee representatives, with the written consent of at least a quarter of the employees of the unit.

In order to declare the strike under the law (Law no. 62/2011, 2012) is required to have exhausted the possibilities for resolving collective labor conflict by compulsory procedures provided by law and after the warning strike. According to the law (Law no. 62/2011, 2012) for the duration of the strike individual employment contract or the employee is suspended by law. During the suspension remain only health insurance rights. During the strike organizers continue negotiations with the management unit in order to settle claims which form the subject of collective labor conflict. During negotiations, strike organizers employer may agree with the temporary suspension of the strike. If negotiations fail, the strike will resume. It is important to emphasize however that strike organizers refuse to continue negotiations during the strike attract legal liability for damages caused to their unit.

If the strike organizers and management of the unit reach an agreement, or decide this collective labor conflict is closed and the strike

ceases. Also in the event that, after the strike, more than half of the employees who decided to declare the strike strike stated in writing, it ceases. The court may terminate the strike as illegal.

Although art.187 of Law no.62/2011 Social Dialogue states that strike organizers are the ones who determine its duration, most often strike is declared indefinitely (until the settlement of claims). Outside court ruling only on the legality of the strike, the collective labor conflict extinction can‘t not interfere factors outside it.

CONCLUSIONS

In principle, the conflict is defused at an early stage through negotiations conducted in good faith and responsibility, the better the chances of reaching a workable agreement. The parties found common solution able to meet their needs (not necessarily desires) will increase the respect and trust between the parties and facilitate future cooperation. To be able to solve such approach must be win-win. Escalating conflict risks at least two reasons. The first reason is the risk of losing control over even the organizers of conflict. In this case, exit from the conflict becomes difficult and may involve unanticipated costs. The second reason is the long-term effects on each side, in case of conflict that results in winners and losers. In such a situation, social tensions are not defused, but continue to accumulate, resentments and frustrations are growing and latent conflicts within the party to overcome will worsen. Future cooperation is threatened and consent "required" is unlikely to be respected (A Practical Guide to Professional Conciliation in a World of Labour Relations – draft ILO, 2015).

Communication is an extremely important element in the prevention and resolution of labor disputes. In this regard it is essential to the proper functioning of the Joint Commission employer-union organization, particularly in the area of conflict prevention. Also creating a realistic expectation horizon represents a gain. Preparation and negotiation must be skills of the committee members (understanding the issues, analysis and listening ability, reliability, balance, anticipation, attitude, ability to negotiate, etc.). It is essential to have a firm and realistic negotiating mandate, credible partner/negotiation. Good foundation and presentations and offer credibility in the negotiation process is considered an aset. Specialists know well that identifying informal leaders negotiating partner and their approach in an informal setting, is a practice commonly used, too. Promptness and accuracy of communications to employees on the status and content of the negotiating committee's work after each meeting it is very important as the content and credibility of messages that employees send this occasion.

It is advisable to use the most appropriate channels of communication and influence employees, so that information reaches as many of them. Full understanding of the risks of a collective conflict (in case of conflict risks must be balanced between the partners).

Ideal is however resorting to alternative procedures for amicable settlement of labor disputes; identify those solutions that allow deadlock maintaining the credibility and communication partners during the course of collective labor conflict. Enhancing communication with formal and especially informal leaders of the other parties, promptness and accuracy of communications to employees about the progress of negotiations during the conflict are also particularly sensitive issues, given that the decision chain is longer if the employer.

Analyzing the phenomenon of statistical data, but also longstanding human resources and central government, I can say that although conflict management work is a critical importance in political and social reality of our society unfortunately does not is based on a culture of dialogue par excellence. Conflict management in industrial relations should include a strategic level, targeting the correct choice of lens on one hand and a tactical level, on the other hand, which consists in the suitable settlement method. Moving from culture of conflict to culture of dialogue requires including the development and promotion of alternative dispute resolution practices work. This requires is a lengthy effort that must

contribute in good faith with all stakeholders, trade unions, employers and public authorities.

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SPECIFIC FEATURES REGARDING THE PREVENTION OF WORK ACCIDENTS AND OCCUPATIONAL DESEASES IN LAND RECLAMATIONS ACTIVITY

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Abstract

The insurance subsystem against work accidents and occupational diseases is one of the pillars of the social security system identifiable at any developed country level, regardless the conferred title or the institution in which subordinations is. The Prevention of occupational risks submits one of the variants of rebalancing the allocated budgets for this subsystem. The developed researches was based on Framework Directive 89/391/CEE for health and safety at work and the correspondent Romanian harmonised legislation. The aim was to avoid or reduce the occupational risks by achieving an integrated prevention and protection to ensure the continuous improvement of the safety level and health protection of workers within the land improvement activity. The developed model for ANIF is also applicable for other components of the social security systems, the acting success condition being the developing of a system based on integrated approaches linked with assets to the passive dimension.

Key words: *framework directive on OSH, NALR (National Administration of Land Reclamation), prevention, occupational risks, risks avoiding.*

INTRODUCTION TO APPLICABLE LEGISLATION

Framework Directive on the occupational safety and health (OSH), "Directive 89/391/EEC on the introduction of measures to encourage improvements in the safety and health of workers at work", defines prevention as "all the steps or measures taken or planned at all stages of work in the undertaking to prevent or reduce occupational risks". The implementation of prevention measures of occupational risks to the end to ensure the safety and health protection of workers, will be conducted by the employer in compliance with the general principles of prevention that the Framework Directive provides in Article 6, which are the follows: avoiding risks; evaluating the risks which cannot be avoided; combating the risks at source; adapting work to the individual, especially as regards the design of workplaces, the choice of work equipment and the choice of working and production methods, with a view, in particular, to alleviating monotonous work and work at a predetermined work-rate and to reducing their effect on health., adapting to technical progress; replacing the dangerous by the non-dangerous or less dangerous that is, developing a coherent overall prevention policy which include technology, work organization, working conditions, social relationships and the influence of the working environment; adoption as a priority to collective protective measures for personal protection measures, giving appropriate instructions to workers.

These principles were transposed into national legislation by the Law no. 319/2006, in Article 7, and they are considered some of the most important issues in the occupational safety and health field, together with the provisions which establish the most important obligations for the employer, namely: "to assess risks for the workers health and safety, to take prevention

measures and apply working and production methods to ensure security and to improve workers occupational health and safety which must be integrated into activities of the undertaking and/or establishment and also which must be present at all hierarchical levels, to take into consideration the worker's capabilities as regards health and safety at work when employer do establish the tasks assigned for worker; to ensure that the planning and introduction of new technologies are the subject of consultation with the workers and/or their representatives, as regards the consequences of the choice of equipment, the working conditions and the working environment for the safety and health of workers, take appropriate steps to ensure that only workers who have received adequate instructions may have access to areas where there is a serious and specific danger.

