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2nd
International
Symposium on
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Management
MINERALS - FORESTS - WATER - HUMANS - ENERGIES - ECOLOGY

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FOREWORD

The problems of rational and sustainable use of natural resources, especially then on renewable ones, attract more and more attention around the planet. Two or three decades ago the warnings about uncontrolled industrial growth based on ever deeper depletion of reserves of non-renewable mineral resources, especially fossil fuels, and consequently, of the increasing environmental pollution, were seriously accepted by a relatively small number of researchers; today there is a negligible number of those who deny it. More over, a constant growth in industrial production and population on the planet, have caused the renewable natural resources to become "conditionally" renewable.

The first Symposium on the management of natural resources held in 2011 was a novelty in the calendar of scientific conferences in Serbia. Although natural resources have always been an interesting topic since they, to a large extent, determine the industrial and social and economicdevelopment of each country, a large number of papers submitted has confirmed our belief that the topic is relevant and of interest to a broad range of researchers, not only from Serbia but from abroadas well.

Since natural resources and sustainable development are issues of planetary interest, the Scientific Committee has decided that, starting from the second, the Symposium becomes international and all works are printed in English in order to make them available to the wide strange of interested researchers. Hence we are confident that aftert his Symposium, there will be a significant increase in the interest of foreigners for the communicati on of works on the following symposia.

The topics of the papers submitted for this year's symposium with equal concern discuss the issues of rational management of both non-renewable and renewable resources. The paperson non-renewable mineral resources management, place aspecial emphasis on the need to preserve the primary reserve, through substitution and satisfaction of consumption needsfrom recycling. At the same time, lower production from primary reserves means less environmental pollution, which directly contributes to the conservation of renewable natural resources (water, land and forests).

We thank the authors of the papersf or theeffort and contribution to the promotion of the International Symposium on Natural Resources Management.

Zajecar, May 2012

Editor in Chief
Professor Rodoljub Jovanović, PhD

COMPREHENSIVE APPROACH TO NON RENEWABLE RESOURCE MODELLING AND MANAGEMENT

SVEOBUHVATAN PRILAZ MODELIRANJU I MENADZMENTU NEOBNOVLJIVIH RESURSA

Radomir A. Mihajlović[1], Aleksandar R. Mihajlović[2]
[1]New York Institute of Technology, 1855 Broadway, New York, NY 10023-7692, USA
[2]Technische Universitat München, Boltzmannstr. 17, 85748 Garching, Germany

Abstract: *As the most fundamental management problem, in this work, we explicitly focus on the managed system complexity and relevant resource consumption. Particular attention has been devoted to the second fundamental problem and the resource and management of resource elements. In addition to the explicit definition of the two mentioned management problems as fundamental, we declare that in the wide sense, there are no infinitely abundant and strictly renewal resources. The conclusion of this work is that all resources, regardless of the availability, are not renewable and as such must be managed. In our presentation we contrast global resource management issues to the local equivalents relevant to the Western Balkan region of Eastern Serbia as the region of particular relevance to the main topic of this work.*

Key words: *Systems, resources,renewable resources, management, non renewableresource management, resource modelling, resurce context, time constant.*

Apstrakt: *Kao naj elemntarniji menadžment problem, u ovom radu, mi se eksplicitno fokusiramo na sistemsku kompleksnost i releavntnu potrošnju resursa kojima je moguće upravljati. Posebna pažnja je posvećena drugom elemnatrnom problemu, problemu resursa, i rukovanju elementima strukture resursa. Uz eksplicitnu definiciju dva fundamentalna problema menadžmenta sistemima, mi prikazujemo sve resurse kao neobnovljive u širom smilsu, t.j., tvrdimo da ne postoje beskonačno raspoloživi i striktno obnovljivi resursi koje ne treba menadžerisati. Zaključak je da su svi resursi, bez razlike na raspoloživost, ne obnovljivi i da kao takvi moraju biti menadžerisati. U ovom radu mi pravimo kontrast između menadžmenta resursa na globalnom i na lokalnom planu sa posebnim osvrtom na region Zapadnog Balkana, t.j., na region Istočen Srbije, kao regiona od naročite relevantnoisti u odnosu na temu ovog rada.*

Ključne reči: *Sistem, resurs obnovljivi resurs, menadžment, menadžment ne obnovljivih resursa, modeliranje resursa, okruženje resursa, vremenska konstanta.*

1. INTRODUCTION

Being born and spending significant life time periods in the town with the largest man made European hole in the ground, (a mile deep and three miles wide), the authors have been deliberating for quite some time on the issue of formal modeling and presentation of the phenomena that has significantly affected tens of thousands of human lives, (causing thousands to prematurely end), indirectly causing un measurable local and state tax revenue losses and welfare regional losses in general. The township of Bor is situated in the Eastern Serbia close to where Danube river connects three states; Serbia, Romania and Bulgaria. After the prolonged period of mining boom, the economical and environmental bust has caused great grief to the governments of all three states in the region, as well as to the citizens of Serbia that have opted to remain living in the region.
Mine of Bor, is one of the most exemplary cases of the depth of misunderstanding of the question of resource management, and in particular, of misunderstanding of the multi dimensional nature of non renewable resources. In order to attempt to just partly rectify mistakes made, and attempt to contribute to the possible change of the incomplete management course that in a way still persists, we present a general resource model which takes into account systems complexity, resource structure complexity and the resource context. Using the model presented it is possible to quantify all relevant resource component elements, redefine management goals and redesign currently used management procedures.

2. FUNDAMENTAL MANAGEMENT PROBLEM

Common definitions of the very term of management such as those definitions found in Oxford or Webster dictionaries are fairly abstract, general, vague, of relatively low implementation value and marginal applicability. For instance, the following definitions are common:

- The act or manner of handling, of maintaining the direction, or control.
- Applying executive ability and tact (Meaning patience, people skills and social intelligence talent but should really refer to maintaining proper timing.)
- Controlling and directing the affairs of a business, institution, etc., where etc. covers wide variety of more important management domains than business and or institutions.
- Singular or plural labeling the people performing management activities ("A team managing a company or organization, regarded collectively as management," [1].)
- The act of getting people together to accomplish desired goals and objectives using available resources efficiently and effectively, [2], (Fair definition mentioning resources but quite anthropocentric.)

The unknown author in [2] elaborates that management comprises planning, organizing, staffing, leading or directing, and controlling an organization (a group of one or more people or entities), or effort for the purpose of accomplishing a goal. The author further mentions resourcing which encompasses manipulation of human resources, financial resources, technological resources and natural resources.

In this presentation we circumvent the standard approach to the notion of management as applied to management of primarily enterprise organizations, where this term may get quite precise formulation. Taking a complex systems engineering point of view, we approach the problem of management in as more general manner. In addition, we approach the issue of management as a primarily systems design and implementation set of activities. In the light of this rather technology bound approach, a manager can be human in nature, it can be an intelligent device or just a module of software. Proper design and implementation of any system of fair or high complexity requiring resources for implementation and operation will be assumed to be part of management activities too. We draw a distinction line between the business organization or institution (an enterprise) management and general complex system design, implementation and operation management. Improperly designed or implemented system cannot be properly operated.

3. MANAGEMENT AND SYSTEMS COMPLEXITY

The fact that management and systems complexity appear as two concurrent problems, is the most vividly illustrated in enterprise systems, where sheer complexity of numerous operational unknowns and hardship with precisely maintaining preprogrammed human activities, maps management from the world of technology and science into the world of art. We are all aware that simple business systems like a corner store can be trivially managed almost by any healthy human being. Management of all simple systems, seems to be trivial, minimal, transparent or sometimes not even existing. Following this view, one may draw a conclusion that trivial activities and simple systems tend to minimize or nullify management effort, and vice versa, that complex systems will require maximized management effort. Management is proportional to the systems operation and structure complexity:

$$\text{Management} \sim \text{“System complexity”}$$

Simple operations and simple systems maybe trivially managed, or sometimes even not managed at all, i.e., operating given system does not require post design and implementation management. In the light of this statement we redefine the concept of management as the post design complementary activity used as a compensator and rectifier of all minor design flaws and operational deviations from the preset course at the time of the systems delivery. Unacceptable management problems inevitably invite a revision and rework of original systems design.

4. MANAGEMENT AND RESOURCES

Besides complexity, systems existence is inseparable from the necessity to have certain resources consumed during the systems implementation and from the continuous consumption during the systems operation. We refer to the systems operation time as the production or run time.

Resource management scope, urgency and intensity, which we refer to as management effort or simply management, is inversely proportional to the resource availability, i.e., resource abundance. Abundant resource, amply available, appears as a resource that almost does not require any management. For example, people with vast financial resources do not have to manage their budgets as people with meager financial means. Management and resource abun-dance maintain inverse proportional dependence:

Management ~ 1/”Resource abundance”

Proportion between the cost of available resources and management is direct:

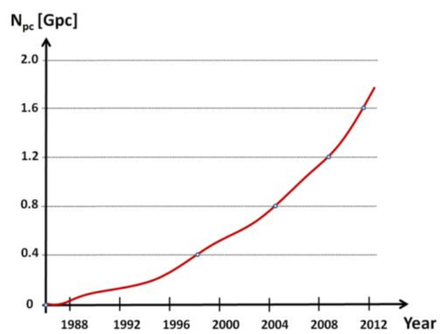
Management ~ ”Resource cost”

These two relationships are reasonable but questionable at the same time. Careful inspection of the profound nature of each given resource and the careful look into the mechanisms of resource production, delivery and consumption, may quickly point to the fact that even the most abundant and inexpensive resource, must be managed with some non zero effort.

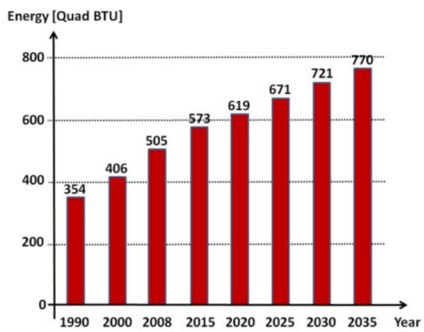
5. GENERAL RESOURCE MODEL

Before elaborating on resource management, it is essential to deal with the concept of the resource with more care. In order to fairly treat an issue of the resources and resource management, we shall consider here several exemplary resources and use these to develop general resource model.

The run time of any system is simply impossible without energy investment into the systems individual component operation. Energy is the most elementary, and the most universal resource needed by all active systems. For instance, in the case of computing systems, the key production time resource is electrical energy. With the world wide explosive growth of Internet and computing, global resultant computing electrical energy consumption has reached record levels. Using the results of [3] for year 2010, the number of personal computers in use today, may be estimated to over 2 10^9 , (see figure 1a).) We can quantify the impact of energy consumed by the computing sector on the environment, as well as on the electricity needs and costs.



a)



b)

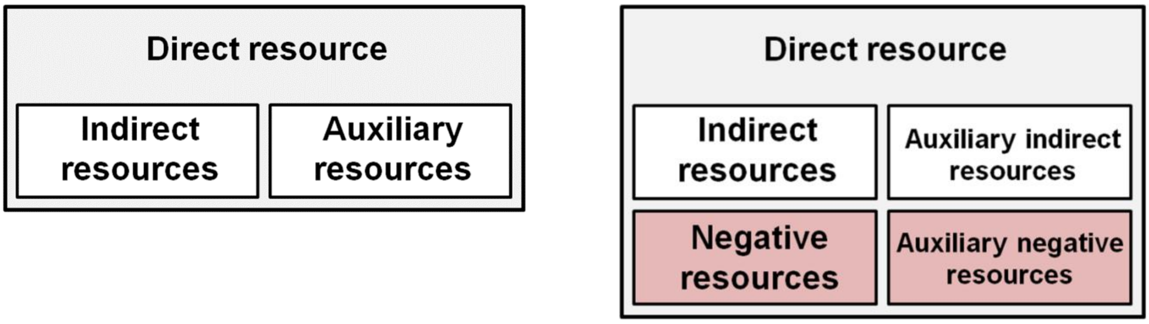
Figure 1. a) Global historical increase of the total number of personal computers in use.
b) History and projection of world energy consumption, [5].

To illustrate, the scale of energy resource consumption levels and energy management signif-icance, it is worth mentioning that estimated total electrical energy consumed by the entire world computing sector for 2012 will be over 1PWh (10^9MWh) approaching 1% of the global energy consumption, (Estimated at 100-150PWh per year), where electricity contributes to about 20% of the global energy requirement, [3.4.5]. Figure 1 b) shows that the world energy consumption in the year 2012 will reach roughly the level of 2 Quads per day. A Quad is US DOE mega unit of energy equal to 10^{15}BTU (a quadrillion of British Thermal Units where 1BTU=1055J). One quad is equivalent to 1.055×10^{18}J or 1.055EJ). A quad is about equal to the amount of energy obtained from 45Mt of coal, or 25.2Mt of crude oil. Mtoe or million tonnes of oil equivalent is frequently use unit, [5, p.65].

It is common wisdom that behind each direct resource such as energy, one may find a set of indirect resources, like fossil fuel, that are used through some sort of transformation to produce and deliver the direct or primary resource, essential for the given system activities. As shown in figure 2 a), the immediate source of the given direct resource, is presented as the lower layer or level, indirect resource. Fossil fuel, as the major energy source (Over 75% of world energy is produced by burning coal, oil and gas, [5]), is one good example of the indirect resource. Besides the main indirect resource, the production and delivery of the primary direct resource, requires a whole set of auxiliary resources such as human resource, electricity, financial investment, and so on. We recognize these resources as auxiliary resources. The position of auxiliary resources is depicted in the two layer diagram of figure 2 a) on the same level with the indirect resources. Auxiliary resources are necessary support resources of indirect resources and are hard to be avoided, neglected or not managed.

To justify the next lower layer in our resource model we look again at energy as the example resource. Intensified consumption of electrical energy causes the depletion of all relevant lower tear indirect resources such as fossil fuels, (fossil fuels dominate as electrical energy indirect resources [9,10,11].) Indirect resources are sources of direct given instance resource. Indirect layer of resources itself may be divided into multiple sub layers. For example coal is a source of thermal energy which is used to produce electric energy.

The lack of the elementary resource of electrical energy is the single most impeding factor on the local development and information technology (IT or Information and Communication Technology also known as ICT), penetration in countries such as Albania, or most of the African, South American and Asian countries. ICT is a mandatory super resource in the modern enterprise and other modern complex systems. On the global level, further development of ICT adds up to and enhances the management capacity of the ICT users. After taking an alternative point of view, on the other side of the resource equation, excessive use of technologies such as ICT, adds up to the deterioration of the vital resources such as climatic [8], chemical habitat (clean air and water, etc. [10]), and physical human health and fitness,



a) b)

Figure 2. a) General envelope resource two layers structure. b) Direct envelope resource involving indirect and negative, as well as respective auxiliary resources.

[6,7]. If we consider electrical energy as a direct resource we may look at the causes of the depletion of the mentioned vital resources as negative resources and the vital resources lost in conjunction with the buildup of negative resources, as auxiliary negative resources. Figure 2 b) illustrates our model relative positioning of the set of negative resources and relevant auxiliary negative resources at the lowest level of the model. For instance, with the increased consumption of the direct resource of electrical energy we have increased amounts of thermal and chemical pollutants and increased loss of human resource. The waste and the trash are typical samples of negative resources and human resource appears as the most prominent auxiliary negative resource.

According to IEA world statistics [11], in four years from 2004 till 2008, the world population increased 5%, annual major pollutant of CO_2 emissions increased 10% and gross energy production increased 10% too. US leads the world as the supreme generator of the negative resources but does not lead as the consumer of auxiliary negative resources. Strict and dynamic legal framework and sophisticated management has been applied to minimize the consumption of the auxiliary negative resources of any sort, which cannot be said for the state of Serbia, which is ranked 54 on the list of [10]. For instance, state of Serbia and in particular regions of Eastern Serbia are among the top in the world in vital resource loss due to industrial development and higher layer resource production, (Resources like energy, raw materials such as copper and gold, etc.)

The urgency for management improvement of all structured resources like energy, with specific clear attention to the enveloped resource elements shown in our model is more than alarming.

Our layered resource model implies that any direct resource can become an indirect resource. Simple layering of the super resource on the top of the direct resource, causes the migration of the direct resource down into the layers of indirect resources. For instance, if the ICT is considered as a new super resource, (ICT power is consider in large enterprise systems as a direct mandatory resource), energy becomes indirect resource. The systems design approach, the point of view taken and the detail attention, will determine what can be accepted as direct and what as indirect resource. The structure of a resource at hand depends on the analysis and design considerations.

In addition to said so far, we must mention that many resources can show certain recursive nature, i.e., given direct and indirect resource may be viewed as the same resource. For instance to produce electrical energy we may need electrical energy and to produce oil we may consume certain amount of oil. When dealing with the resource management, this subtle resource recursion attribute must be taken into an account whenever and wherever it may be applicable.

6. RESOURCE CONSUMPTION CONTEXT

By common definitions, the very term management refers to the enterprise systems and the set of, primarily human, supervisory activities, governed by the scripts, scenarios, design blue prints, rules, plans, algorithms, programs and protocols behind the said activity set, aiming at some end-goal, common to all functional systems elements. It is essential to observe the key attribute "supervisory" and to be aware that management supervision activities may result in initiation of the system reengineering, adaptive restructuring of functional elements, reprogramming of operational processes as well as in extension and redefinition of the existing management procedures and the original system design.

To simplify the above made argument, we may claim many believe that even with complex systems, tapping to the zero cost infinite resource of whatever kind does not require any deliberation, caution, planning, organization, evidence collection, journaling, book keeping, uncollected data preprocessing, accounting, audit trail procedures, coordination, synchronization, delegation, optimization, and so on. Doing any activity from this, by no means complete list of itemized activities, would lead to unnecessary waste of energy and use of appropriate auxiliary supporting resources that naturally have to be involved. Frequently we face "practical" situations of neglected lower layer resource model elements. Profit driven enterprises, whenever possible, exercise no management activities relevant to resource model elements that do not directly contribute to the enterprise mission of positive wealth flow, i.e., profit generation. Violation of this simple selective no-management rule we commonly classify as a poor management in a wide sense.

Upon further clarification of the hidden pitfalls behind the management in the narrow sense, where the "bottom profit line" is the only optimization parameter, we introduce the concept of the context aware systems management or management in the wide sense.

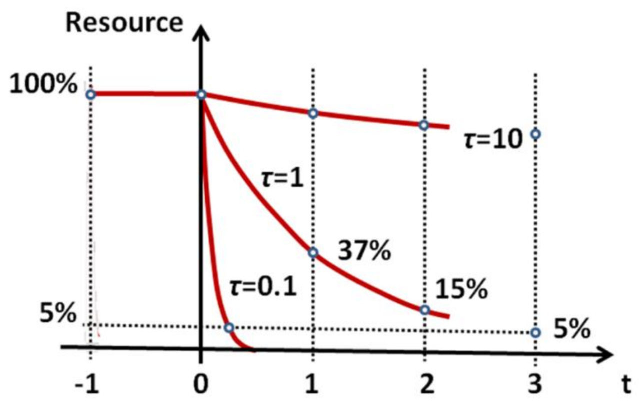


Figure 3. Time constants and relative resource capacity decline when using the exponential model.

Among engineers, the term of the time constant is popular and frequently used in dealing with transient phenomena. By definition time constant, typically labeled as τ is the time period after which exponentially decreasing function of the form $f(t)=e^{-t/\tau}$ decreases to the 1/e level or 37% of the initial value. Figure 3 shows three cases of hypothetical resources exponential decrease with three time constant values different in the order of magnitude: $\tau_1=0.1$, $\tau_2=1$ and $\tau_3=10$. As figure 3 illustrates, several orders of magnitude resource availability changes, e.g., with $\tau_3=10$, appear as no transitions, as constant resource levels, to all consumers that are aware of and that operate in the real time with time constants several orders of magnitude below. In other words, any management that operates in the real time with $\tau_1=0.1$ will barely be aware of any changes and problems that take place in the time context with $\tau_1=10$.
Ignoring the time scales and managing only for the real time, focused at the narrow sense real time goals alone, may lead to the devastating and unmanageable situations in the future, when several orders of magnitude time constants take charge. Leaving to the future generations to deal with the currently mismanaged negative and auxiliary negative resources may be suicidal in the long range. In addition, taking the space management dimension into prospective, leaving poorly managed negative and auxiliary negative resources to some other people, somewhere else in space, frequently not even existing parties, leads to the very localized gain that translates into the orders of magnitude magnified global neighborhood or context loss.

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ACCOUNTING OF NATURAL RESOURCES

RAČUNOVODSTVO PRIRODNIH RESURSA

MSc Radica Pavlović[1] , Prof.dr Slobodan Stamenković[1], MSc Marko Pavlović[2]
MSc Mladen Stamenković[3]

[1]Graduate School of Business Studies, Pozarevac, mail: rpavlovic@megatrend.edu.rs
[2] High Professional School for Entrepreneurship, Belgrade
[3] Faculty of Economics, Belgrade

Abstract: *The human and economic activities have a negative impact on natural resources, which are manifested in the lifetime and pollution of natural environment, degradation and exhaustion non-renewable natural resources. Accounting for natural resources should contribute to the relationship between economic activity and the natural environment and for optimal management of natural resources and a realistic presentation of the value of domestic products.*
Key words: *natural resources, accounting, national account value.*

Abstrakt: *Ljudske i ekonomske aktivnosti imaju negativne posledice na prirodne resurse koje se manifestuju u zagađenju prirodne i ćivotne sredine, degradaciji i iscrpljivanju neobnovljivih prirodnih izvora. Računovodstvo prirodnih resursa treba da doprinese vezi između ekonomske aktivnosti i prirodne sredine a u cilju optimalnog upravljanja prirodnim resursima i realnijeg prikazivanja vrednosti domaćeg proizvoda.*
Ključne reči: *prirodni resursi, računovodstvo, nacionalni račun, vrednost.*

1. INTRODUCTION

Natural resources represent a kind of natural capital in their characteristics contribute to improving the quality of life and human health and the economy in general. Given that natural resources are divided into renewable and nonrenewable, it is very important to preserve non-renewable and renewable resources reasonable exploitation. Natural resources as capital have their value, although not entirely possible for each source of expressing how much money is really worth, but also has its expenses. In this way they directly or indirectly contribute to the creation of value of domestic products, but in the national accounts, the value is not included and creates illusory images that the domestic product is worth more than is realistic given that in its calculation are Calculated cost of natural resources. In this regard it is important to implement strategies to manage natural resources to ensure sustainable development, especially in the economic and environmental aspect of the integration costs and benefits in the national account.

2. THE ORIGINS OF THE IDEA OF NATURAL RESOURCES ON ACCOUNTING

In early fifties, it was realized that the existing system of macroeconomic aggregates and national accounts do not adequately reflect the impact of environment and natural resources have on social welfare and income or the income or in calculating domestic product did not include the contribution of natural and environmental as well as costs arising from depletion of natural resources [1], causing a number of critical inquiry where there is the following statement, which according to Perman and McGilvray in can be classified into three categories [2]:

The criticism category includes:

- Completely ignoring the natural capital;
- When calculating social wealth consisted only of physical capital, or capital that is produced by human hands;
- When calculating mentioned was left out everything that is not traded in the market (clean air, water, nature reserves, national parks, forests, etc..).

II includes the categories of criticism:

- Omission of depreciation of natural resources leading to unrealistic values increased net product.
- Sales of natural resources shall be included in the calculation of macroeconomic aggregates, but no depreciation of natural capital while creating an unrealistic image of a higher national income.

III category of criticism is the inconsistent treatment of costs and protecting the natural environment. These so-called defensive expenditures are included in the calculation of national income but the cost of depreciation and degradation of the natural environment and are also involved and create an unrealistic picture of GDP.

As subsequent critics considered the problem of tracking funds and reserves of natural blood pressure on natural resources. For this purpose, have developed numerous models that contain the list of indicators to measure environmental conditions (OECD methodology - A proposal for the statistical service of Great Britain, indicators of the Canadian Department of Environment, the index of sustainable economic welfare - ISEW). However, despite numerous attempts failed to find an adequate and comprehensive system for measuring these parameters.

In an attempt to include calculation of the contribution of natural resources in the creation of wealth and income and operating costs of including them, the System of National Accounts has undergone many changes. In the early nineties the revision of national accounts by the United Nations in the process of posting and are included in natural resources. The balances have been introduced which should show the initial and final state of the stocks of natural resources, and sources of their increase or decrease. These new financial statements include both exhausted and non-renewable assets (minerals, fossil fuels) and renewable or inexhaustible assets (plantations plants, farm animals, renewable energy).

3. INTEGRATION OF NATURAL RESOURCES IN THE ACCOUNTING SYSTEM OF NATIONAL ACCOUNTS

In order to monitor and evaluate ecosystem and social values developed a structured approach to accountability for the environment based on four components (policy, goal, indicators and monitoring), whose presentation is given in Figure 1.

Figure 1. A conceptual model of environmental accountability, showing the relationships among policy, goals, indicators of ecosystem services, and monitoring
Source: [3]

Emphasis is placed on the development of adequate measures for the effective combination of natural values and integrative coverage of values and value that contribute to human well-being. The value of natural resources means the economic value of natural capital in order for people and society, and for the economic system in general. In essence, the accounting value of ecosystem services is the value of property based on natural resources (state forests, wetlands, minerals, fish and wildlife populations, etc.). When non-renewable resources are gone, their services become more valuable. Currently, the national accounts do not reflect changes in these natural resources. In this sense, numerous efforts have been made to calculate the value and costs of natural resources in the value of domestic products.

The classical system of national accounts under the net social (national) product (GDP (GNP)) implies the reduction of gross national product for the depreciation of natural resources (A).

BDP (BNP) = BDP (BNP) – A 1.1.

Since the value of GDP and enter the values obtained by processing or exploitation of natural resources is necessary to include the same and their depreciation. Depreciation of natural resources involves depletion of natural resources and land degradation. Accounting terms, cost of natural resources, less the residual value, divided by the estimated total amount of resources in the deposit. The resulting cost per unit (ton, cubic meter, etc..) Multiplied by the number of extracted (excavated, cut) and the resource units sold in the market during the year. The result is the annual cost of the observed depletion of natural resources [4]. Adjusting the relations 1.1. the aforementioned value depreciation nonproduced natural resources (ANR) we obtain the so-called "eco domestic product" (ENP) [5], which is represented by the relation 2.2:

ENP = BDP (BNP) – A – ANR 2.2.

Although this approach provides a more realistic picture of the domestic product should be stressed that it is not entirely adequate. Specifically, it treats the value of depreciation on the basis of revenues from the sale of natural resources are treated as annuity income and not as cost of capital. Also, there is the problem as a way of proper evaluation of the costs of exploitation of natural resources.

El Serafy is by using so-called. "user cost method" gave way to more advanced adaptation of national accounts in which income from the sale of natural resources, including capital expenditure, or expense of the user and real income (relation 2.3.), which depends on the level of reserves, resources, rate of exploitation (or the current rate of extraction), the choice of discount rate, the reduction of future size of the current [6]:

$(R – X) / R = 1 / (1 + r)^n$ 2.3.

where is:

- X - real income;
- R - net sales (total, or gross income, less the current cost of goods and services required to extract the resource);
- r - discount rate;
- n - number of years that are still, at the present pace ekstakcije can exploit the resources (reserves divided by total available current rate of extraction).

Despite the attempt to capture a more complete cost of natural resources and their integration into the national account, and still remains the problem of calculating the amortized cost of natural resources which are not subject to market exchange and influence economic activity. With them it is difficult to determine how the degree of degradation and the degraded value. In this sense, is defined by access to "willingness to pay" or willingness, of the subjects to pay for a specific environmental good. In this way, given the national economic product II [4], according to the relation 2.4:

$$NNP\ II = NNP - NNR - NNR_{K,} \qquad 2.4.$$

NNR_K – nonproduced depreciation of natural resources is contingent values

It should be noted that none of the model presented so far did not provide a comprehensive accounting of all securities and the expenses related to natural resources. In order to further improve the national accounts department of the United Nations Statistical 1993rd The latest published version of the SNA. The essential basis of the proposed version of the SNA in 1993. The system makes the idea of ecological and economic accounts (SEEA), given in the handbook Integrated Environmental and Economic Accounting in 1992. year. Eco Multiplies obtained on the basis of the relation 2.5:

$$EDP = NDP - Use_{np} \qquad 2.5.$$

Use_{np} shows the use, ie. consumption of natural assets. This category is the result of degradation of both economic and noneconomic, natural assets, and by the logic of corresponding depreciation of physical capital.

Despite numerous problems and attempts, non-market valuation of natural resources remains as one of the most delicate, open, issues in environmental economics and natural resources and their impact on economic development.

4. CONCLUSION

- Natural resources represent a kind of natural capital in their characteristics contribute to improving the quality of life and human health and the economy in general.

- The current system of macroeconomic aggregates and national accounts do not adequately reflect the impact of environment and natural resources have on social welfare and income or in calculating the income or national product did not include the contribution of natural and environmental as well as costs arising from depletion of natural resources.

- Despite numerous problems and attempts, non-market valuation of natural resources remains as one of the most delicate, open, issues in environmental economics and natural resources and their impact on economic development.

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KNOWLEDGE BASE FOR PLANNING, PROBLEM SOLVING AND DEVELOPMENT OF NORTHERN PART OF WESTERN BALKANS

BAZA ZNANJA ZA PLANIRANJE, REŠAVANJE PROBLEMA I RAZVOJ SEVERNOG DELA ZAPADNOG BALKANA

Sasa Ivanov[1], Nebojsa Simeonovic[1], Zoran Milovanovic[2]
[1]Faculty of management, Zajecar
[2]Regional development agency Eastern Serbia

Abstract: *This document is based on assessed needs of key local and regional stakeholders in Bor, Zajecar and Vidin districts. The Project draws a cross-border data base as well as informal cooperation networks. The The project establishes a joint cross-border "Knowledge data base" and informal cooperation networks. The Project will be implemented jointly, meaning that joint activities will be carried out and coordinated among partners on both sides of the border.*
Key words: *Knowledge base, planing, problem solving, development.*

Abstrakt: *Ovaj rad se zasniva na procenjenim potrebama ključnih lokalnih i regionalnih zainteresovanih strana u Borskom, Zaječarskom i Vidinskom okrugu. Projektom se kreiraju prekogranične baze podataka kao neformalna mreža za saradnju. Projekat uspostavlja zajedničku prekograničnu „bazu znanja" i neformalnu saradničku mrežu. Projekat će se sprovoditi zajednički, koordinirano između partnera sa obe strane granice.*
Ključne reči: *Baza znanja, planiranje, rešavanje problema, razvoj.*

1. INTRODUCTION

A knowledge base [1] is a special kind of database for knowledge management. A knowledge base provides a means for information to be collected, organised, shared, searched and utilised. Knowledge bases are essentially closed or open information repositories and can be categorised under three main headings: Machine-readable knowledge bases store knowledge in a computer-readable form, usually for the purpose of having automated deductive reasoning applied to them. They contain a set of data, often in the form of rules that describe the knowledge in a logically consistent manner. An ontology can define the structure of stored data - what types of entities are recorded and what their relationships are. Logical operators, such as And (conjunction), Or (disjunction), material implication and negation may be used to build it up from simpler pieces of information. Consequently, classical deduction can be used to reason about the knowledge in the knowledge base. Some machine-readable knowledge bases are used with artificial intelligence, for example as part of an expert system that focuses on a domain like prescription drugs or customs law. Such knowledge bases are also used by the semantic web. Human-readable knowledge bases are designed to allow people to retrieve and use the knowledge they contain. They are commonly used to complement a help desk or for sharing information among employees within an organization. They might store troubleshooting information, articles, white papers, user manuals, knowledge tags, or answers to frequently asked questions. Typically, a search engine is used to locate information in the system, or users may browse through a classification scheme. A text based system that can include groups of documents including hyperlinks between them is known as Hypertext Systems. Knowledge base analysis and design (also known as KBAD) is an approach that allows people to conduct analysis and design in a way that results in a knowledge base, which can later be used to make informative decisions [2].

2. MEASURE

The project promotes integration of the underdeveloped territory of the Northern part of Western Balkans by establishing a joint Knowledge data base and informal cooperation networks between key regional stakeholders.

The project delivers institutional building results, consistent with key area:
- Informal cooperation networks
- Joint knowledge data base established
- Forums for sector development.

The overall project objectives are:
1. "To improve the capacity of the region to deal with key issues by joined resources and exchange of information and experience"
2. "To contribute to stronger territory integration providing a balanced and sustainable development across the border".
The overall objectives contribute towards the Programme strategy with an effective and efficient knowledge-based intervention in four relevant sectors for the project area: infrastructure, agriculture, environment and tourism. The specific objective of the project is "Enhanced planning, problem-solving and development capacity of key stakeholders in Bor, Zajecar and Vidin cross border area". The Project improves administrative, business and academic links. The project pursues equally quantity and quality achievements, aiming to enhance the capacity of stakeholders to jointly address common issues. The target groups (TG) include 19 local administrations, regional development institutions and organizations in the business and education sectors. The Project builds on existing knowledge that can be deliberately and actively shared. The project builds on the following results:
- Informal cooperation network - bringing together at least 80 representatives of TG on 4 Sectors Development Forums
- Knowledge data bases - combining 3 data bases: planning and development documents; profiles of experts available in the cross border region, research studies.

3. SWOT

The regions of Vidin, Zajecar and Bor are among the least developed in Serbia and Bulgaria. Timok region (Districts Zajecar and Bor) is second most undeveloped region in Serbia, while Vidin district is most underdeveloped region in Bulgaria and in EU. As an example unemployment rate in Timok region was 25,4% (3% higer then Serbian overage) in August 2011, while in Vidin district it was ??? .

There is no practice to exchange experience or share best practices in the region. Similar activities lead by local authorities, business community or educational institution from both side of the border are done in isolation. For example:

- Local development: Local Environmental Protection plans, Municipal spatial plans.
- Regional and sector development: Strategy for Sustainable Tourism Development in Vidin District 2009 – 2013. Regional Development Strategy of Bor and Zaječar Districts 2010. Each district or municipality develops its own documents in isolation, without using existing relevant references or experience.
- Research papers and studies concerning the region are not available at the moment. In the last decade numerous studies were undertaken in various sectors but they are to be found only in Sofia and Belgrade, where they were produced. A regional database will take out of archives significant studies and make them available in the region.
- Although there is expertise in the region, outside experts are more often engaged. A regional expert database will benefit public institutions and private companies.

Consequently:

- Key institutional, business and educational actors lack information about available resources and knowledge elsewhere in the region.
- Experience and knowledge in the Region are not used properly; -Insular knowledge leads to overlaps and unnecessary efforts;
- External experts are often engaged, although there is knowledge in the region.

4. PROJECT STRATEGY

The situation analysed in the region reflects untapped potential for joint development, to benefit key stakeholders in the public and private sectors in the project area across the border. The project strategy enhances existing capacities by professionally selecting and providing relevant available information and by creating the framework for networking between institutions and individuals. The project proposes an intervention based on the following results:

- A Knowledge database combining 3 sets of documents made available to the target groups: planning and strategic documents; regional experts; research papers and scientific studies. The information to be included in the database will be researched, selected and systematized in order to be relevant and user friendly. The Project will make the database available to business community, local and regional authorities, business support organisations, researchers, etc.

- A cooperation network bringing together representatives of institutions and organisations in the project region who recognise the benefit of joining and sharing knowledge and skills for mutual benefit. This is an “informal cooperation network”, whose strength and sustainability are underpinned by the need to learn, grow and develop in synergy rather than isolation. The project will enable joining of resources and exchange of information in four key areas for development of border region: infrastructure, agriculture, environment and tourism.These areas were identified as main areas for development of the Project region. These areas appear as priorities in:

- Updated document for implementation of the District Development Strategy of Vidin District 2010-2013.
- Regional Development Strategy of the Timok region (Bor and Zajecar district) 2010 – 2015.

5. TARGET GROUPS, BENEFICIARIES AND ESTIMATED NUMBER

Targt groups:
TG1: 11 local authorities from Vidin District, 4 from Bor District, 4 from Zajecar District provide their expertise, studies and other relevant documents to the joint Knowledge data base. They benefit from accessing and using information in the Knowledge data base. They participate in the informal networking. Their planning, problem solving and development capacities are enhanced through relevant information, improved practice and skills and proactive attitude towards cooperation.
TG2: District administrations from Vidin, Bor and Zajecar provide relevant documents to the joint Knowledge data base and participate in informal networking. Their administrative authority is instrumental to ensure all relevant information is provided. They benefit from accessing and using information in the knowledge base. Their planning, problem solving and development capacities are enhanced through relevant information, improved practice and skills and proactive attitude towards cooperation.
TG3: Business support organizations and Regional Development Agencies provide their expertise in regional development and planning; Vidin Chamber of Commerce and Industry Regional Development Agency and Business Centre Vidin Regional Development Agency for Eastern Serbia RARIS Chamber of Commerce / Zajecar TG3 provides studies and other relevant documents to the joint Knowledge Base and participate in information networking. By their missions and status they can be the links between local, regional and national institutions and organisations and they bring valuable cross border and international expertise. They can also provide the link with the business sector, in particular SMEs. They benefit from accessing and using information in the knowledge base. They participate in the informal networking. Their planning, problem solving and development capacities are enhanced through relevant information, improved practice and skills and proactive attitude towards cooperation. Educational institutions from the region: High schools and Faculties will provide their expertise, studies and other relevant documents to the joint Knowledge Base and participate in information networking. They provide professional managerial expertise. They benefit from real life examples of planning and strategic documents.

Direct beneficiaries:
Project partners have identified, developed and applied for funding for the project. The consortium includes: Faculty for Management Zajecar provides the appropriate management approach, supported by academics and students. It brings to the consortium a professional hub for the knowledge data base and the technical sustainability. Vidin District Administration is

the best placed administrative institution to engage TGs and stakeholders on the Bulgarian side. VDA provides the link with 11 municipalities, business and education sector on the Bulgarian side. RARIS Regional Development Agency Eastern Serbia will engage the 8 municipalities and organisations in business and education. On short and medium term other institutions in the education sector than the those in TG who have access to expertise and research results 15 On short and medium term Key regional stakeholders and experts as participants on Promotional events, Forums, Workshops and Final Conference.

Final beneficiaries:
On medium term SMEs in Project region will have opportunity to apply research results/resources and regional expertise in practice in four development sectors. On medium and long term other institutions in the education sector than the those in TG who have access to expertise and research results. On short and medium term pupils and students from the region who will get enhanced access to regional data and better knowledge of the Project region. On medium and long term regional stakeholders, professionals, and experts dealing with development. On long term the population in the 3 districts in the project region will benefit better socio-economic conditions.

6. PROJECT ACTIVITIES, DESCRIPTION AND METHODS OF IMPLEMENTATION

The first project activity will be the formation of the Joint Project Team. The project team will consist seven members: Faculty for Management will provide: . Project coordinator manager, and accountant, RARIS will provide: and Project assistant and Project manager , Procurement Vidin District Administration coordinator and accountant . Joint Proj will provide Project ect Team will meet regularly project duration (alternating location by 8 t imes during country). In addition, they will sessions through Skype , two times per month . hold regular The Joint Project Team will establish and maintain good and regular communicati will visit them on site every 3 months and on flow target groups through project and invite them to Joint Project Team meetings.

Internal evaluation will be carried out on several levels. 1. Evaluation by the Joint Project Team members. Meetings of the project team will be used for review on development of project documentation and monitoring. At the project completion stage each team member will prepare own internal evaluation report descr ibing the scope of his/her own engagement. 2. Evaluation by project target groups. This evaluation will be carried out by recorded interviews and questionnaires. Interviews with 80 participants of Sector Development Forums will be held through filing in q uestionnaires after key activities (Forums and other information networking meetings.

A consultant will be . tendered and engaged to develop a methodology for establishment of Resources Base / Knowledge Base. The methodology should define: type of documents to be collected, the method of collection, transfer to a suitable format for the base and browser etc. Resources Base/ K nowledge base will be established for each of the four key areas of development (infrastructure, agriculture, environment, tourism) in the region. Resources Base/ Knowledge base will contain three main elements:

- Database of relevant development documents. This data base should collect various local/municipal/regional development strategies, Environmental Protection plans, sector's strategies (agricultural, tourism, rural…), s plans etc
- Database of most relevant expertises. Most relevant expertise patial to be recorded. Interviews with the recorded experts should be conducted and a detailed record of their expertise should be mapped.
- Research database. Various researches, studies and surveys of importance for the region should be recorded, as well as doct or and master works. All data should have a summary on English, Serbian and Bulgarian, while main contest will stay in original language.

All data should have a summary on English, Serbian and Bulgarian, while main contest will stay in original language.

During this process all interested parties will be invited to participate in the project, to submit their inputs to the Knowledge datebase and to take part in informal cooperation networking. Promotion will be effected through the promotional workshops to be organized in 11 municipalities (8 from Serbian and 3 from Bulgarian side). It is expected that 220 participants, or 20 per municipality, will take part on those events. Project Team members will explain the purpose of the project, present the methodology for creating the data base, provide information on Sectors Development Forums and invite participants to actively participate in all project activities.

7. ESTABLISHMENT OF "KNOWLEDGE BASE"

According to adopted methodology a consultant will be engaged to collect, analyze and present at least 200 data for Knowledge base:
- 60 Relevant development documents (regional and local development studies, spatial plans, sectors actions plans etc) Those document will be provided by target groups – owner of those documents, without any expenses
- 90 most relevant expertises. Consultants will interwove experts and present their expertise in specially designed template which will allow searching in data base
- 50 various researches (studies, master and doctors theses and surveys. Consultants have to visit the relevant institutions (universities, institutes, ...) and collect relevant data Consultants have to prepare a short summary for each of the data on three languagues: Bulgarian, Serbian and English.

8. DEVELOPING WEB-BASED "KNOWLEDGE BASE"

A web designer for developing Web-based "Knowledge Base" development will be engaged. A web database for required data entering will be developed. All documents will be processed in a manner that can be searched by several key determinants at the base, on three project languages (Bulgarian, Serbian and English) as well as it can be downloaded from the Internet in unique format. Data base will be posted on project partners web pages. Faculty of Management will keep on maintaining this database by the end of the project as a part of their activities.

9. ESTABLISHMENT OF "INFORMAL COOPERATION NETWORK" - SECTORS DEVELOPMENT FORUMS

In order to enable the direct exchange of experience and initiate the process of knowledge transfer in four key areas for development (infrastructure, agriculture, environment, tourism) Forums will be established. sectors) an "informal cooperation network" In total 8Sectors Development workshops will be held (two for each of four will last two days , four in Bulgaria and four in Serbia and each of them total 80 persons will participate on those workshops (20 per sector and per workshop). External moderators will lead the workshops. . In Number of participants and equal gender participation from both sides of the border will be secured. Sectors Development Forums will support use and application of the knowledge, experience and documents collected in this project in selected sectors, in concrete daily work of institutions and companies. Those Pilot workshops will future support long term cooperation in selected sectors and identify cooperation potentials on this basis.

10. PROMOTION OF THE PROJECT

Four press conferences will be held, 2 RARIS and VDA at the start of the project (one in Vidin and one in Zajecar) and 2 in the end of the project (one in Vidin and one in Zajecar). First conferences have to promote the project and reach a wider circle of potential participants in four key development sectors. The other two conferences have present proj to ect results and support its replication widely. In addition, there will be a total of 6 publications in medias in both regions (3 per country: 1 at the start, 1 in the middle and 1 in the end of the project).

In it the course of it the presentation of the project Final Conference will be organized. The Final Conference will bring together key representatives from the Project region and representatives of relevant institutions from the central level and from oth er regions as well. The results of the project as well as demonstration of concrete benefits, as identified in joint Forums and Workshops will be presented. The Final Conference will present innovative approach in cooperation and use of regional resources. The Final Conference will open possibilities for multiplication of results in other regions or sectors. The Final Conference will be organized in Serbia, it will last two days and 80 participants will take a part in it.

11. GENERAL CLASSIFICATION OF THE OUTPUT

Web page "Knowledge data base" established Databases of relevant development documents, Database of most relevant expertises and Research database established.

12. SUSTAINABILITY

The sustainability of the:
a) project is ensured by the following elements of the project design: Stakeholder ownership: the institutions and the organisations in the target group who demonstrate genuine interest and recognise a benefit from using the knowledge base and working in cooperation with peer and related organisations will continue to do so a fter the project ends. Synergy and cooperation can be continued with no or minimal costs: the use of information and contacts requires only a positive pro active attitude.
b) Institutional framework: target groups are well established institutions and organi sation, with clear missions and objectives. Their involvement in cooperation can be assumed, once the benefit is recognised.
c) The location of the K nowledge data base in an education hub ensures sustainability over generations of students and teachers, who wi ll go and work in public or private sectors. The Faculty of management in Zajecar will take over the responsibility for maintaining the database. d) Thus the project implementation will help to improve the execution of state policy at local and regional leve l. From the standpoint of promoting the economic potential of the crossborder region the produced intellectual products will be used after the project by the wider public .
e) Project extension to other sectors than agriculture, infrastructure, environment a nd tourism can be envisaged. The current intervention had a clear economic focus, leaving room for extension towards social sectors of common interest in the project area. An example can be planning and problem solving for securing minority rights, or for mainstreaming social groups at higher risk (youths, unemployed, elderly people, etc).

The project is in line with economies. The four sectors the Lisbon agenda, emphasising on innovation and learning are clearly stated as priorities in the following documents:

- Updated document for implementation of the District Development Strat District 20102013:
  - Development of technical infrastructure in Vidin District
  - Ensuring economic growth based on investments. egy of Vidin competitive enterprises and attracting
  - Environment protection and improvement in accordance with European standards. Support for measures addressed to overcoming regional and global environmental problems.
  - Reduction of interregional disparit regional level. ies and promotion of cooperation at local and regional level.

Regional Development Strategy of the Timok region (Bor and Zajecar district) 2010 2015, includes Strategic development priorities:

- Agriculture and Food processing,
- Tourism,
- Accessibility and traffic in the region
- Support of entrepreneurship and investments
- Regional human resources
- Environment

13. CONCLUSION

The informal network created through the project will enable the direct exchange of experience and initiate the process of knowledge transfer . Such approach will cooperation between the institutions and it allow future will continue to exist and expand the scope of its activities after the project . A possibility for multiplication lies in the tripartite partnership between government officials, education society an d business. The accumulated positive experience will be distributed in the other interested parties through web based Knowledge database, Final conferences other promotional activities The project strategy and the selection of target groups cover local and and district administration and regional development. The project provides links with selected representative stakeholders in the business sector and in education. In the future there is room to replicate the project with an emphasis for building capacity in the business sector in the cross border area.

The Faculty for Management has the leading role in the sustainability of the project since they will continue to maintenance the data bases after the end of the project. They will be responsible for development of methodology for Knowledge database, developing Web-based database, project visibility, procurement of equipment for data base maintained and internal monitoring of the project RARIS, as the specialist implementing agency with strong experience in project management, will take over mayor project implementation responsibility including the logistical back up and reporting. Vidin District Administration will undertake the coordination of all project activities from Bulgarian side Vidin District Administration will share responsibility with RARIS: for establishment of "informal cooperation network" ensuring public participation and project promotional activities, and collecting the data and establishment of Knowledge database. Project budget is proportionally agreed between project partners according to activities to be undertaken.

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INFORMATION TECHNOLOGY IN THE MANAGEMENT OF NATURAL RESOURCES – A CASE STUDY

INFORMACIONE TEHNOLOGIJE U UPRAVLJANJU PRIRODNIM RESURSIMA – STUDIJA SLUČAJA

Nenad Č. Bojat[1,2], Tamara Galonja Coghill[1], Ivona Mladenovic[3]

[1]Faculty of Biofarming, Megatrend University, Bačka Topola, Serbia
[2]Center for Interactive Education, Pančevo, Serbia
[3]Simon Fraser University, Burnaby, Canada

***Abstract**: Four examples of information systems used in the management of natural resources presented here, are used as a case study to analyze how various software could be used in resource management. Individuals as well as larger entities benefit from information technology on daily basis. Countries, even continents find themselves parts of larger projects, that not only monitor, but offer possibilities to help maintain importrant natural resources. This paper presents the PHYGROW, a point-based algorithmic/computation engine that models above ground plant growth, forage consumption and hydrological processes, the BRASS (Burning Risk Advisory Support System), model implemented on the Prescott and Coconino National Forests, the LEWS (Livestock Early Warning System), project aiming to provide information on drought conditions in Africa in regard to the affected livestock, as well as the Forage Risk Assessment Management System (FRAMS), a dynamic risk management decision tool currently in the beta test phase of development.*
***Key words:** Software, Information Management Systems, PHYGROW, BRASS, LEWS, FRAMS*

***Apstrakt:** Četiri informaciona sistema za upravljanje prirodnim resursima upotrebljeni su u ovoj studiji slučaja, da bi se analizirala upotreba različitih softvera u oblasti upravljanja resursima. Pojedinci, kao i različite interesne grupe, svakodnevno se koriste informacionim tehnologijama, a države, pa čak i celi kontinenti, participiraju u projektima namenjenim praćenju i iznalaženju boljih rešenja u funkciji održavanja značajnih prirodnih resursa. U ovom radu predstavljena su četiri informaciona sistema, i to: PHYGROW, algoritamsko-računarski softver namenjen modeliranju različitih procesa (npr. nadzemnog rasta biljaka, potrošnje stočne hrane, različitih hidroloških procesa i dr.), BRASS (Burning Risk Advisory Support System), model koji je primenjen u upravljanju šumama Preskot (Prescott National Forest) i Kokonino (Coconino National Forest), LEWS (Livestock Early Warning System), projekat kreiran da bi pružio informacije o uslovima tokom suše u Africi, kao i o uticaju sušnog perioda na stoku, i FRAMS (Forage Risk Assessment Management System), dinamična aplikacija za upravljanje rizikom, koja je još uvek u razvojnoj fazi.*
***Ključne reči:** Softver, informacioni sistemi za upravljanje, PHYGROW, BRASS, LEWS, FRAMS*

1. INTRODUCTION

Natural resource management mostly refers to application of ecological principles of conservation and restoration by humans. The last 50 years have proven the fact that the earth cannot sustain current levels of pollution, utilization of natural resources and exploitation of those, so a need for the management of natural resources has risen.

Natural resources are defined as a supply of raw materials modified by nature. Natural resources are subdivided into non-renewable and renewable [1]. Non-renewable resources are those that have evolved over time and cannot be replaced. Renewable resources are considered those capable of continuous regeneration. However, over exploitation of

renewable resources converts those into non-renewable resources, and such destruction represents a loss both of resources presence and management [2].
Natural resource management involves manipulation of the resources to preserve or supply products on a sustained basis [3]. It revolves around many applications in the domain of information technology. The scale of available applications is variable, and it depends on several factors. However, it is usually viewed from global down to small acreages and households, even to the microscopic aspects [4].
Regulations and laws are implemented, but these may as well as being assets, also easily become impediments. This depends on several factors, most notably on adaptability of the laws to specific conditions – local and temporal. In addition, the laws and their applications are subject to skillful management over time.
Economic may also affect the natural resource management by producing strong forces that may support or undermine the success. Groups or even individuals often conflict with changes and implementations of regulations.
Although resource management is based on science, we do not have enough information and are not always aware of how to apply this information to routine procedures that need to follow. Therefore, we need to monitor our natural resource management activities, by analyzing them often, summarizing the observations and obtained results, and compare our knowledge with other institutions who implement similar or even different natural resource management methods.
However, the single greatest difficulty for achieving desired results becomes that of unrecognized human ignorance acted upon with overconfidence [4]. What this practically means is that complex environmental changes must coordinate with the process of human dynamics. Clear understanding of human desire to protect the nature, and what our capabilities to do so are, are crucial in facilitation of the progress of successful natural resource management. After all, we should be all willing to see the nature we are a part of, continue to thrive for generations to come.

This paper analyzes experiences and information technology methods used by the Center for Natural Resource Information Technology (CNRIT), Texas, US. This Institution is chosen as a good example of application of the information technology in management of natural resources, and its problems, tasks, possible solutions, implementations, and success.

Successful management implies continuous learning, and for that reason this analysis is relevant to us.

2. HISTORY

In 1980's, Dr. C.J. Scifres, formed a small interdisciplinary group of scientists to work on Integrated Brush Management Systems (IBMS). IBMS was focused initially on the Coastal Prairies and South Texas Plains Land Resource Areas and was the first formal attempt to develop a protocol for applying a systematic, integrated planning and implementation approach to dealing with rangeland brush and weed problems, while recognizing multiple land values and management goals [5].

After this initial interest, a subgroup formed from the IBMS team, headed by Drs. J. Satuth, R. Conner, and W. Hamilton, started expanding and focusing on the development of computerized decision support systems for management of natural resources. They formed the Ranching Systems Group (RSG) and began to apply and receive grants in the form of annual funding for work in information technologies. Over a period of several years, they provided approximately $1,000,000 for the development effort and planning software [5]. Based on this, they were able to establish a skilled staff of programmers, technical editors and research associates.

Over the time of successful practice, the RSG turned into the Center for Natural Resource Information Technology (CNRIT), and began developing a grazing-land plant growth simulation model (PHYGROW), which became increasingly sophisticated and complex. However, this was just the very first simulation model, and CNRIT later expanded by developing other resource management software, such as BRASS is, and lead to several projects, such as LEWS and FRAMS.

3. PHYGROW

PHYGROW is a point-based, daily time step, algorithmic or computation engine that models above ground plant growth, forage consumption and hydrological processes [5].

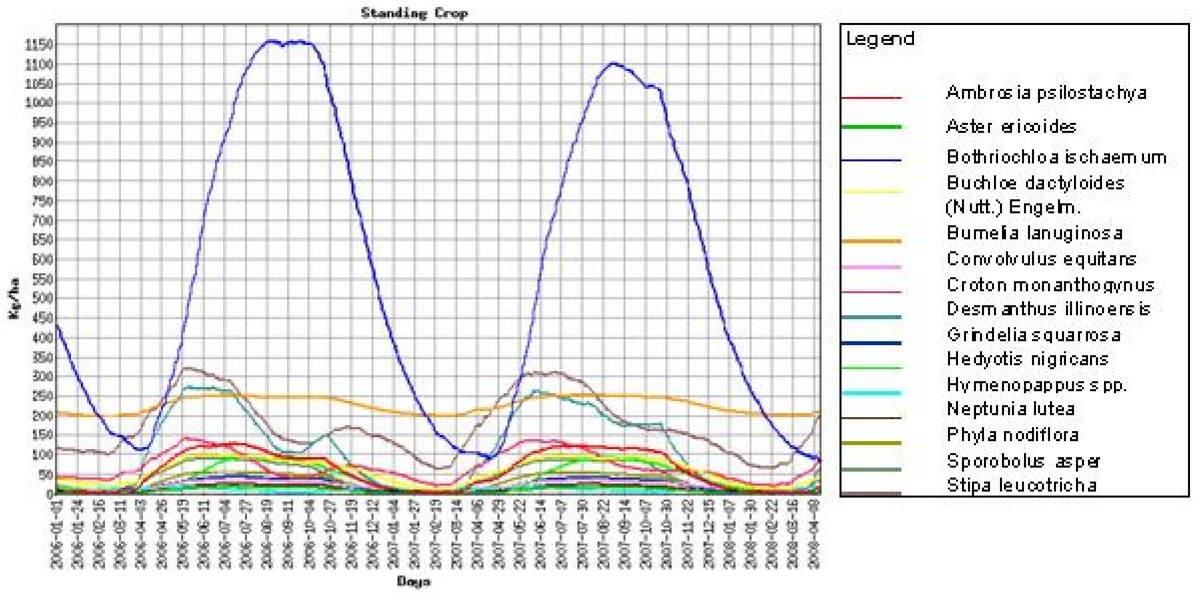

Figure 1. An example of obtained results applying PHYGROW [2]

The model can be started and stopped at any time in the computational process to allow full integration of data. It can simulate growth of multiple species of plants, depending on variety of factors that affect them, such as weather, vegetation, grazing animals, etc. This data is introduced through each individual database. Final data is entered into PHYGROW in the form of comma-separated values (CSV), which is relatively easy to perform. It can be fully automated and linked to weather satellites.

PHYGROW has been used in several analytical projects that study livestock management, and it mostly offers early warning based on a previously established national degree of standards for each of the natural factors. Some projects that utilize PHYGROW are Early Warning System in East Africa (since 1998), Texas Livestock Early Warning System (since 2002), and Mongolian GOBI initiative's national forage monitoring system (since 2004).

4. BRASS

The BRASS (Burning Risk Advisory Support System) model was first established in 2005 on the Lincoln National Forest, Big Pasture Burning Association, and Edwards Plateau Burning Association with funding by USDA's Risk Management Agency. Since then, it has been implemented on the Prescott, and Coconino National Forests as well as Fort Hood Military Installation [5].

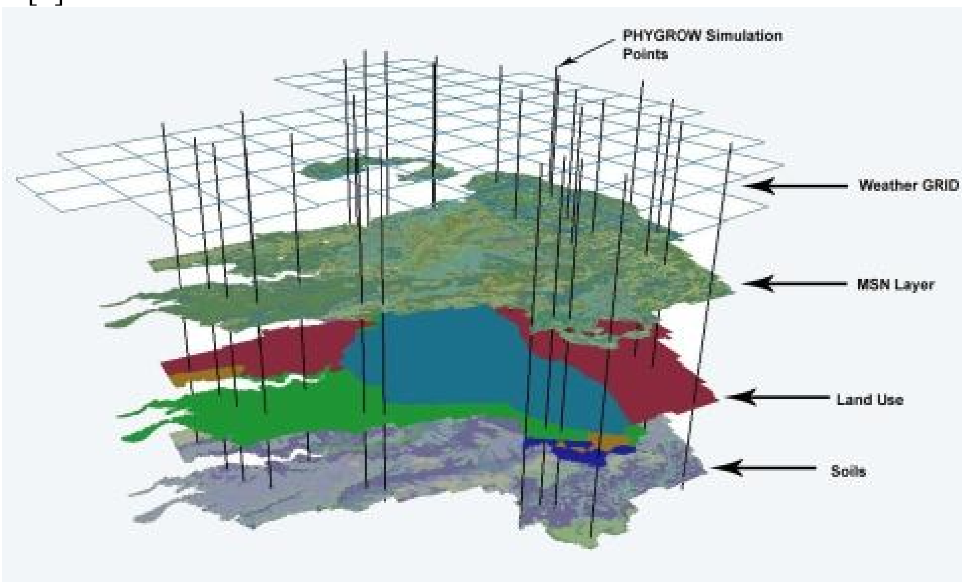

Figure 2. Input datasets for BRASS system for creation of unique burn polygons [2]

This system has two parts: a PHYGROW model, that is updated daily, by current and historical weather conditions, and a burning risk model called PHYRESIM developed from software used previously for other burning applications.
This model is used to apply our previous knowledge and research obtained from fires, and to help develop more scientific and advanced decisions on how to deal with burning in wilderness. It is capable of providing natural resource management with a visualization of near real time status of vegetation affected by fire, which has impact on forage, habitat and soil on a continuous basis.

5. LEWS

The LEWS (Livestock Early Warning System) was developed in 1997 through a collaborative research support program of Kenya, Ethiopia, Uganda, Tanzania, and Texas. The LEWS was designed to provide an early warning system for monitoring rangeland forage conditions, livestock nutrition and health for maintaining the food security of pastoralists [5].

The main goal of the LEWS project is to provide information on drought conditions in Africa in regard to the affected livestock.

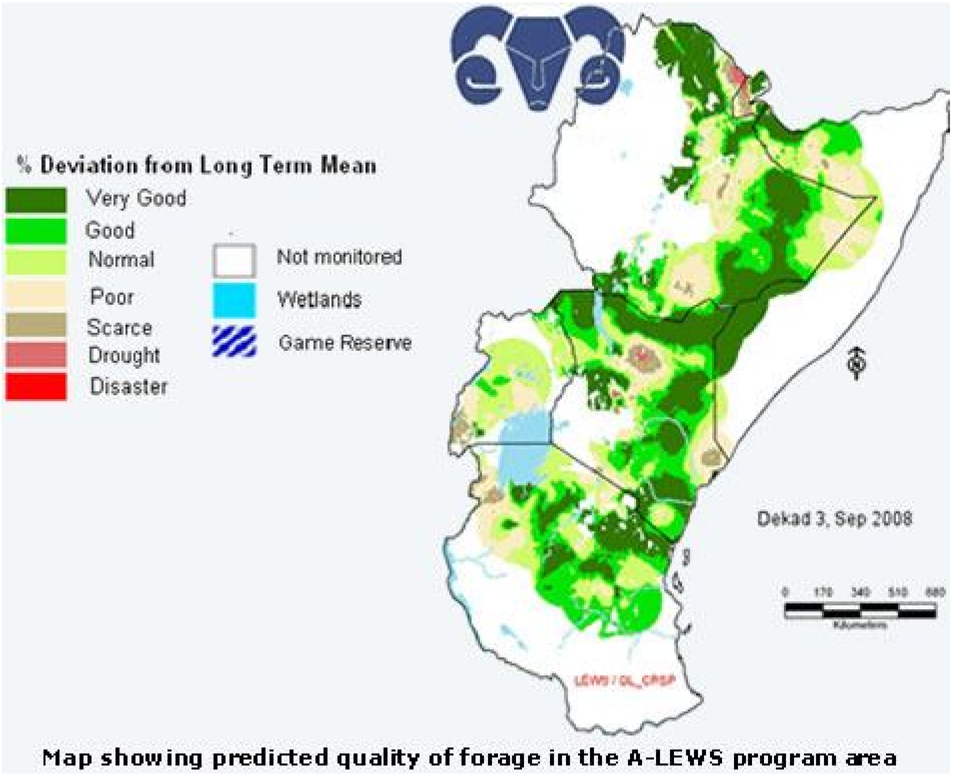

Figure 3. An example of results obtained in LEWS project

The project contributes to specific forage situation and deviation status reports are updated every 10 days. It is used as major advisory for many African countries.

6. FRAMS

Forage Risk Assessment Management System (FRAMS) is a dynamic risk management decision tool currently in the BETA test phase of development [5].

Its objective is to offer a web based risk management to ranchers, by allowing them to use web based management system available to them 24/7. It accesses the performance of animals that are free-grazers, monitors their condition in regard to weather changes, and allows for potential solutions.

The system is supported by several automated monitoring procedures that automatically update their databases, informing the user about most current situation in the wilderness. Ranchers benefit from this system, because they have immediate access to it, and are able to monitor the status of their ranch based on foraging pattern.

7. CONCLUSION

This case study is an excellent example how information technology could serve – if not protecting, at least managing natural resources.

What is the future of information technology in managing natural resources?

Variety of software should be available or is in progress that should be utilized for managing different natural resources, and these should be available to various officials, and even individuals. Ranchers, who even individually apply information technology, could benefit daily from this easy to use information technology system. The benefit linked to its usage, outweigh the cost for them.