THEORETICAL CONSIDERATIONS

Taking into consideration the definition of prevention from the legal point of view mentioned above, the preventive measures are the technical, organizational, hygienic and sanitary ways, which provide or improve the safety and health at work and by them, actually, the risks are eliminated, avoided or decreased. Stepping out this legal area and passing to the research ones, these risks represent the possible action of the existing risk factors (effect of present hazards) on the human body and eliminate the risk of a workplace is very difficult in practice. In our opinion, it would be appropriate to use the concept of "prevention" only in such case. In the other two cases of avoidance or mitigation processes, the concept of "prevention" use would be justified only partially, because it must to apply "the protective measures". Since, both in theory and in practice, the risk factors are classified most commonly in relation with the work system elements (performer - work tasks - means of production - working environment), the protection and prevention measures can be classified, also by reference thereto. For example, the measures related to worker (e.g. medical examination, psychological examination, training and counselling) aimed to eliminate intrinsic causes are: omissions and wrong actions or their causal substrate, lack of attention, lack of physical and mental attitudes, lack of occupational safety knowledge, inadequate attitude towards risk. To establish a correspondence between a cause and a protection and its prevention measure is not always possible. Frequently, a cause can be removed by several measures, and vice versa - a single measure can eliminate many causes or risk factors.

The protective and preventive measures can be classified into two broad categories:
- Organizational measures, aimed in particular on contractor and work task;
- Technical measures relating in particular to the means of production and work environment.

The main organizational protective and preventive measures against work accidents and occupational diseases are health surveillance measures: medical examinations and, where appropriate, psychological examination; staff training; counselling; communication and consultation with staff in the health and safety at work issues; organization of the work and workplace. Technical measures to prevent work accidents and occupational diseases are classified into the following categories of protection: individual, collective, intrinsic and integrated.

1. Organizational measures

1.1. Medical examinations

Medical examination is an important preventative measure, helping to eliminate the causes of accidents and occupational diseases which have no substrate, failure or shortcomings of physical and mental qualities of the performer, that means his health that abnormal condition. In terms of industrial activity, the medical examination has an important preventive role. First of all, it contributes to reducing the incidence of occupational diseases and accidents, by targeting subjects who have abnormal susceptibility to the action of professional hazardous chemical, physical or biological agents. On the other hand, detection of occupational diseases in an early stage can

prevent worsening illness or disability installation.

1.2. Psychological examination

In the system of actions and measures designed to achieve optimum efficiency and a maximum security at work, the psychological examination occupies an important place. Along with the medical one, it has two key objectives: it ensures consistency between tasks/objective requirements of the profession/employment, in particular, and real capabilities of the individual; Detecting and preventing the causes of psychological disorders and accidents in the system "man - tasks - means of production - working environment." In achieving these objectives the psychological examination is involved in the professional adults training guidance, the professional selection, the distribution for the jobs in the same profession or trades, to maintain or not the workers in their jobs, in promoting the employees for the higher level of skill jobs, also for the expertise of and the recovery of the work capacity.
In all cases listed above the examination is complex, involving multiple correlation methods and procedures: observation, biographical method (the detection and evaluation of the most significant episodes and events in the history of the person), the method of analysis work products, and call the questionnaire method, experimental methods (lab and natural), test method. Each method involves a logical operational scheme different criteria and measurement techniques for specific evaluation. Whatever, the purpose for which it seeks psychological examination is based on a series of general principles whose observance is likely to prevent possible mystification, distortions, exaggerations, giving meaning diagnostic - prognostic's expected results.

1.3. Staff training

Training in safety and health is part of general training and it is done either at work or in educational institutions (secondary, post and / or higher). Personnel training in the safety and health at work domain is a set of organized activities which aim to acquire knowledge and skills of occupational safety, including practical exercises on how to achieve action in predictable cases. Considered one of the most important preventive measures, training is aimed at eliminating or reducing the number of human errors or failures resulting from lack of safety knowledge. It is through training processes - processes of information exchange in health and safety at work. The content of the training process consists of all information related to the sphere of labour, through assimilation and repetition lead to the formation of normal behaviour, optimal work, developing the correct orientation to risk and boost capacity to mobilize against them.

1.4. Consultation of workers and communication on the health and safety at work

In addition, "the workers with specific responsibility for safety and health of workers shall have the right to ask the employer to take appropriate measures and to submit proposals to him to that end to mitigate hazards for workers and/or to remove sources of danger." Therefore, the representatives of workers acquire more than an advisory function, they can get involved in policy development and health security of the company. This work is paid, the workers' representatives can not be discriminated against their positions taken and they can appeal to the authorities responsible for the protection and safety during inspections and can freely express their observations. Consulting staff on issues related to safety and health is a concept introduced by the Framework Directive (Article 11), which establishes the principles of consultation by employers of workers on these issues. In Romania, this concept is achieved, especially in the health and safety committees established in enterprises and work units established by Law no. 319/2006. Employees have the right to be consulted, to make proposals, namely balanced participation, in accordance with law and / or practice in order to discuss problems concerning health and safety at work.
Along with training, professional selection and consultation, communication measures implemented or planned, as well as important data for the activity, are important

organizational measures to prevent accidents and occupational diseases. It consists of a set of actions, methods and means of influencing human behaviour in relation to health and safety requirements of work. The communication aims to eliminate risk factors arising from the dangers of impropriety, is the main way to disseminate ideas and information to strengthen the opinions, attitudes and behaviours appropriate in terms of knowledge, respect and Law Enforcement its safety and health at work.

The main objectives of business communication and health security can be formulated as follows:

- modification of the individual and collective behaviour in relation to occupational safety requirements;
- influencing and correction of personal and collective characteristics that can lead to accidents in the workplace;
- increasing of the security for individual and collective work process;
- promoting appropriate attitudes about risk;
- create and maintain a tendency of individual and collective responsiveness to concrete activities to prevent industrial accidents and occupational diseases.