On a global scale, information technology helps establish and maintain projects of national importance, such as the example in Africa. These could be spread to variety of geographical areas and even individual countries. However, team work and cooperation with other information technology sources is necessary for creating a future in which majority of natural resources could be maintained automatically and safely.

Implementation of information technology implies continuous learning, and is developing with an incredible speed. However, we need to contribute to the global awareness of its benefit and user friendly applicability, and apply appropriate aspects of the scientific method and good documentation and analysis for the validation of results. The future of managing natural resources utilizing information management on daily basis is ahead of us, and it is constantly opening new areas of for improvement and further research.

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THE ROLE OF GEOMECHANICS FOR THE SUSTAINABLE, SAFE, EFFECTIVE AND ECOLOGICAL USE OF THE ENVIRONMENT

ULOGA GEOMEHANIKE U ODRŽIVOJ, SIGURNOJ, EFEKTIVNOJ I EKOLOŠKOJ UPOTREBI ŽIVOTNE SREDINE

Prof. Dr. Ventsislav Ivanov[1], Prof. Dr. Lyuben Totev[2]

[1] Head of the Science and Research Laboratory "Rock mechanics" at the University of Mining and Geology; vivanoven20@gmail.com
[2] Head of the Underground Construction Department, Rector of UMG "St. Ivan Rislki"; Rector@mgu.bg

Abstract: *The paper discusses the relation between the technological impacts and the environmental damages during the exploitation of mineral resources and the geotechnical construction. The key role of the geomechanical damages which accompany the process for utilising the Earth's interior and their influence on the ecosystem has been characterised and assessed.*
Key words: *georesources, mining, geotechnics, geomechanics, technological influences, environmental damages.*

Apstrakt*: U radu se razmatra odnos između tehnološkog uticaja i oštećenja životne sredine tokom eksploatacije mineralnih resursa I geotehničke izgradnje. Ključna uloga geomehaničkih oštećenja koja prate proces iskorišćenja Zemljine unutrašnjosti I njihov uticaj na ekosistem su razmotrena i procenjena.*
Ključne reči*: georesursi, rudastvo, geotehnika, geomehanika, tehnološki uticaji, oštećenja životne sredine.*

1. INTRODUCTION

The mining and use of mineral and energy resources is undoubtedly of fundamental importance for the progress of human civilisation. In addition to this, out of the three life-ensuring environments - the atmosphere, the water and the terrestrial crust –the Earth's crust is the most important and accessible for the man nowadays and within the foreseeable future. Mankind lives and feeds itself from the earth and mines the georesources necessary for its existence from the Earth's interiors*.

The social development and the quality of life today are defined by two global tendencies [3]:

- Continuous and increasing consumption of mineral resources which in practice cannot be reproduced and are limited in quantity;
- Continuous increase of the population in a limited territory.

The main user of mineral resources is mining industry. Nowadays, more than 200 types of mineral and energy resources are extracted at depths more than 3 km [1,3].

Throughout the last several decades the public associates mining industry with the following assumptions [5,1]:

* The term "georesources" encompasses various geologic anomalies and properties of the Earth's interior – from the deposits of mineral resources to the technogenic areas [1].

- It has the leading position among the industrial branches in scale and intensity of impact on the environment;
- It is a key factor for the worsening quality of the environment and the climatic changes on the planet;
- Its development is in conflict with the other life ensuring uses of the Earth – the agriculture and urbanisation.

At the same time, society is aware of several other factors:

- Each of its needs ensuring the living progress is impossible without some direct and/or indirect exploitation of georesources;
- Nowadays the mining technologies do not have any alternative, irrespective of their negative impact on the environment;
- The reserves of mineral resources in the upper part of the Earth's crust worsen their quality or are at the stage of exhaustion;
- The time for the current exploitation (exhaustion) of these resources and the time for their natural creation are incomparable, the first lasts centuries, the second – geological epochs.

These challenges require new solutions both for their overcoming and for the change of ideology in the mining of mineral resources. They are based on the documents adopted by the UN and the EU which define "degrees of freedom" of the industrial branches and their future sustainable development in view of the usage of the Earth's interior, namely:

- The development should meet the needs of the current generation without creating risk of shortage of georesources for the next ones;
- Their development should preserve the quality of the environment without accumulating risk of irreversible ecological damages.

The publication reviews two interrelated, basic for the utilisation and exploitation of the Earth's crust, scientific branches – the mining and the geotechnic engineering.

2. STARTING POINT

Mining and geotechnic engineering are branches of the sector of mining sciences and have a common scientific base. The object of both of them is the geological environment and their aim is to utilise it by transforming it. The transformation of the environment is technogenic without change of its chemical composition or aggregate state. Both of them employ technological impacts in the destruction, mining or excavation of part of the rock mass by applying external energy. Both of them produce complex engineering constructions and/or facilities whose setting up is accompanied by different geomechanic phenomena and processes with high geomechanic potential for incidents and/or catastrophes in the host rock.

However, there is one significant difference between the two branches. With the production of mineral resources, the mining industry uses territories and worsens the environment, while the geotechnic engineering saves territories and as a result improves the environment.

2. UTILISATION OF GEORESOURCES, GEOMEHANICS, ENVIRONMENTAL CONSEQUENCES

The main characteristic of all methods for developing the Earth's georesources is that empty spaces of different form, size and purpose are formed within the rock mass. The rock mass is by nature broken, built up of different types of rocks, with unknown properties and behaviour and it is pre-stressed by the natural fields of the gravitational and tectonic stresses [6].

The networks of workings and mined out spaces violate the natural stressed state and in the rock mass appear induced fields of acting stresses with unknown magnitudes and orientation. Zones of concentrations or discharging of stresses are formed. The rocks, building the host rock, deform, break, move and collapse depending on the stressed state, properties and structural characteristics, the geometry and configuration of the mined out spaces, the intensity and scale of the technological impacts. Sudden, similar to explosions, destructions from the accumulated as a result of the blasts and/or seismicity induced by the technological operations appear in the over-stressed parts of the rock mass. With the development of the construction or exploitation, the above mentioned processes encompass increasing areas of rock masses and in many cases the instability zones proliferate to the surface and break the landscape [6].

The underground engineering complexes and the host rock form an intricate system whose effective exploitation and long-term sustainability are defined by its geomechanic state. After the end of the exploitation the described geomechanic processes do not stop. The said system transforms from engineering and technological into natural and technological. Uncontrolled and unmanageable natural factors – tectonic processes, natural seismicity, climatic phenomena, etc. exert decisive influence on its geomechanic condition [6]

The main features of the interaction between the geoengineering facility and the host rock are the stressed state, properties and reaction of the rock mass as a result of the technological influences during the construction and the exploitation. These features are studied by geomechanics. The methods of contemporary geomechanics are the only ones which give quantitative characteristics of this interaction. They provide the algorithm and the input parameters for the calculation of the constructive elements of the facilities, the optimal characteristics of the technologies for mining and/or construction, the regimes for setting up and exploitation, adequate to the geomechanical conditions or limitations in the geological environment. The geomechanical methods provide possibilities for assessing and predicting the character and scale of the consequences from both the impacts upon the rock mass and those of the geomechanical processes generated in it. The geomechanical monitoring ensures the comparison between the predicted and real parameters of the condition which provides possibilities for the optimal management or the application of operations for minimisation or prevention of unmanageable loss of stability and destructions. That's the main aim and task of geomechanics: the scientific and information logistics of each stage from designing, construction and exploitation to liquidation of the geoengineering site [6,4,1].

The methods used in the utilisation of georesources harm the environment. The changes induced by the technologies in stressed state and the accompanying geomechanical processes and phenomena described beforehand change the hydro-geological conditions [2,1]. The mining workings and geotechnical cavities drain, create depressions or dewater the rock mass and landscape [1,4]. Some cases are known when the unevenly distributed border stresses form water networks of polluted waters, with streams different from the gravitational ones [1]. Apart from directly harming the landscape, the opencast mining generates landslide processes and violates the hydrograph network. The underground mining violates the hydrodynamics of the surface water strata – main source of the atmospheric waters, and damages the bottom and coastline landscape. The polluted waters influence the soils and damage the biomass and bio organisms in natural or biochemical way [5]. The rocks contain different gases – ammonia, hydrogen, carbon dioxide, sulphide, methane, etc., most of them harmful and/or poisonous. During the destruction, these gases are released and harm the atmosphere. For instance, methane – one of the most technological energy sources (cheap and easily transported) - creates greenhouse effect in the atmosphere. The emissions of the exhaust gases also inflict damages. The blasting works, apart from their poisonous gases and dust, bring about negative seismic loads. If they are underwater, they destroy the flora and fauna at large distances. Last but not least, the mining industry produces waste. It is of significant amount of the so called technogenic masses which not only take away territories but also destroy the landscape, its aesthetic look and change the climate of the local ecosystem [5,4,1].

This short (and non-exhaustive) overview of the consequences from the exploitation of the georesources and the technogenic change of the Earth's interior shows that they directly or indirectly harm people, soil, air, flora and fauna, landscape and even the climate in the affected areas [4].

A zone with complex damage of the environment forms around each geoengineering site. The harmful influences are of different nature and they influence different elements of the environment. Their character is different in form and appearance, duration and orderliness.

If we take into account that environment is defined by the natural and social conditions surrounding mankind and its generations [4] we should also add the economic and social dimensions of the damages. Among these we can mention the effects upon the economy (boom, collapse, migrations of the population or settlement, investments, infertility) or social ones – disabilities, diseases and traumas, treatment expenses, etc.

4. INSTEAD OF A CONCLUSION

The main quality of the Earth's interior is the georesouces contained in it. Mankind mines the necessary mineral, energy and industrial resources, building materials and decorative rocks, uses the drinking, mineral and thermal waters. The interior is used for infrastructural, energy and defence facilities, storages, repositories for hazardous waste; many dangerous manufactures are also moved there.

At the same time mankind has realised that the Earth's interior is vitally important not only as a source of georesources but also for the agriculture, the industry and the economy. Moreover, together with the sun, air and water, it is considered to be the bearer of all primary conditions for life [1].

Unfortunately, all known mining and construction technologies have one main problem – they violate the environmental balance which cannot be compensated by nature any more. This calls for a new ideology for utilisation of the georesources based on balance in the interaction between technogenic systems and the ecosystem. The technologies for exploitation should become multi-functional in order to ensure complex utilisation of the interrelated georesources. The applied technologies in a deposit should not damage the other georesources accompanying it, e.g. hydrocarbons, deep waters and heat or others for which there is still no technology developed or there are no commercial conditions for mining and exploitation. Moreover, the applied technology should ensure that the geoengineering facilities could be used in some other function of theirs after the end of the exploitation [1].

The authors' point is that together with the utilisation of the georesources, the environmental harms are determined and initiated by geomechanics. This sets geomechanics as the key factor for assessment and management of the interaction between the technological impacts and their consequences for the environment.

Taking into consideration the above-mentioned facts, contemporary geomechanics, as a scientific foundation of geoengineering, disposes of knowledge and has its own analytic and applied methods for the technogenic transformation of the Earth's interior with minimum harm of the ecosystem. Additionally, it can provide technical solutions reflecting the economic and social limitations in the course of exploitation, i.e. to ensure the effective management of the utilisation.

The issue is that the scientific branch – mining ecology, still does not dispose of a complex indicator for assessment of the environmental damages caused by the mining and construction industry. Currently, it uses instantaneous characteristics for damages of the separate elements of the environment – sanitary standards for people, quantitative characteristics for the pollutions or dimensions of the affected zone.

Being aware of the complexity of the problem and on the base of the view that the interrelation technological impacts – environmental damages is realised through geomechanics and hoping to be useful, we would like to propose the following elements of a "geomechanic" approach for overcoming some of the mentioned problems:

- An attempt for geomechanic identification, systematisation and "parametrisation" of the factors causing the environmental risk;
- Setting up quantified criteria for assessment of the risk's level;
- Assessment of the probability for the appearance and character of its manifestation;
- Justification of the technological solutions with minimal geomechanic damages.

The integrated assessment will be complex, multi-criteria and probably rating but most likely it will be more useful than the current practice for assessing the negative influence of the mining and construction activities on the environment.

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RECYCLING TECNOLOGIES BASED ON WASTE GLASS AND FLY ASH

RECIKLAŽNE TEHNOLOGIJE NA BAZI OTPADNOG STAKLA I LETEĆEG PEPELA

Vladimir D. Živanović[1], Mihajlo B. Tošić[1], Snežana R. Grujić[2], Srđan D. Matijašević[1], Jelena D. Nikolić[1], Snežana N. Zilđović[1], Ana M. Vujošević[3]

[1] Institute for the Technology of Nuclear and other Mineral Raw Materials, 86 Franchet d' Esperey St, 11000 Belgrade, Serbia.
[2] Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia.
[3]Faculty of Agriculture, University of Belgrade Nemanjina 6, 11080 Zemun, Serbia

Abstract: *In this paper the results of the laboratory scale experiments for obtaining of light weight aggregates based on coal fly ash and waste glass were presented. To prepare the pellets a coal ash /waste glass mixture contains 70 wt% of waste glass powder was made. The lime ($CaCO_3$) was used as a foaming agent. The pellets were expanded at $T=900^{\circ}C$ for $t=30min$ in a electric furnace. The samples with high macro porous structure and apparent bulk density $\rho < 0.5$ g cm^{-3} were obtained. It was shown that the waste glass and coal fly ash can be utilized for fabrication of the light weight aggregates for application in the building industry.*
Key words: *waste glass, fly ash, light weight aggregates.*

Apstrakt: *U ovom radu su prikazani rezultati laboratorijskih eksperimenata dobijanja lakih agregata na bazi letećeg pepela i otpadnog stakla. Za dobijanje peleta smeša leteći pepeo/otpadno staklo sa 70 mas% praha otpadnog stakla je napravljena. Kao agens za razvijanje pene korišćen je krečnjak ($CaCO_3$). Pelete su ekspandirane na na $T=900^{\circ}C$ u vremenu $t=30min$ u električnoj peći. Dobijeni su uzorci sa visokom makroporoznošću i prividnom zapreminskom gustinom $\rho < 0.5$ g cm^{-3}. Pokazano je da se otpadno staklo i leteći pepeo mogu koristiti za izradu lakih agregata za primenu u građevinskoj industriji.*
Ključne reči: *otpadno staklo, leteći pepeo, laki agregati.*

1. INTRODUCTION

A sustainable development becomes one of the main goals for every country in the world. To achieve this goal the environmental policy which assumes a proper waste management must be made. The modern waste management is based on the recycling witch is one of the component of the waste hierarchy defined by EC directive 2008/98. The 'recycling' means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes [1].

Excluding the nuclear waste, the fly ashes from power stations as well as the incinerator bottom ashes can cause a great environmental damage because of large quantity and the content of the toxic metals (Cd,Cu,Cr,Ni, Pb,Hg,As etc). Therefore, the common disposal techniques for such materials are not environmentally acceptable. Unfortunately, only small amount of fly ashes were recycled mainly in the cement and mortar production [2,3].

The investigations performed have shown that the parent fly ashes or ashes combined with other waste industrial materials can be utilized in fabrication of different kind of building materials with great mechanical, thermal, chemical and other properties [4-7]. Most interesting of them are the materials obtained by combination of flay ashes and the waste glasses. Any kind of waste glasses can be use for such purpose (bottle, window, laboratory, TV, etc.). These materials can be systematized in two main groups as: a) glass-ceramics materials b) expanded (foamed) materials. The potential application of expanded materials is wide and includes: isolation layers for roads and barriers, roof isolation, plates for thermal and sound isolation, filters for waters, aggregates for light concretes, etc.

In this paper the results of the laboratory experiments for obtaining of light weight aggregates (expanded pellets) based on coal fly ash and waste bottle and window glasses are present.

2. EXPERIMENTAL

The waste fly ash was collected from the open pit near the TPS „Nikola Tesla" – Republic of Serbia and the glass cullet from a local municipality dump were used as starting raw materials. The waste glass powder was obtained by crushing and milling previously washed and dried sample. Jaw crusher Retsch 300 and a vibrating mill with rings Humbolt Wedag KHD 953/3 were employed. The thermal characteristics of both samples were determined by thermomicroscope Leitz. The chemical compositions were determined by using a gravimetric and spectroscopic methods (AAS Analyst 300). Warman M4 cyclosizer was used for determination of the grain size of fly ash sample and the phase composition was defined by the XRD – Philips PW-1710 automated diffractometer with a Cu K_{α} radiation tube operating at 40 kV and 32 mA.

The raw pellets were prepared from the mixture of the powders of fly ash and waste glass and as a foaming agent the powder of $CaCO_3$ was added (75:20:5). The palletizing was performed in a mixer Tonitehnik by slow mixing of the mixture with water addition. To obtain light weight aggregates the raw pellets were previously dried and then expanded in an electric furnace Carbolite CWF1300 at T = 900^{0}C for t = 30min. The bulk density of the as-expanded pellets samples was determined by Archimedes' method.

3. RESULTS

Тхе цхемицал цомпоситионс оф тхе флI асх анд њасте гласс самплес аре схоњн ин Табле 1.

Table 1. Chemical composition of the fly ash and waste glass samples

Sample	Oxide [wt %]								
	SiO_2	Al_2O_3	CaO	MgO	K_2O	Na_2O	Fe_2O_3	TiO_2	L.o.i
Fly ash	58.52	24.03	3.31	2.11	1.08	0.32	6.23	0.87	3,16
Waste glass	68.22	1.86	9.97	3.65	0.63	13.57	1.57	0.17	0.33

The sulfur was present in small quantity in fly ash (0.33 wt%). As shown in Table 2, the heavy metals are present in the range of 25-365 ppm. The index of radioactivity determined for this fly ash is below the limits prescribed for building materials.

As determined by XRD analysis, the phase composition of fly ash is complex, Fig.1. The crystalline phases in the sample are: quartz, feldspar, mullite, melilite, crystoballite and anhydrite. The glassy phase (> 30 %) appeared in the sample in a form of pearls of different colors with dimension up to 1mm. The large porous aggregates (> 40%) belong to the burned clay (chamotte) with inclusions of coal and iron oxides.

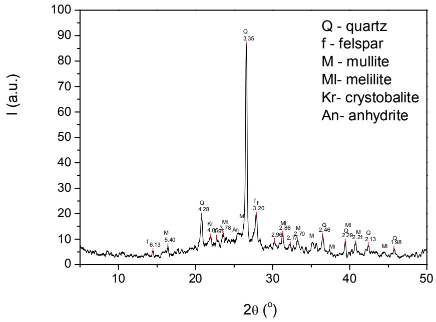
High temperature microscopy revealed that the fly ash sample does not melt below T = 1250^0C. The waste glass sample softened at T = 870^0C and melted at T = 980^0C.

Table 2. Contents of heavy metals in fly ash sample

metals	ppm
Zn	255
Cd	25
Bi	365
Cr	335
Cu	145
Pb	255

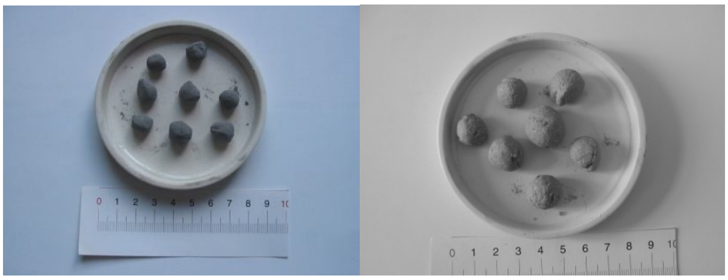
Table 3. Grains size analysis of the fly ash sample

Grain size (mm)	wt (%)
+ 0.6	1.37
- 0.6 + 0.5	0.81
- 0.5 + 0.4	1.73
- 0.4 + 0.3	4.32
- 0.3 + 0.2	12.23
- 0.2 + 0.1	28.51
- 0.1 + 0.075	17.13
- 0.075 + 0	33.90



Фиг.1 ЏРД оф флI асх сампле

Тхе еџпандед пеллетс њитх лоњ аппарент булк денситI □ = 0.43 г цм$^{-3}$ њере обтаинед. Ин Фиг.2 тхе аппеаранце оф тхе рањ анд еџпандед пеллетс ис схоњн. Ас маI сее тхе волуме оф рањ пеллетс инцреасед маркедлI, Фиг.2. Тхе хеатинг оф самплес индуцес тхе форматион оф хигхлI пороус мацро струцтуре. Тхе ларге порес аре интерцоннецтед анд овералл поросітI (> 70 %) њас естиматед. Ин Фиг.3, тхе мацроструцтуре оф еџпандед самплес ис схоњн



a) b)

Fig.2. The appearance of pellets a) raw b) expanded

Fig.3. The macrostructure of expanded pellet (sample cross section)

The flow sheet for fabrication of the light weight aggregates (expanded pellets) is shown in Fig.4.

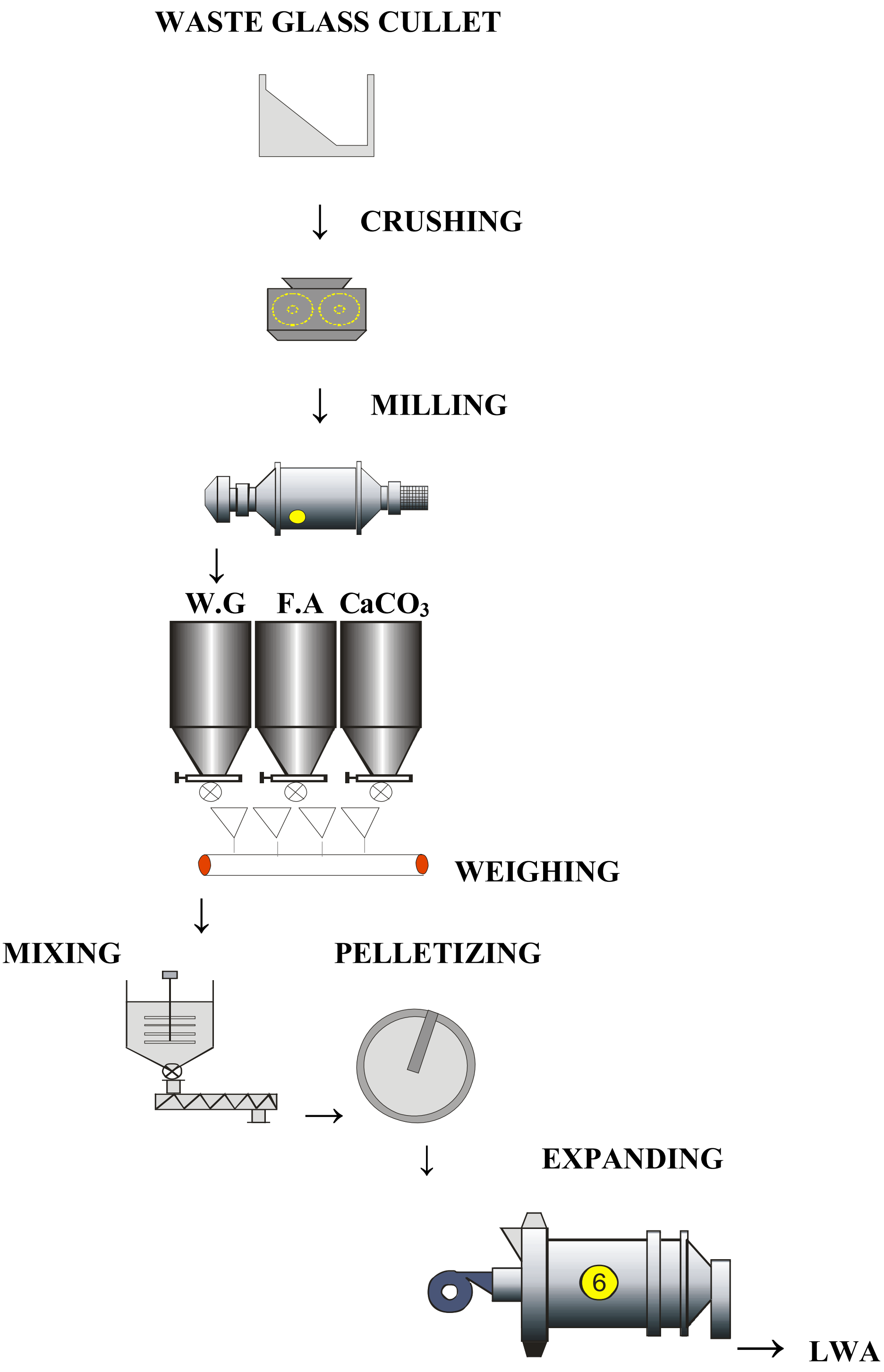


Fig.4 Flow sheet for fabrication of light weight aggregates (LWA)

4. CONCLUSION

The light weight aggregates were obtained by heating the pellets prepared from the mixture of the powdered coal fly ash, waste glass and $CaCO_3$. The pellets expanded at T = 900°C have high macro porous structure and low apparent bulk density ρ = 0.43 g cm^{-3} . It was shown that these dangerous waste materials can be recycled successfully through the fabrication of new harmless and useful materials with wide application in the building industry.

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RADIATION SAFETY OF PHOSPHATE MINERAL PRODUCTS

RADIJACIONA BEZBEDNOST FOSFATNIH MINERALNIH PROIZVODA

Mirjana Stojanović[1], Gordana Vitorović [2], Brankica Mitrović [2], Zorica Lopičić [1], Marija Mihajlović[1],
Marija Petrović[1], Duško Vitorović[3]

[1]Institute for Technology of Nuclear and Other Mineral Raw Materials, Belgrade, Serbia
[2] Faculty of Veterinary Medicine, University of Belgrade, 11000 Belgrade, Serbia
[3] Faculty of Agriculture, University of Belgrade, 11080 Belgrade-Zemun, Serbia

Abstract: *Processing of phosphate ores,the application of phosphate minerals products, mainly fertilizers and animal feed additives (monocalciumphosphate and dicalcium phosphate) are the main antropogenic sources of uranium in Serbia. Uranium in these products are located in easily accessible forms and easilz plugs into the food chain as a metabolic analog of calcium. Serbia is due to reduced national capacitz, oriented to import these product, often not environmentally acceptable quality for the product of healthy and safe food.The aim of these paper was the quality assessment of radiation phosphate products which are in retail in Serbia and indicate on inacculare legislation in this area and the possible misue of used monocalciumphosphate and dikalcium phosphate, specified quality for fertilizers (MPC 1600 Bq / kg) as a feed additives(MPC 500 Bq / kg). Results indicate the importance of monitoring and control of production and use of phosphate products for the prevention of involvement in the uraniumchain.*
Key words: *phosphate ferilizers, feed additives, uranium,safe food*

Apstrakt: *Prerada fosfatnih ruda, primena proizvoda na bazi fosfora, pre svega mineralnih đubriva I dodataka stočnoj hrani (monokalcijum fosfat i dikalcijum fosfat) predstavljaju glavne antropogene izvore urana u Srbiji. Uran u ovim proizvodima se nalazi u lako pristupačnim oblicima i lako se uključuje u lanac ishrane kao metabolicki analog kalcijuma. Srbija je zbog smanjenih nacionalnih kapaciteta orjentisana na uvoz ovih proizvoda, često ekološki naprihvatljivog kvaliteta za proizvodnju zdravo bezbedne hrane. Cilj rada je procena radijacionog kvaliteta fosfatnih proizvoda koji se nalaze u prometu u Srbiji i ukazivanje na nepreciznu zakonsku regulativu u ovoj oblasti I do moguće zloupotrebe korišćenja monokalcijum fosfata i dikalcijum fosfata, propisanog kvaliteta za djubriva (MDK 1600 Bq /kg) kao dodatak stočnoj hrani (MDK 500Bq/kg).Rezultati ukazuju na značaj monitoring i kontrole proizvodnje I upotrebe fosfatnih proizvoda radi sprečavanja uključenja urana u lanac ishrane.*

Ključne reči: *fosfatna mineralna đubriva, fosfatni dodaci stočnoj hrani , uranijum, bezbedna hrana*

1. INTRODUCTION

Background radiation dose consists of the radiation doses received from natural and man-made background. Man-made radiation is generated fron nuclear and non-nuclear (industrial) activities. Natural background radiation contributes about 81% of the annual dose to the population and man-made background radiation contributes the remaining 19%. (http://www.doh.wa.gov/ehp/rp/factsheets/factsheets-htm/fs10bkvsman.htm). It is estimated that the Chernobyl radioactive fallout added about 2% to the natural radioactive background [1].

Anthropogenic (man-made) potential sources of uranium could be classified [2]:

- Nuclear activities (nuclear industry through enriching uranium anh productio energy, radioactive waste management, nuclear medicine, accident situation),
- Military activities (production of nuclear weapons menagement, …)
- Conventional- non- nuclear activities (mining, production and combustion of coal, phosphate indystry, oil and gas exploatation, water treatment…)

The major contributor of background radiation is NORM - "Naturally Occurring Radioactive Material". NORM is used for all naturally occurring radioactive materials where human activities have increased the potential for exposure compared with the unaltered situation and potentially includes all radioactive elements found in the environment.

The acronym TENORM, "Technologically-Enhanced Naturally-Occurring Radioactive Materials", or technologically enhanced NORM is often used to refer to those materials where the amount of radioactivity has actually been increased as result of industrial processes, or as a result of past or present human practices (http://www.epa.gov/radiation/tenorm/)".

Major uranium sources of TENORM:

- **uranium mining** (uranium mining overburden, uranium in-situ leachate, evaporation pond, solids)
- **phosphate industry** (phosphogypsum, phosphate slage,scale, phosphate fertilizer
- **coal combusion** (fly ash, bootoom ash, slage)
- **petroleum . oil, and natural gas production** (sands, sludge, hard scales,…)
- **metals mining (**rare earths, monazite, xenotime, bastnasite), gold and silver,titanium,copper,aluminium, zirkon, molybdeium,tin,tungsten,vanadium- tailings ,dump and heap leach wastes .waste rock and overburden, solid waste from liquid
- **waste and drinking water treatment** (treatment sludg, treatment plant filters, treatment plant ash)
- **geothermal energy production** (scale,brine pond deposit)
- **building materials** (certain construction materials- gypsum and stone (e.g. granite)

2. PHOSPHATE INDUSTRY - SOURCES OF NORM AND TENORM

Technological processes in power plants and production of phosphate fertilizers and their use has contributed to the increased the concentration of uranium in certain areas and present the main form of TENORM in Serbia. According to some estimates the "natural level of ionizing radiation”, in Serbia, has increased about 30 times in the last 40 years[3].

The concentration of uranium in phosphate ore is 12 to 180 Bq/kg. In Serbia are imported annually about 1,000,000 tons of phosphorite for production of mineral fertilizers.

The average concentration of uranium in phosphorite imported was 150 Bq / kg. This mean that annually imported about 150 tons of uranium or 50 TBq of radioactivity, which ere applied to Serbian agricultural solis [3].

During the processing of phosphorite is obtained and phosphogypsum, phosphate for feeding livestock, etc.. The concentration of uranium in these production is in the range of 5.6 to14 Bq / kg. For the production of phosphoric acid annually processes some 120,000 tons of raw phosphate with average uranium concentration of 90 g/t (about 100 GBq).

The activity of ^{238}U in phosphoric acid is 467 Bq/dm^3 and ^{235}U is 34.4 Bq /dm^3, and sediment in this production contains 360 Bq /dm^3 U^{238} and 20 Bq / dm^3 U^{235} . The uranium in the secondary geochemical environments shows tendency for phosphate binding and it is significantly concentrated in the phosphate rock in the range of 5 – 300g/tU.

Uranium in phosphate rock may be present as ionic form U^{4+} or U^{6+} or both. Tetravalent uranium state in isomorphous substitution with calcium ion; the ionic radius of U^{4+} which is 0.97Å being very near to that of Ca^{2+} which is 0.99Å [4].Therefore, from the point the dislocation of uranium from the soil into the plant, calcium is considered a metabolic analogue of uranium [5].Current world phosphate rock production is about 170 million tons annually, which represents a potential source of about 17 000 tons of uranium per year.

Phosphate rock used for fertilizers is a major NORM with regard to redistribution of uranium, thorium and radium and with significant inventories uranium on the world level before any production occurred.The most important use (over 90 %) of phosphate rock is in the production of phosphate fertilizers. Before phosphate ore is turned into fertilizer or other products, it is transformed into either phosphoric acid (through the “wet process”), or elemental phosphorus (through the thermal process). This processing concentrates NORM in the waste products, transforming them into TENORM. This wet-acid process includes reaction sulphuric acid with phosphate rock which produces phosphoric acid and phosphogypsum. For every ton of phosphoric acid it is produced five tons of phosphogypsum byproduct which is being generated. The production of 1 t of phosphate (P_2O_5) results in the generation of approximately 4–5 t of phosphogypsum.

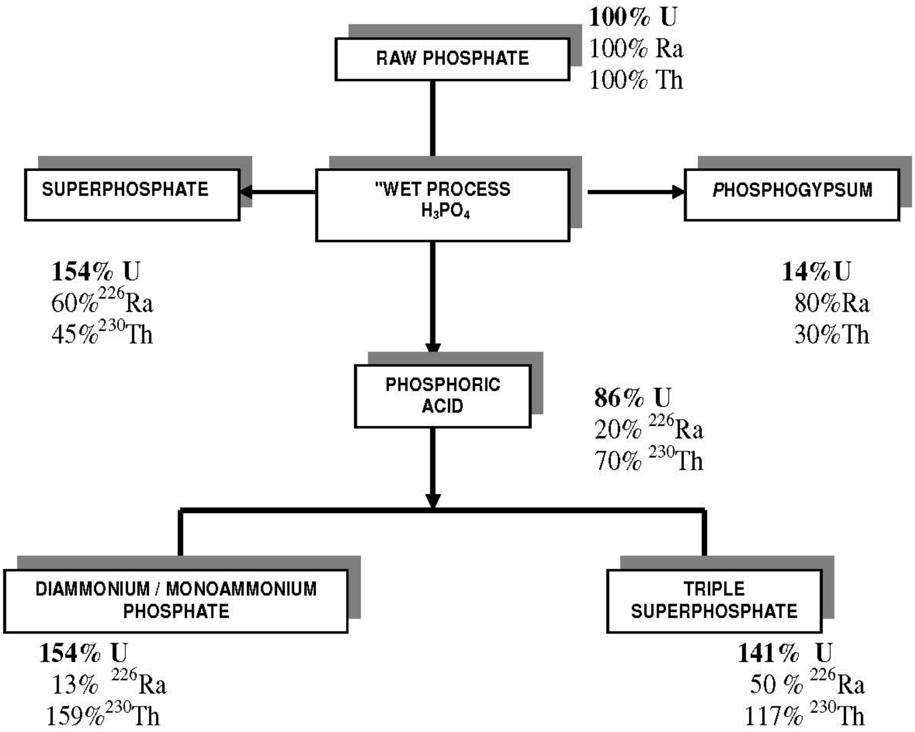

Figure 1. Distribution of the radionuclides in the „wet" process of phosphoric acid production

As indicated above, sedimentary phosphate rock contains radionuclides of the uranium, thorium and actinium series. The activity concentrations of the elements of these series vary with the source of the ore. There are some identifiable trends in the distribution of radionuclides during processing of phosphate rock and production of phosphoric acid and fertilizers, presented in Figure 1. Generally, "wet acid processes" is in category of NORM and generate TENORM product and byproduct. [5]. Eight plants for the recovery of uranium from phosphoric acid have been built and operated in the United States since 1976 (Florida 6, Louisiana 2). Plants have also been built in Canada, Spain, Belgium, Israel, and Taiwan. Unfortunately, this is a very small number compare to 400 wet-process phosphoric acid plants in the world [6].

3. EFFECT OF LONG-TERM APPLICATION OF PHOSPHORUS FERTILIZERS

Use of phosphoric fertilisers is the main anthropogenic source of the uranium input in the environment (about 73% of the total input uranium). On the basis of the U concentration in phosphate fertilizers, estimated that 50 years of the application of a specific phosphate fertilizer (e.g., 100 kg ha^{-1} year^{-1} as P_2O_5) would lead to the addition of 2.4 kg of U per hectare to the topsoil, corresponding to an increase of about 1 mg kg^{-1} in the soil U[2].

Effect of long-term application of phosphorus fertilizers on uranium contamination soils was the subject of many studies in the world. The first report on this topic was in the 1960s [7] Increased content of U in the topsoil due to the long term application of chemical P fertilizers ranges from 0.08 to 1.3 mg ⁄ kg soil for periods of application ranging from about 20 to over 80 years. In a paddy field in Japan, the increase in soil U due to the application of calcium superphosphate fertilizer (600 kg $ha^{-1}year^{-1}$ as mixed fertilizer) for 10 years was estimated increased of 5.3% of the total U in the soil.[7,8,9,10,11]

Kratz and Schnug [12] reported that a mean value of uranium from 7 to 23 g/ha (annually) can be loaded onto soil using of 22 kgP/ha from various phosphorus fertilizers.Takeda et al., [9]. were found that in the soils at 0-35 cm depth, during a 61-year cultivation period, U concentration increased about 200 mg/m^2 by the vertical profile. Also, Taylor [13] found that mean levels of total U increased by 1.30 ± 0.03 mg/ kg of soils sampled about 40 years ago compared with recent soil samples, an annual increase of 0.033 ± 0.008 mg/ kg yr^{-1}, and these increases are probably associated with phosphate fertiliser application.

Effect of long term application of phosphate fertilizers to increase the content of uranium in the soil can not be generalized, but that is specific to each individual site. Pathways of uranium determine different factors such as: soil pH, Eh-redox potential, content and types of organic and inorganic ligands, amount of Fe oxide, mineral composition of soil, physico – chemical properties of soil, partial pressure of CO_2, temperature, microbiological activity [5]. Positively charged UO_2^{2+} is adsorbed on the negatively charged sites of soil components, and these sites increase with soil pH. The U sorption capacity of soil, therefore, increases with soil pH. Under a reductive environment, the major U species is insoluble UO_2. In addition to soil composition, the types and concentrations of coexisting ions, soil pH, and redox conditions control the mobility of U in soil. This implies that agricultural practices have significant effects on the mobility of U in soil. However, when carbonate concentration increased with increase in pH, U became mobile in soil because of the formation of a soluble and negatively charged carbonate-U complex. UO_2^{2+} is also sorbed on Fe and Al sesquioxides [11].

Around 1500 t of mineral fertilizers based on phosphorus are applied per annum in Serbia. It is estimated that around 210 kg of uranium (30 g/ha) are in this way introduced into the environment [8,10].

Stojanović et all., [8] investigated whether long-term application of phosphorus fertilizers causes increase of uranium content in three types of soil, different acidity *(chernozem, smonitza and pseudogley)*. Results indicate significant differences in the average uranium content between pseudogley on one side and other two soil types (chernozem and smonitza) on the other side. Highest value for uranium content was in chernozem and the lowest in pseudogley. Physicochemical soil properties have effect on process of uranium migration and mobilization, and for this reason fixation of uranium in investigated soil types decreases in the following direction: *chernozem* > *smonitza* >> *pseudogley*. Generally, the values obtained for total uranium content in the investigated experimental variants were in the range from 0.65 to 1.94 g/t. Natural content of uranium in Serbian soils is in the interval from 0.08 to 5.9 g/t, so it can be concluded that the results obtained in this investigation are within natural limits.

3. RADIOACTIVITY OF PHOSPHATE MINERAL PRODUCT IN SERBIA

Our research involved measuring the specific activity of natural and artificial radionuclides in samples of phosphate mineral supplements, imported origin (monocalcium phosphate and dicalcium phosphate) for animal feeding and phosphate fertilizers, as well as potential carriers of high levels of natural radioactivity, particularly uranium (^{238}U). Gama spectrometry measurement were perfomed on the HP Ge detector (ORTEC) resolution of 1.95 keV, relative efficiency 25%. Measuring time was 100 000s. In a samples of monocalcium phosphate origin from Finland (Table 1.) activity ^{238}U was 640 Bq/kg in sample from Spain 2120 Bq/kg. These samples were not radiation safe , because the correct MPC (maximum permitted concentration) for the ^{238}U - 500 Bq / kg.In other samples the level of ^{238}U activity was in accordance with applicable regulations (Sl.List. 9/99) and they were safe for animals.

Table 1. Activity of radionuclides in monocalcium phosphate in traffic in Serbia

Origin / factory	**^{40}K (Bq/kg)**	**^{137}Cs (Bq/kg)**	**^{238}U (Bq/kg)**	**^{235}U (Bq/kg)**	**^{226}Ra (Bq/kg)**	**^{232}Th (Bq/kg)**
VZ Subotica	68 ± 2	< 0.2	60 ± 4	3.2 ± 0.9	18 ± 2	10.2±0.6
Belvit Nis	78 ± 3	< 0.1	79 ± 3	3.2 ± 0.8	37 ± 3	15 ± 1
FSH Jabuka	78 ± 3	< 0.1	60 ± 6	3 ± 1	33 ± 3	6 ± 0.5
Hrana produkt	62 ± 2	< 0.1	71 ± 8	3 ± 1	30 ± 3	6.8 ± 0.5
FSH Union	51 ± 2	< 0.1	12.9 ± 0.8	< 0.6	11 ± 1	2.2 ±0.2
FSH Nutriko	80± 3	< 0.2	72 ± 4	2.3 ± 0.7	19 ± 2	14 ± 01
Narcis – (Sabac)	50 ± 2	< 0.2	17 ± 3	< 1	6 ± 2	2.5 ±0.4
VZ Zemun	78 ± 3	0.3	73 ± 5	3.1 ± 1.7	20 ± 2	12 ± 1
FINSKA	41 ± 5	< 0,2	**640 ± 61**	< 10	/	/
ŠPANIJA	22 ± 3	< 0,4	**2120 ±106**	**835 + 44**	/	/

In a samples of dicalcium phosphate (Table 2.) measured significantly higher levels of ^{238}U. These values indicate that these samples does not meet the criteria for radiation hygiene recommendation about their use as animal feed.

Table 2. Activity of radionuclides in dicalcium phosphate in traffic in Serbia

Origin / factory	**^{40}K (Bq/kg)**	**^{137}Cs (Bq/kg)**	**^{238}U (Bq/kg)**	**^{226}Ra (Bq/kg)**	**^{232}Th (Bq/kg)**
VZ Zemun	20 ± 1	< 0.2	**1907 ± 58**	**400 ± 21**	1.5 ± 0.5
FSH Pozega	80 ± 3	< 0.2	52 ± 4	17 ± 2	13.4 ± 0.7
IHP„Prahovo“	19 ± 4	< 0.4	**1800 ± 114**	79 ± 7	/
Italija	29 ± 1	< 0.2	**2000 ±45**	**940 ±45**	/
FSH Union	40 ± 2	< 0.1	**860 ± 31**	**441 ± 21**	1.9 ± 0.2

The results indicate an abuse of application monocalcium and dicalcium phosphate to a feed additive, whose quality is such that it can not be used as mineral fertilizer (MPC 1600 Bq/kg). Passing through economic sanctions on Serbia and the transition of the entire economy,the past two decades, have caused serious problems in the production and use of fertilizers, permanent decline in production of fertilizers, of 2.8 million tons by 1990. to 660 thousand tons today, and orientation to import scarce amounts of fertilizer, high prices, in an environment of falling purchasing power of consumers, are aligned of Serbia to the bottom o in Europe by the consumption of mineral fertilizers. The consequence are a reduction yields about fifty percent compared to the European average and declining fertility and degradation of soils resources.

Analysis ofimported fertilizers (Russia, Uzbekistan,Croatia, Hungary, Germany,Austria, Israel) and domestic, which are marketed in Serbia, indicate a significantly higher content of radioactive uranium (up to 160g / t) and some heavy metals(chromium, lead, cadmium, nickel, strontium), which contributes to the degradation and contamination of agricultural soils and production of unsafe products consists heath (Table 3.) [14].

Table 3. The content of heavy metals and uranium in fertilizers in Serbia (mg / kg)

Formulation	Producer	U	Cr	Cd	Ni	Pb	Sr
NP 11:52	Serbia	153*	350	16	61	10	45
NP 10:46	Uzbekistan	89	172	6	70	20	128
NP 10:46	Kazakhstan	12	74	3	41	20	72
PK 10:30+Mg	Germany	38	88	11	99	60	489
NPK 15:15:15	Croatia	54	145	8	39	40	119
NPK12:12:17+Mg	Germany	5	17	1	21	20	4500
NP 12:52	Russia	3	16	2	24	20	274
NPK 15:15:15	Hungarian	6	33	6	19	20	25
NPK 15:15:15	Austrija	47	113	6	79	10	259
NPK 8:16:24	Serbia	10	26	2	10	50	255
NPK	Israel	0,3	16	3	11	10	0,01

*1.0 mg U /kg = 12.35 Bq/kg

Overcoming this problem requires radical changes in the long term that must involve the wider community, giving it national proiritet, given that the total national exports, agricultural products account for about 25%. One way is to develop a new technological process of obtaining mineral fertilizers on the basis of domestic mineral resources, as the main recommedations of this study.

4. RECOMMENDATION - USE OF NATURAL MINERAL FERTILIZERS

The application of raw phosphates for soil fertilizing is economically cost-effective and environmentally eligible then industrial phosphorous fertilizers, but it is limited on acid soils. To extend their use on all types of soils, and increased solubility of phosphate, we examined a synergistic mixture of phosphate rock -hidroksiapatita (PR) and the nature of modified zeolite.

Modified zeolite with NH_4^+ ions, increases the solubility of phosphate rock through the exchange of cations Ca^{2+}, can be described by the following equation (1):

$$\mathbf{PR + NH_4^+\text{- zeolite} \leftrightarrows Ca^{2+}\text{- zeolite} + NH_4^+ + PO_4^{3-}} \quad \mathbf{(1)}$$

Preliminary results showed that the addition of modified zeolite (with 2M ammonium sulphate solution) increase PR dissolution due to removal of Ca^{2+} by zeolite through cation exchange. In time period of 24 h it increased the PR phosphate rock dissolution from 0.406 mg P/dm^3 to 3.621 mg P/dm^3 which was confirmed by an increase in pH value and decrease in concentration of Ca^{2+} ions. Such hybrid materials can be applied as natural phosphate fertilizers [15]. Examined the efficacy of these natural fertilizers,produced from domestic mineral resources, in real conditions with two varieties of maize, are ongoing.

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5. CONCUSION

Environmental contamination by radioactive substances has become one of the important problems of modern civilization. The data obtained by monitoring the level of radioactivity in the environment should be the basis in determining the limits of radioactive contamination of phosphate mineral supplements for animal feed. It also requires a regular review of phosphorus ore from imports, as well as all products, both importedand domestic production. Only in this way we can prevent the uranium from anthropogenic sources introduced into the food chain and thus to reach up to the man asthe end consumer.The importance of the results is that they offer the possibility of obtaining a clear picture of the state in radiation safety of product based on phosphorus (fertilizers and feed additives-monocalcium and dicalcium phosphate) from export and domestic production, and the assessment of endangered radiacion agricultural soils, livestock, all in order to produce a healthy and safe food and protecting the population from ionizing radiation. Recommendation- use of natural fertilizers based on natural phosphate and modified zeolite cost-effective natural mineral fertilizers based on phosphate and zeolite would be competitive with chemical fertilizers.

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PALEOECOLOGICAL CONDITIONS FOR ZEOLITE FORMATION AND ZEOLITE DEPOSITS IN SERBIA

PALEOEKOLOŠKI USLOVI FORMIRANJA ZEOLITA I NALAZIŠTA ZEOLITA U SRBIJI

Nenad Č. Bojat[1], Svetlana M. Polavder[2], Ljiljana Grujičić[3], Dražen D. Vicić[2], Suzana Bogojević[4]

[1]Faculty of Biofarming, Megatrend University, Bačka Topola, Serbia
[2]Faculty of Ecology and Environmental Protection, University Union – Nikola Tesla, Belgrade, Serbia
[3]Contractor, Belgrade, Serbia
[4]Serbian Institute of Occupational and Radiological Health "Dr. D. Karajović", Belgrade, Serbia

***Abstract**: Zeolite deposits in Serbia (Bor, Zlatokop and Meckovac near Vranje, Jovacka river near Vladicin Han, Igros near Aleksandrovac, Toponica near Kosovska Kamenica, Slanci near Belgrade and Opciste at Fruska gora) are presented in this paper, as well as the reconstruction of paleoenvironments where zeolite deposits at the given localities were formed, analyzing infauna and paleoflora from the locality Zlatokop near Vranje.*
***Key words**: Zeolite, paleoenvironments, infauna, paleoflora*

***Apstrakt**: U ovom radu prikazana su nalazišta zeolita u Srbiji (Bor, Zlatokop i Mečkovac kod Vranja, Jovačka reka kod Vladičinog Hana, Igroš kod Aleksandrovca, Toponica kod Kosovske Kamenice, Slanci kod Beograda i Opčiste na Fruškoj gori), kao i rekonstrukcija paleosredina u kojima su stvarane naslage zeolita na pomenutim lokalitetima, a na osnovu analize infaune i paleoflore sa lokaliteta Zlatokop kod Vranja.*
***Ključne reči**: Zeoliti, paleosredine, infauna, paleoflora*

1. INTRODUCTION

Zeolites are a group of about 70 minerals that can be found in nature. Those minerals are named after their characteristic to seethe and foam when exposed to flame (greek: *ςεο* – to seethe, to boil; *λίτοσ* – stone).

By their chemical structure, zeolites are hydrated aluminosilicates of alkaline and earth alkaline metals, mostly containing univalent or bivalent cations Na^+, K^+ and Ca^{2+}. Zeolite crystal structure is build from silicon tetrahedra linked into chains and rings, with specific substitution of silicon by aluminum. This structure is dominated by systems of interconnected micro-cavities filled with water molecules and exchanging cations. Such porosity provides adsorption, catalytic and ion exchange, as well as many other features, which are very useful in modern industry [1].

Zeolites occur in four basic forms: as filamentous and needle-shaped (natrolite, scolecite, thomsonite, mesolite), leaf-shaped (heulandite, stilbite, epistilbite, dachiardite, brewsterite), hexahedron-shaped (chabazite, phillipsite, harmotome, analcime, gmelinite, faujasite, levyne, montmorillonite) and mixed zeoletes (clinoptinolite, mordenite, laumontite, erionite, gismondine, ascroftine) [2].
So far, several zeolite deposits were discovered in Serbia. Their locations are related to sedimentary rocks of different ages, including pyroclastic rocks, and primarily contain

clinoptinolite, heulandite, analcime, laumontite, mordenite and stilbite [3], created in marine and lacustrine environment. The largest deposits of zeolite in the world are found in California (USA), Canada, Australia, Mexico, Italy, Israel, United Arab Emirates and Russia.

2. ZEOLITE GENESIS AND DEPOSITES IN SERBIA AND THE WORLD

The genesis of zeolites is diverse and can last for millions of years or only a few days. They are often formed by crystallization of amorphous volcanic glass, while the others are related to global cataclysmic events. The analysis of specific characteristics of zeolites genesis, enables successful reconstruction of certain periods in the history of the Earth, while their sites can be used as indicators of deep and "blind" copper and gold deposits, and the level of rock metamorphism [4].

Zeolites were first ascertained in the sediments of Serbia in 1968, using non-destructive analytical method of X-ray diffraction. So far, within the sedimentary rocks in Serbia, including pyroclastic rocks, different types of zeolites were found (analcime, clinoptinolite, heulandite, laumontite, mordenite and stilbite [3]) at the following sites: Bor, Zlatokop and Meckovac near Vranje, Jovacka river near Vladicin Han, Igros near Aleksandrovac, Toponica near Kosovska Kamenica, Slanci near Belgrade and Opciste at Fruska gora [4]. At the above localities, the genesis of zeolites is related to the Neogene age rocks and aquatic environment, mainly lakes. In the northern part of Serbia (*baden*), zeolites were formed in the marine environment [4]. In Slanci near Belgrade (*burdigal, helvet*), zeolites occur in tuffs and belong to the lake-type of development known as – *Slanci series* [5]. Zeolites also formed in the lake-type environment are found near Kosovska Kamenica (Toponica), Vranje (Zlatokop, Mackovac), Vladicin Han (Jovacka river) [6], and Aleksandrovac (Igros) [4].

Clinoptinolite, analcime and mordenite occur in marine and lake sediments, laumontite, stilbite and heulandite only in marine and erionite in lake sediments only [4].

Zeolite and zeolite tuffs in Serbia mainly contain calciteous clinoptinolite (70-95%), formed by diagenesis of particles primarily built of volcanic glass. It is known that the Neogene lacustrine basins in Serbia contained freshwater and it is in those basins that the fine grain volcanic ash was deposited, through marl lake sediments. Shallowing lake basins and suitable climate, caused changes in the characteristics of lake water, which became alkaline and saline, hence favouring diagenetic transformations of volcanic glass into clinoptinolite and heulandite [7]. Basin had to be a closed system, most likely a shallow lake, since only in shallow isolated basins, a suitable weight ratio of water and volcanic ash could have caused such physical and chemical changes.

Zeolite crystallized in aquatic environments, where climate was suitable for drying sediments, facilitated changes in water quality (freshwater-alkaline-saline), as evidenced by drying cracks, diagnosed on the upper surface layer of zeolite tuff at Zlatokop open pit (Figure 1) [7].

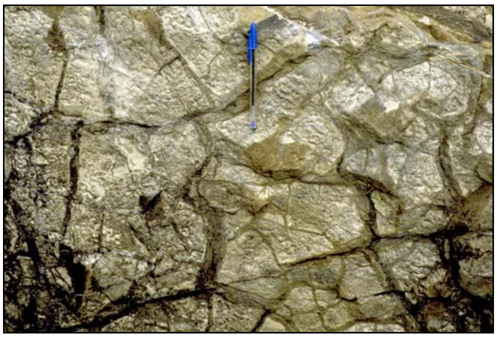

Figure 1. Drying cracks (Zlatokop near Vranje) [9]

3. PALEOENVIRONMENTAL RECONSTRUCTION OF ZEOLITE DEPOSITES

Reconstruction of paleoenvironment at the locality of Zlatokop near Vranje was based on its paleoflora and other biogenic structures [8]. Amongst those were very nice infossile sections in zeolite tuff, e.g. section of the drilling worm from the *Scolithos* group (Figures 2 and 3).

B

A

Figure 2. Infossile sections, from the *Scolithos* group (Zlatokop near Vranje).
(A) infossile section; (B) polished infossile section (natural size) [9]

A B

Figure 3. Infossile from the *Scolithos* group (Zlatokop near Vranje).
(A) upper surface; (B) underside surface (R 1:3) [9]

Discovery of infossiles from the *Scolithos* group suggests that the Zlatokop zeolite site was created in shallow aquatic environment and intertidal zone, most likely a shallow lake or larger lake bay, with exerted influence of the wave energy.

Zeolited tuff has a distinct ability of fossilization and always is a challenge when it comes to paleoflora analysis. Fossil remains of leaves and grass are always charred, while the woody parts (branches, seeds, acorns, etc.) are silicified. The surfaces of leaves in such fossils are perfectly preserved and usually brown, rarely black (Figure 4). The fossils that have retained their natural form and the "third dimension" are particularly interesting.

By the analysis of fossil flora in the sediments of Zlatokop zeolite site near Vranje, a small number of species was found: *Gleditisia lyelliana* (Heer) Hantke, *Fagus attenuata* Goeppert, *Quercus mediteranea* Unger, *Alnus julinaeformis* (Strenberg) Kvaček & Holy, *Zelkova zelkovaefolia* (Unger) Bužek & Kotlaba [10].

Analysing the leaf morphology, it was concluded that *Alnus julinaeformis* (Strenberg) Kvaček & Holy has the largest number of common features with the *Alnus* species native to China and Japan, and particularly with *Alnus trabeculosa* Hand.-Mazz., which inhabits mesophilic forests in the valley of the Yangtze River (China), but is also often found in evergreen forests. *Fagus attenuata* Goeppert is an ancestor for a number of modern types of beech and is very common in the Neogene flora of Central Europe, and so is *Zelkova zelkovaefolia* Unger. *Quercus mediterranea* Unger has a very thin cuticle, not characteristic for plants living in dry habitats.

Location of fossil plant remains at the Zlatokop site near Vranje also suggests high sedimentation rate and yield of plant materials that had built mesophile forests of subtropical regions [11, 12]. Flora determined at Zlatokop near Vranje indicates lower Miocene age of the zeolite [10].

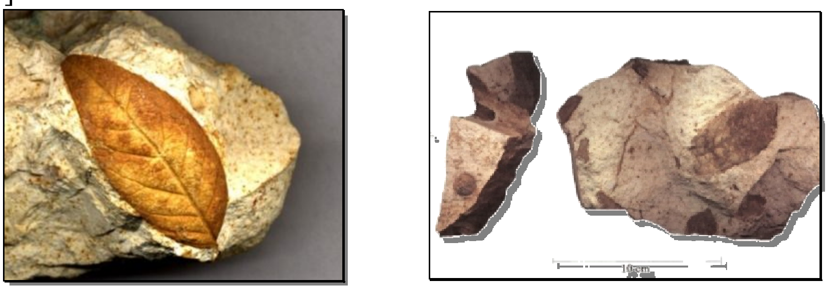

Figure 4. Plant fossil remains in zeolite [9]

4. CONCLUSION

Several deposits of zeolite were discovered in Serbia, in sedimentary and pyroclastic rocks, at the sites in Bor, Zlatokop and Meckovac near Vranje, Jovacka river near Vladicin Han, Igros near Aleksandrovac, Toponica near Kosovska Kamenica, Slanci near Belgrade and Opciste at Fruska gora. The aforementioned zeolite sites were primarily created in lake environment and are mostly related to the rocks of Neogene age. Zeolite tuffs in Serbia mainly contain calciteous clinoptinolite (70-95%), formed by diagenesis of particles primarily built of volcanic glass. This mineral was created in shallow, closed lake basins, where certain climatic conditions enabled transformation of freshwater into saltwater. Such an environment facilitated diagenetic changes of volcanic glass into clinoptinolite and heulandite. Discovery of infossiles from the *Scolithos* group in zeolite tuff at Zlatokop site suggests that zeolite was created in shallow aquatic environment and intertidal zone, most likely a shallow lake or larger lake bay, with constant mild waves. The paleoflora analysis at the same locality, revealed the plant species that had composed mesophile forests of subtropical regions in the past. The position of paleoflora within the zeolite mass, indicates that both material yield and sedimentation rate were significant during the genesis of zeolites on this site.

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THE POSITION OF THE SERBIAN COPPER PRODUCTION COMPLEX ON THE WORLD MARKET

POLOŽAJ SRPSKOG KOMPLEKSA PROIZVODNJE BAKRA NA SVETSKOM TRŽIŠTU

Branislav Mihajlovic, Ph.d., grad. min. eng.[1]

Abstract: *This paper presents the status, importance and the role of copper in the development of the modern world economy in Serbia. We analyzed the main features of the world copper market such as: trends in consumption - and the cumulative per capita, trends in production, exploitation reserves of copper - and the cumulative number of years, and the impact of new mining projects in the projection of the balance or imbalance of supply and demand on the world copper market. An analysis of the Serbia copper complex position in the world market is presented, together with the comparison of the Serbian copper resources with the world resources. Also, the cost curve and the position of the Serbia copper complex production are presented, accompanied by the analysis of influencing factors that define the position of the Serbian copper complex on the world market, as well as comparison with companies for mining and processing of copper in the world. Finally, a suggestion for possible routes of strategic activities is introduced, which aims at strengthening the current position of Serbia copper complexes on the world copper market.*
Kay words: market, strategy, copper, trends, reserves, resources.

Apstrakt*: U radu je prikazan položaj, važnost i uloga bakra u razvoju moderne ekonomije u Srbiji. Analizirane su osnovne karakteristike svetskog tržišta bakra kao što su trendovi u potrošnji – i kumulativni per capita, trendovi u proizvodnji, eksploataciji rezervi bakra – i ukupan broj godina, kao i uticaj novih rudarskih projekata u projekciji balansa ili disbalansa ponude i tražnje na svetskom tržištu bakra. Prikazana je analiza pozicije kompleksa Srbije na svetskom tržištu bakra, kao i poređenje srpskih resursa sa svetskim resursima bakra. Takođe, prikazana je kriva troškova i pozicija proizvodnje bakra u Srbiji, zajedno sa analizom uticajnih faktora koji determinišu poziciju srpske proizvodnje bakra na svetskom tržištu, kao i poređenje sa rudarskim i prerađivačkim kompanijama u svetu. Konačno, predstavljen je predlog mogućih pravaca strategije, koja za cilj ima jačanje postojeće pozicije srpskog kompleksa proizvodnje bakra na svetskom tržištu.*
Ključne reči: *tržište, strategija, bakar, trend, rezerve, resursi.*

1. INTRODUCTION

Copper production in Serbia has a long history. Exploitation and processing of copper ore are continuously carried out for over a hundred years. During this period, the complex of copper has gone through various periods and had a strong influence on the impressive economic growth taking place in a very turbulent public - social circumstances. Generally, by the end of the seventies of the last century, it can be assessed that the Serbian copper production was growing. In the eighties and nineties there has been a stagnation, while during the first decade of the twenty-first century there was a significant production decline and collapse of the powerful system for copper production and processing. At the beginning of the second decade of this century, and in recent years, government of Serbia has assumed jurisdiction over the production of copper and initiated a program of reconstruction, modernization and

[1] RBB Bor, Kestenova 8, banem8@hotmail.com

stabilization of its production capacity. This program began in 2010 to be specifically implemented through a comprehensive technological and organizational intervention, with a very large level of investment. Because of the importance and impact of the residency program in the overall development of Serbia as a whole, the work represents a professional assessment of the current position of the copper complex on the world market, as well as projections of future status in accordance with the above development program.

2. THE ROLE OF COPPER IN THE DEVELOPMENT OF MODERN WORLD ECONOMY

The oldest copper objects were found dating from about 6,000 BC. Its application for the development of primitive tools and weapons characterized the entire epoch in the development of humanity, known as the Copper Age. And in the next era, the Bronze Age, which occurred about

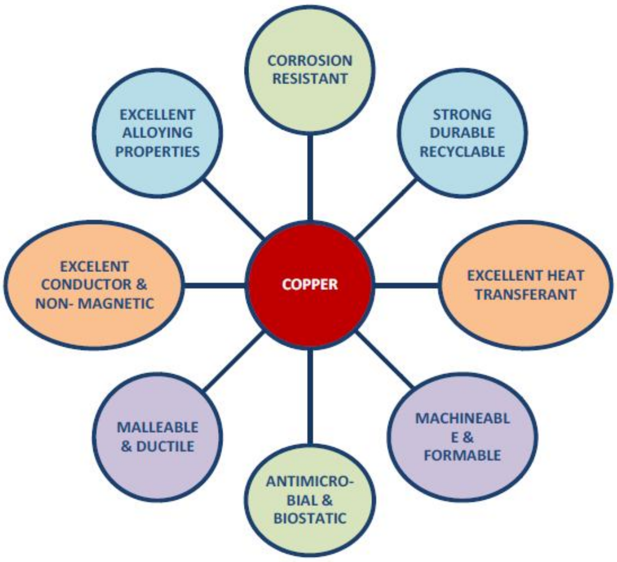

Fig. 1: Overview of the most important properties of copper [4]

3,000 BC, an important factor was copper, which is made of hard alloy - bronze. The use of stone tools was entirely superseded in the Bronze Age, and it is believed that this era ended only in the Middle Ages. The oldest copper mines at that time were in the Sinai desert, then Cyprus, hence the Latin name for copper - cuprum. One of the oldest copper mines is also the “Rudna glava“ (Ore head) near Bor.