In terms of occupational safety organization work station, regulating the activity of the performer can be a source of errors by insufficient training of the workers or lack of equipment, work tools, time,, work tasks and rules disproportionate against the workers full potential etc. The constraints due to wrong methods of work, assignment of excessive work tasks can lead to excessive anxiety and disruption, favouring the occurrence of dangerous situations. The same effect it has poor service job, its poor planning, the personal issues. All matters listed are part of the work subject, understood as an integrated set of techniques and methods used for analytical research, systematic and critical work processes, potential or existing, in order to achieve greater economic efficiency.. Making a correlation between technical progress, with its constructive solutions, and the human body's ability to react promptly to receive information in different ways, within its physiological, psychological, professional and cultural, it is an important requirement of modern society. Labour productivity should assist the contractors to reduce their effort in the process of work. In the current economic conditions, saturation occurs mainly workers under psychological report, with serious consequences for increasing errors, and survey work is essential to optimize work processes, especially in the ergonomic sense of their organization.

The analysis lead to an ergonomic work for the purpose of mutual adaptation of the work system components, so that the implementation process has to allow the daily restoration of work capacity. Generally, work organization can be defined as determining the work tasks and their distribution between the performers. A good organization of work appeals to the study of the work and to ergonomics, has solved a number of steps. Among them, some are more important in terms of health and safety at work, being, in essence, and measures to prevent accidents and occupational diseases.

The streamline of the movement of men and machinery by identifying solutions that provide (in addition to reducing the length of routes) the elimination of the overlaps and cross flows, the reduction of the number and duration of transport, the reduction of the number of vehicles, the avoidance of overcrowding of jobs and periods of waiting for processing, the avoidance of the collision between objects (products or means of transport) or between objects and different performers etc..

By analysing the contractor movements, it appears that the manner of execution of movements and energy directly determines the degree of strain at work. The purpose of the analysis is to eliminate the unnecessary movements, reducing the distances that are performed and to rationalize the direction and execution effort of the movements. Finally must be obtained simultaneously the removing of the causes that lead to premature appearance of fatigue, and reducing the work time to perform a task.

As it knows, between the technical measures to prevent occupational accidents and diseases are the following main areas of action: individual protection, collective protection, intrinsic protection and integrated protection. Integrated

and collective protection are priority actions to prevent accidents and occupational diseases. The current level of scientific and technical progress does not make possible the complete personal protection, because it cannot entirely eliminate the risks..

2.1. Personal protection

The personal protection equipment consists in all personal protective means that are used by the worker during his work. It behaving like a screen; this type of protection helps to prevent or eliminate the risks.

2.2. Collective protection

Collective protection includes all technical means and methods which prevent or reduce risk factors on the action of two or more performers. In practice, collective protection consists mainly in providing facilities, machinery, devices and appliances designed for the sole purpose of protecting workers during the work process and it is achieved by providing technological facilities and equipment, security devices, additional work,, independent tasks designed with unique technological process. In this manner, it is possible to correct protection deficiencies of machinery, equipment or the parameters of the working environment for the purpose of bringing them in the security limits.

2.3. Intrinsic protection

Intrinsic protection is the best way to eliminate risk factors for occupational accidents and its goal is the integration of security, productivity and reliability issues in the phase of technical design. Each element must be designed to ensure simultaneous satisfaction of the production function and security criteria throughout the expected life of the product, in any operating conditions. Intrinsic safety makes unnecessary the development of special occupational safety regulations, along with technological requirements, but needs instructions for the use of machines and facilities.

Although the most efficient, in terms of economic and social achievement,the intrinsic safety is a goal whose achievement is strictly conditioned by the technical progress and science in general. It implies the existence of design methods to enable simulation of all the possible alternatives of operation and of behaviour of each element of a technical system in order to be able to choose constructive solution corresponding to the intrinsic risk equal with zero. Also, it should be possible the materialisation of such solutions with costs that meet the criteria of profitability.

The robots, automated processes and especially businesses that are fully automated are the solution to protect the man from the possible action of some specific risk factors in the work place, starting from the fact that only the presence of man, as a performer, working in a system, makes possible an occupational accident or disease. There are objective limitations in improving security office machines, equipment, technologies and that human behaviour. This is the reason why the increasingly accepted solution by some authors, to achieve complete intrinsic safety, is to replace human performers with mechanical systems, automated or robotic. The transfer function of the actual execution of the processing, transport, supply of machinery, etc., to the mechanical systems, and even then the function of command and decision, allows to obtain not only higher yields, but also the physical impossibility of interaction between man and danger.

2.4. Integrated protection

The integrated protection is the ideal way to protect the human at work and eliminate the danger of accidents and occupational disease before the formation and the entry into service of the work system. In this respect, the integrated protection concept was created as a way to eliminate the risk, by providing all necessary measures and means of protection from the design phase and implementation of labour resources. In this way you can be working systems which operate to provide minimum acceptable risk for executing against the technical and scientific progress.

The principles of the integrated protection are:

• the design and implementation of equipment, machinery etc. In this stage, it must be

identified all risk factors of occupational accidents and professional diseases, must to assess risks and to choose the most appropriate solutions, based on scientific and technical progress in aim to eliminate or minimize the risks;

• when we choose the best solutions, the following criteria must be applied, in the above mentioned order: eliminate or reduce risks, establish and implement the necessary protective measures against risks that can not be removed, inform the users about the residual risks due to incomplete efficacy of the adopted measures;

• the protective functions must be made at the same level with the other functions of the product;

• it will consider both situations: the normal circumstances of the operation and the unusual, abnormal, but predictable ones.

The result of the principles application of the integrated protection is that the integrated security can be expressed quantitatively or qualitatively. Currently, the concept of integrated protection began to be extended to systems work together at which the gravity potential risk is extremely high, especially in their accidents representing a massive loss of lives and considerable material damage.

Achieving integrated protection involves the design, development and selection only of those items that meet all safety criteria in the phase of work, prior to its entry into service of all measures to maintain the security function in optimal parameters.

RESULTS AND DISCUSSIONS

This concept was applied in the specific conditions of the National Administration of Land Reclamation, to prevent work accidents and occupational diseases, by occupational risks avoiding.

CONCLUSIONS

Implementation of occupational risk prevention measures to ensure safety and health protection that can be achieved by compliance with general principles of prevention, which are provided by Framework Directive, as follows:

- avoiding risks;
- risk assessment can not be avoided,
- combating risks at source;
- adapting the work to humans, especially in regard to design workstations, choosing work equipment, work methods and production, to reduce the monotony of work, work with predetermined rate and reducing their effect on health;
- adapting to technical progress;
- replacing the dangerous by the non-dangerous or what is less dangerous;
- developing a coherent overall prevention policy which include technology, work organization, working conditions, social relationships and the influence of the working environment
- adopted as prior the collective protective measures instead individual protection measures;
- providing appropriate instructions to workers.

Following the assessment that the employer have the obligation to make, if necessary, the preventive measures and working methods implemented by him must to ensure security, to improve occupational health and to be integrated in the overall business and / or establishment, at all hierarchical levels.

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LIFE'S PUZZLE

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Abstract

The paper deals with the binominal sentence "Agriculture for Life". Associated with its reversed form, i.e. "Life for Agriculture", it was successfully used by a bright mind as an appealing motto. This is why the meaning of that homogenous sentence is further investigated on the basis of the third axiom of classical logic namely, that of the included third. When as hidden third the gravity is included then one of motto's fascinating meanings seems disclosed. Gravity contains life's key. For this purpose some legends and fairy tales, well known to Romanians, have been selected. The paper concludes that gravity holds indeed the key of life, but the nature of gravity remains unknown. A higher level of consciousness is necessary before decrypting the gravity.

Key words*:anthropomorphism, automorphism, congruence, idiomorphism, transcendence.*

INTRODUCTION

For theoretical physics the twenty-first century started in force. Stephen Hawking has summarised his former works and published in the year 2005 "The Theory of Everything" (Hawking, 1996; Hawking, 2001;Hawking, 2003; Hawking, 2005). In seven lectures the history of the universe from big bang to black holes is briefly presented. The book concludes with a desideratum, namely to do a unified theory of physics. That will allow understanding the real identity of mankind, where it is coming from and where it is directed to. For the time being the nature of gravity, even with the involvement of quantum mechanics, was not disclosed yet. The physicists are however optimists. After only two years from coming out of Hawking's book "New Theories of Everything" was published (Barrow, 2007). The author's quest for the ultimate explanation to discover the laws that govern the universe and are responsible for human existence, seems weak. In the year 2013 Lee Smolin in Canada, author of the book "Three Roads to Quantum Gravity", 2001, recently published a fascinating theory about time (Smolin, 2013). Since according to his view time is real and space only an illusion he is suggesting to reverse the binominal "space-time" in "time-space" and that would open the future for disclosing the most familiar of the four fundamental forces existing in universe, the force of gravity. The other three forces, namely the electromagnetic, weak nuclear and strong nuclear ones are already well known and kept under control. The force of gravity is by far the weakest of all four forces and classical physics assumes it is propagating by gravitational waves while quantum mechanics by matter particles called "gravitons". In order to support the research in theoretical physics Large Hadron Colliders were built in the last two decades first near Geneva, Switzerland, and then, the second, in Manchester, (Marcelloni, 2013). In the year 2015 Manchester will produce collisions of a scale never achieved by any accelerator in the past, equivalent with 154 tons of TNT or similar to earthquakes of magnitude 4 on Richter scale. In addition, one of the objectives of laser research project, which recently started at Magurele Platform near Bucharest, is also to study new concepts in construction of particle accelerators. Therefore a true scientific offensive, based on the analytical Aristotelian thinking, is now, in the dawn of the new century, devoted to disclose the mystery of gravity.

The 4th International Conference of University of Agronomic Sciences and Veterinary Medicine of Bucharest is held this year under the well-known motto "Agriculture for Life, Life for Agriculture". The reversibility of this

binominal expression emphasises that the Life devoted to Agriculture is supposed to be rewarded in return by Agriculture with refreshed Life, according to endless cyclical laws of Nature (Sofronie, 2012).Since Agriculture and Life have similar biological roots the expression of the above praised motto is homogeneous and worth to be analysed according to the third axiom of classical logic, namely that of excluded third (Nicolescu, 2009). Recently, this axiom was further expanded by Prof. Basarab Nicolescu, and the included third may be optionally replaced with the hidden one (Nicolescu, 2014).In a trans-disciplinary analysis this new philosophical tool is a source of knowledge able to reach all levels of "Reality" namely those that corresponds to existing levels of understanding. For sure, in a world that is continuously moving, and Malthus theory of evolution not yet forgotten, such an analysis is expected to bring surprising results about the binominal Agriculture-Life. Particularly, for the purpose of this paper devoted to life, gravity is chosen as a hidden third. The interest for gravity is as old as the conscious life. There are many proofs that primitive people were aware about gravity and behaved accordingly. The knowledge progressively acquired was stored in legends or fairy tales, always cryptically protected. The thinking used in the past was concise and of synthetic type, like Plato's one, often with several meanings. From very early times people learned to use knowledge as an ascendant against the others. Some historians assumed first this attitude as being generated by self-surviving instincts. Not much later, at a planetary scale, the stored knowledge in human minds degenerated into sources of aggression against confrères. In spite of that primitive component of mankind evolution, amazing discoveries were made during centuries. In order to answer to the bewilderment expressed by paper's title few of the best known legends or fairy tales, more or less devoted to gravity and already fixed for a long time in the consciousness of Romanians, were selected below as study cases.

WHAT GRAVITY DOES IS?

Thinkers like Aristotle, Archimedes and Galileo Galilee dealt with what today is called gravity, but none understood it properly. Isaac Newton (1643-1727) was the only one who discovered the two fundamental proprieties of the matter, namely inertia and gravity. Inertia preserves the mechanical state of rest or rectilinear and uniform motion of a body, while gravity is the force of attraction of the Earth. He extended the interaction between material bodies to the whole universe as a law equally valid in Heaven and on Earth like the *Pater noster* prayer also states. Newton's work, in its three books, also includes action as cause of motion and the equilibrium of material bodies as well. It is entitled *Philosophiae Naturalis Principia Mathemathica,* in deliberate contrast with Descartes' *Principia Philosophies*, and was published in 1687.

According to the law of universal gravitation, as it is called by Hawking in (Hawking, 2003), the attraction force F developed between two bodies with masses m_1 and m_2, distanced between them by r, is defined by the expression

$$F = K\frac{m_1 m_2}{r^2} \quad (1)$$

where Newton's universal constant K, determined with Cavendish balance, assumes the value

$$K = 6.673x10^{-11} Nm^2 kg^{-2}. \quad (2)$$

Particularly, by considering the Earth as one of the two bodies with mass M while the gravitational mass of the other body, located on Earth surface at distance R from its center, is written with m_g, expression (1) assumes the form

$$F = K\frac{Mm_g}{R^2}. \quad (3)$$

On the other hand according to Newton's second law, the force acting on an inertial mass m_i moving with acceleration a, has the expression

$$F = m_i a. \quad (4)$$

By comparing expressions (3) and (4)

$$m_i a = K\frac{Mm_g}{R^2},$$

and since experimentally it was proved that the two masses m_i and m_g are equal, i.e.

$$m_i = m_g = m \quad (5)$$

one finds the intensity of the gravitational field under its two forms of scalar and vector,

$$a \to g = K\frac{M}{R^2} = 9{,}81 m/s^2 \to \vec{g} \quad (6)$$

which assumes acceleration dimension with its numerical usual value. Returning to expression (4) one obtains the scalar and vector forms of gravity force

$$F \to G = mg \to \vec{G}. \quad (7)$$

This is the attraction force of Earth that keeps all material bodies on permanent contact with Earth surface and is also called weight. The above theoretic results are confirmed by reality and are of great use for practical purposes. Unfortunately, more than that is unknown. This is why about gravity a legend with Newton's apple, which follows the cryptic rules of antiquity, was created.