The new century with the rapid development in science and industry has led to a large demand for copper. The invention of dynamo machines (1870) and alternating current motor (1887), started the era of Electrical Engineering, which has made the necessary copper metal, which lasts to this day.

In addition to excellent electrical conductivity, copper has a number of other useful features that make it one of the most indispensable metals in modern industrial world. The Fig. 1 gives an overview of its main features for which is applied in the industry.

3. CHARACTERISTICS OF THE WORLD COPPER MARKET

Consumption trends - cumulative and per capita

The twentieth century was characterized by strong growth and expansion of industrial production. Global redistribution of power at the beginning of the century with the once powerful colonial powers spilled over the side of the strongest of the developed capitalist countries of the time, led by the United States and Germany.
During this period stronger momentum of industrial development has created a hunger for ever-increasing quantities of raw materials. Copper recorded an exponential growth curve of consumption. At the beginning of the twentieth century, global consumption of copper was equal to the less than one million tons per year (see Fig. 2), at the end of the century it was nearly twenty times higher. Trend growth of such spending has continued into the twenty-first century, and at the end of 2011 consumption reached a level of 20 million tons per year, which is approximately 3 kg/year of land per capita.

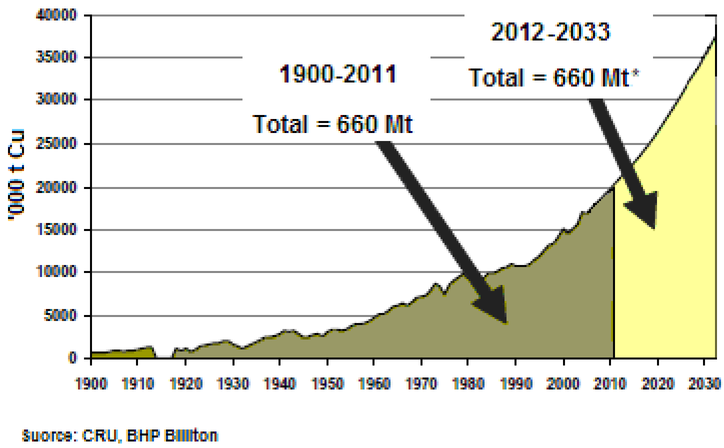

Fig. 2: Cumulative consumption of copper in the world and forecast till 2033 [1]

4. TRENDS IN PRODUCTION

Industrial production of copper in the world occupies a strategic position in the high overall economic growth. Throughout the previous century to the present day a high demand for raw materials is present in the world, especially for non-ferrous metals, with copper in the leading position. This trend is significantly enhanced in the last decade by the explosive expansion of China's economic development, some Far Eastern countries in Asia and BRIC.

Despite this trend, copper production has managed to successfully follow the exponential growth in consumption. However, the above mentioned explosive growth in copper consumption in some countries in the world and forecasts of its further growth for the first time led them to suggest the emergence of imbalance between the appearance of exponentially growing consumption and limited production capabilities. The trend of rapid industrial and population growth in the world are superimposed and will increase the pressure further for demand on the copper market in the future. The Fig. 2 clearly shows that the projection of consumption of copper in the world is at such a level that it is predicted for the next 22 years to spend almost the same amount of copper as in a total history of mankind up to date. Copper production in the world will not be able to follow these trends.

5. EXPLOITATION RESERVES OF COPPER - IN QUANTITY AND BY YEARS

In parallel with the expansion of copper production in the world, existing ore reserves were more rapidly and intensively exhausted. It was an imperative to constantly explore new reserves to offset the spending of the ones already existing. Characteristic for this practice was a lower quality of new resources, with lower content of useful components and the increasing depths.

This trend was bound to impose the need to increase the amount of excavation and proecessing for the same amount of metals. Industry of copper production and refining in these circumstances had to constantly seek for solutions to counter such trends, thus constantly lowering the unit costs of production through the rise in productivity, technological innovation and organizational improvements.

As a result of an intensive work on the geological survey, world copper reserves have steadily increased, but their lifetime remained at 30 to 50 years. Current exploitation reserves amount to 630 million tons of metal, which is projected to increase reserves for the next thirty years (see Fig. 3).

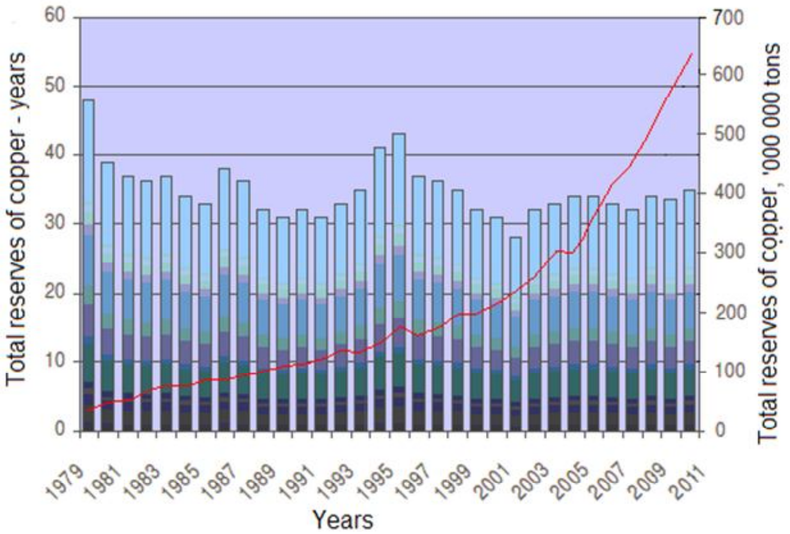

Fig. 3: Total reserves of copper in the world, volume and duration [9]

6. NEW PROJECTS - BALANCE / IMBALANCE OF SUPPLY AND DEMAND

The current level of mining production and primary copper processing in the world amounts to less than 17 million tons per year. Analysis of movement in the world market shows that a few more years the copper production will be able to follow the trend of consumption from existing mines, but it will be followed by a decline. The Fig. 4 shows that already in 2018 the imbalance of supply and demand will be 5 million tons of copper, and 6 million tons in 2020. This means that the inclusion of new mines into production in this period have to be filled by the dynamics of the production capacity of about 1 million tons of copper annually.

The development of new projects is taking place in terms of decreasing copper content, and valuable metals in ore, with an increasing volume of excavation per ton of copper obtained. This raises the cost of copper production in these mines. Currently, the world's new mining projects are done with an average copper content of 0.5 to 0.6 % and with average cost price of 5.500 US$/t. Meanwhile, the planned revenues from by-products are becoming increasingly influential on the overall economics of the projects.

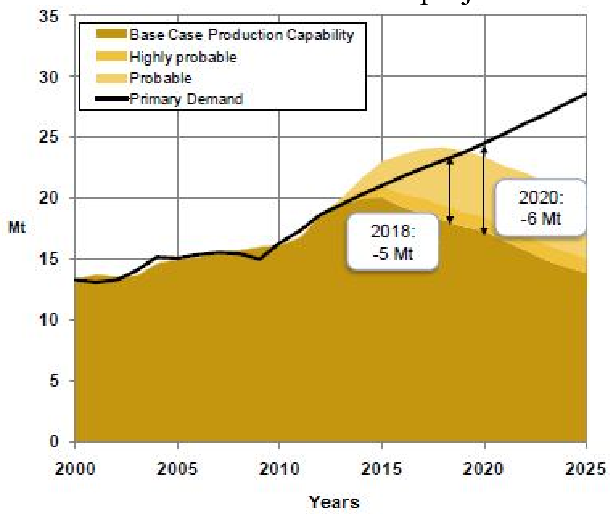

Fig. 4: Mine production trends of copper in the world [2]

It is also characteristic that in circumstances where the profits are more difficult to obtain from the basic copper production, it inevitably leads to compromises between political and geological risk. This means that the future copper production is increasingly migrating to the developing countries with a higher business risk. It is also increasingly present a compromise between capital and operating costs. This means that in terms of lower quality of available resources, the principle, according to which high levels of capital investment are automatically searching for lower operating costs, is being abandoned.

Therefore, there is an intense work in the world in order to develop new projects for copper exploitation and primary processing. Currently there is a development of some 7.000 projects in total. Schedule of projects (for ten major countries) is given in Fig. 5.

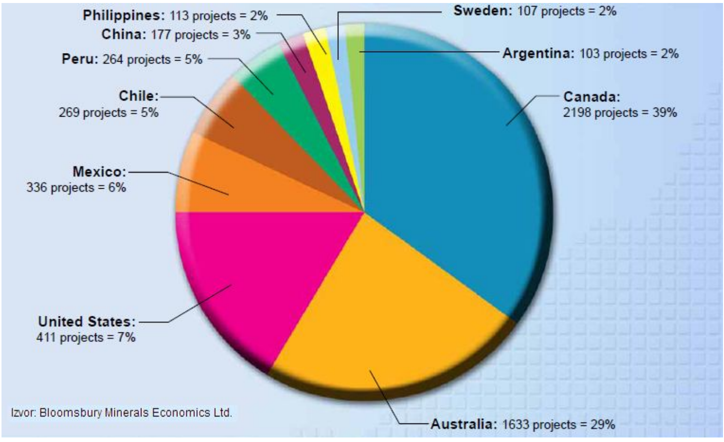

Fig. 5: Distribution of projects for the extraction and primary processing of copper in the top ten countries in the world [5]

7. POSITION OF THE SERBIAN COPPER PRODUCTION COMPLEX ON THE WORLD MARKET

The complex production and primary processing of copper in Serbia is for many years present on the world market. As previously mentioned in this paper, until the end of the seventies, this position was very competitive. Serbia at that time participated in the total world production of copper with 2 %. Its resources were pointed out for the content of copper and the existence of associated precious metals. At that time, copper production complex of Serbia was widely respected in the world.

After this period, there was an increasing depletion of existing reserves of copper - lower content of copper and associated metals in the exploitation of reserves with increasing depths. At the same time, the existing conditions in the mines grew more difficult. An increasing amount of excavation per ton of copper produced and its low prices on the world markets were becoming more pressing for business economics.

Comparison of production and primary processing resources of copper in Serbia with the world resources

After nearly eighty years of exploitation and work in conditions of relative prosperity, in the late seventies, a medium copper content in ore produced has gone down below 1% and continued with further decline. Currently exploited ores are with high copper content level from 0.25 % to 0.28 %, while the plans for the next ten years of planning are with average copper content of 0.33 %. As noted previously, the development of new projects in the world accounts with average content of 0.5 to 0.6 % Cu. This means that the exploitation of resources which Serbia uses to enter the plan for the next ten years is as twice as lower in quality than in the world. The average copper content in ore produced in Serbia is given in Fig. 6.

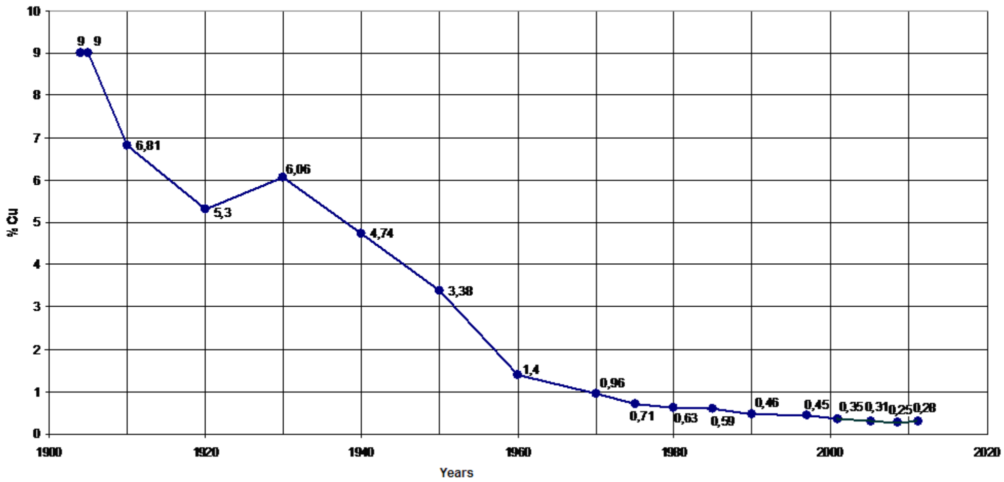

Fig. 6: The mean content was achieved at the exploitation of copper ore in Serbia [10]

In the world, the design of new mines accounts with the amount of 400 up to maximum 800 tons of excavation per ton of copper produced. In Serbia, the ratio is 1.000 t of copper per ton of excavation. If one compares the amount of excavation per ton of copper produced from which projections are made future production in the world and in Serbia, we come to the conclusion that the production of one ton of copper in Serbia, the excavation is from 1.25 to 2.5 times larger than the excavation in the world. This means that the exploitation reserves with which Serbia is entering a development program for the next ten years, can not ensure its competitive position in the world. While the world is working with a reliable degree of certainty on the projection of new mines with price of 5.500 US$/t, the projection in Serbia is made with high 8.000 US$/t to 8.500 US$/t, which significantly increases the risk of future survival of copper production complex in the world market.

Cost curve and the position of the copper production complex in Serbia in it

In order for a mining company to survive in the market (including its profitability), it must be positioned so as to be competitive with other mining companies. The use of price metals for the

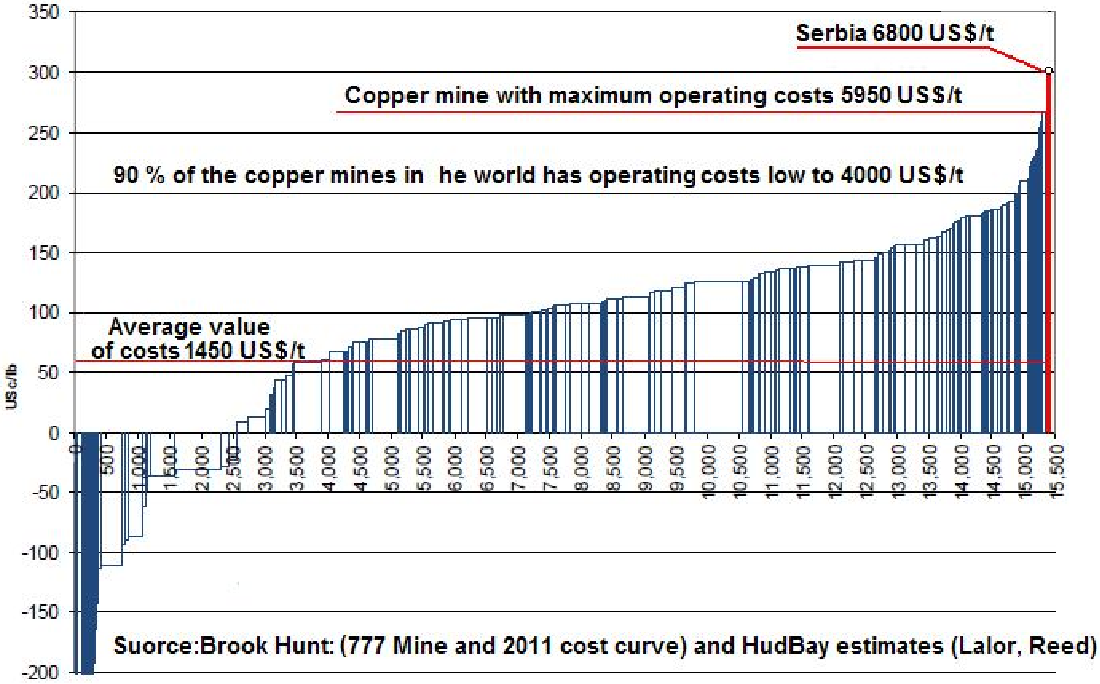

Fig. 7: The position of copper production complexes in Serbia in the cost curve (competitiveness) [3]

purpose of planning is not referring to the competitiveness of companies. The price of metals is uncertain and mostly outside of control of the manufacturer. But the cost is subject to control. The position on the cost curve identifies the competitiveness of production operations with the risk of loss, which means that the cost price should decrease. Cost curve (competitiveness) in the world for 2011 is as shown in Fig. 7.

Key long-term strategy or vision for a mine or a company is to provide the best possible position on the curve for the cost of copper production. Its primary strategy should be ongoing efforts to better position itself in the bottom (left) part of the curve. The Fig. 7 shows that the position of the copper production complex in Serbia is far right on the curve, with the cost of operating expenses of 6.800 US$/t, which gives it a remarkable lack of competitiveness in the market. In Fig. 7 is also shown that 17% of the world's copper comes from mines as a by-product, which increases the income of primary products, usually of gold, that the average cost of copper production is 1.450 US$/t, and that even 90% of world copper companies are currently working with a lower cost price of 4.000 US$/t, while the highest recorded level of operating costs in the world amounts to 5.950 US$/t.

8. CONCLUSION

The main problem that has for a long time burdened the position of copper production complex in Serbia is the low quality of mineable reserves of ore, increasing their depth and a large amount of excavation required to produce one ton of copper. Therefore, there is a very low level of its competitiveness with other companies in the world. From this point the recommendation is to make every effort to find out the possibility of lifting the quality of mineable reserves and reduce the burden on large amounts of excavation. This can be achieved by copper production complex carefull consideration of the already researched and partially prepared ore deposit "Borska Reka", which is unjustly neglected in the development strategy. The quality of its total and certified ore reserves is considerably higher than those included in development programs and is not burdened by large amounts of digs per ton of copper produced.

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ASSESSMENTFOR STRATEGY MANAGEMENT SUSTAINABILITY OF COPPER RESOURCES IN SERBIA

PROCENA ODRŽIVOSTI STRATEGIJE UPRAVLJANJA RESURSIMA BAKRA U SRBIJI

Branislav Mihajlovic, Ph. d., grad. min. eng.[2]

Abstract: *We are witnessing a dramatic global developments that are taking place parallel with the rapid growth of the population. The growing imbalance between the exponentially growing needs of human kind and limited natural resources imposes on the imperatives of the world to establish an overall balanced strategy for sustainable development in all spheres of human activity, and particularly in the management of non-renewable natural resources. In the "Mineral Resources Management Strategy of the Republic of Serbia until 2030 "[2], among other things, the complex of mining and refining of copper is being examined. In this paper, an overal insight is presented, followed by the professional assessment of this document's compatibility with the general principles of sustainable development on which the modern world science and practice is based.*
Key words: *strategy, concept, sustainability, technology, economy, ecology, improvement.*

Apstrakt: *Svedoci smo dramatičnih globalnih promena koje se dešavaju paralelno sa brzim rastom stanovništva. Sve veći debalans između eksponencijalno rastuće potrebe ljudi i ograničene količine prirodnih resursa nameće imperativ svetu za donošenjem strategije za uravnotežen održivi razvoj u svim sferama ljudskog delovanja, a posebno u upravljanju neobnovljivim prirodnim resursima. U „Strategiji upravljanja mineralnim resursima republike Srbije do 2030 godine“ , između ostalog se ispituje i eksploatacija i prerada bakra. U radu je predstavljen celokupan uvid, sledeći profesionalnu ocenu usklađenosti ovog dokumenta sa opštim principima održivog razvoja na kojima je baziran savremeni svet nauke i prakse.*
Ključne reči: *strategija, koncept, održivost, tehnologija, ekonomija, ekologija, poboljšanja.*

1. INTRODUCTION

The process of intensive mining and refining of copper in Serbia is in continuity for more than a hundred years. That long period is characterized by many different stages of development. In the first 80 years were evident both quantitative and qualitative indicators of manufacturing growth,while in the last 30 years stagnation and decline are recorded. Last few years efforts of the Serbian state are evident throughthe "Mineral Resources Management Strategy of the Republic of Serbia until 2030", in order to make a successful reconstruction and modernization of production capacities for copper production and processing from its own resources at the level of 80,000 t per year. Because of the importance and impact of the complex of copper mining and processing on the overall position of the Serbian economy, this work will be presenting a critical review of such a strategy designed to develop copper manufacturing and processing in Republic of Serbia.

[2] RBB Bor, Kestenova 8, banem8@hotmail.com

2. CURRENT DEVELOPMENT STRATEGY OF COPPER PRODUCTION IN SERBIA

The complex of copper production in the "Mineral Resources Management Strategy of the Republic of Serbia until 2030" can be analyzed from many different aspects, but in this work analyses and evaluations will be carried out by concentrating on the viability of such a planned development. From the aspect of sustainable development, its key elements are the following:

- Sustainability of the technological part of copper complex in the "Strategy", which is, in this case, divided into two subgroups:mining and processing structure, and mining is further divided into surface and underground exploitation,
- Economic viability of the copper production complex in the "Strategy" and
- Environmental sustainability of copper production complexes in the "Strategy".

Each of these units must itself have arguments for its viability, and all three parts must fit into a unic strategy for sustainable development. This paper will summarize whether and to what extent this document demonstrated the sustainability of development strategies mentioned earlier.

Sustainability of the technological part of development strategy

As stated above, the technological part of the „Strategy" is divided into two subgroups: mining and processing.

The sustainability of the current mining strategy for development

It is estimated in the "Strategy" substratesthat the production of copper should developedynamically and capacitive in accordance with the reconstruction of metallurgical facilities, as shown in the diagram below:

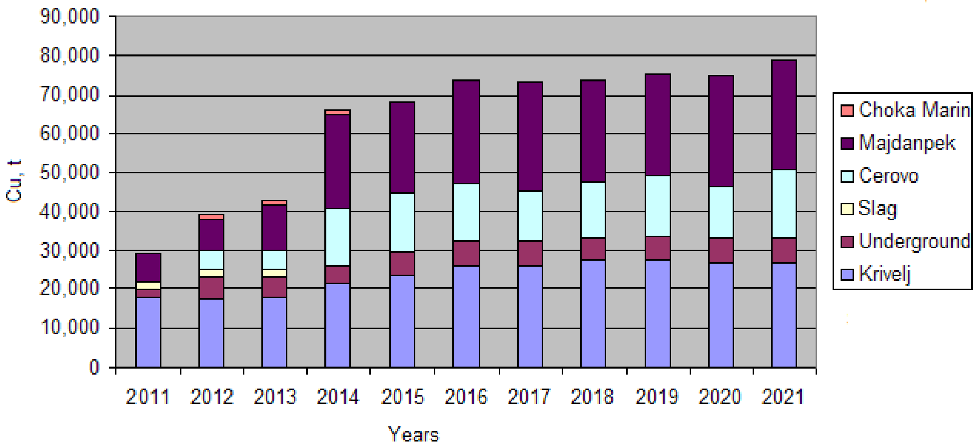

Fig. 1: Copper production according to the development documents on which the "Strategy" is based in the period 2011 – 2021. [2], [6]

In the above diagram, although it is not covered by the "Strategy", exploitation of RT "Choka Marin - 1" is added, since it is estimated that its exploitation should start by following the fast-track procedure.

Sustainability of copper open pit mining in Serbia

According to the development documents on which the "Strategy" is based, it is estimated that from the in total planned 715,753,350 t of excavations, 704,112,000 tons or 98.37% is to be recovered by open pit mining. Based on this information, it can be concluded that the mining part of the development strategy is based primarily on surface mining.

If the parameters for the aggregate surface mining are extracted from the development plans on which the "Strategy" is based, the following parameters are obtained, necessary for analysis and evaluation:

Excavations, t	704,112,000
Waste, t	454,812,000
Ore, t	249,300,000
Cu content in the wet ore,%	0.314
The amount of copper in ore, t	782,367
Dry concentrates -total, t	3,414,360
Cu in the concentrates - total, t	681,772
Au in the concentrate, kg	16,803
Ag in the concentrate, kg	102,897
Cu - cathode, t	662,797
Au - cathode, kg	15,291
Ag - cathode, kg	87,457

The following parameters are also needed for the evaluation:

- Projected prices, US$/t	Cu = 5,500 (global criteria)
US$/oz	Au = 1,050 (global criteria)
US$/oz	Ag = 15 (global criteria)
- Equivalent Cu, %	Cueq = 0.367(calculated)
- Tons of excavation / ton ore, t/t	2.824
- Tons of excavation / tonne Cu cathode,	1,062.334
- Cost per ton excavation, US$ /t	6,047 / t

Based on the above parameters, a preliminary analysis ismade together with the comparison of the development orientationsfor pit mining of copper in Serbia with those obtained worldwide and the result is shown in Fig. 2.

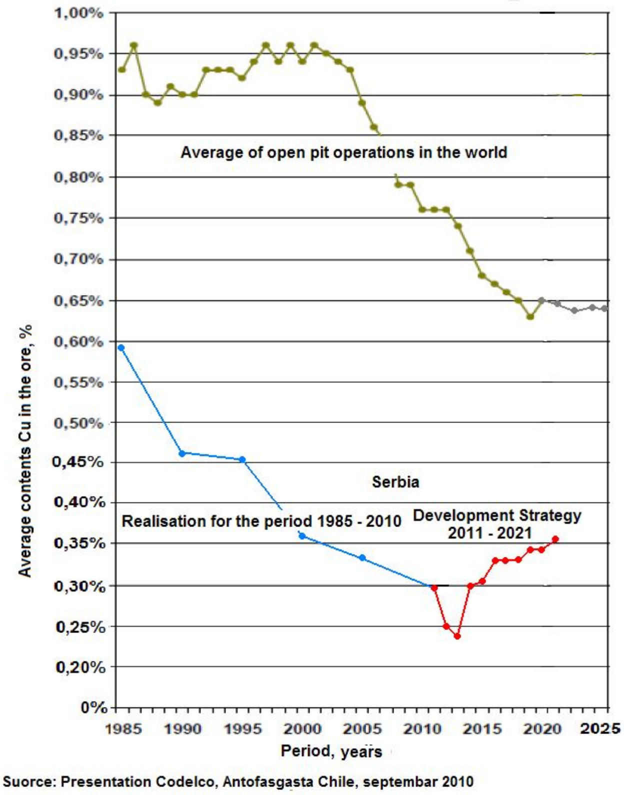

Fig. 2: Ratio of average copper content from surface mining in the world and in Serbia [1]

It is evident from the graphics that the average copper content from the pit mining in Serbia for a longer period is almost twice as lower than in other countries.

If one examinesin the same way the relationship between excavations per ton of copper produced in the world and in Serbia (see Fig. 3), it leads to the conclusion that, also in a very long period, it is needed to produce nearly twice as many excavations in Serbia than in the world, in order to produce one ton of copper. As a somewhat comforting circumstance, it should be noted that, according to projections, in the future this proportion will converge at the end of the development period will amount to 60% above the ones in the world.

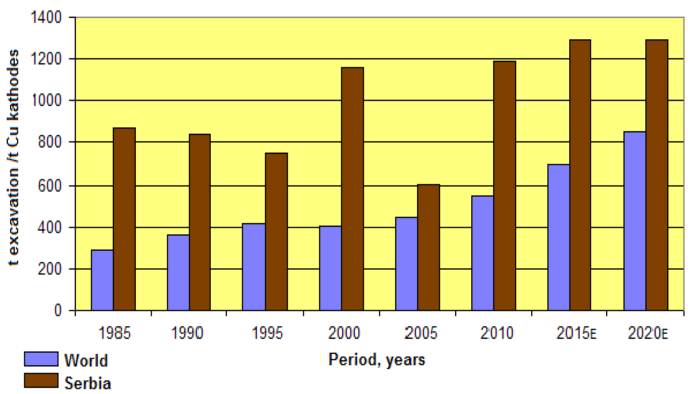

Fig. 3: Proportionbetween excavations per ton of copper produced in the world and in Serbia [2], [6]

The current average level of excavation costs per ton in the world is about 6 US$/t, while in Serbia 6.86 US$/t. The projections of future production in the world is calculated with the level of 5 to 6 US$/t, and in Serbia with 6,047 US$/t. This proportion clearly shows that the projected excavation cost per ton in Serbia is to move at the world level to a maximum of 20% above the world.

If we gather the effects arising from differences in the content, the quantity of excavation per ton of copper and the excavation cost per ton, it will result in a common aggregate benchmark which states that the cost of producing a ton of copper obtained by surface mining in Serbiais approximately twice as higher than the world.

All the things mentioned above make it clear that there is a very low level of sustainability of current strategies for copper pit mining in Serbia.

The sustainability of underground mining of copper in Serbia

As stated above, according to the development documentson which the "Strategy" is based,the projected total quantityof excavations, underground mining gets only 1.63%, while in the total quantity of produced copper participates with 8.64% (thanks to the participation of rich ore). This implies that the long-term development considerations of copper production in Serbia underground mining is unduly neglected. All around the world there is a present tendency for the percentage increase of copper production from underground mines in total production. The projections estimate that the amount of copper obtained by surface and underground mining is going to be equal by the year 2018. So, in pursuit of profit, international companies are shifting from the surface to underground exploitation. This trend has obviously not yet reached Serbia, although the conditions were created two decades ago. Therefore, the issue of sustainability development strategy for underground mining of copper in Serbia must be given much more importance than it is done in the "Strategy".

If the projected average copper content of the underground exploitation is extracted from the development plans on which the "Strategy" is based, we will get a diagram as shown below:

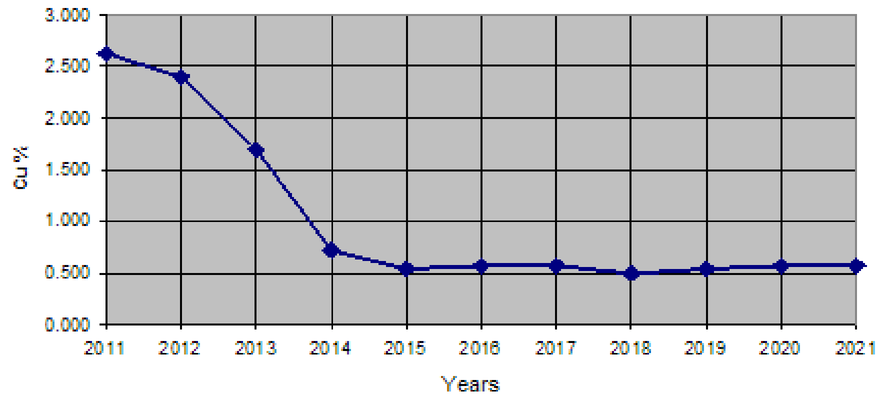

Fig. 4: Average projected content of copper from underground mines in Serbia [2], [6]

If we analyze the projected average cost of copper production from underground mines we will get a diagram as shown below:

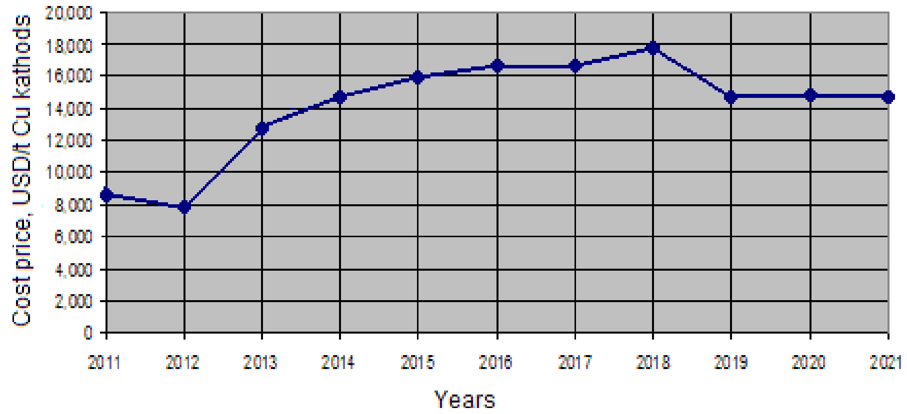

Fig. 5: Average projected cost of copper production from underground mines [2], [6]

If one looks at the projections on the graphics in Fig. 5, it becomes needless to comment on the viability of underground mining of copper in Serbia according to the concept of the "Strategy". As noted above, the main motivation for the work of a mine is the realization of profit from such work, and that profit does not exist here.

Sustainability of copper processing in Serbia

In the development plans on which the "Strategy" is based, especially in the part related to copper, two statements are given:

1. The reconstruction and modernization of facilities for melting starting from the year 2014 will enable the production of 80.000 t of copper cathode per year and
2. Mine copper production was seen in three possible outcome:

- Optimistic, with a capacity of 70,000 t/yearof copper cathodes,
- Realistic, with a capacity of 60,000 t/year of copper cathodes and
- Pessimistic with a capacity of 40,000 t/year of copper cathodes.

The thing that immediately strike usis inconsistency of these two statements, which entails the need to ask two questions:

1. Why to build a smelter with a capacity that in no possible way any mine will be able to meet?
2. Who and with what assets is going to buy the concentrate inorder to cover the imbalance? The complex of copper production itself will not be able to do it. If it goes to the option to cover this imbalance through melting service, loss on that basis will vary, depending on market conditions, from a few million to ten million US$ per year.

Solving the problem of imbalance between the production capacity of mining and metallurgical processing capacity should be given maximum attention.

The sustainability of the economic part of the "Strategy"

As stated above, the question of economic viability of each mining program is of fundamental importance for the fate of the company. It is common in the world for the mining industry to calculate the projection of future production with a minimum IRR of 15%. This means that the average realized price of copper production cost in the world rises from 3,000 US$/t (in 2011) through development insights (taking into account the risk) to the level of 5,500 US$/t. In such circumstances, the world's largest copper producing companies estimated to have provided a good strategic position in the market. In the development plans,on which the "Strategy" is based,it is calculated that a minimum price of copper on the market varies from 8,000 to 8,500 US$/t.

If you look at the economic conditions that made the "Strategy", we must have in mind the following:

- Amount of debt for the production of copper complexes at the end of the year 2011 is 980 million US$,
- Amount of the investment cycle in the period 2011– 2019 reaches 619 million US$,
- Projected copper content in the development documents on which the "Strategy" is based is twice as lower than the content with which mining companies in the world enter new projects,
- The quantity of excavation per ton of copper cathode produced is almost twice as higher than the world,
- Projected prices of copper on the world market on which the "Strategy" is made, is more than 8.000US$/t, while companies in the world are counting with the cost of 5.500 US$/t and
- The "Strategy" does not include possible risks and is not made on the basis of modern strategic planning, as it works in other companies in the world.

The observations stated above indicate a very low level of economic viability of the "Strategy". The risks that existin its implementation are impermissibly high.

Ecological sustainability of the "Strategy"

Industry production and refining of copper by its nature and character is one of the biggest polluters. Mineral resources are reducing and getting poorer every day, with steady growth of environmental damage. Therefore, in recent decades, environmental sustainability aspects of mining production have taken imperative importance.

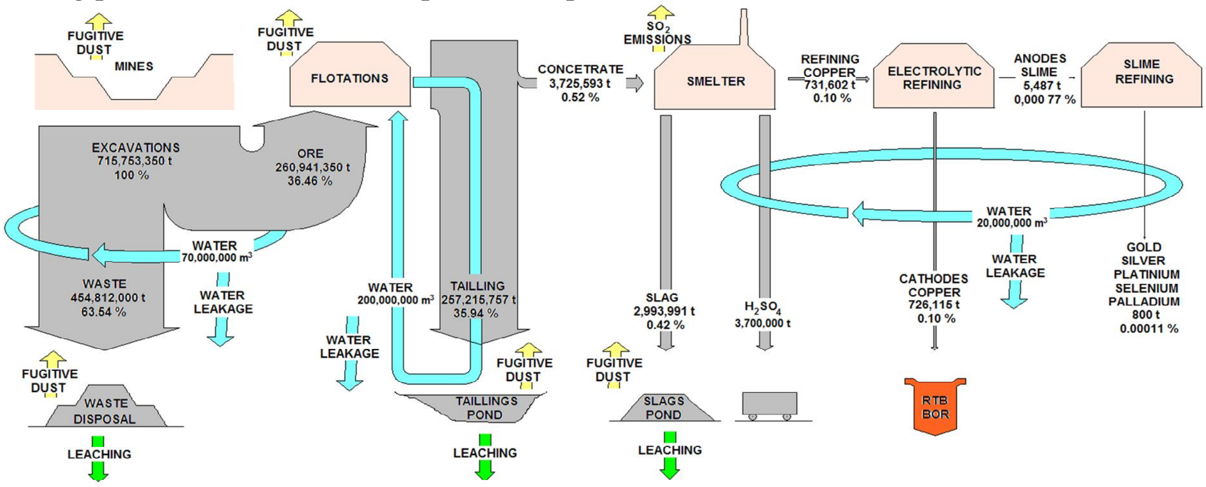

Fig. 6: The mass flows in the production and processing of copper in Serbia according to the development documents on which the "Strategy" is based [2], [6]

A part of the "Strategy" which is referring to the resolvment of the issue of environmental sustainability in the mining area (mines and flotation) is very poorly explained. In the part related to metallurgical processing, it should be expected that the implementation of smelter reconstruction and modernization could signficantly contribute to reducing pollution from metallurgical plants, and that is good.

However, in this paper we would like to point out the environmental damages caused by mine activities. The enormous amounts of waste stripping that occur at surface mines will have to be permanently disposed of in specified landfills. The same goes for the flotation tailingsand smelter slag. Fig. 6 gives a graphical representation of the mass movement that will be produced by excavation and further treatment.

With the graphics in Fig. 6 it is shown that only 1 % of the total amount of excavation is valorized through copper. The other 99 % remains as waste in landfills around the mine and smelter. One should know that in the world for the same quantity of copper only a half of that amount of waste is produced. This knowledge should be used again as a guideline to illuminate and examine the ecological sustainability of the "Strategy".

3. CONCLUSION

The strategy for development of copper production in Serbia, which is given in "Mineral Resources Management Strategy of the Republic of Serbia until 2030"[1] has, in general, a very low level of sustainability. Each component of the strategy, technological - in mining and processing, as well as economic and environmental are at a low level of sustainability. Risks to successful implementation of strategic objectives set out in it are extreme, even unacceptably high. Therefore, raising the level of sustainability development strategy is a crucial question on whose solution depends the continued existence of copper production complexes in Serbia.

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THE VALORIZATION IMPACT, SOURCES AND TREATMENT OF NON FERROUS SECONDARY RAW MATERIALS

ZNAČAJ VALORIZACIJE, IZVORI NASTAJANJA I PRERADA SEKUNDARNIH SIROVINA OBOJENIH METALA

Miroslav Sokić*, Branislav Marković, Vladislav Matković, Zvonko Gulišija, Aleksandra Patarić

Institute for Technology of Nuclear and other Mineral Raw Materials, Franše d'Eperea 86, Belgrade, Serbia,
*m.sokic@itnms.ac.rs

Abstract: *Production of non ferrous metals from secondary raw materials is far less costly than its production from primary raw materials, due to lower energy consumption. Besides, by recycling of non ferrous metals from secondary raw materials, the natural resources are saved and the amount of waste materials is reduced, directly protecting the environment. The secondary raw materials can originate in metal production and treatment, accompanied by their incorporation into the final product and its elimination due to amortization. The different methods of preparation and metallurgical treatment are used depending on secondary raw materials type. Some of them are very easy to be recycled by remelting in metallurgical furnace, while others must pass through complicated preparation before metallurgical treatment.*
Keywords*: non ferrous secondary raw metals, sources and recycling*

Apstrakt: *Proizvodnja obojenih metala iz sekundarnih sirovina daleko je jeftinija od njihove proizvodnje iz primarnih sirovina, prvenstveno zbog manje potrošnje energije. Pored toga, reciklažom obojenih metala iz sekundarnih sirovina racionalnije se koriste prirodni resursi i smanjuje količina otpadnih materijala, čime se direktno štiti životna sredina. Sekundarne sirovine obojenih metala nastaju u procesu proizvodnje i prerade metala do njihove ugradnje u gotove priozvode i izbacivanjem tih proizvoda iz upotrebe usled njihove dotrajalosti ili tehnološke zastarelosti. U zavisnosti od vrste sekundarne sirovine, koriste se različiti postupci pripreme i metalurške prerade. Pojedine se veoma jednostavno recikliraju pretapanjem u metalurškim agregatima, dok druge moraju proći komplikovane operacije pripreme pre metalurške prerade.*
Ključne reči*: sekundarne sirovine obojenih metala, izvori nastajanja, reciklaža*

1. INTRODUCTION

The environmental protection is one of the major problems of our planet. Therefore it is necessary to take care of natural resources rationally using, which can be achieved by intensive use of secondary raw materials. [1]:

Intensive technological development has imposed several problems including:
- -rapid consumption and depletion of primary resources,
- -increased energy consumption,
- -progressive environmental pollution.

Thus, the industry gives more importance to "internal reserves" or secondary raw materials, investing in research about the possibility of their processing into useful products.

2. THE VALORIZATION IMPORTANCE OF NON FERROUS SECONDARY RAW MATERIALS

Importance of use non-ferrous secondary raw materials is reflected in the economic effects through the preservation of primary resources, increasing production of goods produced completely or mainly by secondary raw materials, increasing the employment capacity of the processing secondary raw materials, energy savings and prevent environmental pollution.

The reserves of non–ferrous metals are reduced due to the longtime exploitation. Table 1 shows the estimate duration of some metals without recycling, based on the amount of ore deposits [2-3]. At the same time, obtaining metals and concentrates from ores becomes more expensive due to lower metal content. The intensive industrial development in recent decades, leads to continual growth of the metal use, resulting in constant growth of the amount of secondary raw non ferrous materials This is clear, if we take into account the fact that the production of non ferrous metals increased 1,77 times in the period 1980-2005 years [4-5]. At the same time the production of non ferrous metals from secondary raw materials increased 1,72 times for twenty five years. The proportion of non-ferrous metals produced from secondary raw materials in the total production of non ferrous metals in the world is approximately 20%., while in developed countries is about 35%.

Table 1. Estimated duration of some raw materials without recycling, energy requirements and recycling rate of some materials

<table>
<tr><td>Metal</td><td>Rezerves (million tons)</td><td>Annual consumption (million tons)</td><td>Duration without recycling (annual)</td></tr>
<tr><td>Fe</td><td>93 600,00</td><td>500,00</td><td>190</td></tr>
<tr><td>Ni</td><td>100,00</td><td>0,78</td><td>105</td></tr>
<tr><td>Al</td><td>6 000,00</td><td>16,01</td><td>375</td></tr>
<tr><td>Mg</td><td>1 410,00</td><td>0,31</td><td>4 503</td></tr>
<tr><td>Cu</td><td>1 200,08</td><td>9,83</td><td>56</td></tr>
<tr><td>Zn</td><td>241,02</td><td>6,33</td><td>38</td></tr>
<tr><td>Pb</td><td>156,70</td><td>-</td><td>29</td></tr>
<tr><td>Sn</td><td>-</td><td>-</td><td>14</td></tr>
<tr><td rowspan="2">Material</td><td colspan="3">Required energy for production(MJ kg^{-1})</td></tr>
<tr><td colspan="2">The primary raw materials</td><td>The secondary raw materials</td></tr>
<tr><td>Al</td><td colspan="2">140</td><td>14</td></tr>
<tr><td>Cu</td><td colspan="2">75</td><td>19</td></tr>
<tr><td>Sn</td><td colspan="2">30</td><td>18-20</td></tr>
</table>

The recycling degree of platinum metals is about 85% which is reasonable due to their high cost. The most important application of platinum metals is in automobile catalysts. Their consumption for this purpose ranged from 11,4t in 1975., up to 67t in 1990. and 93t in 2000. years.

The use of secondary resources is of great importance which is reflected in protection resources and environment, lower costs processing and relatively small investments. Thus the production costs of some metals from secondary raw materials is to 10 times lower than the production from the same ore, due to less fuel and electricity consumption. Energy consumption for obtaining metals from secondary raw materials is about 13 GJ / t for aluminum, magnesium and lead and 19GJ / t for copper and zinc. The energy savings is greater if the required energy to obtain one tone of metal from ore is higher. The required energy to obtain one ton of aluminum from primary raw materials is adequate for obtaining 23 tones aluminum from secondary raw materials. Similarly, the required energy to obtain one tone of primary cooper is adequate to obtain about 4,5 tones of secondary copper.

3. SOURCES OF NON FERROUS SECONDARY RAW METALS

Depend on the site and way of origin, the secondary raw materials of non-ferrous and rare metals can be divided into three main groups:

a) the secondary raw materials that are in extractive metallurgy occur as secondary products, mainly in the treatment polymetallic ores and concentrates. They can have a high commercial value due to their composition.
b) the secondary raw materials originating in metal processing and some other industry branches (mechanical, electrical, electronic, chemical, military, etc)
c) the secondary raw materials in the form of amortized machine, apparatus, devices and their parts (cars, household appliances, structural construction, aircraft, tools and industry equipment etc).

The secondary raw materials from the first group are not recycled and they are being disposed at damp sites. Rarely, some of them are the raw materials from other branches of metallurgy. The raw materials disposed at damp site are the biggest environmental polluters. For this reason, their valorization is great challenge, especially if it is known the fact that they often have a high content of non-ferrous, precious and rare metals. Secondary raw materials of non-ferrous metals from the second and third group are mostly recycled. Method of their treatment depends on pollution degree. Some of them are very easy to recycle by melting in metallurgical aggregates (waste and scrap in foundries and rolling mills), while others (mainly depreciation waste) must pass a complicated preparation before metallurgical treatment.

3.1. COOPER SECONDARY RAW MATERIALS

Copper is a metal that has a wide application so the quality of copper secondary raw materials varies in wide range considering size and composition. High-quality copper waste contains not more than 3% impurities. Low quality waste, according to our research, besides copper (7-50%), lead (3-6%), zinc (3-65%) and tin (2-5%) contains other elements and compounds in small concentrations. It consists of metallic and non-metallic parts. Non metallic part (which consist of Cu, Zn, Fe, Si oxides, chloride and petrogene minerals), is in the highest percentage represented in low size fraction below 1,5mm. This size fraction contains 60-90% non-metallic parts, depending on the waste type. The metal part consists of small particles of copper, brass and bronze.

The most important cooper secondary raw materials are:

-Copper metal waste, which originated in the copper and copper alloys production and treatment.
-Used cables, wires, sheets, etc..
-Dross, chips and dust from the cathode copper, copper alloy and especially brass treatment
-Amortized products from military industry, municipal activity etc.

In addition, copper secondary raw materials originating like intermediate product in the extractive metallurgy of lead and zinc.

- intermediate product lead metallurgy (copper stone)
- intermediate product zinc metallurgy (cooper sludge)

The different methods of preparation and metallurgical treatment are used depending on secondary raw materials type.
Waste rich in copper can be remelted and refine in the metallurgical furnaces without prior preparation. The copper conductor preparation includes cutting, crushing, an air separation and sieving in order to separating the copper from the insulation. The brass dross is being grounded and by the process of gray or wet separation separates the metal from the oxide components [7]. The preparing chips process is more complicated and consists of sorting, sieving, degreasing, magnetic separation, and briquetting. Complete preparation affect the quality of metallurgical treatment and product quality.

For metallurgical treatment of prepared raw materials in order to obtaining copper and copper alloys the shaft, flaming and short-tumble furnaces, converters and electric furnaces (electro-resistance, electric-arc and induction furnaces) are used.

3.2. ZINC SECONDARY RAW MATERIALS

Zinc is a metal with wide application and therefore the different composition and form of zinc waste is generated. Considering the basic characteristics and type of treatment, the zinc secondary waste materials and its alloys can be classified into two main groups [1,8-9].

- zinc metal and zinc alloy waste and
- zinc residues (dross and dust).

The metal zinc and zinc alloy waste include the waste from zinc and zinc alloy treatment, zinc scrap from zincography, hard zinc and zinc alloy chips. This kind of waste can be in form of metal or fragments. Waste resulting from production of zinc sheets, wire and castings are pure waste. The impurities content is up to 1%.

The main impurity in hard zinc is iron with content up to7%. Besides, lead and aluminum appears as impurities too.

Wastes originating in zinc alloy treatment content minimum 88% Zn. Maximum content of aluminum is 10%, copper 3% and can also content other impurities.

The composition of zinc alloy chips is similar to waste generated by zinc alloy treatment resulting from their mechanical process. Zinc remains are mainly dross, dust where the zinc is in zinc oxide form. The low zinc content is characteristic for amortized waste so it is usually treated in ferrous metallurgy plants. The different method of technological process are used depending on raw material type.The Waelz-process is the major process for treating a wide range of zinc raw materials such as dust from electric-arc furnace, sludge, mud [10].

Obtained zinc oxide is being further treatment by hydrometallurgical process. Zinc recovery degree from raw materials in Waelz process exceed 95%. The zinc and zinc alloy waste treatment can be carried out by melting in flaming or induction furnace with composition correction depending on the alloy type. Zinc recovery degree is about 90%.

Zinc and brass dross content zinc in elementary or oxide form [7]. Their separation carried out by grinding and sieving. Coarse, mostly metal phase contains 90-98% of metals, is being directly remelted obtaining zinc and brass. Small, mostly oxide phase is being treatment by hydrometallurgical process for zinc valorization in zinc-sulphate or zinc-chloride form.

3.3 LEAD SECONDARY RAW MATERIALS

The most important lead secondary raw materials are spent lead catalysts. The fact that 60-70% of the total lead world production are used in production of catalysts witch service life is short, indicate that they are the dominant lead waste. For lead regeneration in the usa are being collected about 85% spent catalysts, while in Italy, Germany and Japan, over 90%.

There are many others lead secondary raw materials such as lead pipes, cables, plates, printing industry alloy, parts of machines and devices from chemical and military industries, etc. Industrial waste originated in catalyst factory (faulty catalysts, different scrap types, intermediate products, etc.) is also one part of waste.

Catalysts waste is a heterogeneous raw material consisting of metallic lead, lead alloys, lead oxide, lead sulfate, polypropylene, acid, etc. [11].

The oldest way of catalyst waste treatment is direct melting. Direct melting is carried out in shaft furnaces, electrical furnace and short drum furnace nowadays. The essence of these process is to melted metal component, reduced oxide to metal, and converted sulphate to sulfide. During the melting process PVC-separators are being burning so the gases content dust with high chlorine content which is the biggest disadvantage.

The contemporary methods of catalyst waste treatment include separation process before its treatment in metallurgical aggregates. They include crashing and separation of different components that are parts of catalyst. Lead mud separates by sieving, while lead separation from plastic is carried out with hydro-separation in high density liquids. The separation products are metal fraction, lead mud and crashed boxes with separators. Metallic lead and lead mud is being treatment in short drum furnace with reducing agent and welding flux addition.

There are many developed catalyst waste separation process using hydro-separation in high density liquids, but the technologies of Italian company „Engitek Impianti SpA" and of American company "MAIndustries Inc." are the most contemporary.

The technological process "Engitek Impianti" [12] consists of four completed units. The first stage is grinding and hydroseparation which old catalyst first crushed and then the catalyst components separated by washing with water at vibration grid, hydrodynamic and hydrostatic separator. The filtered electrolyte with 15-25 wt.% H_2SO_4, lead separated part, filtered lead mud, filtered polypropylene and plastics are obtained as a result of this stage.

The second stage is lead mud desulfuration with sodium carbonate. In this way besides, obtained Na_2SO_4, the free sulfuric acid is neutralized and environmental protection is resolved.

The third stage treatment includes melting and refining of desulfurated lead mud and of metallic lead in order to obtain secondary refined lead or lead alloys.

The fourth stage is crushed polypropylene treatment obtained in the first stage, where the final product is polypropylene granules.

3.4 NICKEL SECONDARY RAW MATERIALS

The largest part of produced nickel is used for alloying and steel production so the steel waste present the most important nickel secondary raw material. It is usually directly remelted to ferro-nickel with composition correction or being used for alloying in ferrous metallurgy [13].

Besides the ferrous metallurgy, the most important of nickel raw materials are spend Ni-Cd catalyst and byproduct of their production, spent catalysts from the chemical and petrochemical industries, waste solutions from galvanization process and others.

Technology treatment of Ni-Cd catalyst consists of catalyst preparation, positive catalyst block treatment to ferronickel or nickel sulfate and negative block treatment to cadmium or cadmium oxide [14].

The process of pyrometallurgical treatment of a positive block is based on melting in electric arc furnaces. It is obtained ferronickel with about 25% of nickel and with recovery degree of 92% nickel.

The hydrometallurgical treatment based on dissolving nickel powder in sulfuric acid and its crystallization in nickel sulfate form with prior solution purifying of iron.

In the production of positive Ni-Cd catalyst block as a byproduct the nickel-graphite powder was obtained, with 35-40% of nickel [15]. It is being treated by hydrometallurgical two stages leaching with sulfuric acid solution. The graphite powder and solution from which nickel sulfate crystallized are obtained after filtering. The recrystallization is necessary due to the high content of cadmium and iron, which reduced the recovery degree below 85%.The spent nickel catalysts are also suitable for hydrometallurgical treatment [16].

At first, they are being washed with water, then two-stages leaching with sulfuric acid was carried out, following by filtrating and crystallization of nickel sulfate. The valorization degree of nickel in two stages leaching process is about 90%.

3.5. TIN SECONDARY RAW MATERIALS

The most important tin secondary raw materials are: [17]:

- tinplate, tin plated can, tin foils,
- tin dross,
- tin mud, sponge and dust from tin plate industry,
- lead-tin alloys,
- lead-tin dross etc.

The main raw materials for tin regeneration are waste tinplate from industry and packaging production. Amortized packaging waste (old tin cans, etc...) represents an important raw material but its collection and preparation is complicated, which can significantly affect the treatment economic effects.

The tin plate waste preparation is sample due to easy collection and their low contamination. The metal packaging preparation is more complicated and include a number of technological operations, such as: collecting, sorting, washing, crushing, degreasing, and others.
The chlorination process, electrolytic dissolution, precipitation, alkaline leaching and electrolysis are used for tin regeneration from waste tinplate [17]. The chlorination process is rarely used because of gaseous chlorine application. The firs applied process for separation tin from tinplate is electrolytic dissolution and precipitation. The high tin content in processed waste and lower purity of obtained tin are disadvantages of this process. The advantage is simple apparatus, because the electrolytic dissolution and precipitation carried out in the same aggregate.

The alkaline leaching and electrolytic precipitation processes are the most contemporary and applied. High purity tin and processed waste with relatively high recovery degree are obtained by its application. The process can be carried out continuous and discontinuous, with plant flexibility of capacity aspects. The used tin cans can be introduced in the process with adequate preparation.

The treatment process of tin dross, mud and sponges which originated as byproduct in the tinplate production process, based on reduction melting and refining obtained raw tin [17]. By its application, the high purity tin suitable for making easily soluble alloys is obtained.

4. CONCLUSION

The generated non ferrous raw secondary metals increased due to the continuous growth of non-ferrous metals production and consumption. The amount increase of non ferrous production and amortized waste on one side and simultaneous reduction of rich ore deposits on the other side indicates the grate importance of secondary raw materials as a resource. The importance of secondary resources using, besides environmental protection, is in the low-cost treatment due to less fuel and electricity consumption and small investments.

The utilization efficiency of secondary raw materials depends not only on their collecting plan by forms and types, but also on their preparation and further metallurgical treatment. For these reasons, the organization, technologies and needed equipment for collection, preparation and secondary raw materials treatment were intensively improved in recent years, so the maximum attention should be given to this problem.

ACKNOWLEDGEMENT

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SOURCES AND BALANCING OF COPPER SECONDARY RAW MATERILAS

IZVORI NASTAJANJA I BILANSIRANJE SEKUNDARNIH SIROVINA BAKRA

Miroslav Sokić[1]*, Zvonko Gulišija[1], Ilija Ilić[2], Marija Mihailović[1], Nada Štrbac[3]

[1] *Institute for Technology of Nuclear and other Mineral Raw Materials, Belgrade, Serbia, *m.sokic@itnms.ac.rs*
[2] *University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia*
[3] *University of Belgrade, Technical Faculty in Bor, Bor, Serbia*

Abstract: *The use of copper secondary raw materials is important to slow down the consumption of primary resources, environment protection and energy saving. Widespread copper application caused the formation of copper secondary raw materials, different in grade and shape. Depending on the site of origin, the three major groups of the copper secondary raw materials are covered here: own or circulating scrap, process scrap - generated during machining and finishing, as well as amortization scrap. The balancing model of the totally generated copper secondary raw materials is presented here, representing the sum of the own/circulating waste, scrap and amortization waste.*
Keywords*: copper secondary raw materilas, sources, balansing*

Apstrakt: *Važnost korišćenja sekundarnih sirovina bakra značajna je zbog sporije potrošnje primarnih resursa, zaštite životne sredine i manje potrošnje energije. Široka primena bakra uslovljava pojavu sekundarnih sirovina bakra različitog sastava i oblika U zavisnosti od mesta nastajanja, obrađene su tri velike grupe sekundarnih sirovina bakra: vlastiti ili recirkulacioni, otpadak pri obradi i amortizacioni otpadak. Predstavljen je model bilansiranja ukupno nastalih sekundarnih sirovina bakra i predstavlja prost zbir parcijalnih bilansa vlastitog otpatka, otpatka pri obradi i amortizacionog otpatka.*
Ključne reči*: sekundarne sirovine bakra, izvori nastajanja, bilansiranje*

1. INTRODUCTION

Comparing with the non-ferrous metals production with primary raw materials, the production that uses secondary raw materials has several advantages, among which the most important are the following [1]:

- reduced consumption of non-renewable mineral resources;
- less energy consumption;
- reduction of environmental pollution;
- reduced investments, etc.

The intensive industrial development in the last few decades has led to the growth of the metal consumption, resulting in a constant growth of the amount of non-ferrous metals secondary raw materials. This is understandable if the fact that the production of non-ferrous metals continually grows is taken into account, and that in period of 1980-2005 it has increased by 1.77 times, with a total copper production increased by 1.73 times [2-3]. At the same time, the production that uses secondary raw materials developed and for twenty-five years period increased by 1.72 times.

The importance of use of secondary resources, in addition to protecting resources and environment, is that processing costs are decreased and investments are relatively small. Thus, the production costs of certain metals from secondary raw materials are up to 10 times lower than the production from the ores, primarily due to lower fuel and electricity consumption.

Preparation and treatment of metallic secondary raw materials are basic operations that provide waste prepared for metallurgical processing and obtaining finished products. The utilization efficiency of secondary raw materials depends not only on the organizing of collecting by the forms and types, but also on preparation and further metallurgical processing.

The treatment of exactly classified and properly prepared secondary raw materials requires less energy, while the irreversible energy losses are lower. Energy efficiency depends on the proper choice of furnaces for melting and alloying, as well.

Interconnection between the raw materials, environment and energy is illustrated in Figure 1 [4]. It is known that metals or alloys obtaining requires the energy consumption, and thereby the chemical reactions products pollute the environment. In that way, the production of metallic materials induces the interconnected impacts of raw materials, energy and environment.

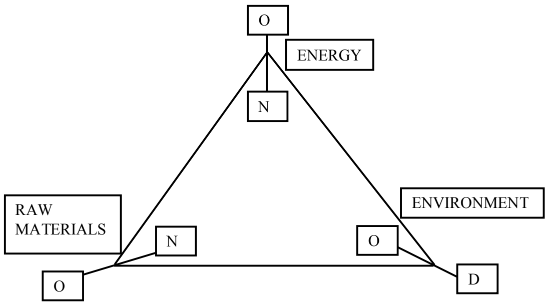

Figure 1. Interconnection between the raw materials, environment and energy:
O-opportunities, N- needs, D- demands

At the angles of raw materials and energy the equilibrium is established between needs and opportunities, while at the angle of environment the equilibrium is established between demands and opportunities.

In this sense, it is necessary to achieve the optimal relationship between these parameters, in order to realize the maximum requirements in terms of exploitation of raw materials, energy consumption and environmental protection.

2. SOURCES OF THE COPPER SECONDARY RAW MATERIALS

Widespread application of copper influences the generating of copper waste different in composition and shape (drosses, cinder, dust, chippings, plates, wires, pipes, castings, cable endings, electromotor turnings etc.). Besides the copper, the copper waste contains other elements (lead, zinc, tin, etc.). This is the reason why the scrap classifying is very important, making easier the quality control and making the treatment more efficient.

Waste generated in the production and treatment of copper or generated as production rejects is called *process scrap* (or new scrap). Process scrap generated in the production and treatment of copper is called *circulating (own) scrap*, while the waste generated during machining and finishing is called *machining scrap.* The other large group of wastes is represent by *amortized scrap (or collecting scrap*), generated after obsolescence products containing copper, either due to amortization or technological obsolescence. The quantity of *circulating scrap and process scrap* depends on the technology of copper production and treatment. The technological advance enabled the direct copper exploitation in the process, while still growing amount of waste due to the constant growth of copper production. The amount of *amortization scrap* is increased year by year and it depends on the amount of copper disposable, i.e. on the amount of metal used and the structure of copper products.

Basic sources of copper wastes generating (Fig. 2) are: 1- copper and copper-alloys production, 2- copper and copper-alloys treatment, 3-amortization of copper containing products.

Copper process scrap or industrial scrap can be generated at:

- metals and alloys production (drosses, sintered materials, dusts),
- rolling (cuts, swarfs, chippings),
- casting (feeders, dust, drosses),
- mechanical treatment of castings, pressure forming products, forgings (cut-offs, chippings),
- cables and conductors production (wire cut-offs).

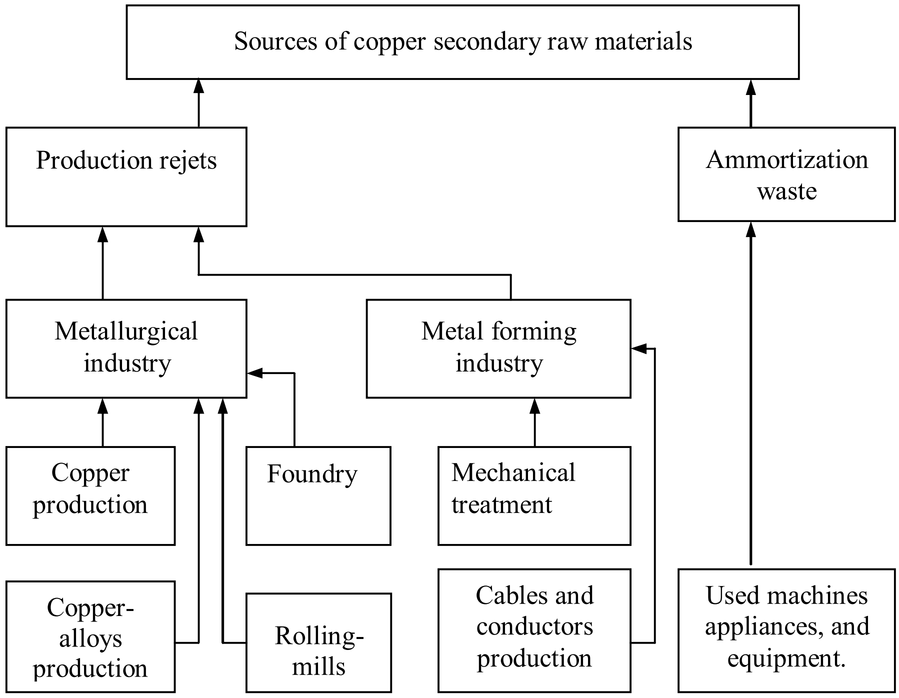

Figure 2. Technological flow-sheet of copper secondary raw materials generating

After the end-of-life, the assets and consumer goods are being disused. This kind of scrap is *amortization scrap* or old scrap, contained in:

- road vehicles,
- rail vehicles,
- agricultural machinery,
- household appliances,
- transformers,
- generators
- cables and conductors,
- foundry products
- telecommunication devices etc.