ETERNAL YOUTH

Among the 37 legends or fairy tales published by Petre Ispirescu (1830-1887) at the end of the nineteenth century in Bucharest, one is titled "Youth without Age, and Life without Death" (Ispirescu, 1882).The story tells that a prince guided by his winged horse went out into the world to find the eternal youth. Needless to say man and horse had to overcome many obstacles, but finally his dream came true. Their arrival on that blessed land was heartily greeted by a beautiful young girl who lived together with two of her elder sisters as well as by representatives of all species of animals and birds like on Noah's Ark. Of course, the prince married that sweet girl and they lived happy for a long time, inside the borders of that privileged territory, but without having any children. When he once, by accident, overpassed the forbidden borders of their land the prince was immediately severely punished. Returning home with his winged horse he was astonished to find out that in the meantime many years had passed. Alone and abandoned even by his horse, he eventually passed away in deep sadness. The message of this story states that life on Earth is like a river, namely a permanent, continuous and endless regenerating process. Only the participants in this universal process are compulsory ephemerides and should be periodically refreshed. Eternal youth, as that imagined by prince, would be possible only on a far planet, with a different gravitational field, and without any regenerative components, like a living utopian museum.

THE KISS

In March 1907, after only two months spent as practicing to Auguste Rodin (1840 -1917) in Paris, Brancusi rented a workshop in Montparnasse area and started his independent work of creation. So, in the same year he created his own "Kiss" as a replica to Rodin's statue with the same title. Brancusi's "Kiss" is reported to an orthogonal system of Cartesian axes such as the faces of lovers are joined along the vertical axis, while the embracing parallel arms along the horizontal axis. That vertical axis of reference is not a randomly one, but an axis of symmetry. This means the two members of the couple are physically well balanced in the gravitational field as a basic condition of being conscious about the step they are following. But really fascinating is that they are mirroring in each other. In mathematics mirroring means congruence or superposing. It is the best proof of true, genuine love that motivates their reciprocal attraction for fulfilling the act of kissing. In the first phase the statue was limited to the bust of lovers inscribed into a hexahedral parallelepiped that satisfies Euler's topological theorem between facets, peaks and edges, F+P=E+2 →6+8=3x4+2. By its gravitational orientation the statue received a cosmic connection, while the horizontal force of embracing, being free of gravity, participates in the act of kissing with its maximum intensity. According to his original concept, radically different by Rodin's "Kiss", the statue is not representing a real, ephemeral kiss, but a symbol of the eternal kiss, that involving the total union of lovers with universe. When Brancusi was asked to produce a funeral monument for Tania Rachevskaia, a Russian anarchist girl who committed suicide for love in 1908, in the

second phase of his act of creation, he decided to extend the statue of "the Kiss" to the whole bodies of the couple. This small statue of only 30x20x89,6 cm, in cheap, ordinary limestone, is still preserved and carefully watched in Montparnasse Cemetery from Paris. In the third phase of creation, thirty years later, already in 1937, the stylized image of this extended "Kiss" was carved in the travertine plates of the "Gate of the Kiss" in Targu Jiu, Romania. A chain with forty copies, is suggesting a typical Romanian round dance that Mircea Eliade (1907-1986) called in his book "Solilocvii", published in 1932, "the cosmic dance". Thus, by his "Kiss", symbolizing the beginning of gravitational life, Brancusi became definitely consecrated in cosmic geometry of the universe.

WISDOM OF THE EARTH

In the same year 1907 this small statue in crinoidal limestone, collected from the Catacombs of Paris, with dimensions 24.9x16.5x56.5cm was called by Brancusi himself "the Wisdom of the Earth". It is written that in 1910, when the statue was submitted to the Art Museum in Bucharest to be exhibited, it roused contradictory reactions, not being well understood by onlookers. Most of them were intrigued by the strange shape of its head, but it was finally accepted. Ten years ago the statue was called *Sophrosyne* meaning "soundness of mind" in Greek (Pogorilovschi, 2005). The above mentioned misunderstandings were possible because everybody *ab initio* believed that the statue is representing a woman what is untrue. Neither is the Sphinx erected in Egypt by AKA Cheops a woman, but a lioness with a woman head. Nowadaysthe reality is regarded with more straightforwardness than before. Wisdom comes from the ability of the human brain to think, and the brain is the matter located in head. Therefore the statue is without any doubt symbolically representing the Earth's geoid, accordingly reshaped by sculptor's intuition, supported by a female body. This proportionally reduced in dimensions model of the Earth is perfectly centered on female body by their common vertical plan of symmetry. As a proof, the female body was also gravitationally shaped with a firm vertical back and a large horizontal base. The stylized eyes, nose, mouth, ears and even hair on the Earth surface were applied by the sculptor for the sake of camouflage only. For long time, people learned to hide their secrets like thesauri. The idea of supporting a cosmic body on human shoulders is not new. In Greek mythology Titan Atlas held up the celestial spheres. It is supposed that for an inhabited Earth Brancusi preferred a female as the unique being able to generate life. Once this meaning of the statue is accepted, it would be easy to understand that its wisdom consists in the gravitational field itself. Earth and humans are in resonance, and therefore the humans are responsible for Earth future. The statue might be regarded as a homage brought by Brancusi to gravity.

OEDIPUS

The question is why should gravity be praised by humans? To this question Oedipus is definitely answering. In short, the story starts in Egypt where the King Khufu or AKA Cheops erected the Sphinx (2558-2532 BC) beside his Great Pyramid. The Sphinx is a memorial devoted to the beginning of time, called by Egyptians *ZepTepi,* which according to Robert Bauval occurred in the year 11,451 BC. In that very year human consciousness was fixed in brain as in solid matter. About that event Plato (428-348 BC) in his *Timaeus,* famously wrote that World Soul was being crucified on the World Body (Black, 2010).According to a legend the Greeks, aware by that event, took the name of Sphinx to a mythological monster, also as a winged lioness with a woman's face, which used to check whether human consciousness works. The people found unconscious were immediately killed. It is said that once the monster met Oedipus, the King of Thebes and asked him the riddle: "What is it that has a voice and walks on four legs in the morning, on two at noon, and on three in the evening?" Oedipus immediately answered that it was man who, as a child crawls on all fours, as an adult walks on two legs, and in old age uses a stick as a third leg. In this way Oedipus escaped by monster's punishment, but his answer contains a great truth: during adult life

the role of the stick is assumed by gravity. It is the gravity which provides to all bipeds their stability of equilibrium in both mechanical states, those of rest and motion. Similarly the gravity acts on plants, flowers and trees. This is why gravity is worth of human homage.