Copper scrap, after preparation, is being reused in different stages of metallurgical process. Foundry scrap is being returned to casting process at most, while some part of it goes to the smelters. Metal forming scrap remains in rolling mills. Copper scrap, such as process scrap and used products, have a commercial character and it is used in companies for the processing of copper, where is being remelted and turned to rolling, forming and drawing again.

In terms of copper scrap, it is usually meant the commercial grade copper scrap, excluding the circular scrap generated in the copper forming company. Certain amounts of copper scrap generated in production process can be also treated as a commercial scrap (wires, cables, pipes).

In copper wires factory, there is a noteworthy amount of copper chippings that should be remelted. However, because of the difficulties in preparation, influencing the furnaces operating slow-down, it can not be remelted completely, so the part of it is being sold on the market.

Copper waste generated in cables production undergoes to firing and the product is so called burnt copper wire, which belongs to a group of high-quality scrap. This wire can not be remelted for the new wire manufacturing, because of the possibility of wire quality deterioration, but can be used in foundries and smelters of copper and copper alloys.

Copper pipes scrap is being generated in the amount of 25-30% of pipes production and can be used in roll mills for billets Ms-63 or Ms-58 production, or for some other products requiring the raw material of better grade. This kind of scrap can also be found in markets, but because of the high quality it is not recognized as copper waste.

Telecommunication companies and networking, as well as railway companies are major producers of copper scrap, because the installations are being continuously changed due to obsolescence and modernization. The old buildings reconstruction or demolition can also be the source of noteworthy amount of copper wires and roof plates.

Foundries are another source of copper raw materials. Depending on the foundry type, the organizational structure, type, quality, range of production and many other factors, the waste can be recurrent and the one that appears on the market. Foundry drosses can also be at the market.From the above it is clear that the copper scrap classification is the crucial for proper evaluation and processing of copper scrap.

3. BALANCING OF THE COPPER SECONDARY RAW MATERIALS

The methods of mathematical statistics are used for the copper wastes quantity assessment. The level of the statistical analysis depends entirely on the amount and accuracy of the information available, referring to the production process.

Based on the statistical data concerning the copper wastes quantity, copper production and consumption, import and export of copper cathodes, intermediate products and finished products, and using mathematical statistics, a conclusion can be derived about the flow and amount of copper scrap in the past and predict the amount of waste in the future.

To forecast origination of copper scrap, the balance method for estimating copper wastes can be used. It is based on balancing the metal production and consumption in the companies [5-6]. This method is developed from the general model for iron and steel scrap estimation [7-10]. The metal amount during the production process, contained in incoming raw materials, various materials and intermediate products, must be equal to the metal amount contained in finished products, wastes and irreversible losses. Balancing of the totally generated waste consists of the sum of partial balances of circulating waste, process scrap and amortization scrap.

Circulating scrap is not a cumulative one, because it is being immediately spent. Process scrap can be partially cumulative, up to one year of accumulation, while the amortization scrap is wholly cumulative.

Fundamental for balancing the current disposable amount of the total waste and generation of the copper waste in the future is balancing the waste in the past. This aims to determine the course of the circulating scrap generation coefficient (K^R) and the process scrap generation coefficient (K^O). Based on KR and KO values, it can be determined the current disposable amounts, and using extrapolation method to determine the expected values in the future.

In determining the coefficients, besides the extrapolation, the forthcoming changes and trends in modernization of production, changes in technology and manufacturing, must be taken into account.

The amortization scrap amount depends on the equipment operating life, as well as on the changes of regulating acts imposed by companies, concerning replacing and repairing of equipment.

The starting values for the amount of amortization scrap generation assess are the data on the copper production, being the most reliable for the copper consumption determining. For the assessment, the time of return (Vp) and copper revaluation degree (η_r) are of great importance [11]. Amortized waste is the most complex for assess because of a number of contributing factors and weaker ability to reliably identify and test the mean time of return and revaluation degree.

The assessment of circulation scrap and processing scrap depends on the forecasts reliability of future production and consumption of copper. Amortization scrap forecast depends on the assessment of the total copper amount and its structure in recent years. The quantity of amortization scrap in the observed year is affected by the current production of finished proucts in that year, but just for products where the return time is less than one year.

Balance method for copper waste determination is one of the most reliable, but quite difficult due to the necessity of using plenty of information from very different sources.

Total amount of copper scrap generated in one year in all sites of formation is equal to the sum of all partial amounts at the individual sources of generation:

$$O_u = \sum_{j=1}^{l} O_j \tag{1}$$

The circular flow of copper in re-production process is described by the following equation:

$$B_{u_s} = O^A + O_p^O + \sum_{i=1}^{n} g_i \tag{2}$$

where: B_{u_s} - circular flow of copper in re-production process,

O^A – amortization scrap

O_p^O - circulating scrap and processing scrap

$\sum_{i=1}^{n} g_i$ - irreversible copper losses.

If the detailed balance statistics was available, the equation (2) would be the most reliable element for modeling the generation of copper waste. Since these data are rare, the estimation of the amount of generated waste can be done through the coefficient of waste generation. It is the ratio between the quantity of generated waste and the quantity of copper used to produce semi-finished or finished products.

$$K_p^O = \frac{O_p^O}{P_p} \cdot 100 \tag{3}$$

The amount of amortized waste (K^A) is expressed through the metal quantity that is by amortization turned into waste and the total copper amount:

$$K^A = \frac{O^A}{M_f} \cdot 100 \tag{4}$$

When the direct data on the quantities of wastes are missing, their quantities can be determined indirectly from data on raw materials, intermediate products and products:

$$O_p^O = P_p \cdot \frac{K_p}{100} \tag{5}$$

$$O^A = M_f \cdot \frac{K^A}{100} \tag{6}$$

In the balancing method, the average coefficient values for technological stage, technology or the company, can be used instead of the coefficients K_p^O and K^A.

4. CONCLUSION

The importance of copper secondary raw materials using is significant primarily for the protection of primary resources, environmental protection and energy savings.

Widespread application of copper influences the generating of copper waste, diverse in composition and shape. Waste generated in copper production and processing to obtain the finished product is called *process scrap*. Process scrap generated in copper production and treatment is called *circulating (own) scrap*, while the scrap generated due to machining and finishing of copper products is called *machining scrap*. *Amortization scrap (or collecting scrap*) is the other large group of wastes, generated after obsolescence products containing copper.

The amount of copper scrap is continuously increasing in proportion to the increment of total copper fund, while the amounts of circulating scrap tend to stagnate because of improvements in technology, production and treatment of copper.

Balance method for copper waste estimation is based on balancing the metal production and consumption in the companies. The metal amount during the production process, contained in incoming raw materials, various materials and intermediate products, must be equal to the metal amount contained in finished products, wastes and irreversible losses.

Balancing of the totally generated waste consists of the sum of partial balances of circulating waste, process scrap and amortization scrap. Estimates of the specified types of waste generation are based on data on production and consumption of copper and the numerical values of coefficients related to the waste generation.

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ENERGY EFFICIENCY IN THE ZAJECAR TERRITORY

ENERGETSKA EFIKASNOST NA TERITORIJI ZAJEČARA

Gabrijela Popovic[1], Nedeljko Magdalinovic[1], Ivan Djordjevic[1]
[1]Faculty of Management Zajecar, Megatrend University Belgrade
gabrijela.popovic@fmz.edu.rs

Abstract: *Serbia is on the bottom of Europe according to energy efficiency. In order to determine the situation with energy efficiency in Zajecar and surrounding villages: Zvezdan, Grljan and Veliki Izvor a survey was conducted. The survey contained 20 questions and 100 respondents were surveyed. The results showed that in the Zajecar territory the energy efficiency is still in its infancy. The main reasons for such situation are: lack of information, age of objects and lack of financial resources for investment in new insulation materials and purchase energy saving devices. The paper shows the survey results and appropriate conclusions.*
Key words: *Energy efficiency, Zajecar territory, survey.*

Apstrakt: *Srbija se nalazi na samom začelju Evrope kada je u pitanju energetska efikasnost. Radi ispitivanja postojanja energetske efikasnosti sprovedena je anketa u gradu Zaječaru i okolnim selima: Zvezdan, Grljan i Veliki Izvor. Anketa je sadržala 20pitanja, a anketirano je ukupno 100 ispitanika. Na osnovu dobijenih rezultata je zaključeno da je na teritoriji Zajecara energetska efikasnost još uvek u povoju. Osnovni razlozi ovakvog stanja jesu neinformisanost, starost stambenih objekata i nedostatak finansijskih sredstava za ulaganje u nove izolacione materijale i kupovinu štedljivih uređaja. U radu su prikazani rezultati sprovedene ankete kao i odgovarajući zaključci.*
Ključne reči: *Energetska efikasnost, teritorija Zaječara, anketa*

1. INTRODUCTION

Serbia is on the lowest level in Europe according to energy efficiency. Energy consumption in the Western Europe is less than 100 kWh/m^2, while in Serbia it reaches between 150 kWh/m^2 and 180 kWh/m^2. Households participate with 50 % in total electric energy consumption. Electric energy is mostly used for households heating (near 65 %). For example, specific consumption of heat during winter season in Denmark is 96 kWh/m^2, while in Serbia energy consumption for heating offices and buildings amounts to 228 kWh/m^2, and the consumption in households is much higher [1]. In order to achieve energy stability in Serbia it is necessary to enhance energy efficiency and develop awareness about significance and necessity of rational energy consumption.

The paper shows the survey results, which is conducted in Zajecar and surrounding villages: Zvezdan, Grljan and Veliki Izvor. Survey consisted of 21 questions, which were directed to energy efficiency and familiarity of the respondents with the methods which contribute to efficiency improvement. The paper is organized as follows: in section 2 the results of the survey are presented, and section 3 contains conclusions.

2. SURVEY RESULTS

An anonymous survey was conducted from 1st to 28th February with a goal to determine the situation with energy efficiency in the city of Zajecar and surrounding villages: Grljan, Zvezdan and Veliki Izvor. One hundred respondents were surveyed as follows: 50 from the city and the remaining from the previously mentioned villages. The survey results are shown in the further text.

Age structure of respondents indicates that responders from rural area are older than respondents from Zajecar. Bearing in mind the fact that rural households are mainly elderly, this data is not surprising (Fig. 1).

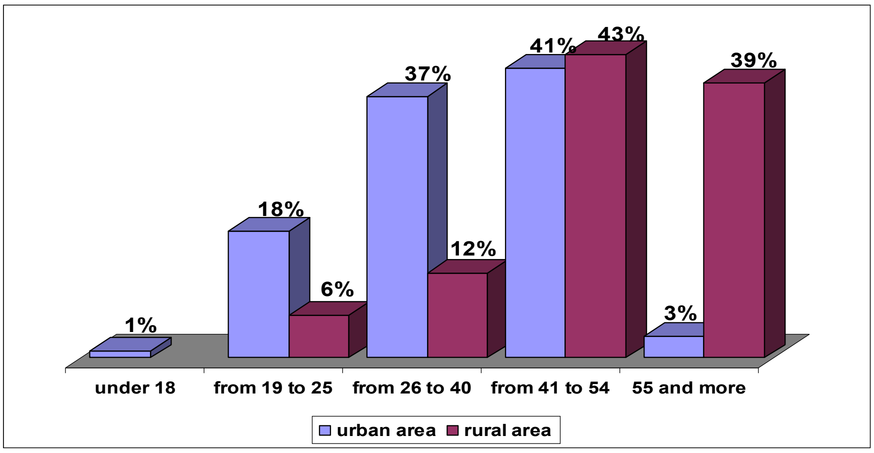

Figure 1. Age structure

There is a distinction in education level between urban and rural respondents. A majority of the urban respondents have secondary and higher education, while the rural respondents mainly have primary education. Only 2 % of the rural respondents finished faculty or college (Fig. 2).

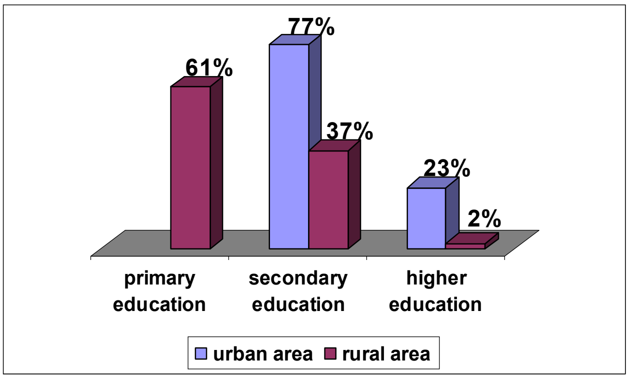

Figure 2. Education structure

As fig. 3 shows, mostly unemployed and retirees are from the rural area.

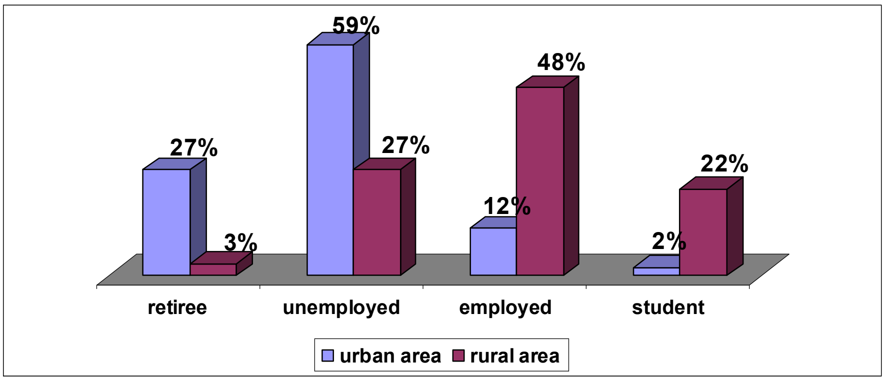

Figure 3. Work structure

The majority of the respondents said that household incomes are not enough, and in respect to that, the distinction between urban and rural areas is very small (Fig. 4).

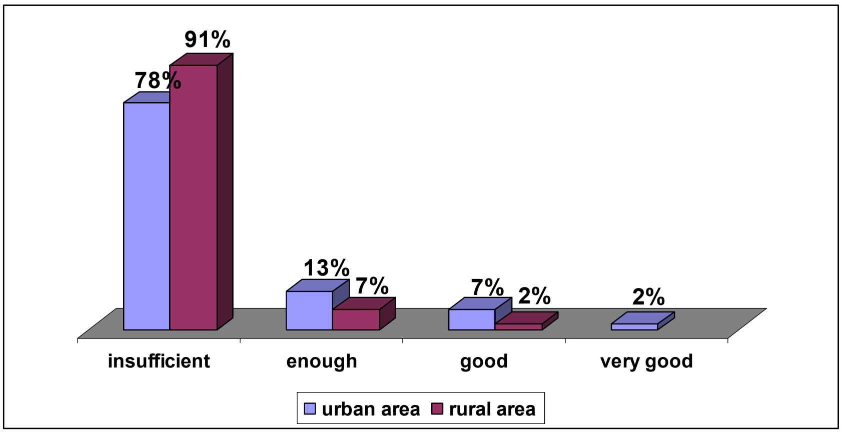

Figure 4. Household incomes

According to the respondents from Zajecar, electrical energy consumption depends on object characteristics and type of heating. Unlike them, rural respondents think that the energy consumption mostly depends on climate conditions. This shows that the rural respondents are not properly informed, and according to that it is necessary to provide them with the information about factors that affect energy consumption (Fig. 5).

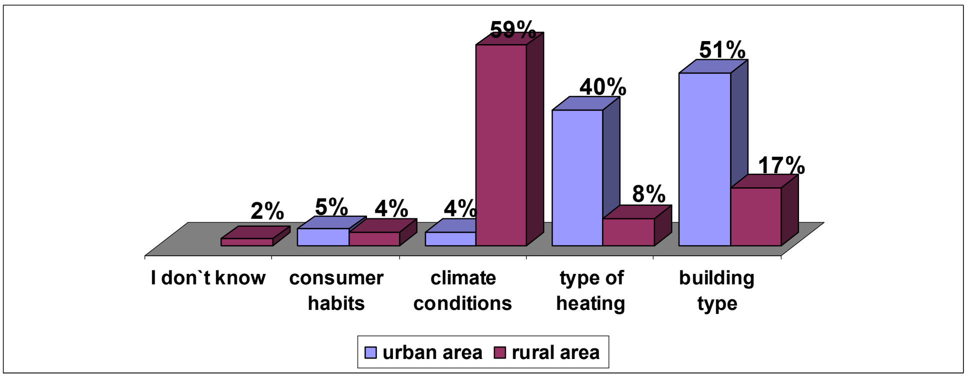

Figure 5. Factors that affect on the electric energy consumption

In both urban and rural areas, population does not rationally use energy. Most of the respondents confirmed that they do not pay attention to energy consumption and this causes higher costs (Fig. 6).

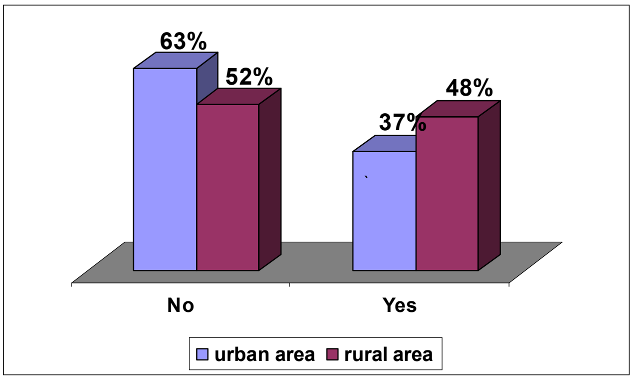

Figure 6. Do you use energy rationally?

A significant percentage of respondents did not know what energy efficiency is, especially respondents from villages (76 %). There were others that heard about energy efficiency, but did not know to explain its meaning (Fig. 7).

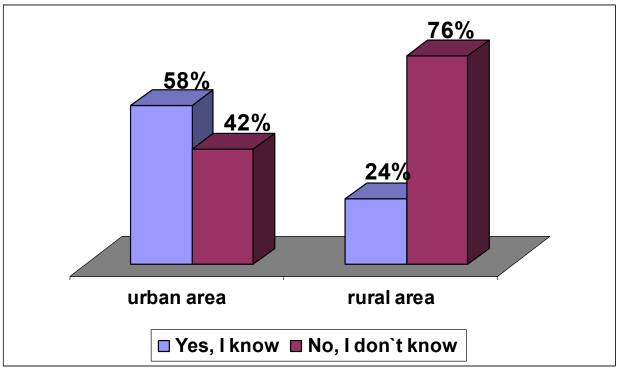

Figure 7. Do you know what energy efficiency is?

Considering the fact that most of the respondents did not know what the energy efficiency is, the answers to this question should be interpreted with caution. Namely, 81 % of the urban respondents and 43 % of the rural respondents said that the energy efficiency is very important, but they could not explain what the energy efficiency means (Fig. 8).

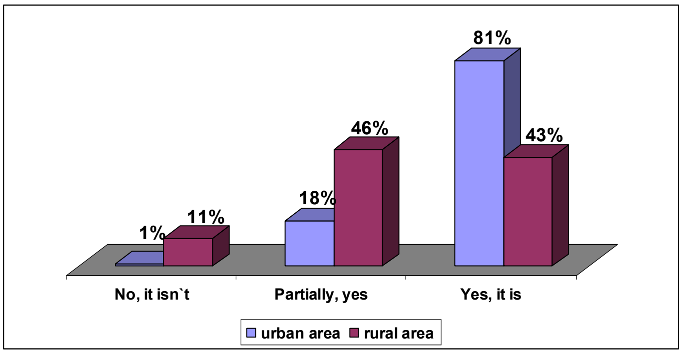

Figure 8. Is energy efficiency important to you?

Regarding age of objects, the answers are quite expected. In the rural areas 99 % of the objects are older than 20 years, while in Zajecar, this percentage amounts to about 87 %. Modern insulation materials which are in use today did not exist 20 years ago or were not used. Because of that these objects have very bad energetic picture (Fig. 9).

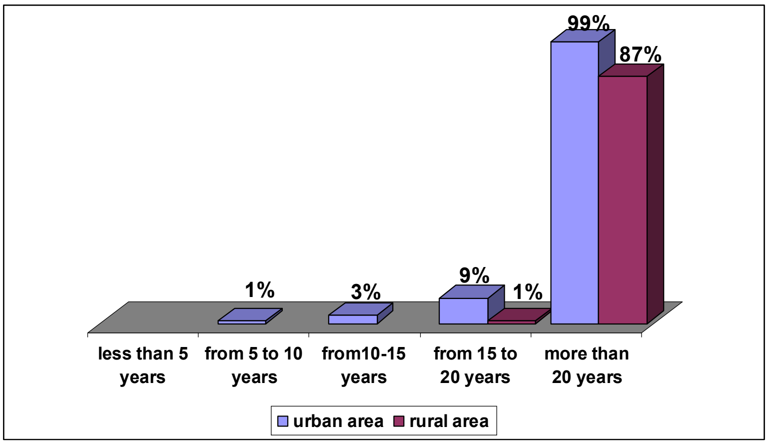

Figure 9. Age of objects

In urban areas, glass wool is the most common type of insulation, and it participates with 90 % in total insulation used, while in rural areas the most used is cane (81 %). This answer is quite expected considering the age of objects (Fig. 10).

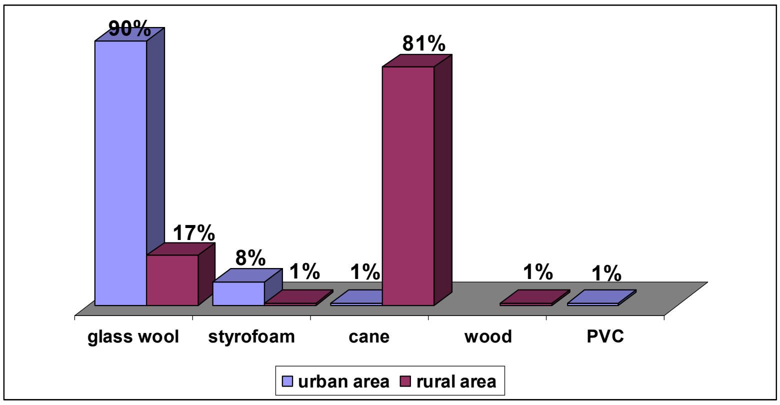

Figure 10. Insulation type

The majority of respondents from both rural and urban areas said that the main role of insulation is saving money. But, insulation type of objects in rural as well as in urban area is outdated. Bad insulation of objects causes losing a significant quantity of energy which affects electricity bills, because the main use of electric energy in winter season is for heating (Fig. 11).

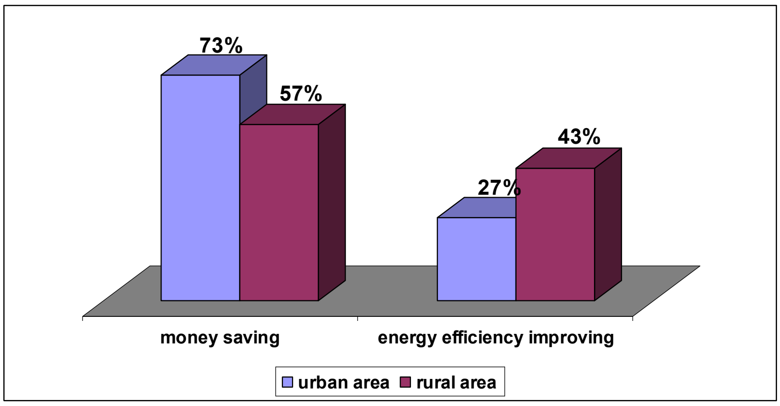

Figure 11. The main role of object insulation

Even 98 % of respondents from urban area and 84 % from rural area said that insulation is very important for “electric energy saving.” The majority of respondents confirmed it is one of the most important segments of an object which is very useful in summer as well as in winter periods. Respondents have difficulties with answering to the previous questions because term energy efficiency was unknown to them. But, they were familiar with the importance of insulation even though they did not bring it in connection with energy efficiency (Fig. 13).

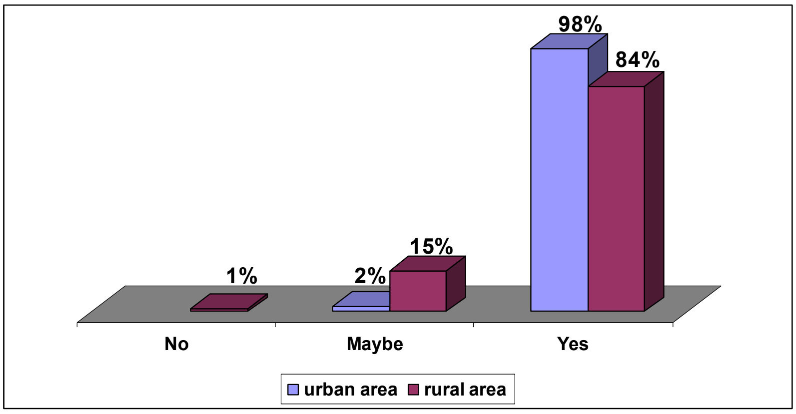

Figure 12. Is insulation material important factor of energy efficiency?

98% of urban respondents and 84% of rural respondents agree that installation of insulation material is extremely good for energy savings, but they said that it is very expensive for present conditions. The main reasons for this attitude are adverse credits and high VAT for insulation material, which prevents the majority of respondents from incorporating it (Fig. 13).

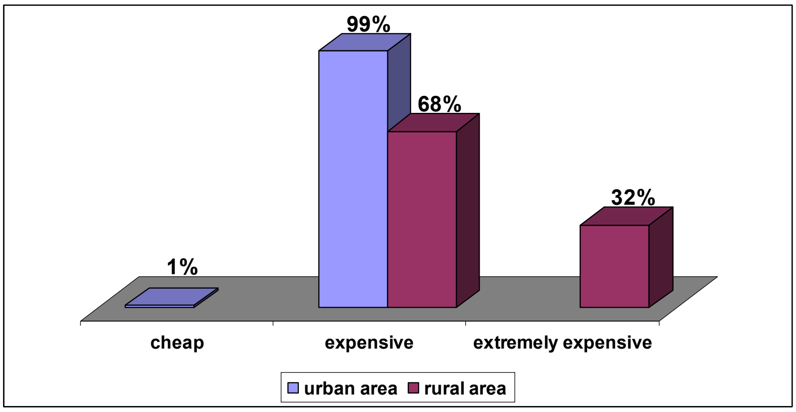

Figure 13. Costs of incorporating insulation material into residential

The respondents mainly heard about energy saving devices, and some of them have it. On the other hand, 62 % of rural population did not hear about them (Fig. 14).

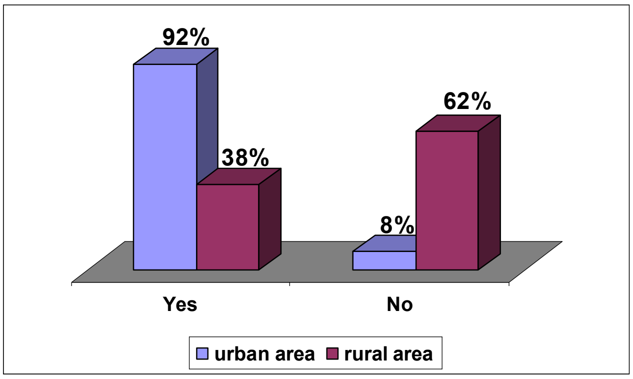

Figure 14. Have you ever heard for energy saving devices?

Energy-saving bulb is the most famous saving device among respondents, and some of them have used it. However, it is necessary to work on popularization of the saving devices and presentation of its advantages with regard to ordinary devices (Fig. 15).

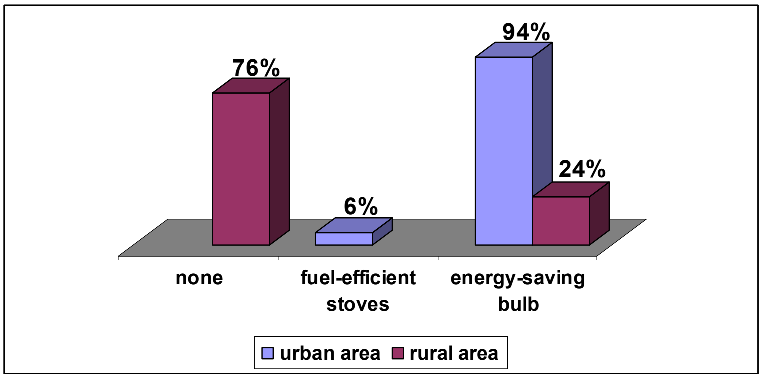

Figure 15. The most famous saving devices

On the question about saving devices price the answer of the majority was that the price is higher than the price of regular devices. Even so, 52 % of the respondents from rural areas said that there is not much difference between price of a regular and saving devices which shows that they are not properly informed (Fig. 16).

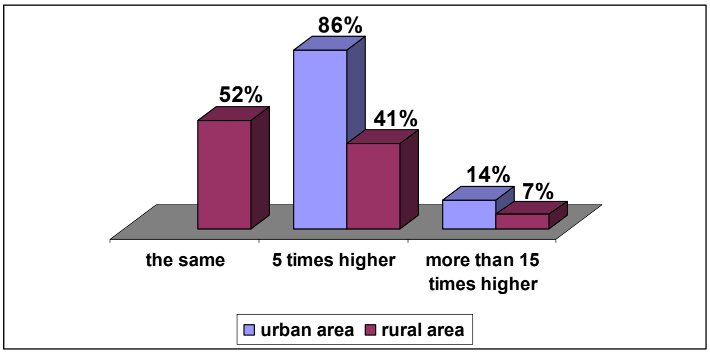

Figure 16. The price of the saving devices according to ordinary devices

93 % of the respondents from urban area said that the main barrier in use of energy-saving bulbs is their price, which is too high according to their opinion. A reason for this standpoint is living standard in this part of Serbia. Many of them would buy those devices if the price were more affordable. In contrast, respondents from rural areas would rather buy old fashioned devices than new ones (Fig. 17).

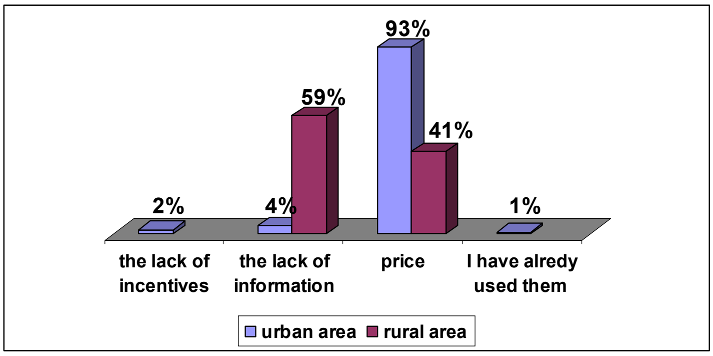

Figure 17. Reasons why population does not use energy saving devices

32 % of the respondents from urban area said that money invested in saving devices return in about 4 years, while 37 % of them consider that invested money returns in 2 years. The majority from the rural areas claimed that refund will be in 4 years (Fig. 18).

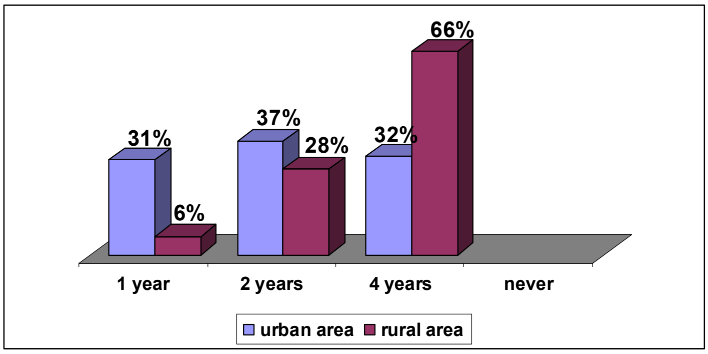

Figure 18. The period of money return invested in energy saving devices

The main method for electric energy saving, according to respondents from urban area, is insulation, while the respondents from rural area consider that rational energy use is quite enough. This standpoint of rural population shows us that they are very poorly informed, which must be improved in the future (Fig. 19).

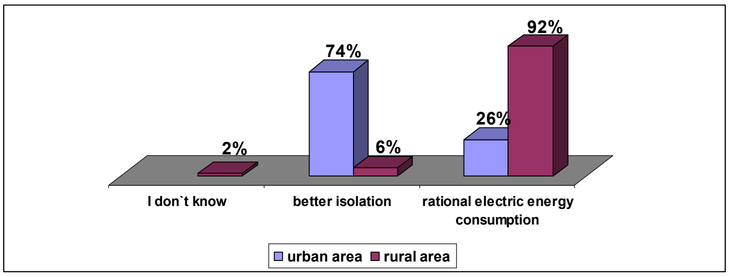

Figure 19. Methods for electrical energy saving in the households

When we asked about electricity bills 69 % of respondents from urban area said that their bills amount between 2000 and 4000 RSD, while in the rural areas these bills amount between 1000 and 2000 RSD. Somewhat expected data, but if energy efficiency were improved, then electricity bills would be halved (Fig. 20).

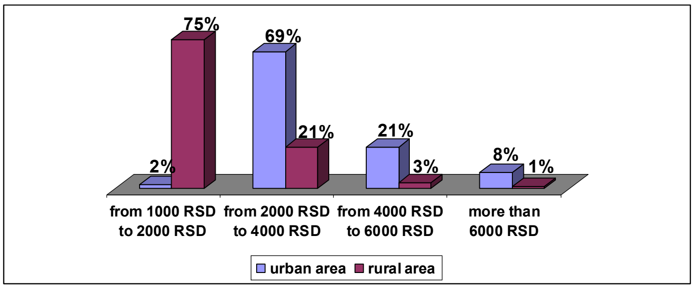

Figure 20. The amount of electricity bills

3. CONCLUSION

The survey conducted among urban and rural population gives data about present situation of energy efficiency in the Zajecar territory and surrounding villages. Respondents think that electric energy consumption mainly depends on object characteristics and climate conditions and they are aware that they are not using electrical energy rationally. We conclude that the majority of respondents are not sure what energy efficiency is, especially from the villages, but they agree it is very important. Objects in the villages as well as in the city are very old. This gives rise to the conclusion that the material used for insulation is obsolete and outdated, although our respondents know that insulation is very important for energy saving. The majority of the respondents wish to improve energy efficiency of their homes, but the difficult financial situation and extremely expensive and adverse credits represent a serious obstacle. Beside the fact that they are poorly informed, this is the main reason why they are not buying saving devices.

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PROPER WASTE MANAGEMENT - ALTERNATIVE ENERGY RESOURCE

PRAVILNO UPRAVLJANJE OTPADOM - ALTERNATIVNIM IZVOROM ENERGIJE

Biljana Ilic, Violeta Jovanovic, Dragan Mihajlovic
Faculty of management, Zajecar

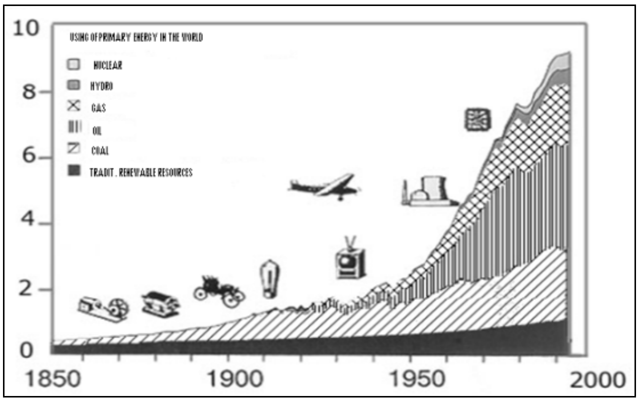
Abstract: *One of the key problems of mankind in modern conditions and its survival, in addition to the needs for drinking water and food, is also need for energy. The changes occurring on the world trade of energy and increasing influence of power production on the environment, have made energy, ecology and economics have the common aim – mutual coordination. It naturally imposes new strategic norms aimed to make it possible for a man to satisfy his needs. Accessibility, referring to its price, and availability, meaning sufficient amounts of energy, are of the same importance with the third requirement, acceptability, relating to the environment preservation. The Paper emphasis one of alternative ways to obtain energy, meaning, to manage the waste properly, having in mind the fact that waste is one of alternative sources of energy in future.*
Key words: *needs, energy, changes, environment, alternatives, waste.*

Apstrakt: *Jedan od ključnih problema čovečanstva u savremenim uslovima opstanka, pored potrebe za vodom i hranom predstavlja i potreba za energijom. Promene koje se dešavaju na svetskom tržištu energije i sve veći uticaj njenog dobijanja na životnu sredinu, doprineli su da energetika, ekologija i ekonomija, poprime cilj međusobnog usklađivanja. Usklađivanje ova tri principa svakako nameće nove strateške norme kako bi čovek zadovoljio svoje potrebe. Pristupačnost u smislu cena i raspoloživost u smislu dovoljnih količina energije idu ruku pod ruku sa trećim zahtevom, prihvatljivosti u smislu očuvanja životne sredine. U radu je stavljen akcenat na jedan od alternativnih načina za dobijanje energije, odnosno na pravilno upravljanje otpadom, kao jednim od alternativnih izvora energije u budućnosti.*
Ključne reči: *potreba, energija, promene, životna sredina, alternative, otpad.*

1. INTRODUCTION

For a very long time, man has satisfied his needs for energy by using the solar energy, then his own body's energy, the power of animals he was keeping, as well as by using mechanical powers of nature (waters and wind), and particularly by using wood that has been a significant source of energy for centuries. At the end of 18th century, the invention of steam engine was gradually reducing the usage of wood in obtaining energy on behalf of coal. At the start of 20th century, coal became the main energy source. Petrol and diesel engines being invented, the group of energy sources was enriched by oil, and very soon after that, natural gas as well. Usage of the natural gas and oil led to the development of electrical power production. In the midst of 20th century, with the dose of salt, to be fair to say so, people started using atomic energy. Today, the importance of energy exceeds far the sphere of economic processes. It was due, particularly, to rapid increase of the world population, rising, in the period of time from 1950 to the year 2000, from 2.5 billion people to as much as 6 billion people [1]. The main energy source in 21st century are still fossil fuels which provide 85-90% of world's energy. Among them, oil is the most significant source participating with 35%, while coal and natural gas provide averagely equal amounts of energy. Atomic energy participates in providing energy with 8%, while renewable energy sources, primarily hydro - energy, are used with only 3.3%.

The picture 1 shows global consumption of primary energy worldwide, starting with traditional (renewable) ones to all other before-mentioned [2]. Interactivity of energy and other branches of economy is the basis of the whole development of each country. Taking into consideration all listed data, the issue of obtaining energy, the needs for which there are more and more increase, has to be considered in adequate way, and some new alternative sources, as a possibility for additional provision of energy, have to be involved.



Picture 1. Global consumption of primary energy [2]

2. WASTE AS ALTERNATIVE ENERGY RESOURCE

Now, we can, for sure, point out the fact that future and development, as well as the survival of the earth and life on it, depend on human's knowledge and skill to use new, alternative energy sources. New alternative energy sources involve all those which can replace traditional fosil sources, those which cannot cause great harm to the environment. Such sources, besides renewable ones involving geothermal energy, solar energy, energy of waves, high and low tide energy, may include also the sources such as biomass, as well as the energy obtained by processing and proper managing of waste. Waste can be defined in the following way: "Waste is made up of materials or objects that their owner disposes of, intends to dispose of, or requires it to be disposed of in accordance with the law and current regulations [3]." Depending on the properties, waste can be classified as follows:

1) hazardous waste – the waste having at least one of hazardous properties (explosiveness, flammability, aptitude for oxidation, acute poisonous effect, aptitude for corrosion, etc.);
2) inert waste – the waste, being disposed on the dump, does not cause any significant either physical, chemical or biological transformations, or pollution of the environment;
3) non-hazardous waste – any other waste that is not defined as a hazardous one.

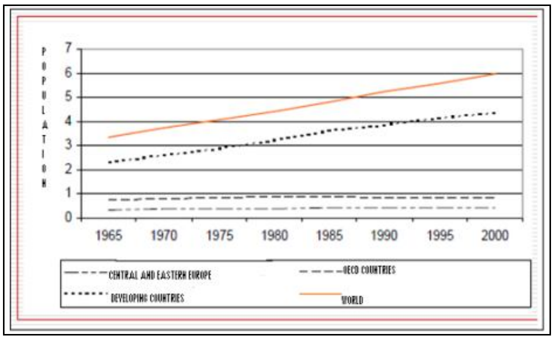
According to the place of origin, it can be communal waste and industry waste. The latter involves waste coming from any kind of industry plant or industry enterprise. It originates during industrial processes, according to its characteristics, it can be inert and hazardous. The former does not have a harmful influence on people’s health, while the main property of the latter is that it contains harmful stuff that are not usable any more and, therefore, it cannot be recycled [3]. Depending on the classification, waste can be treated in a few ways. Aimed to manage waste in a proper way, it is necessary to list the following ones:

1) Temporary disposal
2) Collecting
3) Processing and re-consumption
4) Final disposal

Temporary disposal can be defined as rejecting used-up material or managing with it up to further processing (sorting). Collecting waste means collecting by authorized services, enterprises or townsmen. Waste processing involves sorting, preparation for further process and processing, that is, recycling in order to be used again. Final disposal includes actions of disposing remnants of waste processing, that is, disposing the final waste. The methods for disposing waste can be utilization and liquidation methods. The former are the methods of using-up waste, so that it can obtain energy or raw-materials of it, using-up the material again, or recycling, composting and thermal processing of waste. Liquidation methods involve eliminating the whole amount of waste without using-up. Waste treatment includes procedures that change its characteristics aimed to reduce its volume or hazardous properties, recycling process, or, what is the topic of this Paper, obtaining energy, that is, to use it up as an alternative energy source.

3. WASTE MANAGAMENT

Although needs for energy are increasing, man’s consciousness of it is not satisfactory, particularly if we have in mind the measures that are undertaken to improve such state. Burning fossil fuels, that are most used for obtaining energy, a great amount of carbon-dioxide and other harmful gases is freed, supporting in this way the effect of green-house. The consequences of such violation of the environment are numerous, besides global warming and changes of climate, some of them involving also melting glaciers, elevation of the sea level, change of precipitations, negative influence on agriculture and worldwide economy.
Increase in world population, noted particularly up to the year 2000 (Picture 2), caused some consequences, such as: increase of amount as well as variety of waste, made by people[1].



Picture 2. Population increase per groups of countries in the period from 1960 to 2000[1]

Potentially harmful influence of waste on the environment and public health, cause increase of consciousness of urgent need to adopt certain scientific methods for safe managing of waste [2]. The first and most important step is to minimize waste and reduce amounts of non-desirable matters and side-products being disposed forever. To manage waste properly, we use modern technologies that, for sure, have a significant role in solving this problem. The projects of the WTE Technology (Waste-To-Energy) cannot be avoided in modern societies. These projects are sustainable only if they are economically and technically feasible. They have a double effect [4]:

1) Financial effect – involving content and amount of waste;
2) Ecological effect – meaning developing and improving technologies for processing waste, and its energetic valorization.

Since, in 1995, the American Environment Protection Agency set a number of demands to the WTE industry, relating to emission of mercury, furan, dioxins and other harmful substances, the WTE industry, on the other hand, has improved its systems for the environment protection.

4. RENEWABLE SOURCES OF ENERGY OBTAINED FROM WASTE

Unconventional methods for obtaining energy, such as wind, hydroelectric and geothermal, make up less than 1% of total production of energy in the world; they can, however, play an important role in the region since they are economical and available. Due to chemistry, there have been developed new possibilities for obtaining energy, particularly from alternative sources, such as waste. Controlled burning of waste on high temperatures in plants for efficient and complete combustion is called burning-down of waste, and this method is considered to be the oldest method for destroying undesirable products and substances. In this way, it is reduced the volume and mass of undesirable products, some substances are degraded, their chemical characteristics are changed, pathogenic particles are destructed, and energy is obtained. In the process of combustion, smoke gases (CO2, SO2, NO 2, steam) and ash appear, however, a significant amount of energy is freed. The system of new WTE technologies was designed with the aim to cause complete burning-down of waste together with obtaining maximum amount of energy through balance of the three factors: time, temperature and air turbulence (surplus of oxygen). Obtained energy can be used for heating, but also for obtaining electric power (hot steam in steam-turbines) [5]. Technological solutions of the process start from the moment when waste is transported direct to so-called “bunker”, the place for disposing waste, from where it is, by the help of specialized machines for combustion, it is further transformed, and in that way, needed amount of energy is obtained. By adequate processing, waste can be used for obtaining fuel. This fuel is called “SRF” (Solid Recovery Fuel). SRF is obtained from communal and industry waste in special plants for mechanical, biological and thermal processing of harmless waste, while by its combustion, it is obtained electric power or heat energy. Talking about technologies, we have to take into consideration proscribed standards or set of proscribed technical specifications for production and trade of the SRF. The advantages of the SRF in comparison to coal are numerous, classified as follows[5]:

1. Long-term availability (renewable fuel);

2. Greater and steady heat value in relation to lignite. For the lignite, this value amounts MJ/kg, while for the SRF, it has the value of 18.7 MJ/kg;
3. Relatively low production price;
4. Long-term durability in price prediction;
5. Ecologically, it is more justifying; it is considered that at combustion of this fuel, CO2, the gas carbon-dioxide which originates then, is neutral, since the SRF itself is greatly of biologic origin (50-80%).

The table 1 shows the amount of waste and SRF in the Republic of Serbia in the period of 20 years, from 2000 to 2020 [6]. It is obvious that, every fifth year, both the amount of waste has been increased for 100 000 units, as well as the amount of SRF and energy obtained.

Table 1. Amount of waste and SRF in Serbia[6]

Potential	2010	2015	2020
Waste (t/y)	827966	921633	1017983
SRF(t/y)	413984	460817	508992
SRF MWhe/y	710000	790000	873000

As for the waste, it should be stated that communal, solid and industry waste consist of various components. Heat potentials of main components of waste are shown in the Table 2 [6]. It shows that the greatest heat is given out by plastics, then rubber and leather, while wood is on the third place.

Table 2. Heat powers of main components of waste[6]

Number	Component	Hkj/kg
1.	Cartons, paper	13.490
2.	Biowaste	9.300
3.	Waste of food	7.560
4.	Plastic	26.980
5.	Tree	16.050
6.	Rubber, leather	19.538

However, to obtain energy from waste, it is necessary to satisfy certain criteria relating to efficiency, amount and content of certain substances. Mentioned criteria involve the following:

1) Heat efficiency
2) Amount of waste
3) Content of water
4) Content of combustible substances

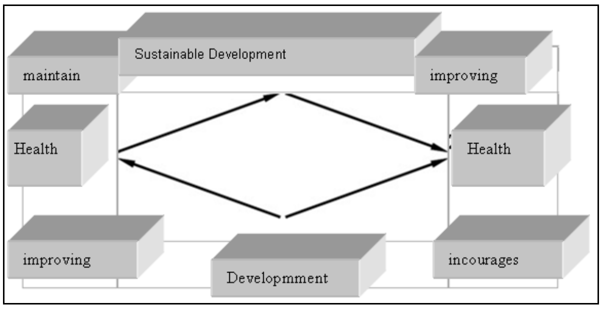
Heat efficiency has to exceed the definite minimum level. The least proscribed medium heat efficiency per year amounts 7 MJ/kg, while during a year, it must not be less than 6 MJ/kg. The amount of waste needed for energy processing in the burning-down plant must not be lower than 50.000 tons per year. The content of water in waste has to be less than 50%. The content of ash in waste should be maximum to 60%, while the content of combustible substances must not be greater than 25%. Combustibility of waste, as well as steadiness of the burning-down process without need to use additional fuel, depends on a few physical and chemical parameters, out of which, the most significant is the low limit of heat power of fuel. We should point out again that the alternative fuel SRF is the least harmful because it contains most combustible components (carbon, hydrogen, nitrogen, and a great portion of oxygen). On the basis of the before-mentioned, we can conclude that a man, by his own conscious acting, more increasingly uses his knowledge and experience in fight for his survival and sustainable development. He tries, in current conditions, to obtain from economy all necessary means and goods (energy), which he, until recently, could obtain from the nature. This is the way how a man is trying to work, do business, on behalf both of the environment and future generations.

5. KEY PRINCIPLES OF WASTE MANAGING, PURPOSED TO SUSTAINABLE DEVELOPMENT

The term ”Sustainable development” defines the development in which, if we want to satisfy our needs, there is no compromise with the possibility that future generations can satisfy their needs. Sustainable waste management means more efficient use of resources, reduction of amount of produced waste and when waste has already been produced, handling with it should contribute to aims of sustainable development. Sustainable development should integrate previous experience, current practice and vision of future. Therefore, sustainable development refers to the development of health and the environment, prosperity of economy and society, so that, as such, it is very important. Key principles, that have to be taken into consideration while establishing and implementing the waste managing plan and which are in accordance with sustainability, are the following seven [7]:

1) Principle of sustainable development
2) Principle of vicinity and regional approach to waste management
3) Principle of precaution
4) Principle “pollutant pays”
5) Principle of hierarchy in waste managing
6) Principle of application of most practical options for the environment
7) Principle of producer’s responsibility.

Sustainability, primarily, means searching for new sense of economics and technology as aspects of man’s rational practice. Accordingly, “Sustainable development is the one permanently keeping us alive as a biologic species and as cultured and social beings”[8]. The Picture 3 shows the circle stream and the connection of health and sustainable development, involving their initiation, development, management and improvement.



Picture 3. Sustainable development [7]

The Principle of Vicinity is defined as the way of treating or disposing waste as nearer as possible to the place of its origin. This principle is aimed at avoiding the undesirable influence of waste transport on the environment. However, this influence depends on the local conditions and circumstances. Application of this principle may vary depending on the kind of waste, as well as its volume, potential influence on the environment, the way how it is disposed and transported. It is necessary to establish balance between the principle of vicinity and principle of thrift. In some cases, thrift can mean that a certain treatment of waste, its re-consumption or disposal is to be located further from the place of its origin.

The Principle of Precaution means that ”if there is a possibility of serious or irretrievable damage, lack of complete scientific reliability cannot be the reason not to take measures to stop degradation of the environment” [8]. The Principle “pollutant pays” means that a pollutant has to pay for all expenses made as results of his deeds. Possible expenses for treatment and disposal of waste have to reflect on the price of the product and charges for waste managing. The Hierarchy of Waste Managing represents the order of priorities in the practice of waste management, as follows:

1) to prevent making waste and reduce or minimize use of resources, and decrease the amount and/or harmful characteristics of waste,
2) to re-use – use again products for the same or other purpose,
3) to recycle – repeat the treatment of waste for using it as a raw-material in production of the same or different product,
4) to use it up – using up waste through composting, production /return of energy and other technology, and
5) to dispose waste – if there is no other adequate solution, waste disposal through depositing or burning-down without using up energy. The principle is to be considered in connection with other principles, as it the Principle of Most Practical Options for the Environment [9].

The Principle of Most Practical Options for the Environment is a systematic and consultative process of decision-making, involving the protection and preservation of the environment. The process of most practical options for given aims and circumstances, when it is the environment in question, establishes the option or combination of options bringing the greatest profit or making the least damage to the environment as a whole, together with acceptable expenses, both for a long-term and short-term period. The principle of Producer’s Responsibility means that producers, importers, distributors and sellers of the products effecting the growth of the waste amount, have to, all together, be responsible for the waste. Being a "producer', in this context, has much wider meaning than usual. Considering the lifetime of a product, it is not only the producer who makes waste, but there are a series of other factors in that chain playing an important role. [10] Waste management and the environment protection are more increasingly becoming preoccupation of different political and economic subjects worldwide. Making laws on waste management enables defining the procedure of managing, collecting, transporting and storing waste.

6. CONCLUSION

Taking into consideration all previously said, we can conclude that waste pollutes the planet rising the problem which cannot be solved only by natural resources. Since waste is neither natural, however, nor the best fuel, the solution to the problem costs, although there are some technological processes and using-up of energetic potential which reduce the price. It might be best to start with small steps on the local level, primarily because the energy, obtained from waste, can never completely replace the energy obtained from primary raw-materials. However, the energy from primary raw-materials can be supplemented by that from the alternative sources. In that way, it is possible to make conditions for proper use of waste in small regions. Processing and removing waste can make the environment cleaner. The waste made by human activity is an organic matter, which is, as such, biodegraded. On the dumps worldwide, through natural processes, it is possible to separate methane, the gas that can be used as a fuel. Even the waste disposed in a primitive way can be re-used. Besides making it possible to obtain energy, and protecting the environment, processing waste has an important role in health protection of people. Therefore, through managing waste properly, as an alternative source of energy, it is possible to balance sustainable development, competence and safety in providing energy, no doubt, the three basic principles of existence of modern society.

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WASTE AS ALTERNATIVE SOURCE OF ENERGY

OTPAD KAO ALTERNATIVNI IZVOR ENERGIJE

Lazar Ružičić[1] , Ljiljana Kostadinović[1], Tamara Galonja-Coghill[1], Predrag Petrović[2]
[1] Megatrend univerzitet, Fakultet za biofarming Bačka Topola
[2]Institut "Kirilo Savić", Beograd, R Srbija
Osoba za kontakt: Prof.dr Ljiljana Kostadinović, e-mail: latimak@tippnet.rs

Abstract: *In modern society, almost everything that surrounds us, and we use becomes unusable after a while and goes to waste. The waste is now considered one of the most important environmental problems of the modern world. As an increasing amount of waste has generated as a result of human activity, one of the specific goals of environmental protection is its proper handling. Development of new technologies has created a series of synthetic materials that have never appeared in nature and that nature itself has no solution for. Failure to successfully solve the problem of waste could be a burden for future generations. In Serbia more than 2.2 million tons of waste is collected annually, and is predicted to to increase to 3.4 million until 2020. One of adverse effects of waste on the environment is the emission into the air, which affects health, and others are various inconveniences such as dust, odours, noise, vermin and litter. It also affects the transport, water resources, causes visual disturbance and the potential utilization of resources. Since it was estimated that Serbian coal reserves will be used up in the period from 2030 to 2050, and the expected growth in electricity consumption by over 60 percent over the next 20 years, Serbia must find alternative sources of energy supply, and waste could be one of those.*
Key words: *waste, alternative energy, environmental protection.*

Apstrakt: *U modernom društvu gotovo sve što nas okružuje i što koristimo postaje nakon nekog vremena neupotrebljivo i prelazi u otpad. Otpad se danas smatra jednim od najznačajnijih ekoloških problema savremenog sveta. Kako sve veća količina otpada nastaje kao rezultat ljudskih delatnosti, jedan od posebnih ciljeva zaštite životne sredine je pravilno postupanje sa otpadom. Razvojem novih tehnologija čovek je stvorio niz sintetskih materijala koji se nikada nisu pojavili u prirodi i za koje sama priroda nema rešenja.Ukoliko se ne reši uspešno, problem otpada bi mogao da bude veliko opterećenje za buduće generacije. U Srbiji se godišnje sakupi preko 2,2 miliona tona otpada, a predviđa se da će 2020. godine ako nešto ne preduzmemo biti 3,4 miliona tona otpada. Jedan od negativnih efekata otpada na životnu sredinu je emisija u vazduh, što utiče na zdravlje, a drugo su neprijatnosti poput prašine, neprijatnih mirisa, buke, štetočina i smeća. On utiče i na saobraćaj, vodene resurse, vizuelno ometanje i smanjuje potencijal iskorišćenja resursa. S obzirom na to da se procenjuje da će rezerve uglja koje Srbija poseduje biti istrošene u periodu od 2030. do 2050. godine, a da nas u narednih 20 godina očekuje rast potrošnje električne energije od preko 60 odsto, Srbija mora da nađe alternativne izvore snabdevanja energijom, a otpad bi mogao da bude jedna od tih alternativa.*
Ključne reči: *otpad, alternativni izvor energije, zaštita životne sredine.*

1. INTRODUCTION

As the civilisation develops, waste becomes increasingly important problem, polluting the air, water and land. Waste that builds up, poses a health threat for living organisms, not only by processes of rotting, but becoming a source of food for rodents, insects and other carriers of infectious diseases. Waste causes so-called ambient pollution, making the environment unpleasant to view and smell. Waste is any substance or object included in the list of categories of waste (Q list) which the owner discards, intends to discard or should discard [1]. Generally, every actitivy should be aimed at diminishing the waste products. Although it is the major part in waste management, it is least implemented.

If it si not possible to prevent the waste generation, its reuse should be considered. By re-using products, the energy for producing a new one is being saved, and the landfilling costs lowered. Reuse is common for glass packaging. Glass bottles can be refilled more than 30 times and replaced 30 disposable plastic bottles. Also, with certain repairs the life of some products can be extended. Although materials such as paper, plastic and broken glass are not eligible for direct re-use, these materials can be reused by methods of recycling, what is the next step in proper waste handling [2].
Landfills, waste, garbage and sewage, however strange it may sound, will be important sources of energy in the future. That future has already arrived in the developed countries of the European Union that use much of the waste as fuel for heating cities or electricity production. According to the EU strategy, until 2020 the alternative energy sources will be given even more importance.
In Serbia more than 2.2 million tons of waste is collected annually, and this amount is forecasted to reach 3.4 million tonnes by 2020, under current waste management (Table 1). Waste shows numerous negative impacts on the environment. One is the emission into the air, which affects health, and other inconveniences such as dust, odors, noise, vermin and litter. It also affects transport, water resources, causes visual disturbance and the potential utilization of resources.

Table 1. Forecasted amounts of waste, in thousand tonnes in the Republic of Serbia, during the period 2010-2019

	2010	**2014**	**2019**
Communal solid waste	2451	2785	3268
Household waste	*2084*	*2367*	*2778*
Commercial waste	*367*	*418*	*490*
Packaging	607	693	817
Biodegradable communal waste	1538	1747	2049
Dangerous communal waste	25	28	33
Construction and demolition waste	1000	1300	1700
Dangerous industrial waste	100	150	200
Waste oil	50	54	59
Waste tires	26	30	34
Batteries and accumulators	27	29	32
Waste electrical and electronic equipment	30	35	40
Waste vehicles	93	106	124
Medicinal waste	49	52	56
Sewage sludge	30	160	350
Waste of animal origin	277	296	321

The waste produced in human settlements originates from households, from free surfaces, industry, health facilities, restaurants, etc. They present a heterogeneous mixture of different materials (feces, urine, food waste, paper, glass, metals, textiles, plastics, etc.). The composition and quantity of such waste varies in different countries, but the major part is presented by the organic wastes (Fig. 1).

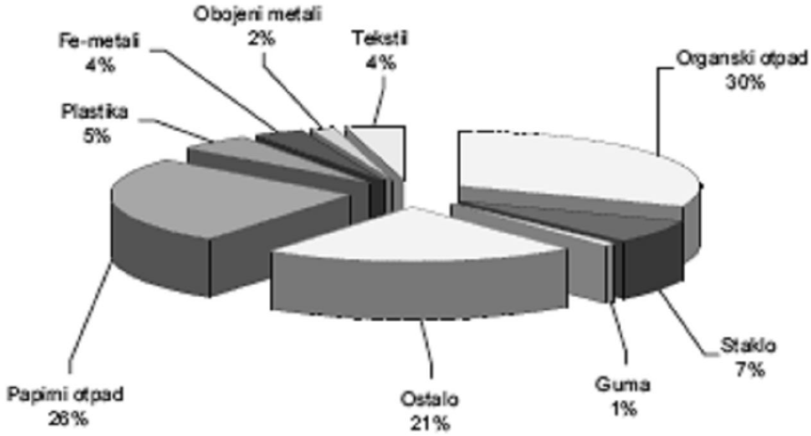

Figure 1. Average composition of waste from human settlements

Some parts of the waste can be great sources of energy. Thus, for example, in the process of composting organic waste turns into humus-like material. Composting is really a recycling of certain types of organic waste in the presence of oxygen in order to get material like humus and reducing the volume of organic waste. Organic waste is a resource that should be returned to nature. Also, in the process of anaerobic digestion (decomposition without the presence of oxygen), organic waste can turn into gaseous fuel (biogas) and organic fertilizer [3].

2. WASTE MANAGEMENT

Waste management is a general interest of society in the Republic of Serbia, and regulated by the Law on Waste Management [1]. This law aims at providing and ensuring the conditions for waste management, in a way that does not endanger human health and the environment.
The Law on Waste Management is based upon the following principles:

- The principle of optimal choice options for the Environment
- The principle of proximity and regional approach to waste management
- The principle of hierarchy of waste management
- The principle of responsibility
- Principle "polluter pays"

The waste management includes: waste prevention, reuse and recycling of waste, extracting recyclable materials from waste and using waste as fuel, development of procedures and methods for waste disposal, remediation of uncontrolled dumps, raising awareness about waste management.

Waste management includes the activities of collecting, transporting, sorting, recycling, disposal, monitoring and monitoring of waste. The biggest problem of collecting waste for recycling is the sorting, because some parts of the process must be performed manually, which increases the cost of recycling. There is also a problem of garbage categorization, so PET and polyvinylchloride (PVC) bottles do not fall into the same category of waste, therefore can not be recycled together [4,5].

The ideal principle of environmental protection regarding waste is to not produce it or to use biodegradable packaging that does not release toxins into the atmosphere. As a consumer, every person can choose a product to buy. Products with oversized packaging not only pollute the environment, but the package is included in the price that consumers pay. It is known as "the perceived value".

In 1997 a law on recycling was introduced in Japan. According to this law, there are currently 44 categories of waste. Any resident of Japan got 27 pages of instructions on the procedure for sorting the waste. It describes every category in great detail, for example, a lipstick fill falls into combustion category, and its packaging into the "small plastics and metal" category. Japan is a very specific country, having 127 million inhabitants, an average of 336 people per km^2, what is 3 times higher than Serbia. Logically, Japan has to take care of minimising the use of land for the purpose of waste disposal. Organized and well-designed system of waste management can achieve positive economic effects and reduce negative impacts on the environment, human health, wildlife, landscapes and natural areas of special interest. Table 2 provides estimates of capital investment in additional capacities for waste handling for the period 2014. -2019 [6].

Table 2 Estimates of capital investment in additional capacities for waste handling for the period 2014 -2019

Summary of total investment costs for the period 2014 – 2019 (in million Euros)			
Period	**2010 - 2014**	**2015 - 2019**	**2010 - 2019**
Solid waste - a total investment costs, including:	380	426	806
Expanding the coverage of collection	43	53	96
Landfill directive	273	223	496
Packaging directive	57	142	199
Batteries directive	-	-	-
Electric and electronic equipment waste directive	8	8	15
Construction and demolition waste	28	32	59
Dangerous industrial waste	14	24	38
Medicinal waste	2	1	3
Directive on the disposal of waste oils	4	-	4
Waste vehicles directive	11	20	30
Used tires	5	-	5
Sewage sludge	-	-	-
Waste of animal origin	4	8	13
Total investment costs	**447**	**511**	**958**

3. OBTAINING ENERGY FROM WASTE

There are several obstacles to processing waste and obtaining heat and electricity in Serbia. This is particularly inexpensive electricity that makes any form of alternative energy production extremely unviable, disregard of the laws and regulations for waste management, leading to only one proper landfill and about 3000 illegal dump sites in Serbia. As long as it is cheaper and easier to throw garbage in the landfill than to recycle it, the use of waste will be neglected. Although it allows the creation of energy, waste processing is necessary primarily because of environmental and human health.

According to the current energy strategy, the so-called "green paper", the European Union has set itself three goals to be met by the 2030. These are: balanced sustainable development, competitiveness and security of energy supply. According to this strategy it is estimated that by the year 2030, the energy consumption in the EU will increase by 11 percent, and total worldwide by 60 percent. If there is no changes, the EU is projected to increase its oil imports by 24 percent and gas by 70 percent during this period. Only in 2008 the EU has spent 350 billion euros on energy imports. Such energy dependence is a major problem under conditions of unstable market and pricing. On the other hand, the current emissions of carbon dioxide have increased global average temperature by 0.5 degrees, and it is estimated that by the end of this century the temperature will increase by 1.4 to 5.8 degrees, which will make a huge impact on the biosphere and the world economies. This is the reason why the EU adopted three key measures: the increasing use of renewable energy and waste that was first included in the energy balances, other measures to increase energy efficiency, and ultimately, the need for unified energy policy for 27 members of the EU. In the year 2008, three percent of total electricity (3.4 million gigawatthours) in the EU was derived from biomass and waste. It was about one fifth of the total energy obtained from renewable sources including hydroenergy. The major part of the plan is that by the year 2030, 11 percent of powerplant produced electricity produces by biomass and waste processing, or seven percent of the total output of 4.4 million gigawatthour electricity would come from these sources. The era of production of electricity and thermal energy from biomass and waste is just beginning, and Serbia certainly has the potential.

According to the most restrictive estimation, biomass in Serbia equivalents 2.8 million tons of oil and waste equivalents further 200000 tons of oil. This maches total annual consumption of liquid fuels in Serbia. Serbia is much richer in those resources compared with many other countries, viewed per capita or per territory. Biomass and waste processing technologies are fully mastered and do not require high investment. High investment activity of about 3000 billion euros in energy sector is planned in the European Union by the year 2020 , primarily in the capacity renewal and efficiency increase.

By the year 2010, the renewable energy industry employed 400000 people, and by the year 2020, some 700000 more jobs will be created. Serbia has a wealth of resources and investing in renewable energy should start the investment energy cycle.

The European Union uses 17 percent waste for energy production, out of the annual potential of 70 million tons. In some countries such as Denmark, Germany, Netherlands and Sweden up to 35 percent of waste is utilized for energy production, while in countries such as Bulgaria, Greece and Romania these activities amount to only two percent. The largest number of power plants with renewable co-combustion of solid renewable fuel (SRF) is Germany, (10), Veneto area in Italy and Denmark. Serbia is lagging behind with use of biomass and waste for energy purposes. We have continual monitoring of waste, municipal waste is disposed of in landfills without treatment, and industrial waste is disposed together with household waste. Composting and incineration are incidental processes, very few companies are engaged in recycling waste, while processed waste is used in only one cement plant. Converting waste into energy is inevitable in modern societies, but it is sustainable only if it is economically and technically feasible. The economic impact depends on the composition and quantity of waste. Environmental effects depend upon the technologies for waste processing and energy values.

Firm renewable fuel (SRF) obtained by processing municipal and industrial waste is better than coal, since is renewable, has a relatively low production cost and price stability, and is considered to be CO_2 neutral. According to some estimates, there were over 820000 tons of waste in Serbia in 2010, that could have provided over 400000 tonnes of SRF. Calorific value of one kilogram of solid renewable fuel is about 18.7 megajoules [6]. Introducing co-combustion of waste with coal in Serbia could be of interest for further work thermo-energetic plants whose exploitation is not profitable. Also, there is the entrance fee paid to the utility company by the citizens for waste collection and entry fee paid to the owner of the SRF co-combustion plant in Europe. European average is 60 Euros per ton, ranging from 30 to 100 Euros, depending on the country. With 60 Euros per ton and use of anout 50 % of waste, it is possible to make profit of 24 million Euros per year. Also, decreasing CO_2 emission could make additional profit of up to 38 million Euros annualy, decreasing coal consumption by 700000 tonnes. Finally, that would help create jobs, waste fule markets and more efficient waste management. Although making great advantages and savings, contemporary processes of waste management are expensive and complicated, making every government postponing its implementation until after the election or leaving it to the successing one. In addition, it is difficult to convince citizens that incinerator in their neighborhood will not adversely affect them, since it may. That is why, Serbian government has failed to find a location for one such facility even after a second attempt. On the other hand in developed countries, these incinerators are located in city centers [7].

Our laws conform to European directives, but not enough. For example, in Germany, one percent of waste goes to landfill, and the rest is processed. In Serbia, out of 2.2 million tons of waste per year, only two cement plants use a small portion. But the transition from municipal waste to fuel is not so simple. On the other hand, as long as the organic waste could be disposed of in landfills, cost will be no motive for recycling into fuel.

One ton of waste can produce 650 KWH electricity. However, utilization of waste for electrical energy is 25 to 30 percent, and the heat from 75 to 80 percent. Calorific value of waste increases with the degree of recycling, as the primary form of waste does not have particularly high value [2].

Burning waste affects the environment. Often referred to dioxins and Furin, substances that are carcinogenic and mutagenic even. Also, the rest of the combustion process makes the ash remains in the filter that must be exported as hazardous waste, because there is no facility for processing hazardous waste in Serbia, and it becomes a problem from an economic standpoint. Waste incineration is one of the controversial issues for many communities and it is important to ensure public support, which is not easy, bearing in mind the possible dangers emerging from it.

With regard to investment levels, estimates suggest that around one million euros per megawatt of installed capacity and annual costs of depreciation amount to about 20 percent of investment, should be invested in the waste operated heating plant. As in all matters, the funding is crucial [8].

Even a primitive way of garbage disposal has the using potential. The same can be done to sewerage. Belgrade is one of the few European cities that discharge untreated sewage into the Danube. Sewage gas is the fuel that many exploit, and the result is a clean water. About 5000 cows produce manure from which enough biogas to power one megawatt power can be extracted.

4. CONCLUSION

Waste has a negative impact on the environment. Since it was estimated that Serbian coal reserves are to be used up in the period from 2030 until 2050, and that electricity consumption will rise by 60 % during the next 20 years, it is clear thet Serbia must find alternative sources of energy supply. For waste disposal in Serbia, currently is spent 15 to 18 euros per ton, while modern and environmentally friendly method of disposal, by which waste could be used as fuel, costs 120 euros. Barrier to the use of waste as fuel in our country are low energy prices, high investment costs, expensive loans and under-developed recycling system.

One of the solutions is the potential of municipal waste, biomass, solar, geothermal and wind energy. Municipal waste could be used as a renewable energy source and that is one solution to the problem of supply security and rational use of energy. This would solve the problem of waste.

Waste as a fuel reduces dependence on fossil fuels, reducing the required capacity of the landfills for over 95 percent, while creates revenues by selling the energy produced.

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FUTURE ENERGY SYSTEMS

ENERGETSKI SISTEMI BUDUĆNOSTI

Ana-Marija Đurić[1], Rade N. Kostić[2], Emir Avdić[3], Saša Stevanović[3]
[1]Faculty of Management Zajecar, [2]Specijalna bolnica za rehabilitaciju Gamzigrad, Gamzigradska banja
[3] Venus Project Serbia

***Abstract**: This paper work presents a comparative overview of already available and known forms ofalternative energy and some previously unknown forms of energy that are part of the Venus Project. What is important is that all of these energy forms are possible and very usable and meet the needs of humanity completely. In this paperwork are represented alternative energies as solar energy, wind energy, hydropower, ocean energy with the example of mariculture and sea-farming and the efficient utilization of the Gulf Stream. It is our present and future. As soon as we all turn at 100% utilization of clean and renewable energy, before we will protect our Planet from disaster.*
***Key words**: alternative energy, Venus project, renewable energy, sustainable development, clean energy, solar energy, geothermal energy, wind power, Golf stream*

***Apstrakt**: Ovaj rad predstavlja uporedni pregled već postojećih i poznatih alternativnih vidova energije i nekih do sada nepoznatih vidova energije koji su deo Venus Projekta. Ono što je bitno jeste da su svi ovi vidovi energije vrlo mogući i iskoristivi i zadovoljavalju potrebe čovečanstva u potpunosti. U ovom radu su predstavljeni vidovi energije kao što su solarna energija, energija vetra, energija vode, energija okeana sa primerom uzgoja morske poljoprivrede kao i efikasno iskorišćenje Golfske struje. To je naša sadašnjost i budućnost. Što se pre svi okrenemo na korišćenje 100% čiste i obnovljive energije, tim pre ćemo zaštitit našu Planetu od katastrofe.*
***Ključne reči**: alternativna energija, Venus Projekat, obnovljiva energija, održivi razvoj, čista energija, solarna energija, geotermalna energija, snaga vetra, Golfska struja*

1. INTRODUCTION

At present we are left with very few alternatives. The answers of yesterday are no longer relevant. Either we continue as we have been with our outmoded social customs and habits of thought, in which case our future will be threatened, or we can apply a more appropriate set of values that are relevant to an emergent society. Experience tells us that human behavior can be modified, either toward constructive or destructive activity. This is what The Venus Project is all about - directing our technology and resources toward the positive, for the maximum benefit of people and planet, and seeking out new ways of thinking and living that emphasize and celebrate the vast potential of the human spirit. We have the tools at hand to design and build a future that is worthy of the human potential. The Venus Project presents a bold, new direction for humanity that entails nothing less than the total redesign of our culture. What follows is not an attempt to predict what will be done, only what could be done. The responsibility for our future is in our hands, and depends on the decisions that we make today. The greatest resource that is available today is our own ingenuity. The Venus Project advocates an alternative vision for a sustainable new world civilization unlike any social system that has gone before. Although this description is highly condensed, it is based upon years of study and experimental research by many, many people from many scientific disciplines.

One of the basic premises of The Venus Project is that we work towards having all of the Earth's resources as the common heritage of all the world's people. Anything less will simply result in a continuation of the same catalog of problems inherent in the present system.

2. RESOURCE BASED ECONOMY (RBE)

Earth is abundant with plentiful resources; today our practice of rationing resources through monetary methods is irrelevant and counter productive to our survival. Modern society has access to highly advanced technologies and can make available food, clothing, housing, medical care, a relevant educational system, and develop a limitless supply of renewable, non-contaminating energy such as geothermal, solar, wind, tidal, etc. It is now possible to have everyone enjoy a very high standard of living with all of the amenities that a prosperous civilization can provide. This can be accomplished through the intelligent and humane application of science and technology. When education and resources are made available to all people without a price tag, there would be no limit to the human potential. Although this is difficult to imagine, even the wealthiest person today would be far better off in a resource based society as proposed by The Venus Project. Today the middle classes live better than kings of times past. In a resource based economy everyone would live better than the wealthiest of today. In a resource based society, the measure of success would be based on the fulfillment of one's individual pursuits rather than the acquisition of wealth, property and power. [1]

3. ALTERNATIVE ENERGY FOR SUSTAINABLE DEVELOPMENT

Power plays a great role wherever man lives and works. The living standard and prosperity of a nation vary directly with the increase in the use of power. The electricity requirement of the world is increasing at an alarming rate due to industrial growth, increased and extensive use of electrical gadgets. According to world energy report, we get around 80% of our energy from conventional fossil fuels like oil (36%), natural gas (21%) and coal (23%). It is well known that the time is not so far when all these sources will be completely exhausted. Nuclear energy is a comparatively clean source of energy. However, safe handling of nuclear energy reactor is a sophisticated task and only around 7% of the world's total energy requirement is being satisfied by it today.

As human needs know no bounds, today most of the nations worldwide have been passing through a phase of power deficit. The crisis is more critical among the developing nations. The increased power demand, depleting fossil fuel resources and growing environmental pollution have led the world to think seriously for other alternative sources of energy. Basic concept of alternative energy relates to issues of sustainability, renewability and pollution reduction. In reality alternative energy means anything other than deriving energy via fossil fuel combustion. Various forms of alternative energy sources are solar, wind, biogas/biomass, tidal, geothermal, fuel cell, hydrogen energy, small hydropower etc.

Solution to long-term energy problem will come only through Research and Development in the field of alternative energy sources.

Many rural communities consume little electricity, and extending electricity grids to meet their energy needs may prove more costly and take longer than harnessing new and alternative sources of energy already available in these communities — wind, solar, and biomass — through Renewable Energy Technologies. Solar energy panels are little costly considering our average economic standard. Studies indicate that cooking with biogas (a highly combustible fuel comprising methane, carbon dioxide, nitrogen, hydrogen and hydrogen sulphide produced through anaerobic fermentation of organic matter) can be cheaper than cooking with any commercial fuel. Wind power has also proved to be a viable energy alternative.

Timochian District is very favorable for the utilization of this type of alternative energy because it lies in a position where it forms a so-called "wind rose". Solar eneregy is also very used in Serbia from individual solar panels for home use to the first solar power plant that was recently installed in Blace, the strenth of 10 kW, which is currently conducting a test work, so in the near future could deliver electricity to EPS.

Figure 1. Solar power plant in Blace
Source:[9]

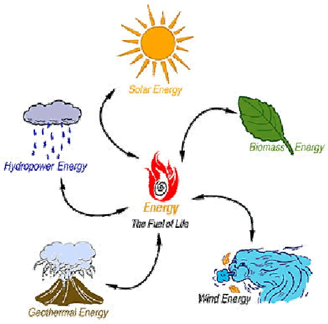

Figure 2. Alternative sources of energy
Source: [8]

4. RENEWABLE AND CLEAN SOURCES OF ENERGY IN VENUS PROJECT

All reliable examinations and analyses the last thirty years point in the same direction: The use of fossil fuels in the transport sector and the energy provision should not continue like today. The increase in greenhouse gas emissions in the same time period also gives rise to concern. In 1987, the international Brundtland Commission, led by Gro Harlem Brundtland, Prime Minister of Norway at the time, presented the report “Our common future”, the first overall and all-inclusive political analysis of the international environmental challenges. The concept "sustainable development" waslaunched here among other things. The report recommends the countries to change the energy consumption and to base their welfare on a sustainable development. In 1997, the Kyoto protocol was established on the basis of the Kyoto agreement. This means that that the global emission of greenhouse gases will be reduced by 5.2 per cent in relation to the 1990-level within 2012. Norway is among the countries that have ratified the agreement that came into force on February 16th 2005. [2]

In this agreement, we were required not to increase the greenhouse gas emissions by more than one per cent compared to our 1990-level. In 2005, emissions had however increased by eight per cent in relation to 1990. The autumn of 2006, former Chief Economist in the World Bank, Sir Nicholas Stern, presented the report "The Stern Review". It painted a gloomy picture of the situation if the international community doesn't manage to halt the increase of greenhouse gas emissions. The report determines that this development must be turned now, and that the serious consequences will manifest themselves as early as within one generation. Stern and his analysts predict that several areas in the world will experience lack of drinking water, several hundred million people will start a migration as a consequence of a rise in the sea level of one meter or more, and what is the most serious: A global lack of food. The report also points at an increase of climatic weather phenomena as storms, floods, forest fires and drought. We still have more than enough resources to achieve a high standard of living for everyone. But it's time to move beyond failed programs and frustrations to innovative solutions that could be applied now if we direct our attention to overcoming scarcity. We have the capability to intelligently apply humane science and new technology to provide for most human needs, and to reclaim and restore the natural environment. Fossil fuels such as oil and coal allowed our civilization to progress to its present state of development. However, these energy sources are limited and non-renewable, and one of many environmental dangers. [3]

In designing a new civilization we must harness energy, a major source of material well-being for all nations. This is a double-edged sword. When placed in the hands of private interests and greed, energy can be used for destruction. The current stock of atomic weapons can destroy the world many times over. But fusion power and other forms of clean energy, when used intelligently, with human and environmental concern, could provide all of the nations of the world with clean, unlimited energy sources and a standard of living unattainable today. Much remains to be accomplished in the undeveloped areas of our planet. Vast and untapped energy sources remain largely unexplored and untouched. These include wind, wave, and tidal action, ocean currents, deep ocean pressure and temperature differentials, falling water, geothermal and electrostatic power, hydrogen and natural gas, algae, bacteria, phase transformation, and thermionics, or the conversion of heat into electricity by boiling electrons off a hot metal surface and condensing them on a cooler surface. Additionally, there is the untapped potential of Fresnel lenses, inflatable dome versions of which are being developed for use as optical concentrators in solar power systems. Fusion power welds together light atoms such as hydrogen and lithium. Fusion energy is the energy that drives the cosmos and the stars. When we learn how to harness it, the world's energy problems can be solved forever, without any detrimental effects or dangerous toxic materials to be disposed of. The only residue would be the clean ash of helium. Oceanographers tell us that the world's oceans, occupying 70.8% of the earth's surface, posses an endless supply of surging energy called deuterium, a heavy hydrogen atom locked in the seawaters. According to John D. Isaacs and Walter R. Schmitt, the amount of fissionable uranium and thorium in the oceans can support our present level of power production for millions of years. It is highly probable that in the next century our main source of energy will be thermonuclear fusion or geothermal extraction. Both appear relatively free of the hazards inherent in energy produced by nuclear fission. We could also utilize solar concentrators as an alternative to fossil fuels for the generation of heat. The Argonne National Laboratory and ARDI are developing a production technique for solar cells that will be nearly 70% efficient at a cost one-tenth that of silicone-based cells. There are many other possibilities for developing photovoltaic systems that generate electricity while harnessing the currently untapped radiant heat energy. [4]

The world's single most powerful hydro-electric project is now being constructed in the Tsangbo Bend in Eastern Tibet, where the river Tsangbo is fed by great glaciers and waterfalls which descend over seven thousand feet. When the Chinese harness the energy of this dam, it is estimated that the turbines in this power project will produce more than forty million horse-powers. This is equal to the total world production of hydroelectric power today. Another vast untapped energy option is the development of piezoelectric materials. This source could be employed by using laminated systems inside cylinders, activated by the rise and fall of tides.[6] A recent development of one of these materials is polyvinylidene-fluoride. Five square kilometres can supply electricity for two-hundred-and-fifty thousand people at a cost of one to three cents per kilowatt power, a considerable savings over fossil fuels. If we developed and harnessed only 1% of the geothermal energy available in the crust of the earth, all our energy problems would be eliminated. Geothermal energy can supply us with more than 500 times the energy contained in all the fossil, oil, and gas resources in the world. Geothermal power plants produce very little sulphur, compared to fossil fuels, and emit no nitrogen oxide or carbon dioxide. A relatively small area of land is required for the power plant itself. Geothermal power is the most economical and efficient way to heat and cool buildings. Natural heat stored underground in combination with the permafrost zones could generate thermal electric power and utilize this power to cool buildings in warm weather with geothermal heat pumps. Geothermal energy can also be used to grow plants year round in enclosed areas, as has already been accomplished in Iceland and elsewhere. In this way fresh vegetables could be cultivated in all seasons. A similar process could be used for fish farming and in other regions where heating and cooling is needed. If we had applied just one tenth of what we've spent on military equipment to the development of geothermal generators, we could have long ago solved any energy shortages.

Only by utilizing the best planetary planning can wasteful consumption be reduced. Only by reducing wasteful consumption can we achieve our end goal, the highest possible standard of living for all of the world's peoples.

Examples:

- HARNESSING THE GULF STREAM

Figure 3.
Source: [7]

These underwater structures convert a portion of the flow of the Gulf Stream through turbines to generate clean electric power. The turbines would have a centrifuged separator and deflectors to prevent harm to marine life.

- DESALINIZATION PLANT

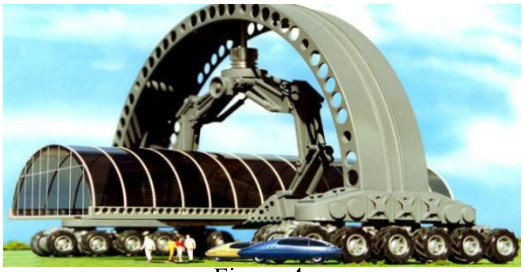

Figure 4.
Source: [7]

This mega-machine if transporting a transparent enclosure used for evaporative condensation. It would be placed over canals, some of them containing salt water, and could serve as a desalinization plant to supply clean water for drinking, irrigation, and other needs. This is accomplished by harnessing the power of the sun and will eliminate water shortages throughout the world.

- GEOTHERMAL ENERGY PLANTS

Figure 5.
Source: [7]

In the future, as refinements in conversion technologies increase its feasibility, geothermal energy will take a more prominent role in reducing the threat of global warming. Readily available in many regions throughout the world, this source alone could provide enough clean energy for the thousand years.

5. CONCLUSION - THE OCEAN FRONTIERS OF TOMORROW

Life on our planet is supported by the hydro-cycle, that great variation of forms of water which are part of the planetary circulation: the ocean, snow, ice, rain, lakes, groundwater, and aquifers. This constantly renewed circulation, powered by the heat of the sun, the rotation of the earth, and Coriolis forces, supports the entire life cycle, including humankind. We often speak of underdeveloped land areas but rarely of the greatest undeveloped natural resource on the planet, which are the world's oceans. Although humans have used the oceans of the world for thousands of years as a source of foods and transportation, we are only now beginning to recognize the enormous potential and diversity of this relatively untapped resource. The oceans offer an almost limitless environment for food, energy production, minerals, pharmaceuticals, and much more. Our near future represent cities under water, mega machines (structures) for ocean mining, mariculture and sea-farming, undersea observatories and many more as possible to build on the vast expanse of ocean. In general, all forms of renewable energy is our future, without exception, endless possibilities of designing and constructing, the only limit is the ocean.[5]

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GEOTERMALNA ENERGIJA KAO RAZVOJNI POTENCIJAL SRBIJE

GEOTHERMAL ENERGY AS DEVELOPMENT POTENTIAL OF SERBIA

Dalibor Miletić[1], Anton Vorina[2], Radosav Milutinović[3]
[1] Visoka škola za menadžment i biznis Zaječar
[2] Poslovno-komercijlna šola, Celje, Slovenija
[3] Centropromet, Ćuprija

Abstract: *A number of unforeseen difficulties at the present time burden the modern society which include more and more present lack of non-renewable energy sources. Highly developed countries have realized the importance and necessity of seeking alternative or renewable energy sources. For a country in transition such as Serbia, of vital importance is the use of renewable energy. An important component of renewable energy sources is geothermal energy which is the major producer of thermal and electrical energy worldwide.*
Geothermal energy, as well as all types of renewable energy sources in our country, is very poorly developed and very little present in the overall energy system in Serbia. On the territory of many municipalities in Serbia there are significant potentials of geothermal energy that are almost not used. Strategy of Energy Development of Serbia does not treat geothermal energy as an important and vital resource that is several times greater than the total coal reserves in Serbia. The aim of this paper is to show the current status and prospects of the geothermal energy use in Serbia as an important component of renewable energy sources.
Key words: *geothermal energy, renewable energy sources, sustainable development, Serbia*

Apstrakt: *Brojne nepredviđene teškoće u današnje vreme opterećuju savremeno društvo među koje spada i sve prisutniji nedostatak neobnovljivih izvora energije. Visoko razvijene zemlje shvatile su značaj i neophodnost traženja alternativnih, odnosno obnovljivih izvora enegrije. Za zemlju u tranziciji, kao što je Srbija, od vitalnog značaja je korišćenje obnovljivih izvora enegrije. Značajna komponenta obnovljivih izvora energije je geotermalna energija koja je najznačajniji proizvođač toplotne i električne energije u svetskim razmerama.*
Geotermalna energija, kao i sve vrste obnovljivih izvora enegrije kod nas, veoma slabo je razvijena i vrlo malo zastupljena u celokupnom energetskom sistemu Srbije. Na teritoriji mnogih opština Srbije postoje značajni potencijali geotermalne energije koji skoro i da se ne koriste. Strategija razvoja energetike Republike Srbije ne tretira geotermalnu energiju kao veoma važan i vitalni resurs koji je nekoliko puta veći od ukupnih rezervi uglja u Srbiji. Cilj ovog rada je da ukaže na sadašnje stanje i perspektive korišćenja geotermalne energije u Srbiji, kao značajne komponente obnovljivih izvora energije.
Ključne reči: *geotermalna energija, obnovljivi izvori energije, održivi razvoj, Srbija*

INTRODUCTION

The modern world is faced with the problem of lack of energy. Non-renewable energy resources were often unavailable and not offering energy independence of a region. Irrational use of non-renewable resources have a huge impact on the environment. In accordance with the conferences on the environment, held 1992 in Rio de Janeiro (Agenda 21) and Kyoto, 1997, EU member states have pledged to reduce emissions which cause the greenhouse effect for at least 8% compared to level in 1990s, and that in the period since 2008 by 2012, through the use of renewable energy resources. [4]

In the last decades of the twentieth century the world has pronounced upward trend in the use of renewable energy sources. Special attention is placed on the use of geothermal energy because this energy resource, in addition to hydropower resources, the most important producer of electricity in the world. Commercial use of geothermal energy in the world there is only the last 70 years. Territory of the Republic of Serbia is rich with wealth of geothermal energy, considering that its specific geotectonic and geological structure determined the occurrence of a significant number of geothermal and hydrothermal vents.

1. RENEWABLE ENERGY SOURCE – GEOTHERMAL ENERGY

Sources of energy coming from nature and can be renewed represent renewable sources of energy. They have been more and more used in practice in recent years primarily because of their harmlessness to the environment. Wind energy, water and sun are most commonly used as renewable energy sources.

The term geothermal energy refers to the use of heat of the Earth inside being 4,000-7,000°C in the very center, which is approximately the temperature of the surface of the Sun. [9] The name geothermal comes from the Greek words *geo*, meaning earth, and *therme* meaning heat. [8] Geothermal energy is heat generated in the Earth's interior by slow decay of radioactive elements, chemical reactions, or frictions in the movement of tectonic masses.

The main medium that transfers heat from the interior to the surface is water or steam, and this component is renewed in such a manner that the water from the rain penetrates the deep cracks and is then heated there and circulates back to the surface, where it appears in the form of geysers and hot springs. The amount of this energy is so great that it can be considered as almost inexhaustible, and thus geothermal energy is a renewable source of energy.

The geothermal energy potential is enormous, there is 50,000 times more of this energy than all the energy that can be obtained from the oil and gas worldwide. Geothermal resources are found in a wide range of depths, from shallow surface to several kilometers deep reservoirs of hot water and steam that can be brought to the surface and used. Geothermal energy is found most often in the nature in the form of volcanoes, hot springs and geysers of water. In some countries, geothermal energy has been used for decades in the form of spa resorts or recreational-curative swimming.

The development of science was not limited to the area of medical exploitation of geothermal energy, but also directed the exploitation of geothermal energy towards the process of obtaining electricity, domestic heating and industrial plants. In addition, geothermal energy can be used for other purposes, such as paper manufacturing, pasteurizing milk, swimming pools, in the process of drying wood and wool, livestock production planning, but also in many other uses.

Benefits of using geothermal energy are:

- use of geothermal energy causes a negligible impact on the environment and does not contribute to the greenhouse effect;

- geothermal power plants take up less space and thus have little impact on the environment;
- it is a huge energy potential (provides unlimited power supply);
- the need for fuel is eliminated;
- when the geothermal power plant has been built, the energy is almost free, with less local consumption;
- the possibility of multipurpose use of resources (affecting the economic feasibility of exploitation).

Disadvantages of using geothermal energy are:

- there are not many places where it is possible to build a geothermal plant (conditioned by position, depth, temperature, percentage of water in a geothermal reservoir);
- restrictions regarding the composition of rocks and the ability to access and exploit;
- source of heat can be exhausted due to improper operation;
- presence of hazardous gases and minerals is a difficulty during exploitation;
- high initial investments required (early use and development) and high maintenance costs (due to corrosion, mineral deposits, etc.). [7]

The total capacity for production of geothermal energy worldwide in 2010 were 10,715 MW, which is 20% growth compared to 2005 when there were a total of 8,933 MW installed in 24 states (referring to the production of electricity). The number of countries that have shown interest in geothermal energy in the last few years has increased even more - in 2007 46 countries seriously considered this source of energy, and in 2010 the number of states increased to 70 which represents an increase of 52%. Notwithstanding this large increase, the number of states that do not use their huge geothermal potential is still great.

Of the 39 countries identified in 1999 as countries that can meet 100% of their electricity needs by using geothermal energy, serious use of this energy source started in only 9 states. A nuclear power plant can be taken as an example for the comparison of installed geothermal capacity: an average nuclear power plant has a capacity of 846 MW, and is therefore currently installed geothermal capacity in the world equivalent to the force of more than 12 average nuclear power plants. [9] We will show countries that in 2010 generated electricity from geothermal energy sources: [9]

Table 1. The generation of electricity from geothermal energy sources in 2010

	Country	MW
1.	USA	3,086
2.	Philippines	1,904
3.	Indonesia	1,197
4.	Mexico	958
5.	Italy	843
6.	New Zaeland	628
7.	Iceland	575
8.	Japan	536
9.	El Salvador	204
10.	Kenya	167

11.	Costa Rica	166
12.	Nikaragva	88
13.	Russia	82
14.	Turkey	82
15.	Papua New Guinea	56
16.	Guatemala	52
17.	Portugal	29
18.	China	24
19.	France	16
20.	Ethiopia	7.3
21.	Germany	6.6
22.	Austria	1.4
23.	Australia	1.1
24.	Thailand	0.3

As can be seen from the data shown USA are the leader in producing electricity from geothermal energy having 3,086 MW of installed capacity. The next are the Philippines with 1,904 MW, 1,197 MW from Indonesia, Mexico, with 958 MW, followed by Italy as the best European country with 843 MW.

The study of the European Organization for Security and Cooperation in Europe (OSCE), indicated that the use of geothermal energy and its resources in Serbia is very small compared to the potential. At first glance, the reasons for this are obscure, especially when considered that some sources are among the best sources in Europe. In addition, the development of geothermal technology in Serbia began at the same time as in the countries where today this area is at the highest level of development, so the lack of use of this resource is simply incomprehensible.

2. GEOTHERMAL ENERGY IN SERBIA

Serbia is very rich in hydrogeothermal resources, which are primarily reflected in the appearance of natural thermal waters with temperatures above 15ºC, the number of which reaches over 200 Unfortunately, their use is concentrated in the spa treatments and in sports and recreational purposes. Thermal power of these sources is less than 160MJ/s, but it is considered that the real potential is at least five times higher than realized.
The Ministry of Energy considers that the main reason for poor utilization of geothermal resources is unsystematical investigative and preparatory work for the use of geothermal resources and lack of incentives for the use of this energy source. The potential of this resource in Serbia is 185,000 tonnes of oil equivalent, which is the fifteenth of the total potential of renewable energy, which is equivalent to burning 3.1 million tons of oil.

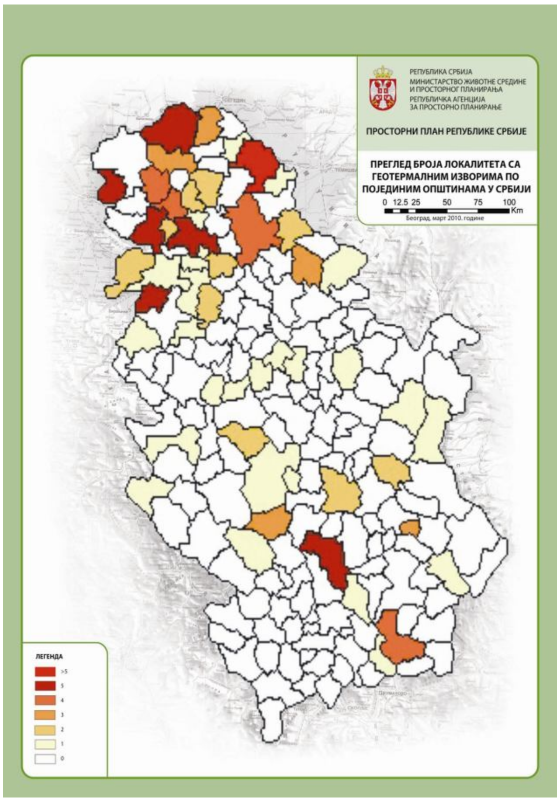

Figure 1 Summary of sites with geothermal sources by individual municipalities in Serbia [12]

As can be seen on the displayed map, the AP Vojvodina has the greatest potential for geothermal heat sources. "In Serbia, except the Pannonian Basin, there are as many as 160 natural springs of thermal waters with temperatures above 15ºC. The total abundance of natural resources is about 4,000 kg/s. In Serbia there are 55 hidrogeothermal systems - 25 in the Dinarides, 20 in the Carpathian - Balkans, and 5 in Serbian - Macedonian Massif and the Pannonian Basin. In the mountainous central part of Serbia there is extremely large number of sites of mineral and thermal waters - even 241 that are located in the territory of Vojvodina, Posavina, Macve, Danube and the wider area of central Serbia, as well as in existing spas. Serbia has about 59 thermal spas.” [5, p. 237]

In addition, "based on previous studies and measurements in the Republic of Serbia natural and artificial sources of thermal waters in the territory of more than 60 municipalities were identified. Water temperature is usually in the range up to 40ºC, while only in the territory of 6 municipalities the water temperature is above 60ºC, that is in the municipalities of Vranje, Sabac, Kuršumlija, Raska, Medvedja and Apatin. The average flow of water from existing sources and wells average up to 20l/s. At several locations the water flow exceeds 50l/s (Bogatić, Kuršumlija, Pribojska Spa, Niska Spa), and only in one location the water flow is over 100l/s (Koviljaca Spa)." [5, p. 237] The total thermal power that could be achieved by the utilization of existing sources of thermal water is about 216 MWt, which is equal to the amount of about 180000 tonnes of oil equivalent.

This energy potential is mostly low-temperature energy, which cannot be used to produce electricity by applying conventional technology. The use of existing geothermal wells will move in the direction of heat production in various sectors - in spas swimming pools for treatments, heating domestic water or space, on farms for space heating, heating greenhouses for agriculture, fisheries and others. Thermal springs in the municipalities and the water temperature: [5, p. 237]

temperature of 20°C to 40°C have on its territory the municipalities and cities of: Mun. of Požarevac, Mun. of Malo Crniće (Salakovac), Mun. of Smederevo (Jugovo), Mun. of Prokuplje (Suva česma, Vička banja), Mun. of Kuršumlija (Prolom banja), Mun. of Preševo (Miratovce), The city of Belgrade (Leštane, Braće Jerković), Mun. of Obrenovac (Poljane), Mun. of Lazarevac (Vreoci), Mun. of Sopot (Koraćica-Kosmaj), Mun. of Ljig (Onjeg), The town of Aranđelovac, Mun. of Topola (Stragari), Mun. of G. Milanovac (Mlakovac), Mun. of Čačak (Gornja Trepča), Mun. of Kraljevo (Mataruška Banja spa, Bogutovačka Banja spa, Vitanovac), Mun. of Vranjačka banja (Vrnjačka Banja spa), Mun. of Aleksandrovac (Mitrovo polje, Veluće), Mun. of Raška (Baljevac), Mun. of Brus, Mun. of Novi Pazar (Vuča), Mun. of Kosovska Mitrovica (Kisela spa), Mun. of Gnjilane (Ugljare)

temperature of 40°C to 60°C have on its territory the municipalities and cities of: Mun. of Smederevska Palanka (Palanački kiseljak), Mun. of Kruševac (Ribarska banja), Mun. of Bujanovac (Bujanovačka spa), Mun. of Uroševac (Klokot spa), Mun. of Mladenovac (Selters), Mun. of Kuršumlija (Lukovska spa, Banjska), Mun. of Novi Pazar (Novopazarska spa)

temperature of 60°C to 80°C have on its territory the municipalities and cities of: Mun. of Vranje (Sijarinska spa), Mun. of Raška (Jošanička spa), Mun. of Kuršumlija (Kuršumlijska spa)

warmer than 80°C: Mun. of Vranje (Vranjska spa)
Geothermal energy in Serbia is used symbolically, with only 86 MW, although according to the geothermal potential it is one of the richer countries. Its use and exploitation have to become more intense due to the force of the following factors: the tension of oil - energy imbalance, the inevitable transition to a market economy, a steady increase in the deficit of fossil and nuclear fuels, worsening environmental situation and the increase in costs for environmental protection.

The most important and largest users of geothermal energy in Serbia are spas. The use of this energy is mainly in balneological purposes, with about 60 spas using geothermal ground water for spa treatments, sports and recreation. "Geothermal energy in Serbia is not used to generate electricity, and research has shown that the use of geothermal energy for electricity generation could be an important component of the energy balance of Serbia. These reserves are estimated at somewhere around 400 x 10^6 tones of oil equivalent. We will present the total power from geothermal sources in Serbia in the following illustration.

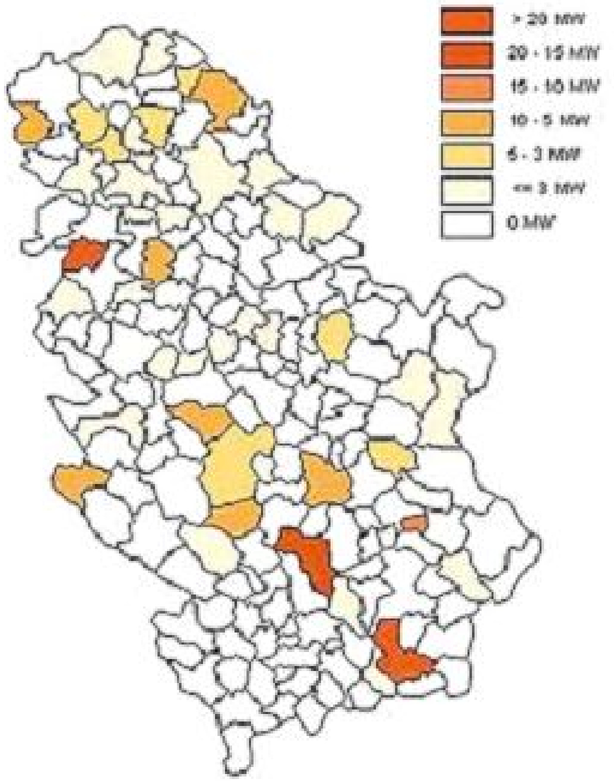

Figure 2 The total output of geothermal resources in Serbia [11]

Geothermal characteristics of the territory of Serbia are very interesting. This is a consequence of the favorable geological composition of the terrain and favorable hydrological and geothermal characteristics of the terrain. Geothermal flux density is the main parameter by which is assessed the geothermal potential of an area. It represents the amount of geothermal heat that every second through an area of $1m^2$ comes from Earth's interior to its surface.

For the most of the territory of Serbia geothermal heat flow density is higher than its average value for continental Europe, which is about $60mW/m^2$. The highest values of over 100MW/m2 are in the Pannonian basin, the central part of southern Serbia and in central Serbia. In Serbia outside of the Pannonian basin there are 160 natural geothermal springs with temperatures above 15ºC. The highest temperature of the water resources are in Vranjska Spa (96ºC), then in Josanicka Spa (78ºC), Sijerinska Spa (72ºC) and so on. The total yield of all natural geothermal sources is about 4,000 l/s. According to present knowledge in Serbia there are 60 geothermal waters with temperatures above 15ºC to a depth of 3,000 m

Table 2 The geothermal potential of the Republic of Serbia [3]

region	productivity/yield (l/s)	heating energy MW	heating energy TJ
Central Serbia	688	90	840–1680
Vojvodina	741	85	756–1512
Kosovo and Metohija	229	14	126–252
Total	1658	189	1722–3444

In Serbia, only geothermal energy from geothermal and mineral water is used, mainly in the traditional way, mostly in balneological and sports and recreational purposes. Using geothermal energy for heating and other energy purposes is at an early stage and very modest in relation to the potential of geothermal resources.

"The current state of application of geothermal energy in Serbia is such that in the last fifteen years, almost nothing has been done. On private initiative several shallow holes were drilled (up to 500m and 40 º C) and were activated for two to three existing wells. Energy efficiency in spas and sports-recreational centers, which use geothermal energy, has not been increased, since these centers are languishing without financial accumulation and are unable to invest in existing or new capacity adapted to new requirements.“ [2, p. 14]

The lack of laws and legal documents in Serbia related to geothermal resources, especially wells, are not available to new investors. Jurisdictions are not known, and if known, are so intertwined among various government bodies that it is virtually impossible to come into possession of a hot spring and to start or improve its use. A typical example is Vranjska Spa, where the whole river of warm water flows through the town, and the population is heated using electricity, wood or coal.

The total amount of heat which is accumulated in the sites of geothermal waters in Serbia to depth of 3km, is about two times higher than the equivalent of thermal energy that could be obtained by burning coal of all kinds from all their sites in Serbia. Abundance of 62 artificial geothermal sources, ie. geothermal wells in the region of Vojvodina is about 550l/s, and thermal power of about 50MW, and the rest of Serbia from 48 wells is 108MW.

For the production of electricity from geothermal sources temperature must be 100ºC, while the water temperature of geothermal resources in Serbia is mostly in the range up to 40ºC. Only six municipalities have in their territory the water temperature of above 60ºC - in Vranje, Sabac, Kursumlija, Raska, Medvedja and Apatin. Flows of water from existing sources and wells usually amounts to 20 liters per second, at several sites the water flow exceeds 50 liters per second (Bogatić, Kuršumlija, Pribojska Spa, Niska Spa), and only in Koviljaca Spa flow of water exceeds 100 liters per second.

Within Serbia, in addition to favorable opportunities for the exploitation of thermal energy and other resources from geothermal waters, there are good opportunities for the exploitation of geothermal energy from the "dry" rocks, that is. rocks that contain no free groundwater. In this case, water is pumped into underground hot rocks where it is heated. By pumping water heated this way, the transfer of energy from hot rocks is achieved. The exploitation of energy from this resource will start in due course taking into account the current minimum use of natural hot springs and mineral waters, although the technology for this application has been developed in the world.

In Serbia only geothermal energy from geothermal and mineral waters is used, mainly in the traditional way, mainly in balneological and sports - recreational purposes. Using geothermal energy for heating and other energy purposes is at an early stage and very modest in relation to the potential of geothermal resources. In Vojvodina, the use of geothermal energy started from 1981. For these purposes there are 23 wells. Waters from two wells are used for vegetable production in greenhouses. Three wells are used for heating in livestock farms for breeding pigs, two in leather and textile factories in the production process, the three warm-up office space, and waters from thirteen wells are used in spas, sports and recreational and tourist centers. The total heat output of these wells is 24MW.

Outside of the Pannonian basin and outside Vojvodina, geothermal waters are used for heating in several localities. This use for this purpose began forty years ago in Vranjska Spa. There is still heated geothermal water for greenhouse flower production, poultry farm, a textile industrial halls and rooms of spa rehabilitation center. The great hotel and rehabilitation center with a swimming pool is heated in Kuršumlijska Spa. The Niska Spa built a system for heating the hotel - tourist and rehabilitation center with a heat pump power 5MW, which uses the "waste" thermal water temperature 25ºC, which is the largest in Southern Europe.

In the same way, ie. with heat pumps, the geothermal water with temperatures of 30ºC is used in Prolom Spa. The total installed capacity at all locations where it directly uses geothermal - mineral water is about 74 MW, a heat pump is 12 MW. According to the present state of knowledge of geothermal resources, the richest, and therefore the most important hydro resources are located in Macve, then the area of Vranjska and Josanicka spa.

In the above examples, spas, and many other spa resorts and spas in Serbia, it is clear that this potential can greatly contribute to the development of tourism and the quality of medical services, but it is also the potential energy of the future. Unused geothermal energy sources in Serbia suggest that in Serbia both the professionals and those engaged in the conduct of politics and the country must address this source of energy.

CONCLUSION

Present, and the old problem of Serbia's energy sector, which is run by people who aim to only millions of tons of coal to be excavated. The concept of low temperature energy does not exist in the current Serbian Energy Strategy. Geothermal energy in the classical sense (hot springs and wells) is mentioned in terms of declarative commitment to the development potential of this sector in Serbia, but without concrete measures and solutions.

In Serbia there are natural and artificial sources of thermal waters in the territory of more than 60 municipalities. The potential energy due to low water temperature is not sufficient to produce electricity, but could be used for heat generation in different areas. This energy of low temperature could be used for heating greenhouses, rooms, pools and other purposes, but the local government, investors and users do not have enough experience in using this source.

Intensification of development of geothermal resources to Serbia by 2015. could replace at least half a million tons of imported liquid fuels per year, according to a study OSCE on renewable energy in Serbia. The total amount of geothermal heat sources in Serbia is about two times higher than the thermal energy that could be obtained by burning coal of all kinds from all sites in Serbia.

Using geothermal energy and its resources in Serbia is very small compared to the geothermal potential. At first glance, reasons for this are obscure, especially when one considers that some of the best sources in Europe and the development of geothermal technology in Serbia began at the same time as in countries where today the area is at the highest level of development, says the OSCE in the study.

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USING OF HYDRO POTENTIAL FOR PRODUCTION OF ELECTRICITY IN SMALL HYDROPOWER PLANTS

KORIŠĆENJE HIDROPOTENCIJALA ZA PROIZVODNJU ELEKTRIČNE ENERGIJE U MALIM HIDROELEKTRANAMA

Violeta Jovanović, Dragan Mihajlović, Dragana Milojić
Faculty of Management Zajecar

Abstract: *It's already been a century since electricity in all its forms became one of the main drivers of civilization and a major engine of technological development of mankind. The issue of energy security and stability has become the major topic for discussion of global economic and social system in recent years. In order to preserve its security, renewable energy sources are becoming topical issue in all developed countries. Among the renewable energy sources, the important role belongs to hydro potential and construction of small hydropower plants (SHP) for generating electricity. Electricity generation in small hydropower plants has little or no negative impact on the environment, which is a major advantage over other sources. This paper presents the advantages of SHP and also points to the hydro potential of the Republic of Serbia.*
Key words: *renewable energy sources, electricity, small hydropower plants (SHP)*

Apstrakt: *Električna energija u svim svojim oblicima je već čitav vek jedan od glavnih pokretača civilizacije i glavni motor tehnološkog razvoja čovečanstva. Pitanje energetske sigurnosti i stabilnosti postalo je u poslednjih nekoliko godina kardinalno pitanje čitavog svetskog ekonomskog, privrednog i društvenog sistema. U cilju očuvanja ove sigurnosti obnovljivi izvori energije postaju aktuelno pitanje u svim razvijenim zemljama. Među obnovljivim izvorima značajno mesto zauzuma hidro potencijal i gradnja malih hidroelektrana (MHE) za proizvodnju električne energije. Proizvodnja električne energije u malim hidroelektranama nema gotovo nikakav negativan uticaj na životnu sredinu što predstavlja veliku prednost u odnosu ostale izvore. U radu su date prednosti MHE i ukazano na hidropotencijal republike Srbije.*
Ključne reči: *obnovljivi izvori, električna energija, male hidroelektrane (MHE)*

1. INTRODUCTION

A trend of researches in the world, dealing with new energy sources, has been going towards discovering renewable energy. Small hydro power plants are considered to have no detrimental impact on the environment, as opposed to the large ones, whose harm is described through major changes in the ecosystem (construction of large dams), impacts on soil, flooding, impacts on freshwater wildlife, increased methane emissions, and the existence of harmful emissions during the construction of hydropower plants, as well as materials manufacturing and transport.

Small hydropower plants are plants in which the potential energy of water is first converted into kinetic energy (in the turbine stator) and then into mechanical energy (in the turbine rotor) and finally into electricity (in the generator). Today, the technology related to hydropower, which is considered to be a renewable energy source, can be said to be technically the best known and most developed at a global level, with very high efficiency level. 22% of global electricity production comes from small and large hydropower plants.

Thorough consideration of the potential use of small hydropower plants in Serbia started in the late eighties of the last century, when the Energoprojekt and the Institute Jaroslav Cerni prepared a Cadastre of the small hydropower plants in The Republic of Serbia. The document showed that Serbia has a significant energy potential in small streams. However, the breakup of Yugoslavia and prolonged isolation of Serbia prevented the significant use of these resources and created a large backlog of Serbia in relation to developed countries, including the countries in the region. These delays and the inability of Serbia to deal with important issues related to the use of renewable energy **RES** and especially to the hydropower potential of small streams, coincided with the increased awareness in the world for the need of faster development of this potential due to threat of oil shortages and escalating climate changes. Serbia is now, on its way to the EU, faced with a number of binding decisions and regulations that must be met in the energy sector. Therefore, the responsibility of the Government and the competent Ministry of Energy to make fast and effective decisions, regulations and laws, is a lot higher. Given the tendency of the energy sector in the world, and considering the fact that Serbia has significant energy resources in hydropower (It is estimated that the total technical capacity to produce electricity is about 17 000 GWh, out of which about 10,000 GWh is used. Out of the remaining 7000 GWh, 5200GWh could be produced in large power plants and about 1800GWh in small. It is evident that the development of this sector could provide the necessary long-term energy source.

2. AN OVERVIEW OF PRODUCTION AND CONSUMPTION OF ELECTRICITY

According to the relevant data of the International Energy Agency (IEA) and other institutions dealing with energy statistics, production and consumption of all types of energy in the world are constantly growing. According to their latest statistics, the total energy consumption in the world in the period 2007 - 2035 will increase by 49%. [1]

Industrialized nations rely on vast quantities of readily available energy to power their economies and produce goods and services. As populations increase in developing countries and their citizens demand better standards of living, global energy use will continue to rise, with developing nations accounting for a growing share of total world demand (Fig. 1).

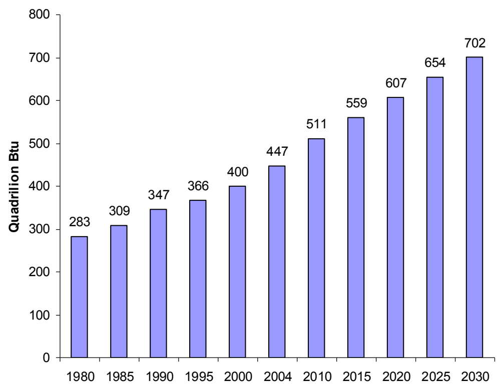

Figure 1. Demand for electricity [2]

As for OECD countries, there will be a mild increase of 14%, and in the countries outside the OECD, it will be as much as 84%.

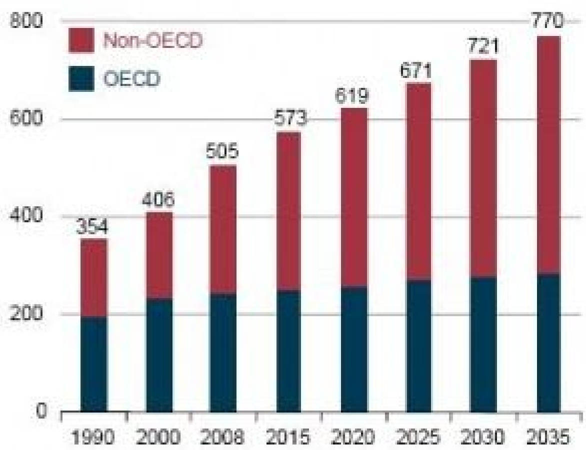

Figure 2. World energy consumtion [3]

In 2007, the annual net production of electricity in the world amounted to 18.8 trillion kWh hours. An increase to 25 trillion kWh, i.e. by 87%, is expected in the next 10 years (by 2020).

Today most of the world's energy is derived from fossil fuels, which are non-renewable resources available only in limited supply. In contrast, many alternative sources of energy, such as wind, solar, and hydropower, are renewable resources because their supplies are refreshed faster than humans consume them. Human society has profited from exploiting energy sources, particularly since energy use became much more efficient during the Industrial Revolution. We are now deeply dependent on reliable, cheap sources of energy. However, it is important to note that energy consumption does not directly improve the human condition. Rather, what matters are the services that we generate using energy. [4]

As for Serbia, our consumption of electricity is also rising year-in-year-out, as shown in the following graph.

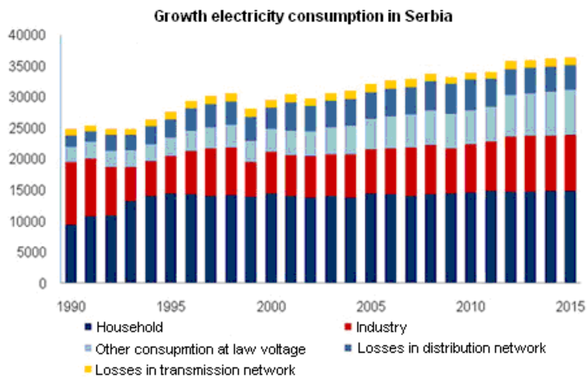

Figure 3. Growth electricity concumption in Serbia [5]

In the period from 2008 to 2015, an average annual growth rate of electricity consumption of about 0.9% is expected in the Republic of Serbia, with a peak power of about 0.5%. Relatively stable growth of electricity consumption of about 1.8% per year in the industry and somewhat lower growth (about 1.4% per annum) in consumption at low voltage, will lead to a reduction in consumption inequality. In 2015, final energy consumption will be about 31195 GWh, with a peak power of about 7,000 MW. Forecast is based on estimates of macroeconomic parameters of the economic development of Serbia until 2015, taking into account the effects of the planned rationalization of energy consumption.

3. DEVELOPMENT STRATEGY AND THE DIRECTIONS OF ELECTRIC POWER GENERATION

Humanity today faces two major problems in relation to electricity production. On the one hand we have considerable atmosphere pollution and excessive warming caused by emissions from various sources, which causes the greenhouse effect. Among the biggest polluters of the atmosphere are coal-fired conventional power plants, whose share in the world production of electricity is not small. On the other hand we are facing the constant need to increase the production of electricity, for which the main reasons are the following:

- Continuous population growth,
- a continuous economic growth (industry, agriculture, transport)
- rapid growth of information and telecommunication technologies in the world
- the introduction of new and tightening of the existing standards in industry, which require increased energy consumption.[1]

Global climate changes call for increased consumption, i.e. electricity production, due to the introduction of electric cooling systems in many parts of the world where previously it was not necessary. The world is fighting against sea level rise by building dikes, canals, etc, which also requires energy consumption. For all these reasons, strategy development and direction of electricity generation in the world in this decade are significantly changing. Since on one side, a steady increase in energy consumption is inevitable, and on the other side it is significant to reduce the pollution of the atmosphere and creation of the greenhouse effect, today's global strategy of electro industry is based on the following steps:

- facilitating production of electricity from renewable sources (hydro, wind, solar, biomass)
- gradual closure of the biggest polluters, mostly coal-fired conventional power plants,
- the closure of old nuclear power plants with high emission of heat into the atmosphere, with the risk of nuclear radiation, and the introduction of new types with the lowest possible heat emission and low risk of nuclear accidents.[6]

The Government adopted a long-term energy development strategy of Serbia until 2015, with the aim to determine priority directions of development in the energy sectors and approve of the program of adequate methods, which enables the implementation of key priorities in the work, operations and development of the whole energy system (in the sectors of energy production and consumption).

The range and structure of energy reserves and resources of Serbia is very unfavorable. Reserves of quality energy such as oil and gas are symbolic and represent less than 1% of the total balance reserves of Serbia, while the remaining 99% of energy reserves are various types of coal, which is dominated by low-quality lignite, with a share of over 92% in the total reserves balance. This especially applies to lignite that is mined from surface mines, with the exploitation of the total reserves of about 13 350 million tons, thus representing the most important domestic energy resource of the Republic of Serbia. The most important renewable energy resource in Serbia is hydropower (about 17 000 GWh), which has not yet been fully utilized, so that the energy development strategy in the future should be planned precisely in that direction.[7]

4. PRODUCTION OF ELECTICITY IN SMALL HYDRO POWER PLANTS

Small hydropower plants are complexes in which the potential energy of water is first converted into kinetic energy, then into mechanical and finally into electrical energy. In literature you can find various information on how to define the SHP. It is almost impossible to find two countries with identical classification. The main parameters that should be used in the classification of SHP are the following:

- Installed power of a generator
- types of aggregates in relation to the turbine and a method of functioning
- number of rotations
- method of functioning in relation to the overall energy system
- installed pad, etc…,

According to the power of the turbine, the following classification was adopted:

- 0 - 500 kW micro hydro power plants,
- 500 kW - 2MW mini hydro power plants
- 2 MG - 10 MW small hydro power plants.[4]

There are many good reasons for the construction of small hydropower plants. The advantages of building SHP compared to the construction of other energy sources are numerous:

- environmental justification;
- small losses in power transmission due to proximity of production source;
- involvement of private entrepreneurs in the sense of self-employment
- in relation to major HE, there are no large flooding areas (in order to provide the space for the accumulation of water), nor distortion of the local ecological system;
- irrigation can be provided, as well as water supply of nearby settlements, the construction of ponds and protection from flood;
- reduction of investments for electrification of remote villages connected to the general electricity network, thus contributing to the improvement of electrification of rural settlements;
- exploitation at very low material costs;
- working life is very long, about 30 years, although there are SHP already working for 80 years.[8]

Of course, SHP as a source of energy, compared to other similar sources have their drawbacks, such as:
- high investment costs per installed kW;
- high costs of research in relation to total investment;
- exploitation depends on the exploitation of existing resources
- It requires integrated water economy solution, but the priority must be given to systems for water supplying and for irrigation. Therefore SHP must work with installed flow which is determined by other consumers:
- if it works autonomously, electricity production depends on consumption, so a surplus remains unused.

5. CONDITION OF SMALL HYDROPOWER PLANTS IN SERBIA

Policy development of electro economy after World War II was for a very short period of time focused on the study and construction of small hydropower plants. In the course of that short period, a certain number of small hydro power plants were built, and then the research of small streams with the aim of building small hydropower plants was neglected. The state policy got oriented mainly to building large hydro power plants, such as the Iron Gate, Bajina Bšta etc. It was the right direction, but together with the construction of large hydropower plants, small ones should also have been explored, studied and built, and especially functioning of a large number of existing SHP should not have been stopped. According to available data, 28 small hydropower plants were built after World War II, with the installed power ranging from 10 to 8800 kW and 10 of them, mostly of smaller power, are out of function.

Given the geomorphological and hydrological conditions in Serbia, we can say that the total available potential is not to be neglected, and also that Serbia belongs to one of water-rich regions in Europe. The total hydropower potential of Serbia is estimated at about 17000 GWh, of which about 10,000 GWh was utilized up to now, so the total remaining, technically usable, power potential in Serbia is around 7000 GWh, which represents approximately 8.6% of final energy consumption in 2003. This potential is largely on the Morava River basin (2300 GWh), then on the Drina and Lim (1900 GWh) and the Danube (1000 GWh), for the construction of individual plants with power exceeding 10 MW and annual production of about 5200 GWh. [9]

About 900 potential sites on the rivers of Serbia, including the small rivers, were found suitable for building small hydropower plants (up to 10 MW), with possible production of around 1800 to 2400 GWh / year. While determining the possibilities for utilization of most of residual technical hydropower potential, one should bear in mind the crucial impact of non-energy related criteria for the multipurpose utilization of water, as well as a political agreement on the sharing of hydropower with the neighboring countries. The picture below shows the structure of the hydro potential of Serbia from which it is evident that the remaining technically feasible hydropower potential, over 25%, refers to the potential for small hydro power (up to 10 MW).[10]

Small hydro power plants are energy suppliers of up to 10 MW and fall into the category of privileged energy producers. Since our untapped hydropower potential belongs mainly to the small hydro power, that part was separately studied. A cadastre of small hydro power plants (below 10 MW) was developed. The results show the total installed capacity of 453 MW and average production of 1600GWh/ yr at about 856 locations. The table shows the allocation of small streams potential, for the unit power of 90 kW up to 8500kW, which can be constructed with the formation of accumulations for 1.2 billion cubic meters of water.

Today in Serbia, only 31 mini-hydro power plants of total capacity 34.654 MW and annual generation of 150 GWh are working. However, there is an interesting example of Knjaževac municipality, in which 15 micro hydro power plants of 20 to 100 kW were built, connected to the mains and put into operation in the period from 1983 to 2006. 38 mini hydro power plants with total capacity of 8.667 MW and the estimated annual production of 37 GWh are out of service in Serbia. These SHP can be trained to function with the investment that depends on the condition they are in. There are significant opportunities for SHP installation in existing water management facilities, which include considerably lower costs.[8]

6. EFFECTS OF BUILDING SMALL HYDROPOWER PLANTS IN SERBIA

As previously mentioned, according to the SHP cadastre, on the territory of Serbia there are 856 locations with the technical possibilities for the construction of SHP with the power of 100 kW to 10 MW, while on the territory of Vojvodina, there are 13 potential sites suitable for construction of SHP. The total installed capacity of these facilities would be about 450 MW with an annual production of about 1600GWh. For this volume of electricity production in thermal power plants, 2.3 million tons of coal or 400 000 m^3 of imported natural gas should be consumed. From this point of view, SHP would save annually about 52 million American dollars. To achieve this ambitious plan for each individual site, it is necessary to dispose adequate technical documentation that includes detailed analysis of all characteristics, so that the best selection of engines, machinery and electrical equipment could be provided. This would provide the best value investments in equipment and construction. The costs of building small hydropower plants vary and depend on the type of terrain and water courses, as well as on the power of the plants. The higher the facility power, the lower the costs per kW. It can be assumed that the average investment costs are 2000 EUR per 1 kW of installed power. Here is a simplified calculation for a small hydropower plant of 30kW:

Investment:
30 kW x 2.000 EUR / kW = 60,000 EUR = 6 million din.
(Exchange rate 1 EUR = 100din.)
The annual average production of electric power:
30 kW x 8000 h / year = 240,000.00 kWh / year
Annual income
240,000.00 kWh / year x 9din/kWh = 2,160,000.00 $ / yr
Functioning of a small hydro power plant is automated, so it does not require a large number of employees but only remote monitoring. Operating costs are minimal, so we are going to

ignore them here. A small plant produces three phase 400V supply and the energy is delivered by asynchronous generator directly into low-voltage network with counter measurements.
If all this is taken into account, the return of investment would be:

6.000.000 / 2.160.000 din/yr = 2,777~2,8 years

This is a very good investment return because all returns in less than 10 years are cost-effective.However it should be noted that such documentation currently does not exist for such facilities, therefore it is difficult to estimate investment possibilities. It should also be noted that a large number of sites listed in the cadastre is not economically viable.