NARCISSUS

Brancusi devoted in 1913 a small statue of white marble to *Narcissus* without expressing any compassion for his sorrow. Brancusi was conscious of this sad and paradoxical legend in the same time. All the boys in the world are beautiful, and therefore none of them is motivated to commit suicide only for reason of his own beauty. Considering the legend from the viewpoint of physics, it seems that in fact Narcissus discovered that his own image mirrored by the shimmering water was immaterial and therefore free of gravity. Only he, the material one, was subjected to the permanent action of gravity being prevented to move and act as a free person. This is why he decided to find his freedom by suicide. Plato also drew attention that by mirroring transcendence from material life to the immaterial one occurs. Since then the call for liberation from gravity's compulsions took large proportions becoming a true Narcissus Syndrome. It is strange however, that the same gravity which is praised in Oedipus Legend is blamed in the Narcissus one. This duplicity of character is typical for human structure.

ADAM AND EVE

This Biblical legend is mostly paradoxical by bringing innocent people under the tree of knowledge and then proclaiming that their access to knowledge is forbidden. Since the seventeenth century Newton had proved that in the incriminated apple tree was hidden nothing else but the knowledge of that time about gravity, namely the free falling down of material bodies. Why should people be kept afar off that knowledge? Is gravity of top secret? Since the end of twentieth century the puzzle started to intrigue scientists. Brancusi devoted to Legend of Adam and Eve, with his sincere compassion, a wooden statue of 239.4cm in height, so that it may always be regarded by anyone upwards. The heads of the two partners, with open mouths as if shouting "not guilty" and faces expressing wonder for their unexpected expulsion are rigorously superposed on the same vertical axis on which their bodies are melting into each other, that a thin trunk resulted. Such shaped the statue is displaying the total solidarity of Adam and Eve in facing with dignity that accusation of sin. Since 1921 the statue is exposed at Solomon R. Guggenheim Museum in New York. Brancusi remained consequent in his interest for gravity in spite of the prohibition around this subject.

THE BIRDS

Like humans the birds are also bipedal and have similar problems for preserving their equilibrium in the gravitational field. Between the years 1910 and 1924 Brancusi created statues of birds gravitationally shaped with respect to their vertical plans of symmetry where gravity centers are always located. With statues like the "Magic Bird" 1910, "Bird in Space" 1923 and "the Cock" 1924 he took a step forward by explicitly involving gravity in his creation. The shapes of statues became more precise than his earlier creations showing confidence and desire to continuing his search.

FLYING BIRDS

Brancusi produced the pen drawing entitled "Snail and Birds" in 1929 for illustrate the book of poet Ilarie Voronca about "Plants and Animals" (Brezeanu, 2005). The flight of birds into precise formation compared with a snail's trail seems magnificent and joyful in the same time. For the eyes of twenty-first century it can equally represent the flight of a formation of drones. But what is a flight if not a proof of taming the gravity? The author's option for the above mentioned Narcissus Syndrome was then definitely expressed.

ENDLESS COLUMN

"The Column" as a vertical succession of coffins is a funeral monument devoted to the Unknown Soldier. It was completed in three

months only, from Aug.15 to Nov.15, 1937. Brancusi used for shaping his Column three topological concepts, i.e. the anthropomorphic, idiomorphic and automorphic ones (Sofronie, 2001; Sofronie, 2004; Sofronie, 2005). In the first stage of his creation by "the Kiss" and "the Wisdom of the Earth" he brought homage to gravity, and that homage has been proved strongly motivated. In the second stage of his creation through "Narcissus" and "Adam and Eve" he expressed some concern about gravity. In the third stage by his "Birds" and "Flight" he praised the gravity. Finally, after three decades of creative work, from 1907 to 1937, his "Endless Column" topologically and transcend-dentally defeated gravity. Brancusi proved consequence about gravity, and through gravity all his creation becomes coherent. It seems that Brancusi has felt the gravity of matter with the same skill as Vincent van Gogh has seen nebula in some stars on the night skies. Indeed, all his creation is based on "divine intuition" as Silvia Paun used to say. Intuition means knowledge beyond logic and feeling the *incognoscibilis* without explaining it. It is answering only to existential questions and succeeds there where reason fails. Finally, intuition comes from the soul not mind and always acts spontaneously.For Brancusi "the Column" was the achievement of his life that none in the World succeeded before. It was also his last masterpiece. After completion "the Column" in Targu-Jiu, during the subsequent twenty years, he didn't create anything else new (Sofronie, 2006; Sofronie, 2012; Sofronie, 2013). The summit was reached. "The Column" has demonstrated that life is not only endless in space, but also everlasting in time.

CONCLUSIONS

The hidden third, chosen at the beginning of this paper, proved to be inspired. Gravity holds indeed the key of life. It is the force that governs the laws of Heaven and Earth. Life is a form of energy, called vital energy, and most of it is produced by motion in the gravitational field. This is why the nature of gravity is still kept top secret by Nature itself. The existing society is not yet prepared to manage the secret of life. Scientists believe, however, that for decrypting the gravity and controlling this magic force, a new level conscience is strongly necessary. It seems therefore that André Malraux's bet for the twentieth first century was well motivated and it still remains open.

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IMPROVING IRRIGATION SYSTEMS AS A SOLUTION FOR RURAL DEVELOPMENT

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Abstract

Of the total population of Romania, about 45%, according to INS, are living in rural areas, and in terms of area, of the 23.84 mil. ha, approximately 14.7 mil. ha, or 62%, is arable land. Of these 14.7 mil., only 1.7 mil. ha are irrigated.
Given that agriculture is one of the main branches of the Romanian economy, being considered by the public authorities, the locomotive that will restart the economy.
Why are speaking in future tense? Because, as it's said in the structural documents of Romania, the Romanian agriculture has a great potential to develop, potential that comes from the state of significant degradation of irrigation systems, machine wear and lack of new techniques of culture, so that production yields are approximately 40% of the average European countries.
The emphasis in the 2014-2020 programming period is the development of rural areas, in this context we cannot forget the development of the irrigation system, especially if we look in the past, during the communist period, when irrigation systems proved their worth.
Today, the desire for economic alignment with the EU, in the context of a country with agricultural profile, obliges us to emphasize that in the development of infrastructure and agricultural services, the irrigation systems represent a lasting investment in rural development.