Besides the direct economic impact, which has arisen due to building SHP, there are also many indirect effects. Taking into account that SHP use renewable energy for their functioning, then the savings of coal per each kWh are 1.6 kg to 2.2 kg of produced electric power (depending on the type and quality), or about 0.25 kg of fuel oil. In terms of sustainable development, this is beneficial not only because of preserving the existing natural resources, but also in terms of environmental emissions of sulfur oxides and nitrogen carbon oxide. These gases with greenhouse effect cause global warming and threaten to cause irreversible process of climate change on Earth. Considerable economic effects of constructing SHP can occur due to the relatively large share of domestic labor and industry, with virtually no imports of equipment from abroad. Domestic participation in such small projects is larger and more likely than it is for large systems.

7. CONCLUSION

Consumption of electricity, both in our country and abroad, is continually growing each year and therefore an increase in production is necessary. Today most of the largest producers obtain electricity mainly from fossil fuels. Classic thermal coal and fuel oil plants are the major polluters of the atmosphere. Unlike them, SHP have almost no impact on the environment. In addition to environmental quality, they have certain advantages over large facilities, such as fast and easy construction, less investment per kW of power, small losses in energy transfer due to the proximity of production, easy and inexpensive maintenance and the ability to install additional turbines, rapid return on investment, power supply to the places where there is no reason to set the transmission line network and so on. Hydropower potential of Serbia is not negligible, and because of all the advantages of small hydropower plants, they have a future in our country and the world, for both small entrepreneurs and large state-owned companies.

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SUSTAINABLE MANAGEMENT OF FOREST POTENTIAL IN TIMOCKA KRAJINA

ODRŽIVO UPRAVLJANJE ŠUMSKIM POTENCIJALOM TIMOČKE KRAJINE

Dragan Mihajlović[1], Vesna Simić[2]
[1]Fakultet za menadžment Zaječar
[2]Skupština opštine Knjaževac

Abstract: *Forests are one of the most complex ecosystems on earth and precious natural resource of great economic importance to man. Their excessive use has led to a constant reduction of forest area and the degradation of the environment. To stop this process, to follow the strategy of rational and wise management of forests, is one of the preconditions for a healthy environment and fight for the survival of the planet. Given the state of forests in theTimok region, the paper, based on internationally accepted definition of sustainable forest management, indicates the requirements for sustainable management that can ensure the fulfillment of certain assumptions. The aim is to point out that the successful use of forest resources should inter alia provide a balanced management of the forest fund, particularly in rural areas and improve the energy efficiency of forest ecosystems.*
Keywords: *forest, sustainable development, sustainable forest management, environmental protection, survival*

Apstrakt: *Šume predstavljaju jedan od najsloženijih ekosistema na zemlji i dragoceni prirodni resurs od izuzetnog ekonomskog značaja za čoveka. Njihovo preterano korišćenje dovelo je do konstantnog smanjivanja površina pod šumom i do degradacije životne sredine. Zaustaviti ovaj proces, slediti strategiju racionalnog i mudrog upravljanja šumama, jedan je od preduslova zdrave životne sredine i borbe za opstanak Planete. Imajući u vidu stanje šuma u Timočkoj krajini, u radu se, polazeći od međunarodno usvojene definicije održivog gazdovanja šumama, ukazuje na zahteve održivog upravljanja koji se mogu obezbediti ispunjenjem određenih predpostavki. Cilj rada je da ukaže da za uspešno korišćenje šumskih potencijala potrebno je između ostalog obezbediti uravnoteženo upravljanje šumskim fondom naročito u ruralnim područjima i povećati energetsku iskoristivost šumskih ekosistema.*
Ključne reči: *šume, održivi razvoj, održivo upravljanje šumama, zaštita životne sredine, opstanak*

1. INTRODUCTION

The global problem of the mankind is the protection and improvement of the environment. Sustainable development is a concept that aims to improve the quality of life in a way that combines: economic development, environmental protection and social responsibility [1]. These three factors are interrelated; none of them is self-sufficient, they must exist together to give a simple yet stable support. The essence of the concept of sustainable development is the harmonization of economic growth on one hand, and on the other, the use of natural resources and ecological systems. The main motto is not to stop development, but to find ways of development, which will not endanger the environment. These facts indicate that it is necessary to base the living standards of people on the capabilities of the environment without depleting the resources which must provide future generations with the satisfaction of their own needs.

By ruthless destruction of forests at the expense of new settlements and roads, a man threatens the survival of all species on Earth. Given the many uses and functions of forests such as productive, protective and social, they have become a multi-purpose facility for use. The requirements of the wider community for a lasting and sustainable forestry have been familiar through the generally accepted principles of forest management continuity. Developing awareness of the importance of forests as natural and industrial resources of the planet, has prompted various organizations in the world dealing with the environment and companies working with wood and managing forests to set up an independent nonprofit organization FSC in 1993. The goal of this council or committee is to encourage a responsible attitude towards the forests on the planet, through raising awareness among those who manage forests, in the wood processing industry as well as consumer awareness of the importance of sustainable development [2].

2. FOREST MANAGEMENT OBJECTIVES WITH REGARD TO THE PRINCIPLES OF SUSTAINABLE DEVELOPMENT

The importance of forests, the richness and diversity of species that are contained in them is best illustrated by the fact that they contain over 50% of global biodiversity. Forests also contribute to the establishment of forest soils, flood control, soil erosion, water retention and purification, oxygen production, etc.. Therefore the consequences arising from deforestation and degradation are so severe that at international conferences conservation and sustainable forest management are treated separately [3].

According to an internationally adopted definition, sustainable forest management is „... *the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems*" [4].

The requirements for sustainable forest management can be met only if certain conditions are provided. The obligations of forest regeneration and reforestation are the basic conditions for ensuring both static and dynamic functional durability [5]. As a contribution to meeting the objectives and priorities of National strategy of sustainable development, National policy of forest management and forest land sets out five general goals [1]:

- to provide and improve long-term resilience and productivity of forests and other ecosystems, as well as the maintenance of plant and animal species;
- management of forests and forest resources ensures sustainable fullfilment of social, economic and environmental functions of forests;
- forests contribute to sustainable social and economic development of rural areas;
- to provide long-term development and competitiveness of timber industry;
- long-term development of the forestry profession and forestry activities.

These objectives are fully compatible with the strategic framework and objectives of forest policy in Serbia. The objectives of forest policy in Serbia are the following [6]:

- preservation and enhancement of forests and the development of forestry as an economic area;
- increasing the contribution of forestry sector to economic and social development of Serbia;
- development and maintenance of the system for protection and improvement of forests in protected areas, based on a realistic evaluation of economic, environmental, social and cultural functions of forests, and in accordance with the National Strategy for Sustainable Development;
- the preservation, promotion, sustainable use and evaluation of biodiversity of forest ecosystems;
- the preservation, improvement, sustainable use and evaluation of protective and social functions of forests;
- ensuring sustainable development and profitability of the state forest sector, taking into account environmental and social requirements, as well as creating the greatest possible added value of forest products;
- creating an effective system of support to private forest owners to meet personal and general interests, as well as achieving the goals of sustainable forest management;
- by appropriate measures of forest management to provide the conditions for forest populations of wildlife (game) to preserve their genetic potential, the size and quality and to provide management control of animal population;
- creating a sustainable and economically efficient sector of wood industry that will be competitive on the world market and thus contribute to improving the forestry sector, environmental protection and development of domestic economy;
- education of appropriate professional staff in the forestry sector, who will be able to effectively fulfill the tasks aimed at sustainable management of forest resources and to actively participate in the development of environmental awareness among the citizens of Serbia;
- encouraging applied multidisciplinary research, technological development and improvement of capacity in research institutions in forestry;
- establishing and maintaining mechanisms for the efficient collection, storage, analysis and exchange of information within the forest sector and between other sectors, as well as raising awareness of the general public about the importance of forests and forestry for society as a whole, with the active participation of all stakeholders;
- establishing and strengthening international cooperation in all aspects of forestry and related fields in order to engage in activities related to forests and forestry in the global and regional level.

Based on the fact that forests are natural resources, the realization of the basic orientation of the Forestry Development Strategy of Serbia requires the definition of optimal forest management, regardless of ownership, as well as specific measures of economic policy. Forestry is a sector of economy which is defined as the science and skill of long-term forest management and other eco structures and resources related to forest [7].

3. THE CONDITION OF FORESTS IN TIMOČKA KRAJINA

The Timok area occupies the eastern part of the Republic of Serbia, and includes Zajecar and Bor region. Forests and forest lands are located in the mountains: South Kucaj, Cestobrodica, Rtanj, Malinik, Crni Vrh, Stara Planina, Tupižnica, Tresibaba, Miroc, Strbac, Deli Jovan and Severni Kucaj. According to administrative division of state forests, "Timok forest area" is located in the municipalities of: Bor, Boljevac, Zaječar, Knjaževac, Negotin, Kladovo and Majdanpek. State-owned forests and forest lands in the Timok forest area are managed by "Srbijašume" through SG "Timočke šume"-Boljevac based in Boljevac.

By analyzing the current state of forests in the Timok region it can be concluded that:

- the total area under forests in the Timok region is 325 600 ha, of which 142 800 ha (42.6%) state owned and privately owned 182 800 ha (57.4%);
- forest covered areas in the Timok region make 45.1%, and the optimal forest cover is estimated at about 55.0%;
- total volume of forests is 48.724.800 m3, and the total increment is 1.138.340 m3;
- average volume is 145 m3/ha, and the average increment is 3.39 m3/ha;
- the total volume of 54% are state forests and 46% are private forests, while the total volume is shared by both State and private forests equally;
- average volume is much higher in state forests and is 184 m3/ha, while in private forests it is 123 m3/ha [8].

As for the representation of tree species in state forests of the Timok forest area, 39 species have been recorded, of which 31 deciduous and 8 coniferous tree species. The most common tree species is beech, which in total volume accounts for 74.7%, followed by 9.5% of sessile, pine 4.0% , oak 3.4% , sladun 3.1%, grab 2.8%, spruce 0.5%, etc.. In the state owned forests of the Timok forest area, deciduous forest areas are represented by volume with 95.0% and by the current volume increment with 89.8%, while conifers are represented by volume with 5.0%, and by the current volume increment with 10.2% [9].

3.1 THE VULNERABILITY OF THE TIMOK FOREST AREA

Speaking of the forest as a complex and dynamic system, the most actual problem in this area is the problem of dry forests in large areas, which can lead to ecological disaster. When considering the problem of the drying of forests, the total number of possible causers of abiotic and biotic nature must be considered, as a connected chain of causers, for which it cannot be precisely told what is the beginning, what the main causer is. Thus, the modern organization in forestry, in addition to solving pollution problems, the occurrence of acid rain, soil salinization, soil degradation, erosion, sets the task of finding solutions to the danger of "dying forests". Registered harmful abiotic influences in "Timok forest region" are as follows:

Forest fires - are regular factors of abiotic impact on forests, which are very significant and very harmful, because in relatively short time they can cause damage of a large scale. Destruction of forests by fire, not only interrupts the process of timber production, but creates a completely different, new and extremely unfavorable situation, both in direct and indirect activities. Forest fires, as the damaging factor of the first order, in addition to great damage they make by direct action, create a lasting impact, sometimes difficult to correct, by their indirect action.

Drought - as a natural disaster, it has two effects on forests. First, it is the main cause of fire, and after long dry periods, the main cause of drying of new plants. The year of 2000 was a year of severe drought. That year a total of 41 fire was recorded on about 600 ha, when conifers and deciduous trees were caught. Also the drought of new cultures of up to five years of age was recorded, on over 150 ha.

Plant diseases - from plant diseases that occur or may occur on a large scale and as such have great economic significance are the following: redness and erosion of conifer needles, rotting vessels - honey fungus, Bending of pine shoots, dark cubical rot, white rot and others.

Pests - pests (insects) that occur or may occur in the calamities (outbreak) and as such have great economic significance are the following: The gypsy moth, a large saffron, saffron and others.

Snow and Ice - damage from snow and ice, as natural disasters, belong to unavoidable damages and the fight against these factors is impossible, except for the implementation of measures of regular care. However, after the damage, the intervention of professional bodies, in the repair of the damaged areas is inevitable. As with forest fires, the rehabilitiation of the damage caused is needed, and is reflected in the removal of broken and uprooted trees and establishing of forest order. Unplanned forestry and planting works are carried out with the very aim of restoring damaged parts and the whole stands, by the application of auxiliary artificial measures, which include reforestation of these areas [9].

4. SUSTAINABLE FOREST MANAGEMENT CRITERIA AND ACTIVITIES

Održivo gazdovanje šumskim resursima podrazumeva ispunjenje socijalnih, ekonomskih, ekoloških, potreba sadašnjih i budućih generacija za šumskim proizvodima i uslugama, kao što su: drvo i drvni proizvodi, voda, hrana, energija, sklonište i stanište za divlju faunu, rezervoari ugljen-dioksida, zapošljavanje, rekreacija, pejzaž i ostali šumski proizvodi. U cilju zaštite šuma, neophodno je preduzeti mere protiv štetnih efekata zagađenja, uključujući aerozagađenja, zagađenja od šumskih požara, štetočina i biljnih bolesti u cilju potpunog održanja njihovih vrednosti. Definisani kriterijumi za održivo gazdovanje šumama obuhvataju

Sustainable management of forest resources means the fulfillment of social, economic, ecological needs of the present and future generations for forest products and services, such as: timber and wood products, water, food, energy, shelter and habitats, carbon dioxide reservoirs, employment, recreation, landscape and other forest products. In order to protect forests, it is necessary to take measures against the harmful effects of pollution, including air pollution, pollution from forest fires, pests and plant diseases with the aim of complete conservation of their values. The defined criteria for sustainable forest management include [10]:

- sustainability of forest resources;
- biodiversity, optimum health and vitality of forest resources;
- productive function of forest resources;
- protective function of forest resources;
- social and economic function as well as legal, political and institutional framework.

Sagledavajući sadašnju situaciju šuma na ovom području, možemo konstatovati da Timočko šumsko područje karakteriše: nedovoljna šumovitost, bespravne seče, neadekvatan monitoring, šumski požari itd. Povećani pritisak na šume rezultat je teških ekonomskih uslova i povećanih potreba za proizvodima i uslugama od šume. Imajući u vidu da su šume sa jedne strane svedočanstvo istorijskih procesa, a sa druge strane razvojne opcije za današnje i buduće stanovnike Timočke krajine prioritetne aktivnosti odnose se na:

Given the current situation of forests in this area, we can conclude that Timok forest area is characterized by: insufficient forestation, illegal logging, inadequate monitoring, forest fires etc.. The increased pressure on forests is the result of difficult economic conditions and increased demand for products and services from forests. Bearing in mind that, on one hand, forests represent the testimony of historical processes, and on the other, the development option for the present and future residents of the Timok region, priority activities relate to:

1) implementation of the Strategy for Development of Forestry of the Republic of Serbia;
2) reducing the risk of over-exploitation of forests and the existing threatening factors in relation to forest ecosystems and
3) education and raising public awareness about the importance of forests for preservation and quality of the environment.

Achieving the goals of sustainable management of forest potential in the Timok region means taking the following actions [10]:

- ensuring the sustainable development of the state forest sector, taking into account environmental, social and cultural requirements, as well as creating the greatest possible added value of forest products;
- импровемент оф привате форестс анд сустаинабле девелопмент оф привате форестрI ин тхе рурал девелопмент;
- the preservation and improvement of genetic potential, the number and quality of wildlife population using adequate measures of planning, management and control;
- цреатинг сустаинабле анд ецономицаллI еффициент њоод индустрI њхицх њилл бе цомпетитиве он тхе њорлд маркет анд тхус цонтрибуте то импровинг тхе форестрI сецтор, енвиронментал протецтион анд девелопмент оф доместиц ецономI;
- education of appropriate professional staff in the forestry sector;
- encouragement of multidisciplinary applied research, technology development in forestry and capacity enhancement in research institutions;
- establishing and maintaining mechanisms for the efficient collection, analysis and exchange of information within the forest sector and between other sectors, as well as

raising awareness of the general public about the importance of forests and forestry for society as a whole, with the active participation of all stakeholders;
- establishing and strengthening international cooperation on the global and regional level in all aspects of forestry and related fields based on equality and national interests.

4.1 CONCEPT OF FOREST DEVELOPMENT IN THE TIMOK REGION

Given the importance of forest resources for the population in this area, and taking into account the principles of sustainable development, the concept of development and management of forests in the Timok region must be based on [11]:
- protection and improvement of existing forests with the efficient use of habitat opportunities and rejuvenation in order to eliminate the category of degraded and diluted forests and reduce it to a minimum;
- gradual increase in forest area should be made in equal pace (annual) with tree species selected in accordance with the natural potential habitat;
- during maintenance and expansion of forests, take into account the distinct territorial characteristics in terms of forest cover and forest condition, and accordingly take appropriate measures such as reconstruction, care, thinning, etc.;
- increasing reforestation should be carried out primarily on clean forest areas, especially those incurred after the cut;
- priority forestation of errosive and other unstable soil as a preventive measure to protect soil;
- afforestation should be carried out by indigenous species (oak, beech, spruce, fir);
- all planned land (750 meters above sea level) which is not allocated as suitable for settlement and agriculture should be put in order and used as forest land;
- existing forest land on flatter terrains of mountain plateau, if it does not represent a particularly valuable forest fund, can be gradually converted to agricultural land;
- in the tourist zone, forest land use must be regulated as a forest park;
- prior to the exploitation of forests, it is necessary to make a forest base and establish measures for the protection of industrial activities (logging, wood processing and transport of semi finished and finished products);
- exploitation quotas must be strictly controlled in accordance with the accepted and approved relevant planning documents (management plans, huntings plans).

Bearing in mind the above mentioned forest management in the Timok region, all of these functions should be fulfilled in a sustainable way. It involves the integration of objectives and measures of nature protection, non-timber products, the preservation of fauna, forest protection and management plans.

5. CONCLUSION

потребе и данаčње и буду□их генерација. Основни циљ одр□ивог управљања čумама и čумским потенцијалом Тимо□ке крајине је стварање од čуме -

трајног, биолоčки - стабилног, виталног, о□уваног, а тиме и посебно вредног природног екосистема који □е обезбедити трајно и потпуно удовољенје потреба неопходних за егзистенцију друčтва и заčтиту □ивотне средине у целини. Предуслов здраве □ивотне средине и опстанка □итаве Планете је управо одр□иво управлјанје čумским потенцијалом.

In addition to agriculture, forests in the Timok region are the most important resource in the environmental, economic and social terms. With their numerous functions, they allow: living in this area, offering significant economic security, provide the needs for fuel and building materials, for timber and non-timber products, providing opportunities for recreation and tourism and create the basis for entrepreneurship and job creation. Sustainable forest management involves the management and use of forests and forest lands in such a manner and to such a degree, to preserve biodiversity, and bring productivity, regeneration and potential of forests to the level that would meet the relevant environmental, economic and social needs of the present and future generations. The main objective of sustainable forest management and forest potential in the Timok region is the creation of forests - permanent, biologically - stable, vital, preserved, and thus particularly valuable natural ecosystems that will provide permanent and complete fulfillment of the requirements necessary for the existence of the society and the environment as a whole . The precondition for a healthy environment and the survival of the whole planet is sustainable management of forest potential.

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SUSTAINABLE FOREST MANAGEMENT AS AN IMPORTANT PART OF THE STRATEGY OF SUSTAINABLE DEVELOPMENT
ODRŽIVO UPRAVLJANJE ŠUMSKIM RESURSIMA KAO VAŽAN DEO STRATEGIJE ODRŽIVOG RAZVOJA

Leposava Jovanović[1], Ivana Avramović[2], Marina Malenović[3], Mladen Jovanović[4]
[1]Faculty of Management Zajecar, leposava.jovanovic@fmz.edu.rs
[2]PhD student, Faculty of Economics Niš,University of Niš, Serbia, ivanajovanovic@rocketmail.com
[3]PhD student, Faculty of Economics Niš, University of Niš, Serbia, marinavujicic@rocketmail.com
[4]Master student, Faculty of Management Zajecar

Abstract: *The essence of the concept of sustainable development is interaction between economic and social development and life environment and mutual dependence and complementarily of economy development policy and environmental protection policy which recognize demands for the preservation of ecological balance.*
Rapid and fundamental changes in economic, technical, social, political and cultural conditions in recent decades have characterized the composition and structure of present national resources. In the Republic of Serbia one of the most significant natural resources are forests. Due to their multiple uses, they are potential for future growth and development.
It is necessary to aim on sustainable forest management in accordance with the principle of sustainable development. Only then the forests can successfully play their ecological, economic and social role.
Key words: *sustainable development, forest resources, sustainable forest management*

Apstrakt: *Suštinu koncepta održivog razvoja čini interakcija privrednog i društvenog razvoja i životne sredine i međusobna uslovljenost i komplementarnost politike privrednog razvoja i politike zaštite životne sredine, koje uvažavaju zahteve održanja ekološke ravnoteže.*
Tokom poslednjih decenija brze i suštinske promene ekonomskih, tehničkih, socijalnih, političkih i kulturnih uslova obeležile su sastav i strukturu današnjih prirodnih resursa. Jedan od značajnih prirodnih resursa u Republici Srbiji jesu šume, koje zbog svojih višestrukih koristi predstavljaju potencijal za budući rast i razvoj.
Kako bi šume uspešno odigrale svoju ekološku, ekonomsku i socijalnu ulogu, treba se usmeriti na održivo upravljanje šumskim resursima u skladu sa principima održivog razvoja.
Ključne reči: *održivi razvoj, šumski resursi, održivo upravljanje šumskim resursima*

1. INTRODUCTION

Sustainable development points out that economic growth, social integration and care for the environment are on an equal basis. They influence each other, can't be replaced and they are necessary for social progress and general development of humanity. One of the national priorities for achieving sustainable development in the Republic of Serbia refers to the protection and improvement of the environment and rational use of natural resources. Due to their multiple functions, forests in the Republic of Serbia are national resource of particular significance. The State should recognize their importance and contibute to sustainable forest mangement. Goals and instruments of economic policy, related to forests, are focused exactly on sustainable forest management. The goals should be aimed on strengthening competitiveness of the forestry sector including forest management, improvement of the economic sustainability of forestry and reducing the inefficiensy of the fragmented forest management.

2. CONCEPT OF SUSTAINABLE DEVELOPMENT

The concept of sustainable development, during the last twenty years, represents one of the essential elements in the theory and politics of economic development. In short, this concept tells us that the growth and structural changing of production and consumption are acceptable, provided that they do not question the quality and usefulness of natural resources. By the end of the twentieth century, the imperative of sustainability has become an unavoidable dimension of economic development strategies for the most market economies. "The idea of sustainable development has long attracted the attention of economists and experts from other domains. This is a new approach to development that puts the spotlight on the man meets his needs, now and in the future. During the past quarter century, the concept has evolved from dealing with environmental problems, to the comprehensive development paradigm, taken with the environmental and economic and social aspects. "[1]

The most commonly quoted definition of sustainable development is the report "Our Common Future", which was compiled by the World Commission on Environment and Development (the Bruntland Commission), at the invitation of the United Nations 1987. year, chaired by Canadian Jim McNeill. This is an elegant and easily understood definition that explains the concept of sustainable development in general, starting from the first term, and without going into detailed explanations. "Sustainable development is development that meets present needs without prejudice to the ability of future generations to meet their own needs."

The concept of sustainable development implies the coordination of various diverse sectoral interests and priorities. It reflects the need to obtain the desired quality and the actual pace of social development and the need to balance different social values. Sustainability, in this sense, means the harmonization of economic growth and development with the interests of environmental protection and social development. Therefore economic sustainability is a necessary but not sufficient condition to achieve the principles of sustainable development.

It has become clear that the control or the prevention against pollution are no longer “luxury” but primary assumption of the sustainable development. The practice has shown that the best solution is to directly integrate ecological questions into the existing instruments and measures of macro ecological policy of development. Constant cooperation between economists and experts about the question of environmental protection is necessary, as well as the combination of instruments of development policy and the environmental policy.
The subjects of economic development are bodies and organizations that directly or indirectly participate in designing and realizing ecological policy. Amongst the most significant subjects of creation and practical realization of economic policy are: international organizations, ecological movements and regional alliances.

The organization of the United Nations represents the most significant international institution whose main activities include the conservation of the environment. Through its numerous specialized agencies, it organizes international conferences dedicated to the preservation of the environment, and it also encourages countries to deal with the problems that emerged from the protecting of environment, agreeably. Ecological movement represents the subject of the ecological policy that functions on a global level. It strives for changes in policy of income distribution, housing, demographical policy, education, health policy etc. In general, this movement fights against weapon policy. Ecological development sets certain political, cultural and economical demands. Regional economic integrations conceptualize and practically realize ecological policy on the level of certain regions.

Sustainable management and the use of forests should be in line with overall national development policies and priorities, and the basis of acceptable national environmental policy, taking into account the internationally accepted criteria. Sustainable forest management can be achieved if there is a permanent continuous monitoring and accurate determination of the state forest fund, professional and real long-term and short-term planning, and technical implementation plans to meet the needs of society and environmental protection.

3. POSITION OF FORESTRY IN THE REPUBLIC OF SERBIA

Forests, as a resource and common goods, have always been an important factor in developing countries and represented a source of goods, services, and thus the total income of society. The first written records of the forest fund of Serbia, dated from 1884 and 1885, speak of 208000 ha public forests, 74800 ha rural and municipal forests, and later estimates of total growing stock was 1546000 ha.[2]

Today, Serbia is considered medium wooded land. The total forest area is 2360400 ha. Forest cover was 26.7%, slightly lower than in European countries where forest cover reaches 46%, and at the global average, which is around 30%. The area of state forests managed by the public enterprises is 1375553 ha, which is 51.4% of all forests and forest land in Serbia. Other forest areas are managed by private owners, public companies and other national parks.

The forest fund of broadleaves account for 90.7% of total forest fund. Forests of beech are represented with 27.6% in the total area of forests, oak with 24.6%, other hardwood 6% , poplar 1.9%, other softwood 0.6%, mixed stands of broadleaves 30%. The forest fund of conifers makes 6% of the total fond and mixed deciduous and conifer forests 3.3%.[2] Since the condition of private forests is less known, this applies more to the balance of the public forests. The current state of the public forest is characterized by insufficient production fund, unfavorable age structure, unsatisfactory and overgrown forest cover, inadequate health condition.

General unsatisfactory condition is based on high number of forests with high proportion of poor quality, improperly nurtured artificially established forests and lack of participation of high quality and valuable natural forests. The state of forests is characterized by unfavorable structure in origin, where, for example, sprout and low-yield forests make large part of the private forests. Compared to total forest area in Serbia, forest stands with high quality origin cover about 27.5%, while the sprout forests cover 64.7%, artificially established culture 6.1% and plantations (poplar and willow) 1.7%.[3] The high share of low-yield forests, beside its economic significance, plays huge part in absorbing carbon dioxide. However, the news is that corporations want to plant genetically modified trees that are: less resistant to diseases, smaller sizes, to be convenient for industrial processing, softer, and resistant only to company's herbicides. Also GM trees spread their genes around 600 km, which means that it will affect other natural tree. What encourages corporations more is the Law of the reproductive materials of forest trees of the Republic of Serbia, which allowes planting of GM trees.

The main problems of forestry in Serbia are insufficient forest cover, and the low level of utilization of the habitat potential. With ongoing drying process of global forests, there are also illegal felling, fires, forest conversion into construction land, inadequate monitoring etc. These adverse factors in a short run can inflict very great damage. Good example are forest fires, which could transform the whole landscape into a wasteland, destroying the environment and causing inestimably great harm to the population. Forest fires are more frequent lately, primarily due to poor technological prerequisites. Also, illegal deforestation led to major ecological disturbances, so it is necessary to prescribe an appropriate minimum measures to prevent illegal felling and consistently abide by them. Therefore these factors are very serious, social, natural and environmental problem. Table 1 presents the forests damage per year from 2006 to 2010 and it shows that the most damage throughout the years came from natural disasters, while not insignificant percent of damage is caused by illegal felling and other man's activities.

Table 1: Damage to forests in the Republic of Serbia, 2006-2010

	2006	2007	2008	2009	2010
Illicit felling, m^3	7 455	11 480	16 671	9 063	8 501
Other damages, caused by man [1], m^3	2 463	5 566	5 558	5 027	5 380
By pests, m3	1 402	2 160	3 877	3 021	4 070
By natural inclements, m^3	9 172	10 549	15 706	19 937	14 902
By plant diseases, m^3	7 933	5 003	4 611	8 313	5 093
By fire [2]					
ha	494	22 161	575	1 210	503
m^3	1 080	5 818	7 149	1 932	57

[1] Covered: theft of forest assortments, illicit pasture, illicit occupation, environmental polution and other damages caused by man.

[2] Covered: damages by fire in private forests.

Source: Sustainable Pocketbook of the Republic of Serbia, Belgrade 2012, Statistical Office of the Republic of Serbia

Dissatisfaction with the state of total forest fund in Serbia, especially in part owned by citizens, is enough reason to run all those activities, which could increase surface area and cause efficient use of forests (in the amount and quality required to improve the forest functions).

The current forest condition, the current role and importance of forest reserves in the country's total economic activity, requires a substantial commitment of the State and society in the protection and improvement of forest lands.

4. ACHIEVING SUSTAINABLE FOREST MANAGEMENT

The forests play the important role on the Earth as one of the most complex ecosystems and they are also a valuable natural resource of great economic importance. The present state of forests and the degree of their transformation by man are determined by social needs and values, economic opportunities and political regulations. The excessive use of forests has led to a sustained reduction of forest area and the degradation of environment. In the past ten years, about 13 million hectares of forest were reclaimed and transformed into arable land.

The multiple demands on forests in a rapidly evolving economic, social, and political environment require maintaining a high level of forest management standards and a flexible adaptation of multiple-use forestry to the complex interactions between the private and public sectors.[4]

Requirements of the principles of sustainable devolopement have led to the need for sustainable forest management. According to the international adopted definition, sustainable forest management is *the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity,regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems* (MCPFE, Helsinki Resolution 1, 1993).

In order to improve the general awareness of the global public about the important role of the forests on the Earth and the necessity of conservation, protection and wise forest management, the United Nations declared the 2011th year as the International Year of Forests.
Forests, as the natural resources and the goods of common interest, have always been, and especially in the previous periods, the essential factor in the State development. They are the sources of goods, services, and consequently the receipts of the society in general. At the beginning of the 21st century, Serbia started a series of initiatives and projects in the field of forests and forestry. In 2006, Serbia adopted the Forest Development Strategy. The main objective of Strategy is the conservation and enhancement of forests condition and the development of forestry as an economy branch. Consistent with the recommendations and commitments arising from the process of the Ministerial Conference on the Protection of Forests in Europe (MCPFE), Serbia also adopted the new Forest Law in 2010, which reaffirms the concept of sustainable forest management.

Felling of the forest or professional use of the forest is at the same time the precondition and the only way of using product function of the forest and, on the other side, care, protection and condition of renewal of the forests. The first criterion for assessing the sustainability of the forests is the relation between net annual increment and annual fellings. In the long run fellings should not exceed increment.
Sustainable forest management and multiple use of forests must be the part of economic policy of the State. In order to enhance the forestry, so that it could obtain a significant role as a branch of economy in the overall economic system of the country, it is necessary to take special economic policy measures.

The wood industry sector has an important role in Serbia's gross domestic product, employment and foreign trade, but its significance is lower than its potential. The privatisation of major social enterprises for wood processing has not been completed and the use of these capacities is at a low level, as well as the organisation of the sector.

A share of income from forestry and forest enterprises is an important indicator of the economic sustainability of forest management. The percentage of export products with higher value added is low, although the situation has changed positively in the past years.

Last year, the export of wood processing products and cork increased by more than 40 percentage, while the import was higher by 15 percenatge. The export of wood furniture increased and the import decresed. If we look at the external trade of wood product, we will see that our country has made the surplus of 86.2 million dollars for nine months last year. The production of pulp, paper and paper products increased.[5]

One of the problems in the sector of wood industry is the applied tehnology, which is predominantly outdated. Therefore, products are often noncompetitive on the demanding foreign markets. The innovations of process and products are at a very low level, as well as quality standards, which are almost not implemented at all. In general, the sector is characterised by very low efficacy. The Forest Development Strategy has set the objective of sustainable and economically efficient wood industry sector competitive on the world market and contributing to the advancement of the forest sector, environmental protection and development of the national economy.

To increase the contribution of the forest sector to the economic and social development of the Republic of Serbia, it is necessary to take some measures: to increase the area under forest cover by encouraging the activities and by providing assistance to the forestation of the land on which it is economically and ecologically feasible to raise forests; to increase the productivity by maximal and rational use of the overall production potential of forest areas, which includes wood, nonwood forest resources and the sustainable use of multiple-use forest functions; to establish the efficient system of forest protection against the harmful biotic and abiotic factors, illegal felling, illegal occupation, illegal building and other unlawful actions.[2]

Owners of private and public forests decide which products and services they want to deliever to the market or to make them available to the community as a whole. Within the limitations posed by the legislation, they may use forest land as a mean of production to create economic benefit and financial income.

The important task of the regulation is to establish and protect the rights of forest owners and their interests to have material and financial benefit of use and management of their estates. The legislature must take into consideration that sustainable wood production changes under the influence of signals from the market and assessment of profitability. Determination of rights and obligations of forest owners requires knowledge of the applicable goals of production for markets that already exist or can be developed.[6]

Will the forest remain useful and productive part of environment greatly depends on economic preferences. The wood used to be necessary source of energy and important material. Today it is replaceable with new source of energy and alternative materials, so its use is influenced by requirements of domestic and international competition. It is impossible to expect that private sector will supply goods and servces, which don't have market realization, unless there is intervention by regulation and economic measures.

In order to support the public goals for forestry, it is possible to use different instruments, which stimulate or discourage targeted groups. Private forest funds are taxable and they also receive some financial incentives, such as grants, loans and compensation. Financing the public forests is made from budget by law. Financial resources for support to forestry can be provided by fiscal policy through allocations from BDP, as well as, allocations at local community level. Tax incentives can stimulate activities aimed on extanding the territory coverde by forests and encourage investment of private capital in the forestry and wood processing.

The scale and the structure of investment in the state sector will depend on the economic value of forest resources. It is necessary to analise different effects of costs and benefits in forest protection and enhancement, forestry development and environmental protection.

To achieve the development of the forestry sector, it is necessary to pay attention on researh and analysis of forestry products markets, as well as marketing, distribution and sale those products in conditions of market economy. Especially is important the application of the certification and standards, notably environmental certification, which aims to ensure that products come from ecologically "clear" production process.

Forest staff should enhance its knowledge in the practice through definition and implementation of programs for modernization of practical and theoretical knowledge. The problems of private forest owners are lack of information and ignorance of potentials of the forest resources, so it is required a special access to permanent and qualified education and information of th private forest owners.

The qualified research staff in forestry is the pillar of forestry development in all segments. The main problem of forestry research is the insufficient research capacities in the existing research institutions. This deficiency in research, and also the numerous problems of the forestry profession, require in addition to the multidisciplinary approach, also an imperative change of the orientation from the predominantly fundamental research to the user-friendly applied research, intended to both large systems and private forest owners, as well as to small and medium enterprises.[2]

CONCLUSION

Forests, as a natural resource of great importance, have their ecological, economic and social functions. In this article, we have paid attention on economic area. In order to achive the economic goals it is necessary to support the: activities for forest growing, use of production functions of forests, new forestry technologies, development and maintenance of forestry infrastructure, marketing of forest products and their sustainable use.

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CAPACITY ANALYSIS OF AGRICULTURAL LAND USE AS A NATURAL RESOURCE

ANALIZA KORIŠĆENJA KAPACITETA POLJOPRIVREDNOG ZEMLJIŠTA KAO PRIRODNOG RESURSA

MSc Radica Pavlović[1] , MSc Marko Pavlović[2]
Prof.dr Slobodan Stamenković[1], MSc Mladen Stamenković[3]

[1]Graduate School of Business Studies, Pozarevac mail: rpavlovic@megatrend.edu.rs
[2] High Professional School for Entrepreneurship, Belgrade
[3] Faculty of Economics, Belgrade

Abstract: *Agricultural land as a natural resource is the backbone of economic development of Serbia. The steady increase in urban and suburban areas, industrial zones, infrastructure and so on., On the one hand and inadequate macroeconomic policies on the other hand, arable land per capita is decreasing. In this way reduces the availability of this precious natural reursa which is not expandable, non-renewable and nonmultiplied, and its degree of used capacity. Analysis of the capacity utilization of agricultural land is intended to indicate the status and trends in the disposition of these important natural resource.*
Key words*: Agricultural land, resource and capacity analysis.*

Abstrakt: *Poljoprivredno zemljište kao prirodni resurs predstavlja okosnicu privrednog razvoja Republike Srbije. Stalnim povećanjem gradskih i prigradskih naselja, industrijskih zona, infrastrukture i sl., s jedene strane i neadekvatnom makroekonomskom politikom s druge strane, obradive poljoprivredne površine po glavi stanovnika se smanjuju. Na taj način smanjuje se i raspoloživost ovog dragocenog prirodnog reursa koji je neproširiv, neobnovljiv i neumnoživ, kao i njegov stepen korišćena kapaciteta. Analiza koriććena kapaciteta poljoprivrednog zemljišta ima za cilj da ukaže na stanje i tendencije raspolaganja ovim značajnim prirodnim resursom.*
Ključne reči: *Poljoprivredno zemljište, resurs, kapacitet, analiza.*

1. INTRODUCTION

Republic of Serbia stretches over an area of 88 407 km2 of which is agricultural land 5.092 million hectares, or agricultural land covers 58% of the total area of Serbia. Agricultural land in Serbia is the primary natural resource, which does not mean that this area has no other natural resources and their exploitation should be ignored.

Economic Development Strategy of R. Serbia should be based on the exploitation of agricultural land, natural resources, given that this resource belongs to Serbia, an area with distinct comparative advantages of land resources in relation to a number of countries. In this regard, consideration will be subject to analysis of capacity utilization of natural resources and identify critical factors affecting the efficiency of use of agricultural land capacity.

2. THE TERM AND THE IMPORTANCE OF LAND AS A NATURAL RESOURCE

The land is one of the most important natural resources and agricultural resource base which is based on agricultural production and provides about 90% of food for mankind as a condition for survival of wildlife. As such, it is non-renewable, nonmultiplied and not expandable. The steady increase in urban and suburban areas, industrial areas, infrastructure and the like arable land per capita is decreasing. In the period 1992-2002. in R. Serbia and Montenegro has been a decline in arable land and 350,000 hectares from 0:39 to 0:35 hectares per capita due to irrational and inefficient use of resources. Comparing the data of developed and transition economies can be seen that in the reporting period, only Japan (0.03), China (0.08) and Netherlands (0.06) have a lower value per capita hectares while for example in the U.S., this value is 0.75.

Land is not only a basic factor of production, but also the food security of the population base, what is the most valuable natural resource from which crucially depends on the development and survival of rural communities and rural families. It has a special social function determined by its role as a space for human activities [1]. Agricultural land is land used for agricultural production and land that can be brought for the purpose of agricultural production [2]. However, Serbia is obviously going to reverse the process: instead of changing land use in favor of agricultural production went into alteration agricultural to non-agricultural land. Namely, in the time from 1990-2006. The reallocation of land was made in favor of urbanization so that the origin of urban space comes mainly from arable land and permanent plantings (41.7%) and mixed agricultural and pasture areas (47.6%).

In order to realize the importance of agricultural land as a resource, it is necessary to give a brief overview of definitions of basic categories of land in agricultural production.

Agricultural areas are land areas used for agricultural production. Agricultural area will consist of arable land, pastures, ponds, swamps and marshes. Arable land are those land areas which are grown on arable and vegetable crops, growing crops and grass, and where processing is performed, mowing and other agricultural activities and, as a rule, the yield of each year. Cultivable area consists of arable land and gardens, orchards, vineyards and meadows. Arable land (fields) are land areas where temporary crops. For them, the established order (crop rotation) sown arable crops: cereals, industrial crops, vegetable crops and cattle fodder. The arable land are included in the areas that are "working vacation" other raw. In addition, arable land is land under vine and fruit tree nurseries, and sown stand.

3. ANALYSIS OF CHANGE OF USE OF AGRICULTURAL LAND TO THE USERS AND CATEGORIES OF LAND

Agricultural land is one of the most important natural resources and agricultural resource base which is based on agricultural production and provides about 90% of food for mankind as a condition for survival of wildlife. It is therefore important to examine and analyze the status and trends of agricultural land as the availability of resources as the degree of its use.

Table 1. Agricultural land: the total surface area and the structure of the beneficiaries, 2000-2010. [3]

Year	Agricultural land	Enterprises and agricultural cooperatives		Family holdings	
		hous.ha	%	hous.ha	%
2000.	5109	1048	0.205128	4062	0.795068
2001.	5111	1046	0.204657	4065	0.795343
2002.	5107	1034	0.202467	4073	0.797533
2003.	5115	1036	0.202542	4079	0.797458
2004.	5113	1027	0.200861	4087	0.799335
2005.	5112	1029	0.201291	4084	0.798905
2006.	5105	1034	0.202547	4071	0.797453
2007.	5092	989	0.194226	4103	0.805774
2008.	5093	936	0.183782	4157	0.816218
2009.	5097	900	0.176574	4 216	0.827153
2010.	5092	876	0.172035	4 216	0.827965

Based on data from Table 1 can be seen the reduction of agricultural land in 2010. compared to 2000. year to 17 thousand hectares, or by 0.33%. The structure of the largest users of agricultural land share family farms (80% average) with the tendencies of slow growth, while companies and cooperatives participated with an average of 20% with a tendency to fall relative share in the period. Decrease in the share of companies and cooperatives in the reporting period is the result of reduced use of agricultural land, which is manifested in the final by reducing agricultural land in these types of users in favor of agricultural holdings.

Namely, in the period of agricultural land companies and cooperatives decreased during the year in 2010. compared to 2000. year decreased by 172 thousand hectares ie 16.41%. (Figure 1). Here's a view of movement use of land from the family farm.

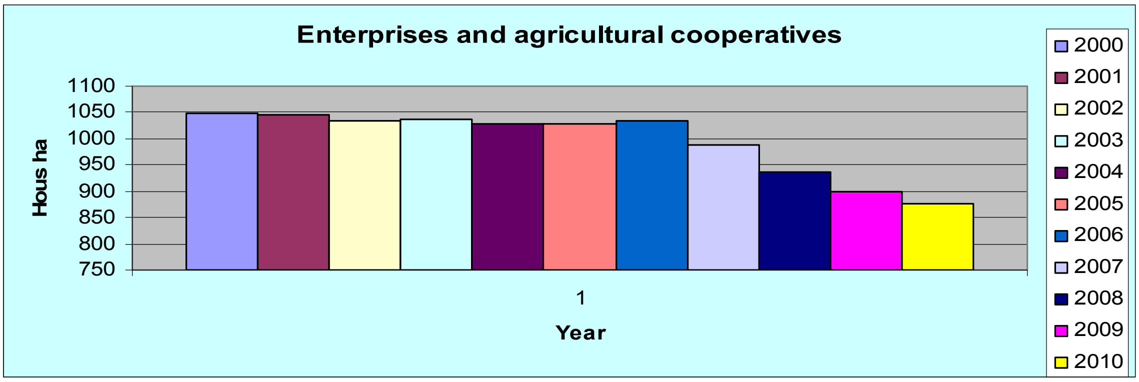

Figure 1. Agricultural land:
Enterprises and agricultural cooperatives, hous ha, 2000-2010.
Source: Prepared by autors

Agricultural land of family farms has a tendency of slight increase in the reporting period. The growth of the agricultural land of this type of users has increased by 154 thousand hectares in 2010. compared to 2000. year (Figure 2), ie 3.79%. Obviously is to increase agricultural land by family farms can not absorb a drop of the companies and cooperatives that have a high rate of decline..

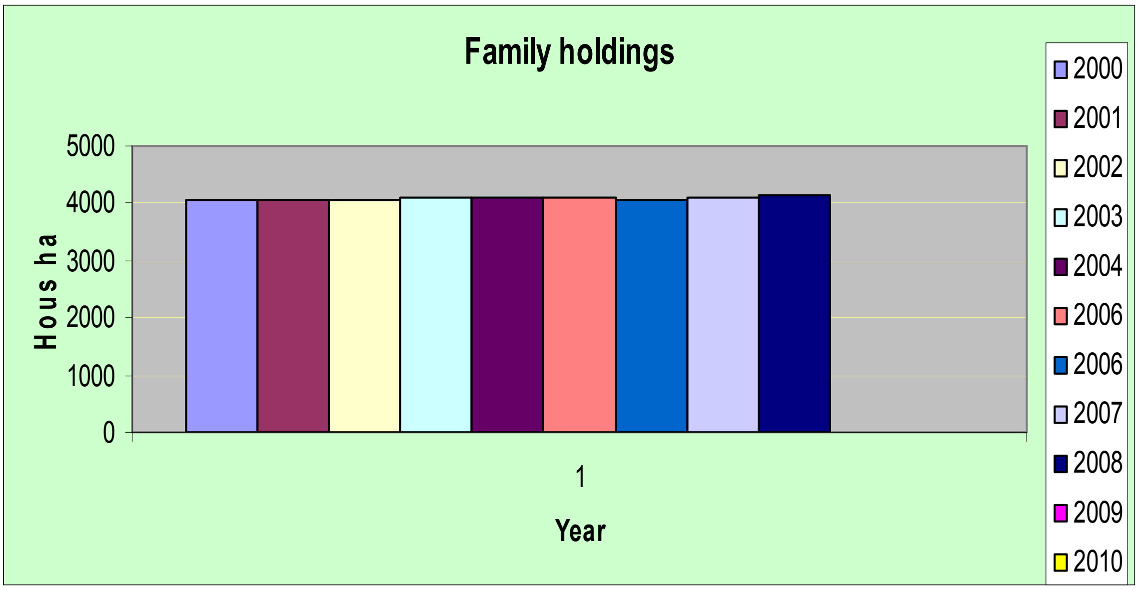

Figure 2. Agricultural land:
Family holdings, hous ha, 2000-2010
Source: Prepared by autors

The reduction of agricultural land conversion of agricultural land for non-agricultural land arises from several factors such as: inadequate macroeconomic policies, the inability to achieve efficient use is satisfactory, low level of education of the population in rural areas, the gravity of the population to larger cities and job outside agriculture despite the specific potential of agricultural resources, high rates of population aging and depopulation. [4]

Utilised agricultural area is land area used for agricultural production. This includes: arable land, orchards, vineyards and permanent grassland. Other area *i*ncludes forest land, other land not used directly for crop production: fish ponds, reeds, marshland and infertile land, ground occupied by houses, back yards, construction sites, factories etc, then by roads, streets, railways, all water currents, bare soil, etc. If we look agricultural land use by category of land it is necessary to consider some basic information for a valid conclusion (Table 2).

Table 2. Utilized agricultural area, 2005-2010.[5] hous.ha

Year	Total	*Arable fields and gardens*	*Orchards*	*Vineyards*	*Meadows*	*Pastures*
2005	5074	3330	239	64	609	832
2006	5066	3318	238	62	610	838
2007	5053	3299	240	59	620	835
2008	5055	3302	242	58	621	833
2009	5058	3301	240	58	625	834
2010	5051	3295	240	57	624	836

Based on data from Table 2 can be used to see a decrease in agricultural land in the time from 2005-2010. year. In 2010 year compared to 2005. one used the land to reduce by 23 thousand hectares ie 0.45%, and compared to the 1939th year to 814 thousand hectares, or 13.9%. The total used agricultural land have the biggest share of arable land and gardens, but with a tendency to fall of land for that purpose. It may be observed by increasing the use of agricultural land in favor of pastures and meadows, while the vineyards are more or less stagnant movement and vineyards tend incremental decline.

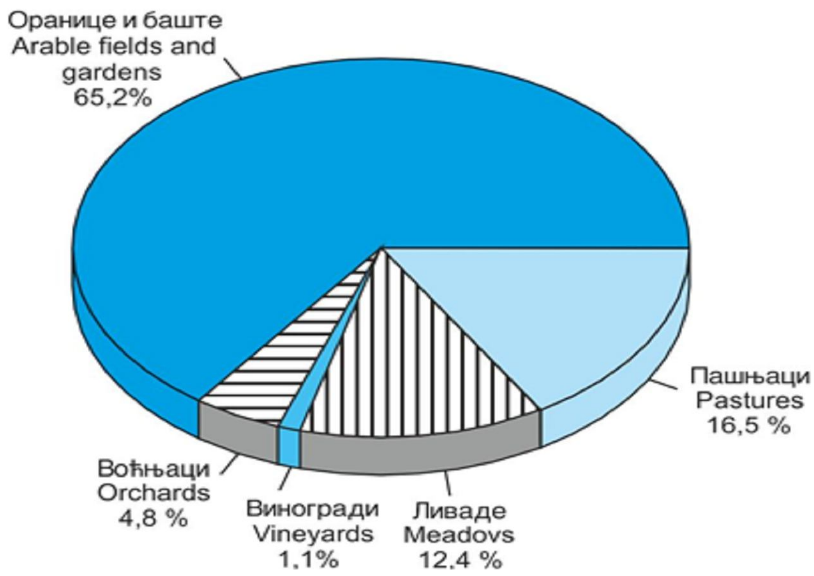

Figure 3. Utilised agricultural land, 2010.
Source:[5]

4. CAPACITY ANALYSIS OF USE OF AGRICULTURAL LAND

Based on the information set out clearly to the conclusion that there is a tendency of decline in the availability of agricultural land and its use. The capacity of agricultural land is the maximum effect that can be achieved by utilizing it in a certain period of time. With the effects of land resources can be different and to depend on various factors (weather, soil quality and fertility, etc.) in the further part of the focus will be on the level of the usage of agricultural land measured by the ratio of available land and used as the first and indispensable condition to the optimum use capacity of the resource. So, to agricultural land could give the maximum effect it must first be used to its full availability.

Table 3: % Utilization of Agricultural Land, 2005-2010.

Year	% Utilization of Agricultural Land					
	Total	*Arable fields and gardens*	*Orchards*	*Vineyards*	*Meadows*	*Pastures*
2005.	99,26	65,14	04,68	01,25	11,91	16,28
2006.	99,24	64,96	04,66	01,21	11,95	16,42
2007.	99,23	64,78	04,71	01,16	12,17	16,40
2008.	99,25	64,83	04,75	01,13	12,19	16,36
2009.	99,23	64,76	04,71	01,14	12,26	16,36
2010.	99,19	64,71	04,71	01,12	12,25	16,42

Source:Autors' s calculations.

The indicators in Table 3 show a relatively constant level of use of agricultural land in the period and on average is 99.23%. Occupy the largest share of arable land and gardens, with over 60% utilization in relation to agricultural land available, but the extent of the usage tendenicijom fall. There is a tendency of slight increase in the use of land for orchards, meadows and pastures. However, consideration of the degree of use of agricultural land can provide relatively inadequate picture of the true state of affairs. In the analysis of the effect, the calculation of the degree of the usage of capacity, the actual sizes, should be included and iteratively reduce the total agricultural land and thus reach the relevant indicators.

In 2010. a total agricultural land is 99.19% compared to 2005. years. and decreased by 20 thousand hectares, which is a decrease compared to 2005. year by 0.39%. In addition, the percentage of utilization of available agricultural land is lower compared to 2005. year by 0.07%, which means that in the fall of the level of the agricultural land available at the same time there is a decrease in the degree of utilization of available land. Cumulatively degree of use of agricultural land decreased by 1.19% in 2010. compared to 2005. year.

The reduction of agricultural land in the total amount and the reduction of capacity utilization of resources caused depopulation of the rural population, urbanization, and conversion of agricultural to non-agricultural land, migration of population from rural to urban areas, measures of macroeconomic policy. Specifically, inadequate fiscal and monetary policy leads to an increase in the cost of agricultural production much higher than the general level of price increase. In other words, inputs (petroleum products, fertilizers and other chemicals) had significantly faster growth rate than the growth in prices of primary agricultural products which is an agricultural activity in the context of primary production, placed in a very disadvantageous position. The active fiscal policy, through excise taxes on petroleum products caused by higher costs in crop production than in any other activity. Consumption of petroleum products because it is the biggest expense is directly involved in the production process. Neither in terms of foreign policy situation is not favorable. In fact, unrealistic exchange rate policy stimulated the import and export of agricultural products not stimulated resulting in "unrealistically" low productivity in the industry [6], which affects the reduction of use of arable land continues to cause a decrease in the share of this category of land in total agricultural land and therefore it clearly shows the data presented in the above table.

CONCLUSION

- Land is one of the most important natural resources and agricultural resource base on which agricultural production is based.

- The steady increase in urban and suburban areas, industrial areas, infrastructure and the like and due to inadequate macroeconomic policies of arable land per capita is decreasing.

- In Serbia there is a tendency of the total land agricultural as the tendency of the usage of the capacity of the resource.

- The fall in the availability of agricultural land and because of using the same drop rate, the total degree of decline in the usage of capacity agricultural land as a natural resource is reduced by only 5 years to 1.19%.

- The reasons for reduced use of agricultural land as a natural resource to be found in the depopulation of rural areas, migration of rural population to large cities, transforming the non-agricultural agricultural land, and inadequate macroeconomic policies.

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SUSTAINABLE MANAGEMENT OF LAND RESOURCES

ODRŽIVO UPRAVLJANJE ZEMLJIŠNIM RESURSIMA

Maria Turtoi[1], Jane Paunkovic[2], Dragan Mihajlovic[2], Andjelija Plavsic[2]Aleksandra Cvetkovic[2], Milica Paunovic[2]
[1]Sibiu Alma Mater University, Romania
[2]Faculty of Management Zajecar

Abstract: *Land is a nonrenewable natural resource, for whose formation thousands of years are needed, while for its destruction and degradation, much less is needed. As one of the key elements of the environment, the land is threatened on one side by natural processes, and on the other by human activities. Land management is process of using and developing land resources, which must be based on the principles of sustainable development and be consistent with the strategy of sustainable development. Sustainable management of land resources requires a high degree of rationality in their use, and purpose of this paper is to highlight the problems of land use and opportunities for its sustainable management.*
Key words: *land, sustainable management, sustainable development strategies*

Apstrakt: *Zemljište je neobnovljivi prirodni resurs za čije formiranje je potrebno hiljade godina, dok je za njegovo uništenje i degradaciju potrebno znatno manje. Kao jedan od ključnih elemenata životne sredine, zemljište je ugroženo, sa jedne strane prirodnim procesima, a sa druge, strane ljudskim aktivnostima. Upravljanje zemljištem je proces korišćenja i razvoja zemljišnih resursa koji se mora zasnivati na principima održivog razvoja i biti usklađen sa strategijom održivog razvoja. Održivo upravljanje zemljišnim resursima podrazumeva visok strepen racionalnosti prilikom njihovog korišćenja., i cilj ovog rada je da ukaže na probleme korišćenja zemljišta i mogućnosti njegovog održivog upravljanja.*
Ključne reči: *zemljište, održivo upravljanje, strategija održivog razvoja*

1. INTRODUCTION

Land is the basis of agricultural production, and thus the survival of mankind. It represents an extraordinary important natural asset, but that creates and regenerates very slowly. In order to form a thick layer of soil from 2 to 3 cm, 200 to 1000 years are needed. The land is mercilessly destroyed, degraded as an fundamental part of the ecosystems and base for human life, the life of animals and plants, for food and water production, for all human activities. If such land is not protected, the consequences can be devastating.

2. DEGRADATION - TERM AND ITS SIGNIFICANCE

Soil protection is a set of specific physical, chemical, technical and bio-technical measures and procedures to ensure all its functions. Land degradation is a process of compromising quality and features of land that occurs naturally or by human activity or is the consequence of not taking measures to eliminate harmful consequences.

Land degradation is the reduction or loss - in arid, semiarid and dry subhumidnim areas - of biological and economic productivity and complexity of moistured soil, irrigated arable land, pasture land, forests and forest lands, caused by their use, one or more of combined processes, including processes that are results of human activities and housing models, such as soil erosion caused by wind or water, deterioration of physical, chemical and biological characteristics, or mode of management of soil, and long-term loss of natural vegetation. [1]

Soil pollution is the introduction of pollutants into or on land, caused by human activities or natural processes, which has or may have adverse effects on environmental quality and human health. In the past, fertility and other important ecological roles of soil were selfrenewed after fire, flood or other natural phenomena, and even after some of man's intervention. Nowadays, when the frequency of pressures is very high, the ground is more difficult to resist and as a consequence there is a temporary or permanent loss of environmental and management productivity.

The processes of land degradation are very intense at global, world, then at the national and regional, as well as local level. The causes of degradation processes are very different. The most common are: excessive, uncontrolled deforestation, erosion caused by water and wind, flood, surface mines in the vicinity of placers and so on. As the land is resource of the future and it reduces per capita, it is our duty to care for it and what is more possible mitigate the intensity of degradation processes. One possible form of reduction of the land degradation processes is the reforestation of the same. Refforestation of the "vulnerable" land and terrain prevent degradation processes, contribute to maintaining the ecological balance in nature, increases the absorption of CO_2 and the oxygen content from the air. Moreover, raising forest plantations - refforestation of the "vulnerable" land, eventually contributes to the increase of raw material base for the wood industry. This creates opportunities for the development of this industry in rural areas, and thus speeds up rural development.

Preventing the degradation can be achieved by any of the known methods:

1. Reclamation;
2. Hydraulic reclamation;
3. Refforestation;
4. Agricultural practices;
5. Fertility control;
6. Rational use of fertilizers;
7. Rational use of pesticides.

Indicators for assessing the risk of land degradation are:

1. degree of vulnerability of land from erosion,
2. degree of threat of loss of soil organic matter,
3. degree of vulnerability of land at risk of soil compaction,
4. degree of vulnerability of land by salinization and/or alkalization,
5. degree of vulnerability of land from landslides, except landslides that can occur during mining activities
6. level of endangerment by acidification of soil,
7. degree of vulnerability of the soil from chemical pollution.

Common elements to identify areas at risk of erosion, the risk of loss of soil organic matter, with the risk of compaction, with the risk of salinization and/or alkalization, with the risk of landslides and the risk of acidification are:

- type of soil,
- soil texture,
- density and water-air properties of soil hydraulic properties,
- topography, including slope gradient and length,
- covering of soil,
- land use and land space,
- agricultural and forestry systems,
- climate (including rainfall distribution and wind characteristics),
- hydrological conditions,
- agro-ecological zone,
- the dominant factors of erosion processes occurrence ,
- quantitative indicator of the threat degreee -erosion coefficient Z. [2]

3. PROBLEMS OF LAND USAGE AT GLOBAL LEVEL

Sixty percent of the Earth is water (oceans, seas, lakes, rivers) and forty percent is the land (agricultural and non-agricultural land). This ratio is practically unchanged from the emergence of the planet until today. It can be influenced by man. It is simply a product of nature. However, the mainland part of the planet is subject to change. These changes can be caused by action of natural factors - that can not be influenced at all, or by our actions.

Land is a natural resource, non-renewable, it can not be mulitplied and expanded. In the last century, the pressure on this resource has been enormous. This pressure continues in the XXI century. As a global problem we have a population that is increasing from five billion in 1985th to 6.4 billion in 2004th up to 8.4 billion in 2025th , and in 2050th is expected to be about 11 billion people. The total mainland surface of the planet is 13 milliard hectares. If we continue with this trend of population growth by the year 2050, total of land will be reduced from 2.0 to 1.2 hectares per capita, relatively to 0.13 hectares of arable land per capita. By the expansion of urban areas, industrial and technological parks and infrastructure networks on one side, and constant growth in population, on the other, arable land is steadily decreasing. By deforestation, followed by translation of arid land (meadows, pastures) and the conversion of fertile and arable land, this problem partly mitigates, but worsens the ecological balance.

At the same time, with the dynamic growth of the population on the planet, then the growth in demand for food and purchasing power, the problem of rational use of land is constantly intensified. For example, the world's arable land had increased by 28.5 million hectares in 2002. compared with 1992. This is the result of deforestation, pasture and turf plowing and converting them into fertile land. It is extremely important, especially in Asia, Africa, Latin America, where population growth is high. Because of that, arable land is decreasing from 0.28 acres (1992) to 0.25 acres (2002), which means that the world population growth is more dinamic then than expansion of arable land. [3]

Table 1. Arable and non-arable land (thousands of hectares)

1992	World	Europe	Serbia and Montenegro
Arable land	1.512.302	318.791	4.076
Non-arable land	11.547.557	1.941.103	6.124
In total:	13.059.859	2.259.894	10.200

2002	World	Europe	Serbia and Montenegro
Arable land	1.540.708	303.993	3.724
Non-arable land	11.526.172	1.956.106	6.476
In total:	13.066.880	2.260.099	10.200

For these particular periods, a major concern is the decrease in arable land in Serbia and Montenegro for 350,000 hectares in the previous period (1992 to 2002) or from 0.39 hectares per capita to 0.35 hectares per capita, which is the order of farmland of south Backa district. Observed on the global level, states with the smallest level of arable land per capita are: [3]

Table 2. Arable land per capita

Japan	0,03 hectares
China	0,08 hectares
Netherlands	0,06 hectares
Bulgaria	0,45 hectares
France	0,33 hectares
Brasil	0,36 hectares
Russia	0,79 hectares
USA	0,75 hectares
Australia	2,80 hectares

4. PROBLEMS OF LAND USAGE IN SERBIA

The share of agricultural land in the territory of Central Serbia is 60.2% and in Vojvodina 82%. In the structure of agricultural land, by categories of use, a high share of arable land is evident (83%). In the past fifteen years, the share of agricultural land has decreased by 10.6%, while the share of arable land has decreased by 10%. Most of the missing are vineyards 20.7%, and a minimum of changes were seen in ponds, reeds and swamps 2.5%. By area, most are missing pastures or 18% over the past fifteen years. About 855.000 ha are not processed (grasslands, swamps, marshes and ponds). Factors of reducing the degradation of agricultural land in Serbia are:

1. expansion of settlements,
2. industrial, mining, energy and transportation facilities,
3. water erosion,

4. wind erosion,
5. salinization of soil,
6. loss of nutrients. [4]

The strategic goals of sustainable land use are:
1. harmonization of legislation acts concerning the use and protection of land with EU legislation;
2. preventing further loss of land and the preservation and improvement of its quality, especially for industrial, mining, energy, transportation and other activities;
3. protection from degradation, change of purpose and cultivation of agricultural land. [5]

Four major problems of land use are:

1. Extensive land use with the extensive planting structure; - despite all the efforts of scientific and professional community in the past few decades to change the structure towards a working and profit-intensive production, we can conclude that they are not realized. Cereals are continuing to dominate in the sowing structure, and there is an insufficient representation of industrial crops, vegetables, fodder crops. Intensive farming have greater profit per unit area. True, they require more labor and capital, but provides a high profitability. Besides, the areas of orchards and vineyards are reducing, and existing plants are antiquated, with unbalanced composition of brand structure, low-contributory, non-performing and insufficiently profitable - which is also an indicator of the extension of a production. In the extensive production, use of fertilizers is insufficient. It is similar with irrigation, only one percent in Serbia. That is, there are systems built on 70,000 acres, but water reaches only to 30,000 acres. For all that, we have low yields of all crops.

2. Тхе релативелI смалл сизе оф прИвателI оњнед пропертиес (тхрее ацрес аверагелI), њхицх репресентс а сигнифицант обстацле фор фармерс то бецоме цоммодитI продуцерс. Ње аре амонг Европеан цоунтриес њитх мост фрагментед поссессионс. Тхе реасонс аре фоунд ин тхе традитионал аграриан струцтуре, унрегулатед инхеританце лањ, ундер-тхоугхт оут ланд полицI. Тхере аре соме поситиве мовемент ин тхе дирецтион оф енларгинг поссессионс, фор еџампле, хоусехолдс оф 10-15 хецтарес хаве инцреасед фром 2.5 перцент ин 1991, то 4.4 перцент ин 2002. Еффортс маде ат енларгинг тхе ланд аре енцоурагинг, њхицх ис сеен ин тхе драфт оф Агрицултурал ланд Лањ анд Агрицултуре Девелопмент СтратегI оф Сербиа. Мергинг тхе ланд ис нот поссибле њитхоут тхе ацтион оф маркет мецханисмс, бут алсо њитхоут лонг-терм говернмент меасурес, ор њитхоут тхеир цонцертед ацтион. Лоцал говернментс аре тхосе њхо схоулд таке царе оф тхис проблем, алонгсиде њитх лине министриес, индустриал ассоциатионс анд мануфацтурерс тхемселвес. Ин схорт, њитхоут енларгинг поссессионс, ратионал продуцтион ис нот поссибле.

3. Децреасед интаке оф органиц маттер анд лоњ усе оф органиц фертилизерс, еспециаллI мануре - хас а витал роле ин маинтаининг фине-црумбI соил струцтуре, импровинг итс цхемицал, биологицал, мецханицал анд пхIсицал

пропертиес, тхат аре верIверI импортант фор тхе девелопмент оф роот сIстем анд тхе суццессфул цултиватион оф плантс. Хоњевер, ин тхе ласт фењ децадес, тхе нумбер оф цаттле ис драстицаллI редуцед, анд тхус тхе продуцтион оф мануре. Аццординг то оффициал статистицс, тхе нумбер оф алл цатегориес оф цаттле ис драстицаллI редуцед, нот онлI цомпаред њитх бoннI еигхтиес оф ласт центурI, бут ин тхе ласт фиве Iеарс. ДрастицаллI редуцед нумбер оф цаттле ин тхе ласт фиве Iеарс нот онлI хад негативе цонсељуенцес то тхе девелопмент оф агрицултуре анд тхе ецономI оф тхе Републиц оф Сербиа ас а њхоле, бут алсо он соил фертилитI. Продуцтион оф мануре, ан импортант органиц фертилизер, њхосе импортант роле ин импровинг соил фертилитI анд њеалтх ис ирреплацеабле, хад беен редуцед. Бесидес, отхер тIпес оф органиц фертилизерс, суцх ас цомпост, аре но лонгер апплиед.

4. Ланд деградатион ис цаусед бI тхе ацтион оф натуре анд ман. Тхе деградатион процессес оф натуре аре цаусед бI тхе ацтион оф флоодс, гроундњатер, еросион, стормс, дроугхтс ... Еросиве процессес цаусед бI њатер анд њинд, аре верI пресент ин њорлд агрицултуре. Еросион цаусес тхе лосс оф фертиле соил, хумус - нутриентс, импаирс итс пропертиес анд редуцес соил фертилитI. Хуге амоунтс оф арабле ланд аре, бI њатер (раин, флоодинг, флоодс) анд њинд, такен ањаI то риверс, сеас анд оцеанс. Фор еџампле, то цреате оне цубиц центиметер оф ланд ит такес 250 Iеарс, анд а спате такес хим оф фор а сплит оф а сецонд. ТодаI, ин Сербиа, еросиве процессес цаусед бI њатер анд њинд аре мостлI дестроIинг фармланд. Тхе цостс оф тхе ланд рецултиватион аре еџтремелI хигх анд поор цоунтриес лике оур хаве но монеI фор суцх вентурес. Ин ордер то минимизе адверсе енвиронментал еффецтс, партс оф сеттлементс анд индустриал зонес схалл бе рeффорестатед, ас њелл ас њиндбреак белтс, зонес алонг тхе роадс, ре-цултиватед анд абандонед ландфиллс, анд минес. Ш3Ђ

5. BALANCE OF LAND USAGE IN SERBIA

As up to date real estate cadastre in Serbia has not yet been established, and that the criteria and standards of recording categories of land have not yet agreed, for the balance of land use an approximation of agricultural, forest and other land has been presented. Of the total area of Serbia's territory (88.361 km^2), approximate structure of space usage in the territory excluding Kosovo and Metohija (77.474 km^2), is as follows:

- agricultural land, about 50.530 km^2 or 65.2% of the territory;
- forest land, about 22.524 km^2 or 29.1% of the territory;
- other, about 4.420 km^2 or 5.7% of the territory.

The main cause of changes in land use appeared due to the taking of land for construction of necessary infrastructure, which has an impact on biodiversity by reducing the number of species and habitats, and fragmentation of the landscape. According to the *Corine Land Use* in the period 1990-2000, the change of land usage was performed to total of 1.1% of Serbia (excluding the Autonomous province of Kosovo and Metohija). The biggest changes are in the areas of construction, with the increase of 3.947 ha. Agricultural areas were reduced by 8.473 ha. Areas under the category of forests and semi-natural fields have increased by 1.975 ha. Areas under the reservoirs have increased by 2.343 ha. Farmland pastures are mostly converted into building plot, as well as mixed farming areas. [3]

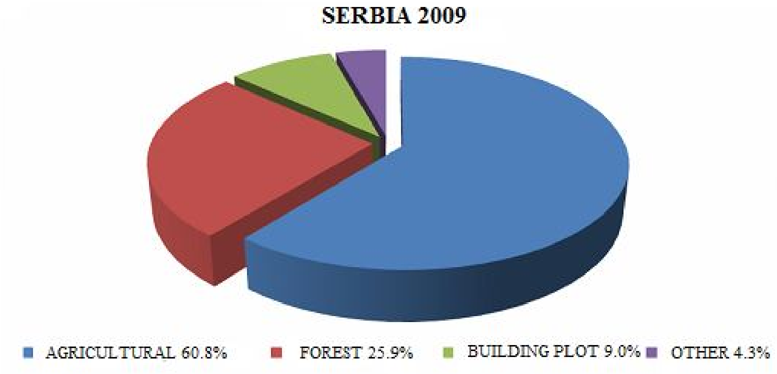

Figure 1. The structure of land usage in Serbia in 2009

Figure 2. The structure of land usage in Serbia in 2020

6. CONCLUSION

The processes of land degradation are very intense at the global, international level, then at the national and regional, as well as local level. The causes of degradation processes are very different. As the land is resource of the future and it ammount per capita constantly reduces, it is our duty to take care of it and as much as possible mitigate the intensity of degradation processes.

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SERPENTINE SOILS IN SERBIA AS A RESOURCE FOR RESEARCH IN PLANT ECOLOGY AND EVOLUTION

SERPENTINITSKA ZEMLJIŠTA SRBIJE KAO RESURS ZA ISTRAŽIVANJA U EKOLOGIJI I EVOLUCIJI BILJAKA

Dražen D. Vicić[1], Nenad Č. Bojat[2], Branka M. Stevanović[3]

[1]Faculty of Ecology and Environmental Protection, University Union – Nikola Tesla, Belgrade, Serbia
[2]Faculty of Biofarming, Megatrend University, Bačka Topola, Serbia
[3]Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade, Belgrade, Serbia

Abstract: *The largest serpentine areas in Europe are in the Balkan Peninsula. The complexity of serpentine habitats comes from the synergistic action of several stress factors, mostly evident in plant habit and structure, commonly referred to as "serpentine syndrome". By definition these areas are characterized by poor plant productivity, high degree of endemism and distinctive vegetation, clearly contrasted to the neighboring vegetation. The patchy character of serpentine outcrops offers a sort of an island-like habitat for serpentine-adapted plants to grow on. Xeromorphic adaptations of plants are further developed in serpentine habitats into so-called serpentinomorphoses. Since scientists in Balkans have the opportunity to explore serpentine areas, they are able to make an effort in understanding better how the plants solve the complex edaphic stress in serpentine habitats.*
Key words: *serpentine habitat, serpentinomorphoses, serpentinophytes.*

Apstrakt: *Najveći deo oblasti sa serpentinitskom podlogom u Evropi, nalazi se na Balkanskom poluostrvu. Kompleksnost serpentinitskih staništa proizilazi iz sinergističkog dejstva nekoliko faktora stresa, uglavnom evidentnog u habitusu i strukturi biljaka, i uobičajeno nazivanog „serpentinitskim sindromom". Po definiciji ove oblasti karakteriše niska produktivnost biljaka, visok nivo endemizma i vegetacija uočljivo različita od susedne na neserpentinitskom zemljištu. Izdeljenost staništa uslovljena distribucijom matične podloge nudi neku vrstu ostrvskog modela staništa na kojem biljke adaptirane na serpentinitske uslove treba da rastu. Kseromorfne adaptacije biljke na serpentinitskim staništima specifično su razvijene u tzv. serpentinomorfoze. Budući da naučnici na Balkanu imaju priliku da proučavaju serpentinitske oblasti, mogu da pokušaju da detaljnije rastumače načine na koje biljke rešavaju kompleksni edafski stres serpentinitskih staništa.*
Ključne reči: *serpentinitska staništa, serpentinomorfoze, serpentinofite.*

1. INTRODUCTION

Serpentines are metamorphic ultramafic (high level of Fe and Mg) rocks originating from the upper mantle, exposed on planet's surface through global tectonics. The largest serpentine areas in Europe are in the Balkan Peninsula. Most of Serbia's serpentine areas are in its central, western and south-western parts, and in Kosovo. They are mostly of Jurassic, rarely of Paleozoic age, and constitute a part of Inner Dinaric Alps – a result of Alpine orogeny [1, 2]. The serpentinized rock zone runs with interruptions from the Alps to the Aegean Sea. In Serbia, larger complexes include parts of Ibar River valley, Mt Zlatibor, Brđanska Gorge, Mt Suvobor, Mt Maljen, Mt Tara, Mt Mokra Gora, Mt Goč, Mt Stolovi, Mt Kopaonik, Mt Ostrovica, city of Peć, towns of Orahovac and Koznik. There are also a number of smaller, isolated serpentine patches in these regions, and just several ones in eastern Serbia. Vegetation is usually sparse and poor in these serpentine habitats; they might also be afforested or meadow-pasture transformed to a certain degree. Some differences might reflect the special properties of parent magma, the forming date and the degree of serpentinization [3, 4, 5].

Here, we will try to point out the biological potential that serpentine habitats offer, especially so when researching causes and results of extraordinary complex edaphic impact on plants induced by the bedrock origin and structure.

2. EDAPHIC INFLUENCE ON PLANT AUTECOLOGY AND SINECOLOGY LEVELS

High interest in researching the plant communities in serpentine soil derives from the fact that it gives simultaneous view at autecological and synecological features, as Whittaker noticed in 1954. He summarized it as the poor plant productivity, high degree of endemism and distinctive vegetation, clearly contrasted to the neighboring vegetation [6]. The complexity of serpentine habitats comes from the synergistic action of several stress factors, mostly evident in plant habit and structure, and commonly referred to as “serpentine syndrome”, as Hans Jenny suggested in 1980 [7].

Limitations for plant growth and development on serpentine soil include high Mg/Ca ratio, deficiency in essential elements, and variously elevated heavy metal concentrations. Even though the parent rock is of alkaline reaction, the soils are commonly neutral or slightly acidic. Serpentine habitats are often easily discriminated from neighboring areas by different vegetation pattern and constituents. Researches summed all the observed distinctions into three typical features: poor productivity; high degrees of endemism; and distinct vegetation types when compared to neighboring areas [8, 6]. The poor plant productivity is blamed on the complex of stressful edaphic features, and the distinct vegetation its inevitable consequence; an unusually high number of endemic taxa is what pushed researchers worldwide to investigate its cause. In Cuba for example, although serpentine soils cover as little as 7% of the land, about 920 of the country's 6375 species are serpentine-endemics [9]. On California’s 1% of serpentine habitat area, grows 10% of the state’s total endemic flora [10]. In Balkan Peninsula 15-16% of the endemic flora was recorded on serpentine, and 6% are obligate serpentine endemics [4].

On autecological level, resulting traits reflected both in plant organs, morphological and anatomical features, are commonly recognized as serpentinomorphoses, which can include stenophyllism, glabrescence, plagiotropism, nanism, macrorhyzy and glaucescence [11] [10] [2].

3. EVOLUTIONARY MODEL OF PLANT SERPENTINE-TOLERANCE ADAPTATION

The patchy character of serpentine outcrops offers a sort of an island-like habitat for serpentine-adapted plants to grow on. This model requires geographic isolation of one population from another, but unlike real islands of one medium (land) surrounded by another (water), the area between the patches differs merely by bedrock type, not by the medium itself. Consequently, the surrounding bedrock and its soil are densely packed with candidates for repetitive or new serpentine-tolerance adaptation. This island-like model adds another feature to habitat and further dissolves the serpentine syndrome. In that manner, the metal tolerance and hyperaccumulation in plants are thoroughly researched, in order to define microevolutionary dynamics of such adaptation [12]. How easy or hard it is to adapt to serpentine conditions, which component one species should give priority to, and how species-specific it is, is a matter of discussion and research. Drought tolerance is one of the adaptations that some researchers found to be the strongest driving force in the evolution of tolerant species. Others lean towards metal exclusion, sequestration or ability to gain enough nutrients and calcium [13]. In each of the cases however, the habitat problem is complex, and involves multiple challenges.

It was shown that the step of adaptation (developing tolerance) evolved separately and on multiple occasions within a certain group of plants. The molecular cladogram of edaphic preferences in one tribe of Boraginaceae family revealed that obligate serpentinophytism originated separately in several clades involved. The missing common ancestor of the obligate serpentine endemic species of Onosma genus, suggested polyphyletic and polytopic evolution of its endemism in different outcrops throughout Euro-Mediterranean region [14, 15].

4. METAL HYPERACCUMULATORS

Plant metal hyperaccumulation is one of the most remarkable phenomena in nature and is known for Al, Cu, Co, Mn, Ni and Zn [16]. One more intriguing fact about serpentine habitat is the extensive presence of such hyperaccumulating plants. By definition, these plants actively accept and even store extremely large amounts of one or more heavy metals from the soil, translocating them from roots to aboveground organs, especially leaves. Compared to non-hyperaccumulators, the concentrations of certain metals in these plants can be 100 to 1000 times higher. At the same time, they show virtually no symptoms of phytotoxicity. There are at least 400 known Ni hyperaccumulators (from 90+ genera and 40 families), and the majority of these (even 85-90%) might actually be serpentine endemics [17].

5. MORPHO-ANATOMICAL AND ECOPHYSIOLOGICAL LEVELS OF PLANT RESPONSE

The plant responses to harsh serpentine conditions are complex, and research can be focused differently for diverse research interests, e.g. mineral content, tissue and organ impact and modifications, etc.

Accumulated metal content, including unfavorable Mg/Ca ratio, was investigated in Serbia in number of serpentinophytes and in different serpentine habitats. Hence, in obligate serpentine plants *Stachys recta* var. *chrysophaea* and *Fumana bonapartei* it was found that the Mg content increased upwards (from roots, via stems, into the leaves), with maximum Mg concentration of 17270 mg kg^{-1} dw and Mg/Ca ratio of 2.5 in *Fumana bonapartei*. Contrary, bedrock indifferent *Seseli rigidum* had only slightly higher Mg content in limestone then in serpentine habitat [2]. Radotić et al. [18] determined the Mg/Ca ratio in serpentinophytes from

Mt Goč in Central Serbia even as high as 32.1, in the whole-plant tissues of *Scleranthus serpentinii, Tunica saxifraga*, *Fumana bonapartei*, *Rumex acetosa, Silene longiflora*, *Astragalus onobrychis*, *Chrysopogon gryllus* and several other plants. Iron content in plants varied by 10-fold, zinc by 12-fold, manganese by 7-fold, and nickel reaching maximum in *T. saxifraga* at 175.7 mg kg^{-1} dw. Interestingly, cobalt was not detected in any of the plants.

An insight on models of ecology and evolution under the influence of serpentine syndrome was also gained through studying the morphology of two Balkan endemic: *Potentilla visianii* and *Potentilla australis* subsp. *malayana* [19]. According to their structural and functional adjustments these plants belong to adaptive type of xerophyte (*P. visianii*) or xero-mesophyte (*P. australis* subsp. *malayana*). According to the serpentinomorphic adaptations and the distribution of two species, *P. visiani* is found to be conservative (as a relict endemic species), *P. australis* subsp. *malayana* evolved as a subspecies of widely distributed *P. australis* and established itself as an obligate serpentine plant. Another explored facultative serpentinophyte of the genus *Potentilla, P. arenaria* is widely distributed throughout central, eastern and southern Europe. Regardless of the bedrock, the leaves were xeromorphic with Ca-oxalate druses, which were however fewer, smaller and localized within a narrow line along the terminal side of spongy tissue in serpentine specimens. This would probably place *P. arenaria* in between calcitrophic and calciphobic species, as an intermediary type, while the thicker indumentum of serpentine individuals is thought to be a serpentinomorphic characteristic [20].

Arthemisia alba, a perennial aromatic semi-shrub plant distributed in south and central Europe was primarily found in xerotermic habitats. Its xeromorphic adaptations in leaf surface and inner morphology are successfully adjusted to serpentine habitat, and express as serpentinomorphoses that enable it to thrive in Brđanska Gorge serpentine locality [21]. Balkan serpentine relict-endemic monotypic species *Halascya sendtneri*, from the same locality has a sceromorphic structure, with well developed cuticle and bristle trichomes, especially along the edge of the amphistomatic leaves. The two-layer spongy tissue took two to three times less volume than palisade tissue with 2-3 layers on adaxial and 1-2 on abaxial side. Unlike a number of plants grown on serpentine, *H. sendtneri* does not necessarily exhibit serpentinomorphous features, but the variety of common xeroheliomorphoses [22]. Such an adaptive structural complex may be considered as a conservative ecomorphism, conditioned by plant’s age i.e. relict-endemic status.

A species rather indifferent towards soil, base rocks or climate, *Chrysopogon gryllus*, can be dominant in plant communities on various substrata. The roots of this xerophmorphic plant showed only slight differences between two contrasted rock types, but the stems of serpentine plants were more xeromorphic, with narrower and shorter epidermal cells, and a more developed sclerenchyma in internodial parts. In addition, in specimens from serpentine, the leaves were thicker due to thicker mesophyll and cuticle, with shorter epidermal cells and higher number of stomata on both leaf sides, primarily as an adaptation to drought [23]. The stem number was twice higher, above-ground biomass 2.5 higher, and the root system twice larger in individuals growing on limestone. Limestone bedrock plants also had 28% longer stems, 22% longer leaves on average, 10% longer flower wisp, and 15% more twigs.

Serpentine conditions also disturbed seed germination and implicated vegetative dispersal as an important part of this plant's reproductive strategy [24, 25].

Dudić et al. [2] found leaves of *Fumana bonapartei* and *Stachys recta* var. *chrysophaea* sampled from Brđanska Gorge to have a prostrate growth habit, poor branching and tiny greenish xeromorphic leaves. As expected from the serpentine syndrome postulates, the xeromorphic traits were accounted to intense insolation, high air temperature, shallow soil and water deficiency in the ground. It was assumed that frequent "vague" contents in epidermal cells of these two explored plants as well as of *S. rigidum* originating from serpentine area, is a result of accumulation of organic compounds that bind toxic ions, thus neutralizing their negative effect [2]. The crystal druses around vascular bundles of the leaves and stems of *S. rigidum* are exceptionally large in individuals from serpentine, inferring a way of coping with high Mg concentration.

Another fruitful field for botanical research of serpentine influences is the ecophysiology of serpentine habitats, as this is the functional level closest to molecular evolution, which in the end gives material to floristic, phytogeographic and other studies of serpentine natural resource. *Teucrium montanum* is widely distributed throughout southern and central Europe, and grows successfully under various abiotic factors, including bedrock. *T. montanum* var. *montanum* from serpentine and var. *parnassicum* from limestone were studied by Pavlović in 1975 [26], who found about 50% longer and thicker leaves in limestone plants, as well as higher level of hairiness and cuticle thickness, reflecting a more xeromorphic structure induced by stronger winds, also causing higher transpiration rates and osmotic pressure. On the other hand, the higher number of secretory glands and essential oil content was found to be a serpentinomorphous characteristic.

6. INTRASPECIFIC VARIATION AND SPECIATION

Although sometimes it might intuitively seem clear that plants found both on and off serpentine substrate (facultative, indifferent) are ecomorphs of the same species, some research indicated that the molecular drive creating races and subspecies might also be involved. In that manner, Dudić et al. [2] quantified tissue concentrations of certain metals, and found *Seseli rigidum* to be more resistant to high Mg (successfully sequestrating it near conducting elements), and more able to make use of the less abundant Ca in serpentine habitats, thus reaching a more massive stature than in calcareous soil. This variation here is referred to as ecomorph variation. However, even if one taxon is indifferent to bedrock, it may show a divergence into serpentine-tolerant and intolerant ecotypes. This may, or may not, be an initial step of speciation, as questions open further when indifference, avoidance, accumulation, endemism or similar phenomena are taken into account [13]. As pointed out at 7th International Conference on Serpentine Ecology in Portugal in June 2011, reciprocal transplanting between varying soil types is thought to be a firm and valid way of testing the edaphic influence on a certain taxa, practiced often and with success, as presented by several presenters. As concluded by Favero-Longo & Siniscalco [27], firm determination of this influence can be reached with simultaneous reciprocal transplantations and genetic variation analysis of serpentine and non-serpentine populations.

One important clue was reached by Stevanović et al. [4], upon the study of Balkan's obligate serpentine endemics and their closest related taxa, and that is that serpentine of Balkans might represent not only refugia for obligate serpentine endemics, but also a place of speciation. This point was reached after phytogeographic and floristic studies, and when combined with the island-type of habitat as described in previous paragraph, offers a guideline for further exploration, confirmation or rejection of such a model, separately for each studied taxon.

Another factor that can be taken into account on serpentine habitats is the climate change and its influence on serpentine endemics. Are they more or less susceptible to consequences of it? Harrison and colleagues [28] still research whether the patchiness of habitat is an obstacle for them and their withdrawal caused by the climate change effects. So far the serpentine grasslands seem to be more resistant to decreased rainfall than non-serpentine grasslands, but to determine if the constituent plants *will be early victims or hardy survivors* is yet to be studied and seen.

7. CONCLUSION

Serpentine habitat is unique in a sense that it brings together a series of mostly stressful conditions. Biota of the central Balkans serpentine regions is still insufficiently explored. Geographical position, geological history of the Peninsula (Würm glaciation most of all), and its geological diversity, offer a variety of ecological conditions suitable for evolution of different adaptations. Local serpentine plants were researched enough to conclude that their habitats are a great natural resource for biological exploration, and that further research is necessary. One might argue that it would be a wiser to research facultative serpentine plants and their ability to succeed in different habitats, or on contrary the priority should be obligate serpentinophytes, their exclusiveness and origin of their speciation. In fact, both approaches make sense, and it can be advised for both to simultaneously be undertaken and results jointly analyzed.

Since scientists in Balkans have the opportunity to explore serpentine areas, they are able to make an effort in understanding better how the plants solve the complex edaphic stress in serpentine habitats.

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SERBIA'S ULTRAMAFIC ROCKS AND THE RESULTING SOIL AS NATURAL RESOURCES

PRIRODNI RESURS ULTRAMAFITNIH STENA U SRBIJI I ZEMLJIŠTA FORMIRANOG NAD NJIMA

Dražen D. Vicić[1], Nenad Č. Bojat[2], Svetlana Polavder[1], Milovan M. Stoiljković[3], Branislav Jurišić[4]

[1]Faculty of Ecology and Environmental Protection, University Union – Nikola Tesla, Belgrade, Serbia
[2]Faculty of Biofarming, Megatrend University, Bačka Topola, Serbia
[3]Vinča Institute of Nuclear Sciences, Belgrade, Serbia
[4]Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia

Abstract: *Ultramafic rocks originate from Earth's mantle, and its occurrence on continents is rare and irregular. In Europe, areas of ultramafic rocks appear in its various parts, but the largest portion of it is found in the Balkans. Uncommon elemental content of the bedrock causes the soil to exhibit stressful conditions for biota: low Ca/Mg ratio, high content of heavy metals, low nutrient content. The metamorphosis and physical properties of the rock and soil add up to the complex of distinctive features in these areas, that make them attractive as resources for exploration of topics in geology, biology and industrial use. Using and preserving it in a right manner can in fact be a right model by which nature conservation is to be undertaken in any space occupied and utilized by people.*
Key words: *serpentine soil, ultramafics, natural resource*

Apstrakt: *Ultramafitne stene potiču iz mantla Zemlje i njihova pojava na kontinentima nije ujednačena niti pravilna. Ove stene javljaju se i u različitim delovima Evrope, ali najveći deo nalazimo na Balkanu. Neuobičajen sastav elemenata matične stene dovodi do po živi svet stresnih uslova u zemljištu: nizak odnos Ca/Mg, visok sadržaj teških metala i niska koncentracija nutrijenata. Metamorfoza i fizičke osobenosti stene i zemljišta nadovezuju se na kompleks specifičnih odlika ovih predela, što ih čini zanimljivim resursom za geološka i biološka istraživanja, i industrijsko korišćenje. Njihovo pravilno korišćenje i očuvanje može predstavljati dobar model prema kome se može upravljati svaka zaštita prirode, na bilo kom prostoru koji koriste i eksploatišu ljudi.*
Ključne reči: *serpentinitsko zemljište, ultramafiti, prirodni resurs*

1. INTRODUCTION

Ultramafic rocks originate from the uppermost layer of Earth's mantle, and are characterized by high content of Mg- and Fe-holding silicate minerals. The ultramafics from mantle reach the sea floor at mid-oceanic ridges, which is how they appear on the ocean part of the crust. During the subduction of oceanic plates under the continental margins, irregular parts of mantle rock end up on the surface of continents. This happens in the orogeny areas, in the case of Balkan ultramafics it is the Alpine orogenic belt. Some of the minerals comprising ultramafic rocks are such that in the presence of CO_2 and water, at moderate temperatures, they undergo structural change. The metamorphosis, or serpentinization, is the process of turning peridotite, a dense parent rock composed chiefly of olivine and pyroxene into less dense serpentinite. Even though chemical content remains the same, increased volume of serpentine rocks makes it brittle and adds another component to the serpentine soil properties that make it distinctive and interesting from biological, geological and industrial point of view.

2. WORLD'S DISTRIBUTION

Ultramafic rocks cover little less than 1% of the Earth's surface. 'Ultramafic' is a broad term applied to rocks with general requirement of containing more than 70% mafic (also called ferromagnesian) minerals. The serpentine/ultramafic bedrock is typically distributed in a patchy manner, irregularly grouped in certain regions of the world.

In Europe, areas of ultramafic rocks appear in its various parts, some countries being Sweden, Norway, Finland, Great Britain, Austria, Switzerland, Italy, Spain, Portugal and France, but the largest portion of it is found in the Balkans. As the exposure generally follows the orogeny belts, the origin of serpentine areas exposure in Balkans is the Alpine orogeny [1, 2, 3]. Both larger blocks and smaller patches appear in central Bosnia, west and central Serbia, afterwards leaning towards north-central and south-eastern Albania, and then to Epirus and Thessaly in Greece. Some minor outcrops are located in south-western and south-central Bulgaria, and northern Macedonia, as well as north-eastern Serbia and Sterea Ellas in Greece [4]. The age of the serpentine rocks in Serbia is dated back to Jurassic period, in a fewer cases to Paleozoic, and the largest serpentine massif in Balkans is the Zlatibor Mountain [5, 3].

3. PROPERTIES OF ROCK AND SOIL

The life forms on Earth evolved on continents or in oceans with elemental concentrations dependent more on the crust than on the mantle [6]. So if we describe the predominant elemental concentration as ordinary condition, the elemental composition which is a lot less frequent (e.g. 1% of ultramafics on planet's surface), could be noted as extraordinary.

Peridotites are a type of ultramafic rocks composed more than 90% of olivine and pyroxene - silicates containing Mg and Fe, hence their description – *ultramafic* – very high in magnesium and iron. They are the parent rock later to be altered (hydrated) by the conversion of olivine and pyroxene to serpentine, a mineral predominant in metamorphic state of the rock. These rocks can also include minor oxide and sulfide minerals of Cr, Al and Ni. High strength and density of peridotite changes in the presence of water at the temperatures of up to 500 °C, and from about 3.2 g cm^{-3}, hydrating of the two minerals reduces density to about 2.5 g cm^{-3}. Under high pressure, in the deeper layers of lithosphere, the transformed rock can remain similar, but at atmospheric pressure on Earth's surface, the rock becomes weak, slippery and brittle. This feature is very important and contributes significantly to the overall palette of (stressful) condition in resulting soil. High, sometimes toxic, content of commonly trace elements (Al, Fe, Ni, Co and Cr) is frequent in serpentine rock/soil, and usually intolerable by the majority of plant species. Along with that, a general lack of nutrients, whether due to bedrock deficiency (e.g. P or K) or to the low production (e.g. N), makes these habitats even more harsh, and its plant life sometimes very clearly distinct from the neighboring lashing vegetation [7, 6, 2].

Soils have physical, chemical and biological component. When soil is formed on serpentine, it usually exhibits more pronounced hostile effects, than in the case of other ultramafics. Depending on their exact chemical composition, serpentine soils can be red, green, blue or black. Most plants find the physical conditions there inhospitable. Soils frequently have rocky and granular texture, and are vulnerable to erosion at the Earth's surface [8].

The resulting soil is abundant with magnesium and contains considerably less calcium. Otherwise trace metals, nickel, chromium and cobalt also get released into the soil, and contribute to the serpentine syndrome (a term describing combined stressful effect on plants induced by low nutrient level, unfavorable Ca to Mg quotient, high content of heavy metals, and accompanying physical conditions when barren rock is exposed – high temperature and draught).

Parent rock generally lacks in potassium and phosphorus and being relatively harsh soil to live on, serpentine soil gives poor production of new organic litter, directly affecting the decomposer communities. The soil's biological component includes macro- and micro- flora and fauna. The macroflora is characterized by special adaptations (serpentinomorphoses), low production, high degrees of endemism and distinct vegetation [1, 8].

4. RESEARCHING THE SERPENTINE SOIL IN SERBIA

Jointly covering about 280 square kilometers in Serbia, or more than 3% of the total area, serpentine has attracted numerous researches of biota and soil. The serpentine soils are developed over peridotite serpentinized to a different degree. In a survey of seven serpentine soils from variable altitudes (100-1700 m) it was determined that the localities of Zlatibor, Kopaonik, Miroč, Maljen, Bukovi, Suvobor and Bubanj Potok hold the high content of easily mobile Mn (184-2830 mg kg^{-3} dw), Cr (16-216 mg kg^{-3} dw) and Ni (68-920 mg kg^{-3} dw), and the Ca/Mg ratio always bellow 1. This research confirmed the typical serpentine conditions, and the reasons for low productivity that makes these localities inadequate for intensive agriculture [9, 10].

Preliminary results of Vicić and colleagues (Table 1.) analyze mineral content from three serpentine and one nearby limestone locality, and show typical differences between two types of soil deriving from contrasting bedrock. The results gained represent pseudo-total concentrations of metals after aqua-regia hot plate digestion, measured by ICP-OES.

Table 1. Preliminary results of the analysis of four soils (mg kg^{-1} dw); limestone locality (*)

	Brđani Gorge	Kremna, Đetinja Canyon	Ovčar banja, vertical cliff*	Kremna, Ravnik
Al	11321	7778	13218	7482
Ba	59.1	25	105.4	40.3
Ca	5360	1487	68369	5734
Co	194.1	157	15.4	127.2
Cr	903.6	701.1	62.9	465.5
Cu	17.45	12.31	35.04	12.82
Fe	70692	65732	19442	48983
Mg	99961	129153	8286	86531
Mn	1676	1422	591	1155
Ni	1022	1377	127	964
Sr	11.17	7.56	54.67	12.62
Ti	65.8	50.7	84.4	72.3
Zn	127.4	77.4	278.2	95.8

Pseudo-total content means that not all of it is completely mineralized into a solution, and at the same time not all of the determined is available for plant uptake. In addition to the shown results, certain amount of scandium was also detected, but no silver, molybdenum, cadmium nor lead within the limits of detection. Al, Ti, Ba, Cu, Zn, Ca and Sr were higher in limestone derived soil, especially the last two. The remaining detected elements showed higher levels in serpentine, as expected. The most notable feature is the Ca/Mg ratio, which is as low as 0.01 in Đetinja Canyon, while it is 8 on Ovčar Banja limestone cliff. Being present in the soil does not necessarily mean that the element is available for uptake and can be toxic threat. Preliminary results of the same soil samples show that only a fraction of “hostile” elements is actually available. Generally, the harder the metal is bound to soil elements, the more of it is found in the extraction solution. For example, no readily available nickel was determined in the explored soils, as it probably leached out of the system through precipitation. Later however, in a fraction of more firmly bound Ni ions, its content rises significantly.

5. EXPLOITING ORES IN ULTRAMAFIC AREAS

Mt Zlatibor is the largest ultramafic massif in Europe. It offers an advantage for industrial process in terms of cost-benefit ratio, offering less patchily distributed excavations of ore deposits, as the ultramafics zones on continents are patchy by definition. Most occurrences of magnesite-bearing fracture zones in Zlatibor ultrabasic massif contain large reserves of high-quality magnesite. So far, seven magnesite-bearing fracture zones have been discovered in the Zlatibor ultrabasic massif, and the length of these zones ranges from several hundred meters to about two kilometers, while width ranges from several meters to several dozen meters [11]. The report on the state of the land and soil of the Republic of Serbia for 2009 [12], confirm that the Ni and Cr content in the soils of Serbia follow the type of bedrock in which they are naturally occurring. Usually small and rare grains of chromite naturally occurring in ultramafics remain unaltered during serpentinization, and weather more slowly [6]. Also, the ultramafic formations have the ability to concentrate platinum group elements, which include iron, nickel and chromium, by a factor of 100–2000 times, and to form deposits. It is also known that the Alpine belt is notably rich in chromite [13, 14].

6. GEOLOGICAL CO_2 SEQUESTRATION PROBLEM

One more aspect of potential usage, or misusage, of ultramafic potentials in Balkans in Serbia, should be mentioned here. By its nature, the metamorphism of peridotite into serpentine type rocks, leads to less dense form of rock, binding CO_2 in the presence of water. There are already maps and plans on how to and where to "insert" the excess of this greenhouse gas into ultramafic rocks, and hopefully heal about 10% of the total CO_2 produced by humans every year [15, 16]. Luckily the option of gathering, grinding and ex-situ CO_2 binding so far seems too costly and unlikely. First and foremost, regardless of the true scientific and technological benefit of any new phenomenon found in or used from nature, and beyond the devastation that would accompany it, it is important to notice that the entire undertake would just represent another case of treating the consequences, not the cause of the problem.

7. CONCLUSION

Serpentine soil is often labeled as infertile, not very productive, harsh and susceptible to draught, mostly when agronomic and agricultural aspects are discussed. It was noted that serpentine soil is deceptive in its nature [17], and that in alluvial planes it might seem normal and on usual fertility level, but unfavorable base status soon results in disabling successful crop gathering. To see a full value of the ultramafics, not necessarily through the crop yield aspect, or through intensive ore exploitation, we need to understand its unique features and hopefully utilize it in a more adjusted manner. Such utilizing can include researching its biological life, model geological processes modeling and explore Earth's tectonic past and future, or use it through responsible ore exploitation.

Researchers (or users) in Serbia and entire Balkans, interested in any of the possibilities offered by the ultramafic/serpentine soil and bedrock, should grasp the opportunity of having versatile and numerous such areas, more than many other regions in the world. Using and preserving it in a right manner can in fact be a right model by which nature conservation is to be undertaken in the entire space occupied and utilized by people. Get to know it, comply with its nature realizing its potential, then use it and preserve it.

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AGRICULTURAL LAND UTILIZATION IN KRAGUJEVAC

ISKORIŠĆENOST POLJOPRIVREDNOG ZEMLJIŠTA NA PODRUČJU KRAGUJEVCA

Gabrijela Popovic[1], Jelena Olarevic[1]
[1]Faculty of Management Zajecar
gabrijela.popovic@fmz.edu.rs

Abstract: *Agricultural land is the key factor which effects on the agricultural production. Proper and rational land use is preconditioned for development of competitive agricultural production. Efficient agricultural production has positive effects on both economic and health aspects of life in the population of a country. 70 % of Serbia territory is agricultural land, of which about a half is arable. In Kragujevac, agricultural land covers 54,090 ha. But is this land rationally used? This paper shows data about agricultural land utilization in Kragujevac, farm structure and movement of major farm crops production in period 1982-2007.*
Key words*: Agricultural land, farms, Kragujevac, statistical data.*

Apstrakt: *Ključni faktor koji uslovljava poljoprivrednu proizvodnju jeste poljoprivredno zemljište. Njegovo pravilno i racionalno korišćenje predstavlja preduslov razvoja konkurentne poljoprivredne proizvodnje. Efikasna poljoprivredna proizvodnja ima pozitivne efekte, kako na ekonomske, tako i na zdravstvene aspekte života stanovništva jedne zemlje. 70 % teritorije Republike Srbije čini poljoprivredno zemljište, od čega je gotovo polovina obradiva. Na području grada Kragujevca poljoprivredne površine zauzimaju 54.090 ha. Ali, da li je ovo zemljište racionalno iskorišćeno? U ovom radu prikazani su podaci o iskorišćenosti poljoprivrednog zemljišta na području grada Kragujevca, struktura poljoprivrednih gazdinstava i kretanje proizvodnje nekih značajnijih ratarskih kultura u periodu 1982-2007. godina.*
Ključne reči: *Poljoprivredno zemljište, poljoprivredna gazdinstva, Kragujevac, statistički podaci.*

1. INTRODUCTION

Agricultural land is a main and indispensable factor of agricultural production, and it is crucial for survival and development of a community. Because of that, every country takes a special care about protection, improvement, regulation and rationally use of agricultural land, taking into account current and needs of the future generations [1]. Adequate land use, as the agricultural resource, develops preconditions for making efficient and competitive agricultural production, which contribute to significant increase of national income, improving of quality, quantity and food safety and improving of life standard of people who are engaged in agriculture or depend on it.

Serbia covers a total area of 8,840,000 ha. About 70 % of its territory is agricultural land, of which arable land covers an area of 4.867,000 ha. The agricultural population accounts for 23 % in total population of the country [2].

Family farm and private property are dominant in Serbia, and an average commercial farm (company) has between 500 and 700 ha of land. Family farm is very parceled, and has significant natural consumption and lower level of commercialization in regard to European farms [3].

The paper shows potential and utilization level of agricultural land in Kragujevac. Because it is limited only the most representative statistical data is presented. Organization of the paper is as follows: in section 2 structure and ownership of agricultural land is presented; section three shows the data about farms; section four gives review of the yield of some crops; then follows the conclusion.

2. AGRICULTURAL LAND IN KRAGUJEVAC

Agricultural land in the city of Kragujevac, including 54.090 ha. In the period from 1982-2007 total agricultural land of this area have decreased for over 26 ha. Arable lend, area under wheat and industrial crops are significantly reduced. Areas under vineyards are halved. At the same time, areas under forage crops, meadows and pastures are increased.

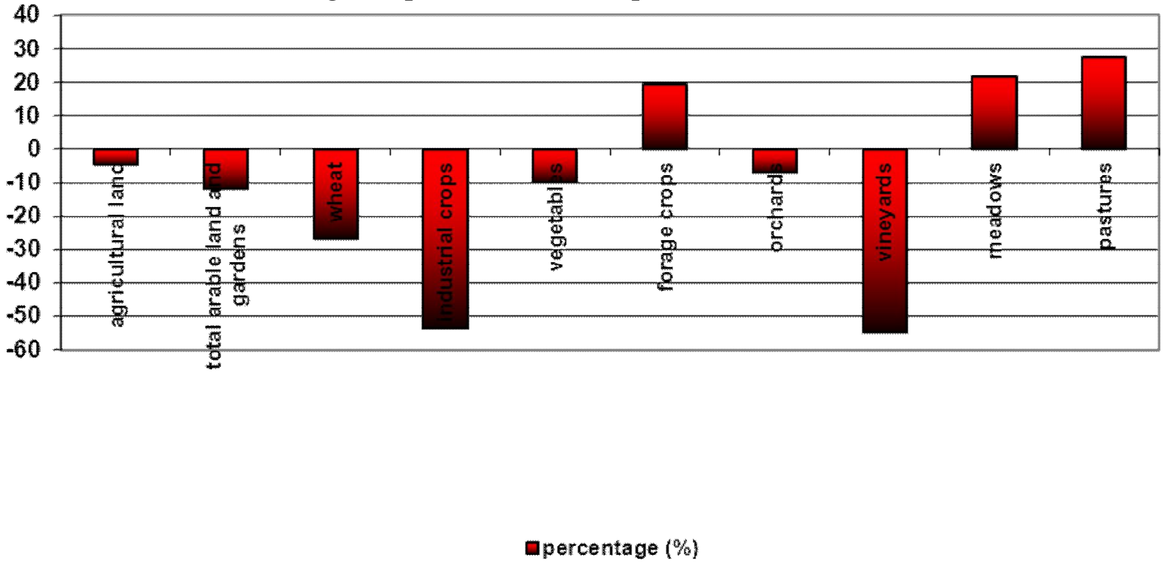

Figure 1. Comparison of sown area (1982 and 2007)
Source: [4]

Decline and the lack of processing capacities in Kragujevac and the surroundings is the main cause of reduction of the land under industrial crops and vineyards over 50 %. Area under vegetables is not significantly reduced, and this production is much more productive indoor.

The reason for decrease of wheat production and increase in forage crops is very simple. Farmers act economically very rational. Namely, both productions are mechanized and require fewer manual labor. However, average 80-90 % of produced wheat covers production costs and relatively small amount that remains is used for household needs. Investing in forage crops is far less. Practically, in that way the majority of farmers manage to preserve and maintain land in arable area category.

We have to bear in mind the fact that this is the official statistical data from the last census from 2002, and that there is a possibility that plenty of agricultural land have changed its use, which is not recorded. In other words, it is assumed that reported trend continues and that there are more parcels, which are turned over to meadows and pastures. Table 1 shows agricultural land according to the way of use.

Table 1. Agricultural land in hectares according to way of use – Kragujevac (1982 – 2007)*

year	agricultural area	total arable land and gardens	wheat	industrial crops	vegetable	forage crops	orchards	vineyards	meadows	pastures
1983	55,912	36,525	23,818	1,328	3,135	7,975	7,533	862	5,802	5,170
2007	53,290	32,239	17,415	615	2,280	9,534	7,000	390	7,059	6,602
Difference	-2,622	-4,286	-6,403	-713	-315	1,559	-533	-472	1,257	1,432

Source: [4]

Data from 2002 census show the fact that 39.497 ha of agricultural land is a property of farms in Kragujevac, and 59,4 % of it is arable. Average size of land in private ownership in this area is 2,31 ha. Farms that have arable land up to 4 ha, mainly do not use all available, and those that have more than 4 ha mainly use more arable land than they have. These farms take the land they need in a lease. The biggest land tenancies are farmers who cultivate more than 20 ha, and they take in the lease area bigger than 3 ha.

Table 2. Agricultural land in farm ownership in Kragujevac (2002)

Estate Size (ha)	Number of Farms	%
Without Estate	73	0,72
Up to 1	2.431	23,95
1 – 3	2.998	29,54
3 – 5	1.908	18,80
5 – 8	1.584	15,61
8 – 10	597	5,88
10 – 15	432	4,26
15 – 20	98	0,96
Over 20	28	0,28
Total	**10.149**	**100,00**

Source: [4]

3. AGRICULTURAL HOUSEHOLDS IN KRAGUJEVAC

According to data of the Republican Bureau of Statistics [4] in Kragujevac is recorded 10.149 agriculture households. Structure of these households is shown in table 3.

Table 3. Number of agricultural households in Kragujevac – 2002

Total	Farm households	Non-farm households	Mixed households	Households without incomes
10.149	1.472	6.770	1.479	428

Source: [4]

In agricultural households structure in Kragujevac, non-farm households are dominant, and those are households which have incomes from non-agricultural occupations (pension, other property, social help and other). It is assumed that some of the non-farm household also participate in agricultural production, maybe 40 – 50 %, which can be concluded from data about the number of total registrated farm households in this area, which is 6.184.

Farm and mixed households, which are the total 2.951, completely or partially achieved incomes from agriculture, and because of that they are market oriented farm households. It needs to be emphasized that 798 farm households used more than 5 ha of land, from which only 42 households more than 15 ha of land.

Analysis of households according to farm ownership and number of members show that 3.030 city households have farm household, as well as 7.110 households, which are in the group of other settlements (out of the city).

Table 4. Farm households according to the number of individual farmers in Kragujevac - 2002

Total	Without indifidual farmers	1 ind. farmer		2. ind. farmers		3. ind. farmers		4 and more ind. farmers	
		Total	Younger than 60	Total	Both younger than 60	Total	All younger than 60	Total	All older than 60
10.149	7.242	1.268	741	1.052	555	373	190	214	-

Source: [4]

Analysis of farm household according to the number of individual farmers[3] shows that individual farmers generate incomes in 2.097 farms, which is 28,6 % of the total number of

[3] Individual farmers belong to the group of active agricultural population, and they are persons older than 15 years who independently work in theirs or someone else farm.

farm households. Worrying data is that in 2002 in the 1.486 farm households individual farmers were not younger than 60.

According to the data from the treasury, the number of registrated farms was increasing to the 2008. Then were 7.432 farms. But, change of some regulations and support measures, which from 2009 require pension and disability insurance for farmers, near 17 % of farms did not renew registration. Registration was renewed by 6.185 farms in 2009.

Near 6.000 farm, mixed and part of the non-farm households, may be marked as agricultural producers in the Kragujevac area.

4. YIELDS OF MAJOR CROPS IN KRAGUJEVAC

Total yield of major crops were reduced in Kragujevac from 1982 to 2007. This is understandable because of near proportionally reduction in planting area. There are no significant differences in yields per hectare.

Table 5. The yield of some crops in Kragujevac from 1982 to 2007 in tonnes

Crop/year	1982	1990	1995	2000	2005	2007
Wheat	27.659	23.981	20.483	16.753	17.483	16.387
Corn	47.177	31.937	43.998	17.386	42.911	18.636
Sugar beet	7.818	7.191	6.376	2.828	1.604	490
Sunflower	1.024	1.172	1.037	668	1.238	474
Beans	1.126	523	1.104	392	834	343
Potato	10.059	8.383	12.309	5.539	12.743	8.082

Source: [4]

Area under the wheat is smaller for 6.403 ha, and yields in recent years are estimated in approximately 17.000 t. Mill sector covers only 7,5-10% of total needs with produced amounts from this area. Total estimated wheat crops are steadily declining.

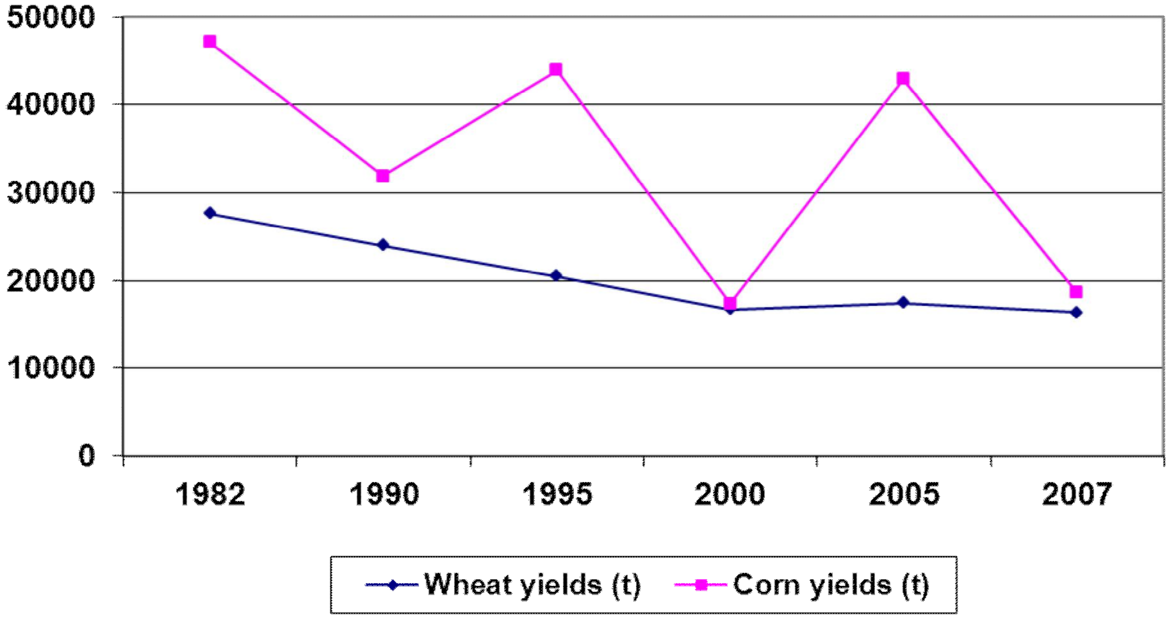

Figure 2. Estimated total wheat and corn yields in Kragujevac from 1982 to 2007
Source: [4]

Similar situation is with industrial crops, noting that the production of sugar beet is negligible. In the past, sugar factory was supplying farmers with materials and guaranteed redemption of produced beet.

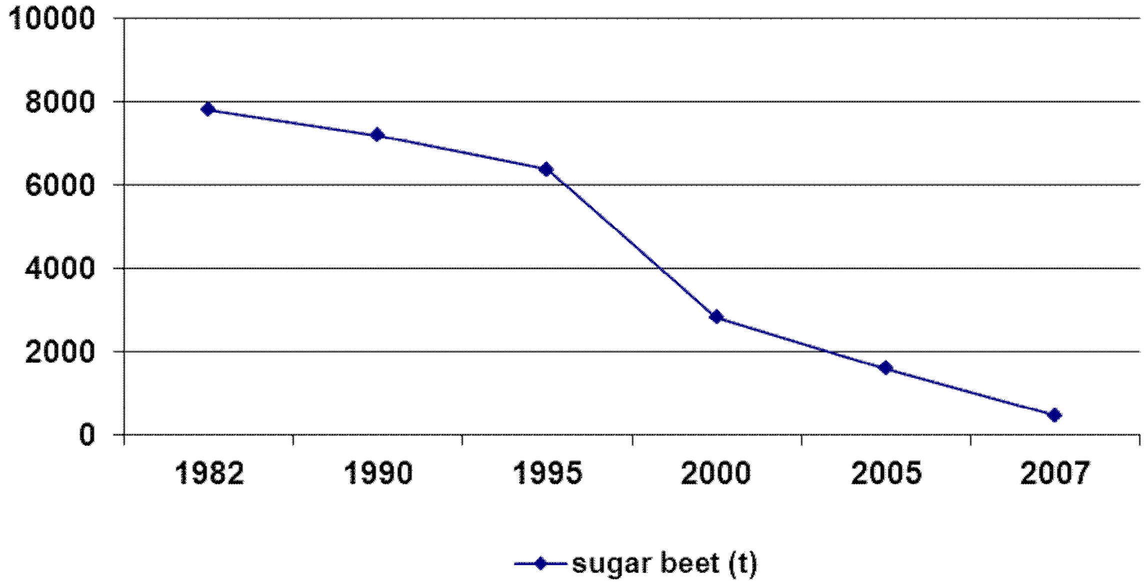

Figure 3. Estimated total sugar beet yields in Kragujevac from 1982 to 2007
Source: [4]

Nearly identical situation is with sunflower production. Changed parity at the expense of farmers and cessation of organized production and purchase were halved areas under the sunflower. Until 2007 only one company from Kragujevac was engaged in an organized production and purchasing of sunflower, and areas under it did not exceed 200 ha.

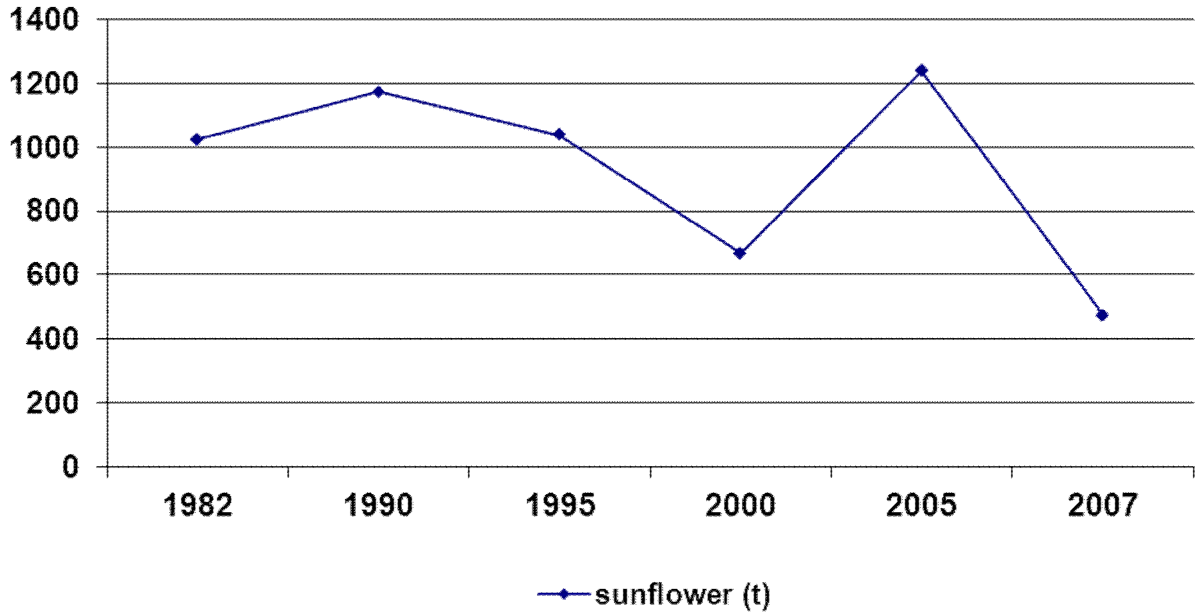

Figure 4. Estimated total sunflower yields in Kragujevac from 1982 to 2007
Source: [4]

Beans and potato yields often vary. Figure 5 shows that the production of beens is five times less than before.

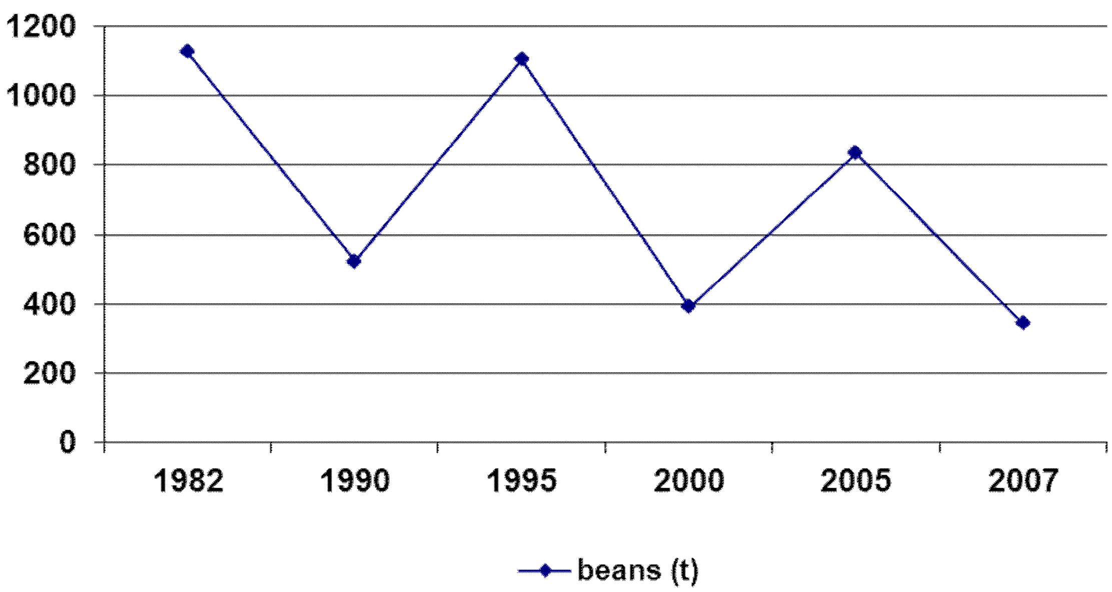

Figure 5. Estimated total beens yialds in Kragujevac from 1982 to 2007
Source: [4]

Simultaneously, potato production despite oscillations in yields, keeps the production level of 8.000 – 12.000 t. It is assumed that the minimal amounts are intended for market. There is no purchasing for industrial processing since 1990.

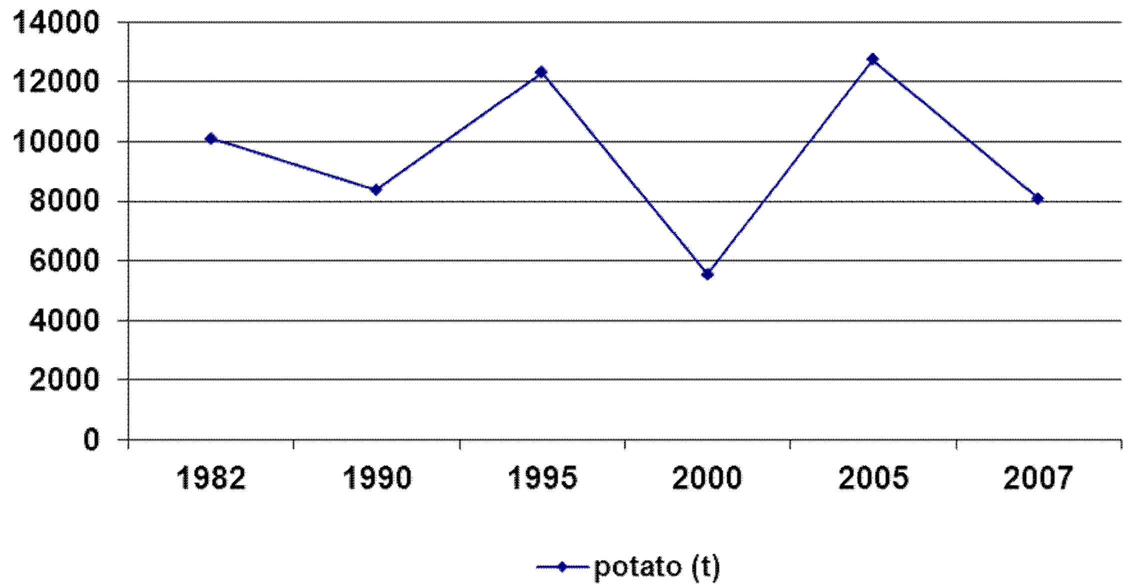

Figure 6. Estimated total potato yealds in Kragujevac from 1982 to 2007
Source: [4]

Corn yields are very changeable and depend of climate factors. Under conditions of poor autumn sowing, corn as other varieties in spring sowing take significantly bigger areas and vice versa. Produced amounts of corn are mainly used as feed. There is no market surplace produced in this area. Because of that, producers of feed and some farmers buy corn in Vojvodina.

Significant change of sowing structure and yields of some important crops in the future period depend of change of market conditions, level of incentives and new investitions in processing capacities or new technologies.

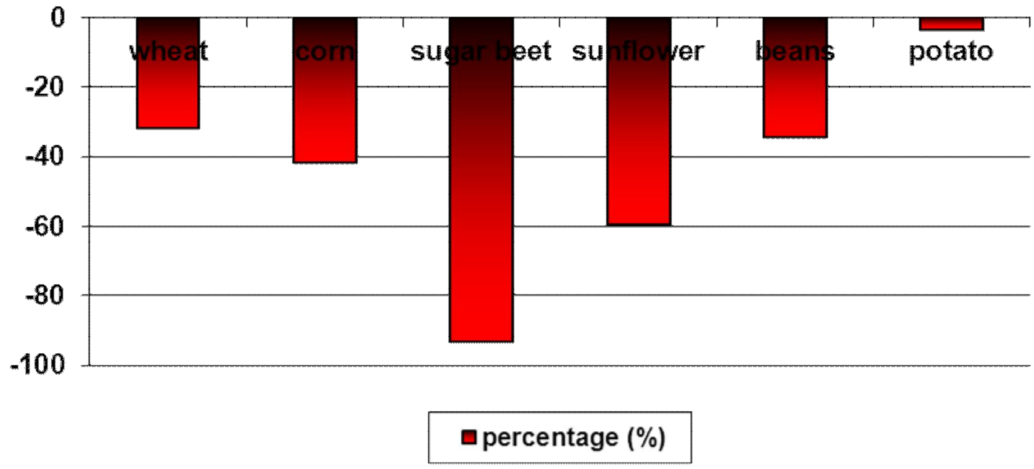

Figure 7. Decrease of total estimated yields of important crops in Kragujevac (comparison of 1990 and 2007)
Source: [4]

6. CONCLUSION

Shown data represents that potential of agricultural land in Kragujevac is not rationally used. Total agricultural land decreased in the period 1982 – 2007, which directly caused decreasing of yields of important crops. Areas under the industrial crops and vineyars were halved, and meadows and pastures were extended. The yield of wheat, sunflower, industrial crops, potato and beans were reduced, with the tendency of further decline. In the agricultural households structure, the non-farm households are dominant which incomes realized independently of agricultural production. Concerning data is that nearly the half of farmers is older than 60. There is no hope for progress in the agriculture if market conditions were not improved. Incentive measures, and organization of new purchasing and processing capacities are necessary.