Key words*: irrigation system, rural developing, potential*

INTRODUCTION

Rural development, in general terms, regards reducing the gaps between the urban and rural areas.
The Romanian rural area is characterised by a high rate of migration towards urban, aged population, lack of sanitary, educational or transportation infrastructure and a high appreciation for land propriety.
After the first seven years of European programming, the rural area started to renew, the youngers started to come back home and take the lead of the farms, to start new business, the authorities started to train their people and work out the infrastructure problems.
The agricultural yield is yet a problem to be solved in the next years, the funding for an efficient and competitive agriculture, sector that needs to be at the same pace with the Western Europe.
The irrigation system is a very important component of performant agriculture, so the paper states that financing this sector could be a way to achieve the efficiency and competitiveness we need so much.

MATERIALS AND METHODS

In order to demonstrate the need for developing the irrigation system, in order to have an agricultural performance, I analysed, in comparison, the level of productivity in agriculture in Europe as an average and in Romania in the last 7 years.
The period analysed in this study was 2007-2014.
The data, collected from the European and Romanian database, have been processed and interpreted, to see if there is any relevance in the statement I first made.

RESULTS AND DISCUSSIONS

Irrigated area is defined as the area of crops which have actually been irrigated at least once during the 12 months prior to the reference day of the survey. Crops under glass and kitchen

gardens, which are almost always irrigated, should not be included (Eurostat, Common context indicators for rural development programs (2014-2020) – Irrigated land).

The acceptance of the fact that a farm is a business, and including an irrigation system represents a business decision that implies costs and benefits is a need.

For that kind of decision to be seen as needed to be made, a farmer has to be sure that the crops structure is adequate for irrigations and the costs of such a system and its use will be covered by the profit brought by the production of irrigated crops.

The problems that are met in the Romanian irrigation sector in this moment are represented mainly by the sharp state of degradation of the existent system, reminiscence of the communist time when the programed economy was working, by lack of financial and organisation power for maintaining the existent system or building a new one.

The Minister of Agriculture and Rural Development, Daniel Constantin, says that for "the rehabilitation of irrigation infrastructure is necessary an estimated budget of 370 mil. euro, amount pre-set in the NPRD 2014-2020 by Measure 04 – the infrastructure needed for developing and modernisation or adaptation of agriculture and forest, including the access to agricultural and forest areas, including consolidation and improvement of land and saving energy and water, and sub measure 4.3 refers directly to irrigation sector through the efficiency of water use in agriculture, mentioning the need of observance of the Frame Water Directive for obtaining finance." (Tintareanu. C., http://agroromania.manager.ro/articole/subventii/daniel-constantin-avem-fonduri-europene-pentru-reabilitarea-intregii-retele-secundare-de-irigatii-16605.html).

The comparison with all the European countries is irrelevant due to their climatic regime. Countries like Great Britain or the Northern Countries don't have a reason for setting up an irrigation system due to medium rain quantity each year.

In Table 1 we can see the evolution of irrigated areas in European countries, evolution that sustains the above affirmation.

Table 1. Evolution of the surface suitable for irrigations in the European countries (ha)

GEO/TIME	2005	2007	2010
Belgium	51.540	48.010	42.850
Bulgaria	534.610	493.130	370.490
Czech Republic	42.250	39.400	22.860
Denmark	51.680	44.620	42.100
Estonia	27.750	23.340	19.610
Ireland	132.670	128.240	139.890
Greece	833.590	860.150	723.060
Spain	1.079.420	1.043.910	989.800
France	567.140	527.350	516.100
Croatia	:	181.250	233.280
Italy	1.728.530	1.679.440	1.620.880
Cyprus	45.170	40.120	38.860
Latvia	128.670	107.750	83.390
Lithuania	252.950	230.270	199.910
Luxembourg	2.450	2.300	2.200
Hungary	714.790	626.320	576.810
Malta	11.070	11.020	12.530
Netherlands	81.830	76.740	72.320
Austria	170.640	165.420	150.170
Poland	2.476.470	2.390.960	1.506.620
Portugal	323.920	275.080	305.270
Romania	4.256.150	3.931.350	3.859.040
Slovenia	77.170	75.340	74.650
Slovakia	68.490	68.990	24.460
Finland	70.620	68.230	63.870
Sweden	75.810	72.610	71.090
United Kingdom	286.750	226.660	186.800
Iceland	:	:	2.590
Norway	53.000	49.940	46.620
Switzerland	63.630	61.760	59.070
Montenegro	:	:	48.870

Source: Eurostat, database analysis, February, 25th.

A descending trend can be observed across all countries, the irrigation systems being set up only in areas where their profitability is very high, as part of the eco-friendly politics. Although Romania has a very high potential for irrigations, a study of the Agriculture and Rural Development Ministry that uses the same data concludes that only 17% or 504.814 ha have viable irrigation systems, of which 245.514 ha are represented by gravitational systems and 259.300 by pumping systems.

Land organised for irrigation has a percentage of 20% or 597.203 ha, the rest of the land that enters in the database as suitable for irrigations is not viable, with a percentage of 63% or 1.830.911 ha.

As part of the development strategies, setting up a viable irrigation system is a priority, especially in the food security context. The arable land potential of Romania is unexploited and underequipped.

Table 2. Irrigated land as percentage in European Union

Country	Irrigated land (ha)	Irrigated land (% of UAA)	Total UAA (ha)
European Union	9.998.810	5,69	175.815.160
Belgium	4.260	0,31	1.358.020
Bulgaria	90.400	2,02	4.475.530
Czech Republic	19.200	0,55	3.483.500
Denmark	320.180	12,10	2.646.860
Germany	372.750	2,23	16.704.040
Estonia	330	0,04	940.930
Ireland	0	0,00	4.991.350
Greece	1.025.210	19,80	5.177.510
Spain	3.044.710	12,82	23.752.690
France	1.583.610	5,69	27.837.290
Croatia	14.480	1,10	1.316.010
Italy	2.408.350	18,73	12.856.050
Cyprus	28.290	23,89	118.400
Latvia	710	0,04	1.796.290
Lithuania	1.530	0,06	2.742.560
Luxembourg	:	-	131.110
Hungary	114.550	2,44	4.686.340
Malta	2.830	24,72	11.450
Netherlands	137.310	7,33	1.872.350
Austria	26.480	0,92	2.878.170
Poland	45.530	0,32	14.447.290
Portugal	466.330	12,71	3.668.150
Romania	133.460	1,00	13.306.130
Slovenia	1.260	0,26	482.650
Slovakia	14.840	0,78	1.895.500
Finland	12.610	0,55	2.290.980
Sweden	63.250	2,06	3.066.320
United Kingdom	66.350	0,39	16.881.690

Source: Eurostat, Common context indicators for rural development programs (2014-2020) – Irrigated land.

From Table 2 we can observe that only a 5.69% of total units in agriculture have irrigation systems, the countries with the highest endowment in the irrigation sector are Greece, Spain, Italy, Cyprus and Malta, countries that have a geographical advantage of being close to the Mediterranean Sea, closeness that gives the possibility of a reduced irrigation water cost.

Romania has a very small percent of irrigated land, of only 1%, if we take into account the fact that the position of our country is a very good one, being geographically privileged, the mountains providing the attraction of precipitation needed, a well spread hydrological basin that offers the opportunity for a developed pumping system are not well managed.

The investment in an irrigation system has to be seen as a business decision in the case of owners of a great surface of arable land or, as the European context dictates for associative structures, as they are seen as the solution for rural development.

For people to understand the need for such a system they have to be trained, to be open to new politics and economic trends, to understand and apply them, to make rational decisions, to connect with the consumers demand and for all of that to be possible they have to be a working part of the economic system. Having a performant farm, the step that needs to be made in order to have power over the market, especially now that we are speaking of a European or even global market.

In terms of potential Romania has the best chances of becoming a great power in agriculture again, but the investments are at very low rate.

The first statement of Investment Strategy in the Irrigation System, that it is not the state's job to improve the irrigation systems but the individuals is not applicable due to the low income of the farmers. The GDP per capita in 7 of the 8 regions of Romania is below the E.U. average, 75% of it, the North-Est region, South region and South-Est, known as mainly rural and with high agricultural potential have only 29.33%, 39.33% and 37.67% of the GDP per capita average (NPRD 2014-2020).

For this reason the European Commission has agreed to set a sub-measure that finances irrigation systems in order to achieve their higher goals in what concerns Romania, the sub-measure 4.3 in NPRD 2014-2020.

Table 3. Irrigated land in Romania – Regional stage

Label	Irrigated land (ha)	Irrigated land (% of UAA)	Total UAA (ha)
Romania	133.460	1,00	13.306.130
Nord-Vest	270	0,01	1.808.350
Centru	910	0,06	1.627.290
Nord-Est	2.420	0,12	1.940.160
Sud-Est	93.790	4,27	2.194.370
Sud - Muntenia	28.360	1,22	2.333.680
Bucuresti - Ilfov	150	0,24	62.450
Sud-Vest Oltenia	6.550	0,41	1.608.410
Vest	1.020	0,06	1.731.410

Source: Eurostat, Common context indicators for rural development programs (2014-2020) – Irrigated land

The agricultural basins of Romania localised mainly in the North-East and South regions

have very low rates of irrigations, South-East has a special approach due the Danube closeness which sustains the highest rate of irrigation. This is also the region where the remains of the communist irrigation system still works, the canals being restored or kept in their formal stage.

The low GDP per capita in this region comes from the lack of other industries.

For an irrigation system to work, the Strategy has a few focal points depending of the particularities of each type of improvement, in the case of restoring the system once built, such as:

- adapting infrastructure to existing agricultural structures;
- uncultivated agricultural land tax increases;
- Development of a framework agreement between NARW and irrigation water users, enabling them and the latter to water when they need it;
- Actions of organization of farmers. This measure is one common to all systems that are intended to be reactivated. In Romanian agriculture predominate individual actions, so if it works only with placing an order and expect the farmers to organise it will not reach the intended outcome. Therefore, the system requires a Technical assistance for farmers (even for large farms) to assist them in organizing irrigation system;
- Watering equipment. Since the system has not been used for a long period, farmers haven't invested in irrigation equipment. A potential investor should have in mind and how they will ensure farmers watering equipment.
- Adapting irrigation method used by farmers. The size of farms growing vegetables require a different design of unused systems, so as to allow individual methods applied drip irrigation or furrow used by vegetable growers in the area (The Investment Strategy in Irrigation Sector, p. 52).

The local systems are characterised mainly by the lack of a clearly defined territory of the system; water is taken directly from the source and irrigate as needed depending of the watering equipment availability; the use is of a single farmer; the reduced irrigated area; irrigated bring high added value; cereals are not irrigated, vegetables and animal feed only; using low power pumps; costs are identified and taken completely by use (The Investment Strategy in Irrigation Sector, p. 53).

These problems to be solved in the next years as a priority for rural development should provide a proper base for farmers to be competitive in the European and global market.

Studies show that the medium price of irrigation water in 2009 was 525 lei/1000 m^3 in Romania, at least 529 lei/1000 m^3 in Bulgaria and about 462 lei/1000 m^3 in a few English farms, as we can see the price in Romania is not different from other countries, it's the stage of the system that is different and lowers the Romanian performance.

CONCLUSIONS

A minimum investment in tree windbreaks can solve a lot of Romania's irrigation problem. In some systems, farmers have applied this method, as can be seen in Ialomita, Calarasi and Braila. Due to the phenomena of reducing and smoothing wind speed, important water economies are made in the protected area by decrease of crop evapotranspiration process (259 m3/ ha / season), conservation and more efficient use of rainfall in winter and used in summer (228 m3 / ha / season), increasing efficiency of application of sprinkler watering in the field (293 m3/ ha / season) (The Investment Strategy in Irrigation Sector, p. 8).

Irrigation hasn't dropped after 1990 due to economic factors, but after degradation mode of agricultural operations in farms.

Irrigations are an input that has to come with farm development; it can't be seen prior to other critical operations in farms.

Romania has a great potential for rural development but reaching that potential is in order for achieving the 2020 Strategy.

The past period has created a gap between farmers, landowners and authorities of any kind, gap that couldn't be bridged in 25 years,

so the equipment and systems that were built in that period have been mostly destroyed as an act of liberation.

In order to reduce the regional gaps there have to be made great investments by authorities, but the interest has to come from the beneficiaries.

The lack of cooperation between farmers has a great influence in all the rural developing problems, the start of cooperation would be a new beginning for solving every other problem.

The high price of energy is more a myth kept between farmers, the lack of information showing it's claws, because compared to a lost crop in a high temperature summer, the cost is more than acceptable.

A very high risk for the development of the sector of irrigations and rural developing per total is for the E.U. to continue it's daunting policy regarding irrigations because Romania isn't a great energy consumer and supporting the irrigation sector could be a catching up to western countries.

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