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MANAGEMENT OF WATER RESOURCES IN THE CONTEMPORARY ENVIRONMENT

UPRAVLJANJE VODNIM RESURSIMA U SAVREMENOM OKRUŽENJU

MSc Jelena Premović, prof. Tamara Premović[1], PhD Slavoljub Vujović[2]
[1] High Professional school „4th.July“, Vrbas
[2]Institute of Economics – Belgrade

Abstract: *Having in mind the fact that water makes 60% of human body and up to 95% of a plant's weight, it can be said that water is the most important constituency element of living beings and the basis of life on Earth. As the most vital resource, water must be treated as "the common good" and must be used rationally.*
On the other hand, the increase of number of people, urbanization and increase of standard of living, the latest toxicology research, and sometimes fear for one's own health, cause the ever growing demand for good quality drinking water. Good quality waters in natural environment are becoming rare due to uncontrolled pollution, but often because geological quality of the water at its source is not in accordance with the quality of water safe for consumption.
In this paper, authors analyze natural mineral waters and their role in the contemporary global environment, pointing out the importance and necessity of strategic management of the natural mineral waters and the water resources overall.
Key words: *environment pollution, renewable resource, water resources, natural mineral waters.*

Abstrakt: *Imajući u vidu činjenicu da voda čini 60% težine čoveka i do 95% težine biljke, može se reći da je voda najznačajniji konstitutivni element živih bića i osnov života na našoj Planeti. Kao najvitalniji resurs, voda se mora tretirati kao „dobro od opšteg interesa“ koje se mora racionalno koristiti.*
Sa druge strane, povećanje broja stanovnika na zemlji, urbanizacija i porast životnog standarda, najnovija toksikološka istraživanja, a ponekad čak i opravdan strah za sopstveno zdravlje, utiču na sve veću potražnju za kvalitetnom vodom za piće. Zbog nekontrolisanog zagađenja, a ne retko i što geološki kvalitet vode u izvorištu ne odgovara kvalitetu vode koja je bezbedna po zdravlje, vode dobrog kvaliteta u prirodi je sve manje.
U radu autori analiziraju prirodne mineralne vode i njihovu ulogu u savremenom globalnom okruženju, ističući značaj i neophodnost strateškog upravljanja prirodnim mineralnim vodama i vodnim resursima u celini.
Ključne reči: *zagađenje okoline, obnovljivi izvori, vodni resursi, prirodne mineralne vode.*

1. INTRODUCTION

Technical and technological progress was accompanied by demands for increased productivity and quality of products and services. On the other hand, these changes in the global economy and society, have influenced the changes in the environmental sphere and to specific environmental problems.

Judging from the literature, there are two processes of civilization, which generate the environmental problems: exponential increase of population and problems of food conditioned by further economic development. (In the literature, claims can be found that the uncontrolled increase of population and fast industrialization are two leading factors, which generate most of the environmental problems). Furthermore, as a consequence of these factors, problems arise which are hard to solve: disproportional increase of number of people in certain parts of the planet, population density, disproportional level of development, distribution of natural resources, constant increase of the number of pollutants. [1]

Natural resources can be classified in different ways. "The most common classification of natural resources includes renewable and nonrenewable, with renewable resources comprising:

- natural biological funds (agricultural land, biomass, fish in free water, forests);
- energy flows (solar energy, wind energy, ebb and flow)
- and resources of natural heritage and ecosystems, which cannot be classified easily (drinking water, clean air, natural landscape).

Renewable natural reserves (or funds), although they have the ability to regenerate, can be utterly exhausted or destroyed; therefore they belong to the group of exhaustible resources, in contrast to energy flows, which are considered inexhaustible resources. Terms renewable and inexhaustible resources are not synonymous, since there are renewable resources which can be exhausted. Although agricultural land, water and air have characteristics of renewable resources, they are not inexhaustible, they are limited in quantity, are not renewed in a biological way, which makes them closer to the reserves of mineral resources. This only points out to the fact that all the classifications need to be taken with reserves. According to their ecological values, renewable natural resources have a double value. The first is the individual, connected to the values they have for individuals; the second is social, expressed in their function of maintaining life in general".[2]

2. WATER AS RENEWABLE NATURAL RESOURCE IN THE FUNCTION OF SUSTAINABLE DEVELOPMENT

Having in mind the fact that water makes 60% of human body and up to 95% of a plant's weight, it can be said that water is the most important constituency element of living beings and the basis of life on Earth. Three quarters of Earth are covered with water. From the total amount of water on Earth, 97.5% is saline water (seas and oceans), while only 2.5% goes to fresh water. The largest reserves of fresh water on Earth are in the form of eternal ice, on the North and South Pole, as well as glaciers and snow (68.7%), then groundwater (29.9%), and rivers and lakes (only 1%).

One of the most important characteristics of water is its circulation and exchange among oceans, atmosphere, rivers, lakes, water surfaces, in the crust of the Earth and glaciers. The circulation starts by evaporation of water from water in the seas and oceans, and transfer of water vapour into the atmosphere. By the process of condensation, the water vapour turns into liquid, and it is discharged onto the surface in the form of precipitation. Around 22% of total sediment is discharged onto the land. This water penetrates deeply into the land or is settled on the surface, adding to rivers and lakes. The remaining 78% of condensed water from the atmosphere falls down on the surface of the oceans. More that a half of the water sediment found on the land surface directly evapourates and goes back to the atmosphere. The rest supplies groundwaters, streams, lakes and glaciers. Groundwaters emerge on the surface as springs, and reach seas through streams and rivers. All in all, 42% of water reaching the land in the form of precipitation finally goes back to the seas and oceans. Thanks to the hydrological cycle, the reserves of fresh water on Earth are continuously being renewed. Scientists and researchers have managed to calculate the amount of the time needed for the complete replacement of water capacity inside the planet's biggest reservoirs. Thus, it has been found that the shortest period for the total replacement is required by the atmosphere (9 days), and the longest by glaciers. From the total 1,386 billion cubic kilometers of water on Earth, only 0.26% is available for life and economic development.

Slowly but surely, changes in climate are starting to put the world as we know it in danger. Seas and oceans are polluted, forests are attacked by pollutants through acid rains, cutting down the trees and destruction, the protective ozone layer is significantly damaged, clean rivers basically cannot be found. There is an increase in the number of people with no access to drinking water. The consequences are manifested by the pollution of the environment and alienation of a man from nature. Complete landscape is easily transformed, which calls for the environmental protection, in order for the environment to stay biologically healthy, aesthetically beautiful and adequate for recreation, not to mention the general social development and increase in standard of living.

With the emergence of the first environmental problems 70th of the last century, and who have acquired a global character, gradually developed the awareness of the necessity of implementation of a new systematic and strategic approach to managing the problems in the field of ecology. [3] Taking into consideration today's development of science, it has been generally accepted that it is necessary to integrate ecological requirements and basic ecological standards into the concrete national developmental policies, as well as the global international developmental policy. The basis of the sustainability is the environment itself, and managing its capacities, in the function of further progress and development of people, but in such a way that the environment is not put in danger and completely destroyed.

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

- the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs". [4]

At the core of sustainable development is the need to consider "three pillars" together: society, the economy and the environment. No matter the context, the basic idea remains the same – people, habitats and economic systems are inter-related. [5]

At the International Conference on Water and the Environment, held in Dublin in 1992, water was defined as "a finite resource and economic good" to whose preservation we should aspire and which should be managed in such a way as not to jeopardize interests of future generations, but at the same time to ensure efficient and fair management. One of the key conclusions of this conference was that sustainability became the essential principle of developmental strategies, especially in the domain of water resources development. As the most vital resource, water must be treated as “the common good“ and must be used rationally, for multiple purposes and for a long period of time, on the basis of compatibility with permits for use and constant social monitoring. While planning sustainable development, key principles in the area of water are included in the following:

- Water is a precondition for survival of all living beings on Earth,
- Water is an irreplaceable (renewable) resource potassium used as a raw material in all process and/or as a tool for work. Thus, it is the only natural resource, which is constantly in circulation as a common tool,
- Only clean (unpolluted) water is healthy water. Preventing its pollution means achieving one of the basic principles of sustainable development,
- Water is the most widespread biotope, populated by the most numerous biocenoses, therefore is the key environmental element, which needs to be protected from destruction.

3. QUALITY MANAGEMENT OF NATURAL MINERAL WATERS IN CONTEMPORARY ENVIRONMENT

Waters were the first to suffer enormous pollution. The Earth, as a planet, has large reserves of water, however not enough drinking water, which is the precondition of life. The fact that only 1% of all the water on Earth is appropriate for drinking is strong enough for a man to understand the necessity of drawing due attention to water, without which any form of life on Earth would die. Synthetic fertilizers, poisonous gases from plants, incidents which cause direct spilling of poisonous substances into watercourses, pollution of watercourses caused by bad storage of poisonous waste in the ground, and other numerous factors caused the large part of watercourses to be seriously endangered. Unimaginable amounts of waste, of which human beings have been uncontrollably disposing for decades, a bad or no system for fecal and atmospheric water disposal, irrational release of solid chemicals from plants into the rivers, seas and ground, are only some of the factors which led to the situation that today as much as a half of world’s population drinks water of questionable quality. The problem of water pollution is becoming bigger and bigger, and manifests itself as unbalanced, degraded and polluted water, destruction of biocenosis, inability of self-treatment, deposited substances on the bottom of the bed, degraded landscapes in the coastal areas, etc.

Good quality waters in natural environment are becoming rare due to uncontrolled pollution, but often because geological quality of the water at its source is not in accordance with the quality of water safe for consumption. On the other hand, the increase of number of people, urbanization and increase of standard of living, the latest toxicology research, and sometimes fear for one’s own health, cause the ever growing demand for good quality drinking water. [6]

Inadequate technology in preparation of drinking water in some water systems, and at the same time inadequate quality of water, keep forcing consumers to look for alternative sources of water, mostly bottled and packaged water, among which natural mineral waters justifiably has an important place. Due to certain wrong ideological beliefs, bottling and consumption of natural mineral waters were treated inappropriately from the economic-human point of view. Bottled water was regarded as luxury, and visits to spas a privilege enjoyed only by a certain category of people. With technological development and decrease in costs of water bottling, a considerable number of people started buying bottled water regularly. Different types of bottled water made by various producers are available on the markets of industrialized, as well as developing countries. Buyers may have different reasons for buying bottled water for drinking, such as: taste, practical reasons or just due to the fashion, but for many consumers, however, safety and good impacts on health are crucial factors for using this kind of water.

In Europe, mineral waters are traditionally consumed, firstly due to their mineral structure, which is useful in maintenance and improvement of health. Bottling and importing of mineral water started in the 16th century in Europe when the water from Spa in Belgium was transported to the capitals of Europe. The very healing characteristics of mineral waters from certain springs caused the need for their bottling, making them available to a larger number of customers. This water is used for health improvement, in therapeutic purposes for treatment of illnesses, by drinking, bathing or inhaling the water. Water with high concentrations of hydrogen carbonates are used for easier digestion, others are used for treatment of kidney illnesses, skin illnesses, neurological disorders, etc.

Traditionally, healing waters have been used in our folk medicine for centuries. On the territory of our country, due to good geological structure, there are a number of registered springs of natural mineral waters, of different physicochemical composition, which represent important natural resources of Serbia. The water can be put into sale only in the original packaging, in hermetically closed containers, which prevent contamination and ensure preservation of quality till the moment of opening within the shelf life of the product. It also has to contain a label in accordance with the Rulebook on Labeling and Marking of Packaged Food.

In 1984 the World Health Organization (WHO) published the first edition of Guidelines, followed by the second in 1993 and third in 2004, which are used to analyze and define the quality of drinking water, without special analyses and parameters for natural mineral waters (WHO, 1984, 1993, 2004). In recent years, international work on testing and achieving ever better quality of bottled water, and at the same time of natural mineral water, has become a subject of interest of the Codex Alimentations Commission (CAC), "The Code of Good Practice", the World Health Organization (WHO), as well as Food and Agriculture Organization (FAO).

In the European Union, the quality of mineral water is defined by Directive 80/777/EES, which was supplemented and partly amended by Directive 80/1276/EES, 85/7/EES, 96/70/ES, and 2003/40/ES.

On the territory of our country, due to good geological structure, there are a number of registered springs of natural mineral waters, of different physicochemical composition, which represent important natural resources of Serbia. In our country, the quality of natural mineral waters is regulated by the Rulebook on Quality and other Requirements for natural mineral waters, Natural Spring Water and Still Table Water, and the quality of bottled water by the Rulebook of Hygienic Safety of Drinking Water.

Current legislation defines chemical physicochemical and microbiological quality parameters of natural mineral water. The Rulebook on Quality and other Requirements for natural mineral waters, Natural Spring Water and Still Table Water defines natural mineral waters as underground water for human consumption in its natural state. It can be put into circulation only in the original packaging, in hermetically closed containers, which prevent contamination and ensure preservation of quality till the moment of opening within the shelf life of the product. It also must contain a declaration on the packaging, container or label that is in accordance with the Rulebook on Labeling and Marking of Packaged Food. [7] [8]
The term “natural” may be used in a name of mineral water that has not been processed in any way, except by: separation of unstable elements, separation of iron, manganese, sulphur and arsenic compounds, and adding or eliminating carbon dioxide. [7] natural mineral waters can be bottled only if it is chemically and microbiologically safe for drinking, if its quality is stable and formed in natural conditions and if it meets the following requirements:

1. if it has its source in the bed of spring waters, protected from any possibility of contamination, and rises to the surface in a natural way through one or more springs, or drilled wells;
2. if it has characteristics by which it differs from drinking water, specifically: by its nature (as the content of mineral substances, chemical elements in traces or their compounds), by its possible physiological effect and original state;
3. if it has the same quality as at its spring, that is, the above mentioned characteristics must be maintained untouched from its spring underground, which is protected from any contamination, all the way to packaging.

Directives and our Rulebook on mineral waters provide a long list of requirements, which must be considered and fulfilled before taking into consideration the status of natural mineral waters, and which can be generally classified in three groups, namely:

1. Requirements concerning characteristics of natural mineral waters, which may be important for health, and which must be analyzed and evaluated from many aspects: geological and hydrological; physical, chemical and physicochemical; microbiological; and pharmacological, physiological and clinical;
2. Requirements and criteria for monitoring and analyses: geological and hydrological monitoring; physical, chemical and physicochemical monitoring; microbiological criteria at the spring and requirements for clinical and pharmacological analysis;
3. Additional qualifications in connection to warm mineral waters: at the spring or after bottling these waters lose carbon dioxide spontaneously and in a visible way, under normal temperature and pressure.

Equipment for exploitation of natural mineral waters springs must be such as to prevent any possibility of contamination and enable maintenance of characteristics this water has at its spring. Technical equipment (e.g. for scooping, pipe and reservoirs) must be made from such a material as to prevent any kind of chemical, physicochemical or microbiological change of water.

Packaging used for natural mineral waters must be made from material which does not affect microbiological and chemical characteristics of water. Transporting this water to customers in containers not marked for distribution is not allowed. [7]

4. CONCLUSION

The Earth as a planet has large water reserves, but not enough water for drinking, which is a precondition for life. The fact that from all the water on Earth, only 1% can be used as drinking water is strong enough for a man to understand the importance of drawing due attention to water, without which all life on the planet would die out. It is well-known that not all springs can be natural mineral waters springs, that is, that selecting the natural mineral waters spring has to meet the following requirements: stability of appropriate water quality, stability of its profusion, and unpopulated river basin without potential effluents. [9]

These are the factors which need to be taken into account when selecting springs in our country, which can be proud of a large number of registered springs of natural mineral waters of significant quality. However, general public is mostly not familiar with their characteristics and potentials. Therefore, in order to use natural potentials and multiple positive effects of using and consuming of natural mineral waters, it is necessary to dedicate more time and space to this topic, with regards to the scientific research of content and characteristics of natural mineral waters (as determining factors), their impacts on people's health, education of people, as well as with regards to working on defining and creating regulations in the field of natural mineral waters.

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DANUBE STRATEGY CORRIDOR AS A MODEL WATER RESOURCES MANAGEMENT SERBIAN

STRATEGIJA DUNAVSKOG KORIDORA KAO MODEL UPRAVLJANJA VODNIM RESURSIMA SRBIJE

Slobodan Stamenković[1],
Marko Pavlović[2] ,
Mladen Stamenković[3,]
Radica Pavlović[1]
[1]Graduate School of Business Studies,
[2]High Professional School for Entrepreneurship, Belgrade
[3]Faculty of Economics, Belgrade

Summary: *The EU has adopted a strategy for the Danube region. The model considers all the necessary changes through the five pillars of the strategy. Protection of water as a natural resource is the guiding strategy to diminish the economic benefits and potential.*
Keywords: *strategic, natural resources, sustainable development*

Rezime: *EU je usvojila strategiju Dunavskog regiona. Model sagledava sve neophodne promene kroz pet stuba strategije. Zaštita voda kao prirodnog resursa je vodilja strategije, ne umanjujući ekonomske koristi i potencijale.*
Ključne reči: *strategija, prirodni resursi, održivi razvoj*

1. INTRODUCTION

The complexity of managing strategic change is evident in the global economic crisis periods, such as the present. The process of change in complex systems and each individual organization, implementation strategy, conditioned by a number of decisions must be made to improve the implementation of vision and strategy, and reducing resistance to change. The very process of managing strategic change is easier if the strategic vision of the arguments given to the fact the transition from the current position in the future if the gap analysis indicate that there is a difference between the current position of the natural resources of the Republic of Serbia and the developed countries of Europe, particularly the European Union, as a target strategic position of our country. The natural resources of Serbia include agricultural and forest land, mineral resources, water, land and water, the potential of renewable energy sources and protected areas. These resources have the potential to which the existing human resources, was based on current economic and business development of the Republic of Serbia. Their sustainable use and protection are the most important goals, plans and future development of the Republic of Serbia, established by the documents of the National Assembly and the Government of the Republic of Serbia.[1] Of the total territory of the Republic of Serbia, about 60%, or about 5.6 million hectares is agricultural land. The quality and manner of its use depends primarily on the substrate quality, altitude, water regime and microclimate conditions. Arable land consists of approximately 3.6 million hectares, mainly in the plains and some valleys, where the prevailing high natural fertility of land suitable for crop-intensive vegetable production. The total area of forests in the Republic of Serbia (without the data from AP Kosovo and Metohija) was 2.2524 million ha, of which state-owned forests make up 53%. 53%. Lack of forest cover of Serbia (30%) and high proportion of forest in somewhat higher percentage (34%), indicating the need for taking urgent measures for the cultivation and protection of forests.

The existing water in the Republic of Serbia to meet the demand, but only if the rational use and protection. Insufficient quantity and quality of surface water from local streams, suggesting the use of transit water, whose quality can not always rely on. Mineral deposits, especially of energy, primarily coal and less oil and gas, are used in a way that is not sustainable. At the same time, there are no complete and reliable data on the status and extent of exploration so far. Reserves in the Kolubara and Kostolac mining basin are sufficient for the next 50 years in service (at the current level of exploitation), while coal reserves in Kosovo basin are not available. There are significant deposits of metallic, nonmetallic construction materials of geological and groundwater, which is underutilized. Using a number of sources of renewable energy (biomass, solar and wind, water resources and geothermal energy) is minimal, although the energy potential of these sources make up about a quarter of the current primary energy consumption.

In Serbia, more than 400 protected natural areas, some of which are of great importance, great significance is registered in the known world list of protected natural and cultural heritage. Finally, the quality and diversity of the potential for the development of high-mountain areas, as well as specific natural resources, was activated only a small part. [2]

Two European transport corridors pass through Serbia – the overland Corridor X and the Corridor VII linking the 10 European countries which have exits to the navigable parts of the River Danube. The Danube Basin is one of the most dynamic parts of Europe, especially after the commissioning of the Danube-Main Canal in the early 1990s. After the Volga, the Danube is the second longest river in Europe totaling 2850 km in length, of which 2411 km are navigable and as much as 588 km of the latter are in Serbia. [3]

2. CORRIDOR VII - DANUBE BASIN

Major energy capacities of the Republic of Serbia are settled in the Danube Region, including also significant quantities of raw mineral materials, above all lignite. Furthermore, there are objects of energy network infrastructure which includes high-pressure gas pipelines, part of the Adriatic oil pipeline and transmission lines for power transmission which have wide regional significance. The only two refineries in the Republic of Serbia are placed in the given area, including a warehouse for oil and gas. After 2000, revitalization and reconstruction of the existing plants has been considered as a priority, along with the enlargement of the distribution network. Electrical energy is mostly produced by thermal and hydro power plants, while the participation of combined power plants is rather small. Except for the water potentials, other types of **renewable energy** are utilized to a small extent. Therefore, the development strategy of the Danube region by the European Union is one of the most important documents in natural resource management of water in Serbia. A comprehensive EU strategy for the Danube region will be based on three pillars [4]:

1. establishment of a safe navigation system and development of transport and supporting infrastructure,
2. environmental protection and sustainable utilization of natural resources and
3. economic development and strengthening of regional cooperation and partnership in the Danube region.
Serbia has proposed the introduction of two additional pillars of the strategy:
4. security and the rule of law and
5. knowledge economy.

The first draft of the EU strategy with an action plan was presented internally to the countries which had participated in its creation, and in July 2009. bilateral consultations were organized with each of the Danubian countries. The Conference in Ulm (Germany), held on 1-2 february 2010, was the first major conference dedicated to the strategy.

In the developing of this strategy the European Commission has so far adhered to three principles: that it will not allow new legal framework, new institutions and additional funds to be created for this initiative in order to best take advantage of existing resources. The Republic of Serbia has great significance in the future realization of the aims contained in the Joint Overall Strategy for the Danube Region (hereinafter: Strategy). By inclusion of the Republic of Serbia in the development of this Strategy and its subsequent implementation, contribution is given to: the economic development, integration of sectoral policies of the Republic of Serbia into the EU development plans, improvement of bilateral and multilateral cooperation between the Republic of Serbia and all other countries in the Danube River Basin. Through its participation in the development process and subsequent implementation of the Strategy, the Republic of Serbia confirms its strategic commitment for its effective membership in the European Union.

The overall objective of the potential use of the Danube as an important resource for sustainable development of the Republic of Serbia, with the priority areas:
1. Development of the transport and energy systems, and information and communication technology (ICT) along the entire Danube River
2. Environmental protection and sustainable use of natural resources along the entire Danube River Basin
3. Economic development and strengthening of regional cooperation and partnership in the Danube Region
4. Establishment of a safe transport system and affirmation of the rule of law principles along the entire Danube watercourse
5. Creating a knowledge-based economy through cooperation in the Danube region and the active role of science in achieving the objectives of the Strategy.

3. PILLAR “TRANSPORTATION AND INFRASTRUCTURE”

Priority area “Development of the transport and energy systems, and information and communication technology (ICT) along the entire Danube River”

Major energy capacities of the Republic of Serbia are settled in the Danube Region, including also significant quantities of raw mineral materials, above all lignite. Furthermore, there are objects of energy network infrastructure which includes high-pressure gas pipelines, part of the Adriatic oil pipeline and transmission lines for power transmission which have wide regional significance. The only two refineries in the Republic of Serbia are placed in the given area, including a warehouse for oil and gas. After 2000, revitalization and reconstruction of the existing plants has been considered as a priority, along with the enlargement of the distribution network. Electrical energy is mostly produced by thermal and hydro power plants, while the participation of combined power plants is rather small. Except for the water potentials, other types of renewable energy are utilized to a small extent.

In order to make alternatives for road transportation, the state should create incentive measures for development of intermodal transport . Terminals must be strategically designed and located near the intersection of major transport infrastructure (road-railway-river) with the flexibility and extensibility in accordance with market needs. Considering suitable locations for the initial development of the terminal, in accordance with the practice and the requirements of the EU, should take into account connections with railway, road and river network (Pan-European corridors 7 and 10) etc.
The condition of waterways infrastructure in Serbia is not satisfying. After 1990, there has been a large halt in the maintenance of waterways and the accompanying infrastructure. As soon as possible, Serbia has been included in the process of monitoring the implementation of a European Action Programme for Inland Waterways - NAIADES (Integrated European Action Programme for Inland Waterway Transport "). Since it is not a member of the EU, Serbia could not directly participate in the process of defining and activating a platform for its implementation (PLATINA project), but all activities are followed with great attention.

Strategies and action plans concerned with the area of information and communication technologies were adopted. The stated documents define the strategic directions and the activities aimed at regulating the market of diverse telecommunication and postal providers (fixed and mobile telephony, Internet, cable TV, point-to-zone radio communication, classical and electronic post mail), introduction of e-government, modernization of operations public offices and numerous institutions of public importance, as well as encouragement of acquisition of basic knowledge of informatics by employees and citizens.

The area of telecommunications is primarily characterized with regulation of legal framework and market, including application of these systems in sectors of state and local government and public service (health, education, culture etc.). The largest number of service providers is concentrated in the two major administration centers – Belgrade and Novi Sad, while some peripheral parts of the Danube Region (especially those in the Eastern Serbia) do not receive the same quality service. The process of implementing river information services (RIS) will be completed during 2012. By that time, the entire course of the Danube will be covered by the most advanced system of monitoring and navigation surveillance. Prominent European companies are participating in the process of the development of technical and project documentation and systems installation, implementation of the EU RIS Directive.

Strategic actions:

• Adopt an adequate strategic and legislative framework in the area of water transport in compliance with European standards and practice;

A draft Law on safety of navigation and ports is under public discussion and it will be thoroughly in compliance with European standards and practice. In addition to this law approved by the Ministry of Infrastructure in November 2008, it is anticipated that on the basis of The Platform for drafting a set of laws in the field of navigation law, four additional laws shall be adopted to round out the scheduled set of laws in the related field. The following laws will likely be adopted: the Law on inland water transport – governing private law matters, the Law on the inland navigation fund, the Law on the national affiliation and registration of vessels and the Maritime navigation law.

• Achieve necessary conditions for undisturbed transport, by establishment of Statutory dimensions of the water transport routes in critical sectors;

Projects such as Regulatory and dredging efforts in critical sectors on the Danube River (Beneficiary: Plovput), and Development of project and technical documentation for dredging and regulatory works in critical sectors on the Danube River are developed in the Ministry of Infrastructure. International Sava River Basin Commission is implementing the project Rehabilitation and development of the Sava River Waterway.

• Remove unexploded lethal weapons and sunk vessels in the Second World War and during NATO intervention along the entire Danube watercourse;

The key project in this initiative Removal of unexploded lethal means in internal transport routes (Prahovo), has been developed by the Ministry of Infrastructure.

• Raise the level of technical equipment of the ports ' offices, and consequently better the performance of security inspection of navigation;

• Establish port directorate as a state regulatory body in the area of port management, with the aim of improving the efficiency of ports operation as potential multimodal junction;

• Support initiatives for development of existing marinas on the Danube and creation of new ones; Ministry of Economy and Regional Development developed projects such as: Moor in Novi Sad, Construction of two moors in Bezdan – Sombor municipality and Construction of international travelers’ berth and marine in Apatin. In the municipality of Apatin, on May 11th 2010, modern moor for travel boats was opened. Municipality of Apatin, also has a project of development of a threemodal logistic centre with the port. Numerous municipalities have projects for development of marinas: Bačka Palanka, Golubac, Majdanpek (archeological locality- Lepenski vir with moor), Negotin, Kovin, Senta, Kladovo, Pančevo, Smederevo and Kanjiža. The tourist organization of Kanjiža has a project Development of touristical info point for nautical tourism and for positioning of moor at cross boarding position, which is awaiting implementation.

• Support the initiative to build a service station for boats on the Danube and Sava rivers;

• Improve the technical conditions required for channel navigation and consider the possibility of opening channels for free international trade;

• Invest in the development of energy network infrastructure in order to connect the regional network for oil and gas transportation and power transmission; Ministry of Environment and Spatial Planning and Republic Agency for Spatial Planning have projects Spatial plan for the special purpose area for the oil products pipeline system through Serbia and Spatial plan for the area of special purpose of Kostolac Lignite Basin. Development of the spatial plan will be funded by Electric Power Industry of Serbia, but development of strategic assessment will be funded by the Republic Agency for Spatial Planning. The procurement process is in its final stage.

• Construct the part of Pan-European Oil Pipeline (PEOP) in the part of the route passing through the Republic of Serbia;

• Complete the construction of the highway of Corridor 10 and other roads and bypass roads that provide better transport accessibility and connection to the terminals; Ministry of Environment and Spatial Planning, Government of Autonomous Province of Vojvodina and Republic Agency for Spatial Planning have two relevant projects : Spatial plan for infrastructural corridor of the state road of the first degree number 21 (Novi Sad – Ruma - Sabac) and the state road of the first degree number 19 (Sabac -Loznica) and Spatial plan for the network of corridors for transport infrastructure at the basic direction of the state road of the first degree number 24 (Subotica – Zrenjanin - Kovin).

• Reconstruct, revitalize and modernize the railway network and terminals in the Danube basin;

• Establish full control of the Danube transport through development of the River Information Service and Vessel Traffic Service (VTS); Project of the Ministry of Infrastructure Implementation of River Information Services – RIS on the Danube (Beneficiary: Plovput), applied for IPA 2007. Timescale for this project is the 3 year period, 2009 – 2012. Main project and installation of a prototype of river information services on the Sava river is pending, (the project is implemented in the period September 2009 - June 2010).

• Encourage innovation and more significant investment in further development of information and communication technologies.

International Sava River Basin Commission is implementing the project Establishment of geographic information systems for the Sava River Basin, which is in its initial phase.

4. PILLAR “ENVIRONMENTAL PROTECTION”

Priority area “Environmental protection and sustainable use of natural resources along the entire Danube River Basin”

Fulfillment of requirements and meeting of EU standards in the area of waters are some of our country’s priorities and an important requirement of the European integration process. One of the activities important for harmonization with European standards is the application of the EU Directives through the cooperation with the activities of ICPDR and Danube commission. In 2003, the Republic of Serbia became a member of International Commission for the Protection of the Danube River (ICPDR) and during the same year ratified the Convention on Cooperation for the Protection and Sustainable Use of Danube River. The basic activity of the water sector is integral waters management and protection, by means of which planned utilization of water resources is achieved: water supply for citizens and industry, irrigation, hydro energy, adequate protection of water quality and protection from water dangers such as floods, erosions, water torrents, water drainage. In December 2009, the Danube River Basin Management Plan was adopted with the respective measures, obliging Member States to realize the planned measures by 2015.

The existing problems of quality drinking water supply and lack of water are going to be addressed by the implementation of specific measures and other activities. During the critical period even big cities have water shortages in peripheral areas. Unrefined communal and industrial waste water is usually discharged into the waterways. Serbia has a small number of treatment plants for industrial and communal waste water, and some of the existing facilities are not functioning. In the settlements the sewage network is insufficient developed (channels includes about 50% of the population). Unconcentrated sources are responsible for about 50% of water pollution (80% nitrogen, 50% phosphorus). Waste landfill in wild dumps is an evident source of environmental pollution.

Strategic actions:

• Adopt an appropriate legal and strategic framework in the field of sustainable use of natural resources and goods (surface and ground waters), environmental protection, ratification of several international conventions; as well as affirmation of environmental protection and European standards in this area;

During May 2010, Serbia adopted a new Law on Waters. This law regulates the Water Management Strategy, and protection of waters from pollution. Adoption of bylaws relating to emission limits and a limit for pollutants in surface and ground waters and sediment is envisaged. Ministry of Environment and Spatial Planning has prepared a draft regulation on the priority substances in water and it is expected to be adopted by the end of the year, as well as, the Law on Ratification of the Convention on the Protection and use of transboundary rivers and international lakes.

• Develop the potentials of national parks and protected areas;

Two spatial plans are pending, one for the area of special natural reserve of the Gornje Podunavlje region (unresolved border issues with Croatia slow its development), and the other for National Park Djerdap area. The Ministry of Environment and Spatial Planning of the Republic Agency for Spatial Planning is in charge for both projects. The Iron Gate area and its surroundings are places with many forms of geological herritage. That is why it is necessary that the Iron Gate area gets its deserved place among protected areas following the example of other geological parks in Europe. The part which would be protected, would considerably increase the percentage of protected areas of Serbia, which currently amounts to 6-7% .

• Adopt and implement measures aimed at increasing the quality of waters in the Danube flow;

The projects of the Ministry of Environment and Spatial Planning, Construction of the Waste Water Collectors, the Waste Water Treatment Plants, Scooping out of the Silt (Veliki Backi Canal) and Monitoring of the Water Quality and Sediments of the Veliki Backi Canal are the two projects developed by the Ministry with a view to improving the quality of the water in the basin of the river Danube; The important projects of the Ministry of Agriculture, Forestry and Water Management in this field are: Remediation of three significantly contaminated locations across the territory of the Republic of Serbia, drafting of the Waste water master plan for the for the sub-basin of the river West Morava, A plant for waste water processing in Leskovac, Sabac, Uzice, Vranje Loznica, Blace and Brus. The Public Urban Planning Institute of Novi Sad has developed a project on the Central Plant for Water Purification . The following municipalities have also developed relevant projects: Backa Palanka, Beocin, Smederevo. Majdanpek, Negotin, Stara Pazova, Kovin and Pancevo. The projects of the Sava Commission within this field: The Drafting of the plan for the Sava river basin management, the Drafting of the action plan in cases of accidental water pollution of the Sava river basin and the Drafting of the plan of adaptation to climatic changes in Sava river basin are pending. The results of the last project will be used for the drafting of the plan of the Sava river basin management.

• Implement measures concerning the provision of an adequate water supply for the citizens residing in the Danube flow;

Related to these initiatives, the Ministry of Agriculture, Forestry and Water Management is preparing a project proposal entitled – A regional system to provide water access to Selovo . A similar water access problem was identified by the Negotin, Stara Pazova, and Smederevo municipalities and they have developed projects which will improve water access in these Danube basin municipalities. The public entity Waters of Vojvodina is responsible for the project Regional hydro systems for water access – Northern Backa, Banat and Srem.

• Establish a research system, develop a general planning document, principles of use of biodiversity components of flora and fauna;

The project proposal Biodiversity and the ecological status of levees, waters and wildlife in the Sava basin is being prepared in coordination with the Sava Commission. Its implementation is planned for the second round of the implementation of the plan to manage the flow of the Sava river basin. The project proposal will be sent to the Third call for Trans-national Program for Southeastern Europe at the end of this year.

• Develop a system of receiving stations for collecting ship waste in order to solve environmental and community problems in the Inland Waterways.

Ministry of Infrastructure approved the project Development of an integrated model for management of ship waste materials in waterways corridors of the Republic of Serbia and it will be funded by the Ministry of Science. Directorate for Inland Waterways is included in the WANDA project. This is the first step, but Serbia is fully committed to implement all EU standards in order to protect the Danube and Sava rivers from all forms of pollution.

5. PILLAR "SOCIO – ECONOMIC DEVELOPMENT"

Priority area "Economic development and strengthening regional cooperation and partnership in the Danube region"

The Republic of Serbia, as a multiethnic state, expresses special interest in development of good relations with neighbors, promotion of human rights, cultural diversity, exchange of knowledge, as well as minorities' rights. The Danube Region presents an area in which promotion of these values should be carried out in comprehensive and systematic manner. Support for socio-economic development can have direct and indirect positive effects on equal opportunities. Our goals are social inclusion and promoting equality.

Rural areas in Serbia cover 85% of the country with more than half of the total population (55%). Demographic trends in rural areas in Serbia are characterized by the trend of emigration caused by urbanization. Despite this trend, the share of agriculture in employment is among the highest in the EU. Poverty in Serbia is a predominantly rural phenomenon, as in many countries in transition. Most of the Danube basin region covers rural areas and because of that a chance for development of this region. It could promote of rural development, including rural tourism, diversification of economic activities, and thus increase employment.

Regional differences in the Republic of Serbia are one of the largest in Europe. The difference between the most developed and least developed municipality is 1:9. A significant number of underdeveloped municipalities are located in the Danube basin. The policy of balanced regional development could be implemented through the activities of socio-economic development in the future Danube strategy.

The Danube Basin is a great potential for economic development, especially for small and medium-sized enterprises and entrepreneurship. Economic development of this region could be improved by increasing competition and better conditions for the promotion of innovative potential; through the development of business infrastructure, which is one of the main initiator of economic growth, and through better inter-municipal and inter-regional cooperation.

6. PILLAR "SECURITY AND RULE OF LAW"

Priority area "Establishment of a secure transport system and affirmation of the rule of law principles along the entire Danube watercourse through the Republic of Serbia"
The security status on the Danube and within its surroundings is under direct jurisdiction of 8 county police administrations: Sombor, Novi Sad, Sremska Mitrovica, Belgrade, Pancevo, Smederevo, Pozarevac and Bor.

The control at border crossing points on the Danube is carried out by 8 border police stations. Monitoring the status and trends in criminal activities, paying particular attention to the organized element thereof, the following four forms of criminal activities are characteristic for the watercourse and surrounding area of the Danube: smuggling of various types of goods; misuse in circulation of goods done by ship crews; commercial crime; smuggling and trafficking of human beings.

In order to enable safe and undisturbed transport on the Danube, it is particularly important to undertake necessary measures in order to reduce possibility of floods occurrence and technical-technological water traffic accidents along the Danube watercourse. The National Security Strategy and the Defense Strategy provide support to regional initiatives as important mechanisms for development of stability and security in the region.

7. PILLAR "KNOWLEDGE BASED ECONOMY"

Priority area " Creating a knowledge-based economy through cooperation in the Danube region and the active role of science in achieving the objectives of the Strategy"
The strategy of scientific and technological development of the Republic of Serbia in the period from 2010 - 2015 is the strategic basis for the development of science in our country over the next five years. This document defines the national research priorities and measures for stimulating technology transfer, encouraging innovation, enabling the national innovation system, all with the aim helping the development of society and transitioning to a knowledge based economy.

Similar aims were set in the strategic documents of other countries in the Danube basin, and the achievement of these aims can be accelerated through the strengthening of regional cooperation in these areas. The University of Belgrade and The University of Novi Sad are members of the Danube Rectors' Conference, which gathers nearly 50 major universities in this region. At the last gathering, members of the Danube Rectors' Conference, signed the "Novi Sad Declaration", in order to express considerable interest for the Strategy and its objectives.

It is important to use scientific knowledge and capacity of the knowledge community of the Danube countries for realization of the first four goals of the Strategy. Serbia and the countries of the Danube region have a large number of experts in the field of environmental protection, preservation and protection of water resources, development of information and communication technologies in the field of energy. Development of these disciplines will contribute to the successful implementation of the Danube strategy. [5]

8. CONCLUSION

Strategy for the Danube region is an important document that water resources of the Danube River and other waterways Serbia considers the most important strategic pillars, development of transport, energy and information and communication technology, environmental protection and sustainable use of natural resources in the Danube River Basin, economic development and strengthening of regional cooperation and partnership in the Danube region, establishing a system of safe navigation and the promotion of the rule of law in the basin of the Danube through Serbia and the creation of the knowledge economy through cooperation in the Danube region and the active role of science in achieving the objectives of the strategy. This allows for further convergence of the Republic of Serbia basic principles and goals that must achieve within its candidacy for EU membership.

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SOME WASTEWATER PURIFICATION METHODS IN THE CHEMICAL INDUSTRY "ŽUPA", KRUŠEVAC

NEKE METODE PREČIŠĆAVANJA OTPADNIH VODA HEMIJSKE INDUSTRIJE "ŽUPA", KRUŠEVAC

Tamara Galonja Coghill, Ljiljana Kostadinović, Jelena Bošković, Nenad Č. Bojat, Lazar Ružičić
Faculty for Biofarming, Bačka Topola, Megatrend University, Belgrade
e-mail: tamaragc@neobee.net

Abstract: *Wastewater is defined as any water used for specific purposes and then discharged into a sewage. Such water can be contaminated by numerous substances, suspended particles, organic acids, inorganic non-toxic or poisonous substances, acids or bases, microorganisms, etc. Technological waste water generated in the Chemical Industry "Župa", Kruševac is loaded with heavy metal ions, such as copper, zinc and chromium. Suspended materials and heavy metals in wastewater before and after the treatment in the purification plant were analysed, indicating high efficiency of the purification method applied. Purification by neutralization and precipitation using* $Ca(OH)_2$*, has proven itself as fast, simple and efficient.*
Keywords: *Wastewater, neutralization, precipitation, heavy metals.*

Apstrakt: Otpadne vode se definišu kao bilo koje vode, koje se koriste za posebne namene, a zatim ispuštaju u kanalizaciju. Takve vode mogu biti zagađene velikim brojem različitih supstanci, suspendovanih čestica, organskih kiselina, neorganskih ne-toksičnih ili otrovnih supstanci, kiselinama ili bazama, mikroorganizmima i drugim. Tehnološke otpadne vode Hemijske industrije "Župa", Kruševac su opterećene jonima teških metala, kao što su bakar, cink i hrom. Analiziran je sadržaj rastvorenih materija, kao i teških metala u otpadnim vodama pre i posle tretmana u postrojenju za prečišćavanje, a rezultati su ukazali na visoku efikasnost primenjene metode prečišćavanja. Prečišćavanje neutralizacijom i taloženjem pomoću $Ca(OH)^2$, se pokazalo kao brzo, jednostavno i efikasno.
Ključne reči: *Otpadne vode, neutralizacija, taloženje, teški metali.*

1. INTRODUCTION

One of the most significant natural resources is water. Because of the complex use and high importance for the maintenance of life on Earth, it is necessary to protect the quality of its resources. Since the beginning of life, water has been contantly used and gradually contaminated by plant, animal and human waste and debris. At the early stages of life development, this pollution was only organic, and not in large quantities, so it did not pose too big a threat, being generally decomposed, helped with the ability of water to purify itself.

The development of human society, rising number of individuals and their concentration in urban areas caused significant increase of the amount of organic waste in waterways, disabling natural biological filtration [1].

In the late nineteenth and early twentieth century, there was epoch-making development and progress of industry, which increasingly used water. Through the industrial production, the increasing chemical pollution was added to organic pollution of water. Producing a large number of new chemicals and other products, agriculture and livestock, ever growing amounts of wastewater appeared, polluting surface water as well as groundwater [2]. The composition of waste water is very complex. The concentration of the pollutants within depend on the kind of technological processes, raw materials and finished products and there is an increasing need for implementation of efficient biological and chemical processes of wastewater treatment, as a part of protection and restauration of global environment [3].

2. WASTEWATER, ORIGINS AND DESTINY

Wastewater is defined as any water used for specific purposes and then discharged into a sewage. Waste water are contaminated by numerous substances, suspended particles, organic acids, inorganic non-toxic or poisonous substances, acids or bases, microorganisms, etc.
Since rivers and irrigation canals are main recipients, effluent wastewater must undergo special assessment [4]. The expansion of the irrigation systems enhances the problem of the quality of water, which is generally contaminated by waste materials from industrial production. The analysis of the volume and composition of wastewater is difficult because of the heterogenity of the polluting constituents, wide diapason of pollution concentrations and the composition changes over time. Therefore, the analysis of wastewater to some extent presents a special problem that needs to be handled [3].

Characterization and purification of waste waters from different industrial plants can not be done by general rules [5]. Therefore, the analyst must be familiar with the technological process in which waste water was created and have data on the qualitative composition of every particular wastewater to be treated. The result of wastewater purification must be water that can be discharged into watercourses without causing any adverse effects [6].

The allowed concentrations of certain substances in the purified water depend on the capacity of natural waters, e.g. the mass of polluting agents natural waters can accept without them causing any adverse effects on the organisms, on the ground water is in contact with [2]. There are a number of methods and procedures for waste water, today, and the choice of method depends on the type of pollutant and pollution levels [4]. Generally, methods of wastewater treatment are mechanical (sieving, sand sedimentation, the separation of fats and oils), chemical (acid or base neutralization, flocculation, chlorination, aeration, removal of biogene elements, the precipitation of insoluble compounds) and biochemical which are the use of wastewater for irrigation, cleaning of waste water irrigation on biological fields, processes with biological filters, activated carbon processes, anaerobic processes with methane fermentation [5].

3. WASTE WATER NEUTRALIZATION PROCESS

Industrial wastewater often are too acidic or alkaline and must be neutralized, before being discharged or further processed, by adjusting pH level to values between 6 and 9. In the process of waste water neutralization, most commonly used reagents are sulfuric acid, or slaked lime. Dilute solutions of strong mineral acids are also used, as well as alkali waste from washing bottles and equipment, sulfuric and hydrochloric acid, chalk, limestone, dolomite, magnesite and carbon dioxide [4]. When neutralising wastewater with sulfuric acid, the poor solubility of calcium sulfate, that tends to form supersaturated solution that is deposited in the pipes creates new set of problems, reducing pipe diameter and often resulting in pipe fail [5].

There are two methods of acid wastewater neutralization. The first is filtration through a porous layer containing carbonate materials such as limestone, marble, dolomite, magnesite, etc. For this type of neutralization the devices with the porous layer made of crumbled carbonate material are used. The second way is direct entering of neutralizing substances into water. Neutralization is not performed in the neutralizer and not at a flow of water, as is the case when using neutralization filter. During the neutralization process it is necessary to constantly control pH value of water. It is done by connecting the neutralization agent dispenser with the system for continuous pH measurement. The major components of wastewater neutralization system are presented in the Figure 1.

After the process of neutralization, water contains an increased amount of the electrolytes. The continuation of the purification process depends on the type of electrolytes present, their total concentration and the intended use of neutralized water.

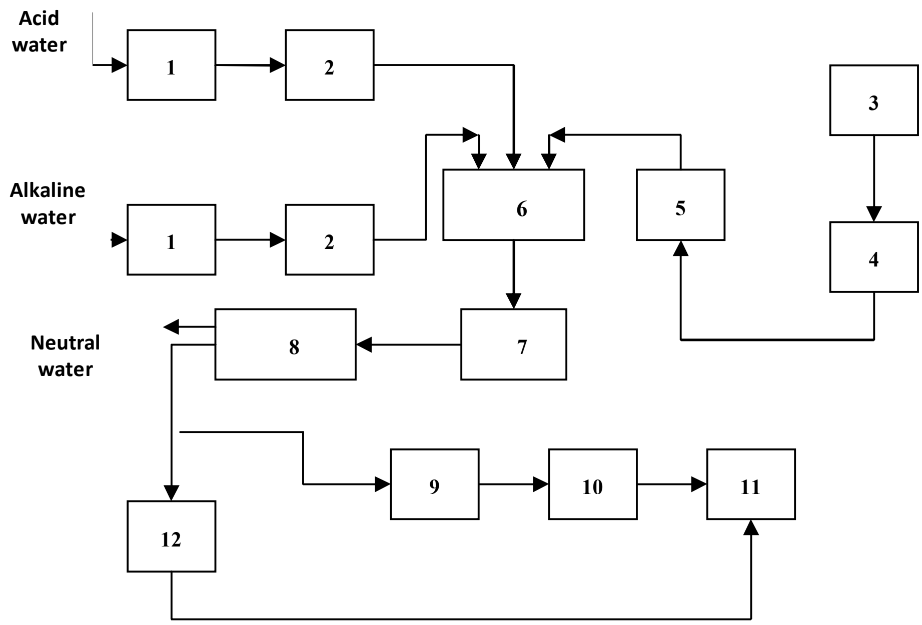

Figure 1. System for waste water neutralization

1-precipitation, 2-homogenizers; 3-reagents storage, 4- reagents preparation, 5 – dispenser (dozer), 6 – mixer (blender) 7 - neutralizer, 8 - precipitation, 9 - sludge coagulation, 10-vacuum filtration, 11- dried sludge dump, 12- sludge drying field

4. PURIFICATION OF TECHNOLOGICAL WASTEWATER IN CHEMICAL INDUSTRY "ŽUPA", KRUŠEVAC

Technological waste water generated in the processes of production of copper sulphate, zinc sulphate and basic chromium sulfate, are loaded with copper, zinc and chromium ions. Discharging such water into the waterways without previous treatment would be ecologically extremely dangerous. Therefore, Chemical industry "Župa", Kruševac has an operational water purification plant.

Neutralization method proved to be most effective in treatment of such wastewater, and is based on the deposition of heavy metals in the form of hard soluble hydroxide [7]. The control and regulation of pH value is done at the same time ensuring optimal values for the deposition or safe discharge into waterways. The transformation of heavy metal ions into hard soluble compounds, is done by adding a suspension of calcium hydroxide, $Ca(OH)_2$, lime milk, and adding sodium hydroxide (NaOH) solution. The wastewater treatment plant in CI "Župa" uses both, e.g. calcium hydroxide in primary neutralization and deposition of heavy metals in the form of insoluble hydroxide, and sodium hydroxide in subsequent neutralization, where the optimum pH value is obtained before the discharge of treated water into natural waterways.

5. SUSPENDED MATERIALS DETERMINATION

Suspended materials in wastewater before and after wastewater treatment were analyzed continuously for 3 days in all three shifts. Samples were taken manually at all outlets and analyzed in composite form: samples of wastewater entering purification system and water samples at the exit point of the purification system.

The aliquote of 0.5 l wastewater was stirred and filtered hrough the filter paper, which was previously dried for 90 minutes at a temperature of 105°C, cooled in a desiccator and weighed. Sample was then washed in distilled water 5 times, drained and squeezed and dried in the oven for 3 hours at 105°C. The calculation of suspended substances in waste water is carried out by the formula: $C = (m_2 – m_1) \times 2 \times 1000$; [$mg/dm^3$], where $(m_2 – m_1)$ is the mass difference. The results obtained (Table 1) were compared with the criteria for discharge of wastewater into the city sewer and waterways (rivers, lakes, etc.).

Table 1. Amounts of suspended materials [mg/dm^3] in wastewater before and after purification

	Amount of suspended materials C [mg/dm^3]	
	Prior to purification	After purification
Analysis 1	256	116
Analysis 2	80	40
Analysis 3	110	71

6. HEAVY METALS DETERMINATION

Heavy metals, e.g. copper, chromium and zinc amounts in water were determined by atomic absorption spectrophotometry, which is one of the most accurate methods of quantitative chemical analysis. The wastewater sample was filtered through the filter paper using atomic absorber, by atomic adsorption spectrophotometry. The spectrophotometer used was manufactured by "Perkin-Elmer", USA, model 1100B. The concentrations of substances determined by atomic absorption spectrophotometric method are very low and range from $1x10^{-6}$ to $1x10^{-3}$ mg/dm^3. The solution containing the substance was entered into flame, that evaporates the solvent, atomizing the substance and creating atomic plasma. Unexcitated atoms from atomic plasma absorb certain wavelength monochromatic radiation.

Determination was carried out in air-acetylene flame with a hollow cathode lamps. Copper, chromium and zinc determination was performed under conditions given in Table 2.

Table 2. Parameters for copper, chromium and zinc determination

	Copper	Chromium	Zinc
Wavelength (nm)	324,8	357,9	213,9
Slit (nm)	0,7	0,7	0,7
Acetylene flow (l/min)	1,2	3	1,2
Air flow (l/min)	8	7,5	8

The results of the analysis of zinc, copper and chromium levels in wastewater, are given in Tables 3, 4 and 5, respectively. Comparing the results at the entrance and exit points, it can be concluded that the applied treatment is efficient, regarding the analysed elements.

Table 3. Results of Zn value analysis in the waste water, before and after the purification

	Before purification [mg/dm^3]	After purification [mg/dm^3]
Sample 1	5,1	2,80
Sample 2	4,0	0,82
Sample 3	2,59	0,64

Table 4. Results of Cu value analysis in the waste water, before and after the purification

	Before purification [mg/dm^3]	After purification [mg/dm^3]
Sample 1	10,5	0,14
Sample 2	0,40	0,20
Sample 3	0,5	0,030

Table 5. Results of Cr value analysis in the waste water, before and after the purification

	Before purification [mg/dm^3]	After purification [mg/dm^3]
Sample 1	0,018	0,004
Sample 2	0,01	0,00
Sample 3	0,35	0,0026

During the purification process, predominantly acidic wastewater become slightly alkaline or neutral. pH values measured shifted from 5.0 to 8.3, from 3.1 to 7.9 and from 2.0 to 6.9. Purification significantly reduces the amount of zinc (5.1 to 2.8 mg/dm^3), copper (10.05 to 0.14 mg/dm^3) and chromium (0.018 to 0.004 mg/dm^3).

Since the sustainable development implies the social and economical development with minimum adverse effects on the environment, it has to be major lead in the processes of decision making and executing in any new project, especially technological and industrial [6]. Water purification plant at the Chemical industry "Župa", Kruševac, has proven it possible.

7. CONCLUSION

One of the biggest problems during the wastewater treatment course is the presence of heavy metals in amounts above the allowable values [7]. They accumulate in the activated sludge and have negative impact on the anaerobic sludge stabilization. The removal of heavy metals naturally is almost impossible, thus their adverse affects on the environment [2]. Therefore prior to discharge of water into the recipient heavy metals need to be removed [6].

A number of different procedures is known today, but few are as fast, simple and efficient as the process of purification by neutralization and precipitation by $Ca(OH)_2$, is used in Chemical industry "Župa", Kruševac, as demonstrated by the results of the analysis of suspended material and heavy metals content in wastewaters after the purification.

Based on the results obtained, it can be concluded that such an efficient purification procedure is of utmost importance, creating the effluent that can be discharged into the waterways, or be used without major problems for agricultural irrigation.

Acknowledgements
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VIRTUAL WATER IN AGRICULTURAL AND INDUSTRIAL FOOD PRODUCTION

VIRTUELNA VODA U POLJOPRIVREDNOJ I INDUSTRIJSKOJ PROIZVODNJI HRANE

Tamara Galonja Coghill, Ljiljana Kostadinović, Nenad Č. Bojat
Faculty for Biofarming, Bačka Topola, Megatrend University, Belgrade

Abstract: *Water consumed in the production process and contained within the product is called the virtual water. It links water, goods and global trade. Virtual water can be qualitatively determined through the water footprint, which refers to the amount of water used by any defined body, ranging from an individual to the entire nation. Futrher understanding of water consuming processes in food production led to the development of the water footprint as the three-part system, comprizing of blue, green and gray water. Shifting previous exclusive importance of blue water into the green water zone, it appears that with the appropriate water management, even the countries suffering water shortage could produce enough food. The concept of virtual water led to understanding the ways water is being traded worldwide, as the volumes virtually contained within the traded products.*
Key words: *Virtual water, water footprints, blue, green and gray water.*

Apstrakt: *Voda koja se potroši tokom proizvodnih procesa i koja je sadržana u samom proizvodu, naziva se virtuelna voda. Ona povezuje vodu, proizvode i globalnu trgovinu. Virtualnu vodu je moguće kvalitativno odrediti putem vodenog otiska, koji predstavlja količinu vode iskorištenu od strane bilo kojeg definisanog tela, u rasponu od pojedinca do čitave nacije. Činjenica da su procesi proizvodnje hrane izuzetno zahtevni u pogledu količine potrošene vode, dovela je do razvoja vodenog otiska kao trodelnog sistema, koji se sastoji od plave, zelene i sive vode. Sagledavanje značaja zelene vode, u odnosu na prethodno ekskluzivno značajnu plavu vodu, učinilo je mogućim da, uz pravilano upravljanje, čak i izrazito sušne zemlje, mogu proizvesti dovoljne količine hrane. Koncept virtualne vode otvorio je nove pravce u razumevanju načina međunarodnog trgovanja vodom u obliku sadržanom u proizvodima kojima se trguje.*
Ključne reči: *Virtualna voda, vodeni otisak, plava, zelena i siva voda.*

1. VIRTUAL WATER

The "virtual water" is the water consumed in the production process of an agricultural or industrial product and is contained within the product [1]. This concept was primarily developed to address water scarcity in the Middle East, but was recognized worldwide, interconnecting water, food and trade. It links freshwater and soil water, in the production of agricultural and other commodities. Knowing that the virtual water content of one kilogram of wheat is 1300 liters, it becomes clear that food production is extremely water consuming. One kilogram of beef contains approximately 15500 liters of virtual water [2].

This raises issues of international trade of water contained in goods that are the subject of trade or used to produce those goods. For example, a country importing one ton of tree nuts is also importing water used to produce them (see Table 1). some countries have chosen to abandon exports of water intensive crops by importing those goods, thus reducing virtual water exports. During the period between 1995 and 1999, the Middle East countries (with the exception of Syria, Lebanon and Iraq) imported 13805 m^3 of water yearly, and exported only 642 m^3 of virtual water, defining itself as net importers of virtual water by the volume of 13163 m^3 per year [3, 4]. By adjusting export oriented food production and measuring net flow of virtual water, a country can save significant amounts of domestic water, which is a feasible way of achieving water sustainability, important in water scarce countries. Specific demands for water, or virtual water needed for the production and contained within some of the primary vegetal products are given in the Table 1.

Table 1. Specific Water Demands of some primary vegetal products [5]

Products	Specific Water Demand (m^3/T)	Products	Specific Water Demand (m^3/T)
Wheat, millet, rye	1159	Groundnuts	2547
Barley	1910	Sunflower	3283
Oats	2374	Tomatoes	130
Sorghum	542	Onions	168
Rice	1408	Vegetable, others	195
Maize	710	Grapefruit	286
Cereals, others	1159	Lemons, limes	344
Potatoes	105	Oranges and other citrus	378
Sugar beet	193	Bananas	499
Sugar Cane	318	Apples	387
Pulses	1754	Pineapples	418
Tree nuts	4936	Dates	1660
Rape and Mustard seed	1521	Grapes	455
Soybeans	2752	Fruit, others	455
Olives	2500		

The analysis of virtual water flow further extends to any product or service that consumed any amount of water. The volume of water embeded into various products in the United Kingdom is given in Table 2.

Table 2. Estimates of the volume of water embedded in different products in the UK (virtual water) [5]

Item	Liters	Item	Liters	Item	Liters
Pint of beer, 568ml	170	Cup of coffee, 125ml	140	Glass of orange juice, 200ml	170
Glass of milk, 200ml	200	Cup of instant coffee, 125ml	80	Glass of apple juice, 200ml	190
Cup of tea, 250ml	35	Glass of wine, 125ml	120	Bag of potato crisps, 200g	185
Slice of bread, 30g	135	Tomato, 70g	13	Hamburger, 150g	2400
Egg, 40g	135	Apple, 100g	70	Bovine leather shoes	8000
Sheet of A4 paper, 80 g/m²	10	Cotton shirt, 500g	4100	Microchip, 2g	32

Surprisingly, one cotton shirt can carry the load of over 4000 liters of embeded water, while ordinary bovine leather shoes account for 8000 liters virtual water (Table 2).
Although some of the economists argue that the international virtual water trade actually is the way of preserving world water, such a presumption would come near to being accurate only in case of water rich countries exporting products with great amount of water embeded within. Also, some suggest the value of embeded water should be incorporated into the product price.

2. THE WATER FOOTPRINT

Wackermagel and Rees [6] developed the idea of the ecological footprint in 1996. Shortly after that, the water footprint concept was introduced by the UNESCO-IHE as an alternative indicator of water use [4]. It refers to the amount of water used by any defined body, an individual, community, business or even one entire nation.

There are three components of a water footprint, described as blue, green, and grey [7]. The blue water footprint is the amount of freshwater used from surface water and ground water to produce goods and services for any individual or community. It accounts for the amount of water that does not return to the catchment it was withdrawn from. The green water footprint is the amount of water evaporated from the global green water resources (rainwater stored as soil moisture), in other words, the amount of consumed rainwater. The grey water footprint is the amount of polluted water created during the courses of production of goods and services, e.g. the amount of water needed for the assimilation of pollutants and maintain certain standard of water quality. According to the blue-green water availability and spatial representation, even some countries with claimed water shortage could be able to produce enough food for their populations, providing efficient management of green water.

Each product, including every type of food, is characterized by particular blue-green-gray water footprint distribution [4, 5], that determines not only the dominant type of water source, but also the polluting impact on water and the entire environment. For example, average beef production implies 93% green, 4% blue, 3% grey water footprint, meaning that major share of water comes from fresh water sources. The volume of water needed to assimilate the pollutants is 3%, what is significantly less comaperd with production of wheat, where grey water footprint accounts for 11%.

3. WATER IN HEALTHY FOOD PRODUCTION

Large quantities of water are needed in food production, therefore can act as limiting factor, especially in healthy food production, where good quality water for irrigation of agricultural areas is an ultimate need [8]. Irrigation water must be classified by trophic level, type and quantity of dissolved salts and suspended solids, which can have a negative impact on plants and other important organisms in soil.

Assessments of global water availability conclude that almost 70% of the world's population will experience some water-related stress, by the year 2050, regarding demands for water to be used in food production [9]. Not only that water supply is limited in many areas, but also the cost of constructing irrigation systems is quite high. Therefore, the whole new methodology of increasing water-food transformation will have to be developed [10, 11].

Due to its restricted availability, water is being increasingly re-used, reaching the point of questionable quality. Although HACCP (hazard analysis and critical control point) programmes have been long implemented, there is an incresing need for development of methods for more efficient use of water in food industry, from its agricultural origins to the market shelfs. Water use refers to the amount of water consumed in the process of completing a given task or producing a given quantity of some product.

During the period of only one hundred years, from the year 1900 to 2000, water use for agricultural production increased five-fold, from about 500 cubic kilometers per year to 2500. The total use increased at the same pace, from around 600 cubic kilometres per year to over 3000. It is estimated that agriculture uses 70% of water resources [12]. After the initial, agricultural food production stage, water remains vital resource during the food processing, used in washing, cleaning, blanching, peeling, cutting, mixing, steaming, freezing, heating and boiling food, as well as in canning and bottling plants. Water is essential in assuring the food hygiene.

While total water self-sufficiency implies a national economy that has sufficient local water to provide drinking water, domestic water, water for industry and services, as well as water for food and other essential agricultural production, valuing virtual water is still a problem. Water requirements in global food production are shown in Figure 1.

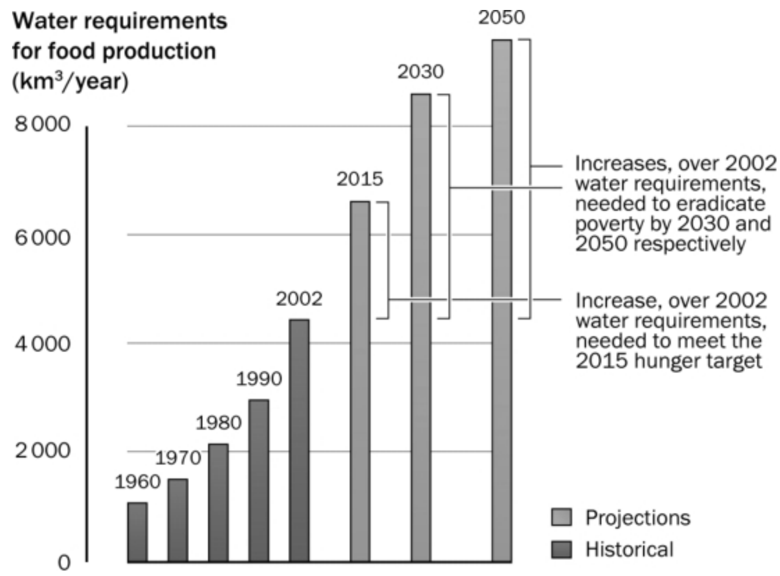

Figure 1. Past, current and projected water requirements for food production [7]
(Ahlenius, UNEP/GRID-Arendal)

Some authors point to the vital difference between the past strategies for agricultural water management that had focused on irrigation (e.g. blue water), and developing strategies that rely on green water in food production [13, 14]. As illustrated in Figure 2, crops for beer production require 85% green and only 6% blue (irrigation) water. The pollution output is quite high, amounting to 9% of gray water, assimilating the resultant production pollutants. Although in the developed countries greatest part of freshwater withdrawal is for industry and only up to 15 % for agriculture (for example, in the UK), 70% of the global freshwater withdrawals are for irrigation, putting significant pressure on water resources.

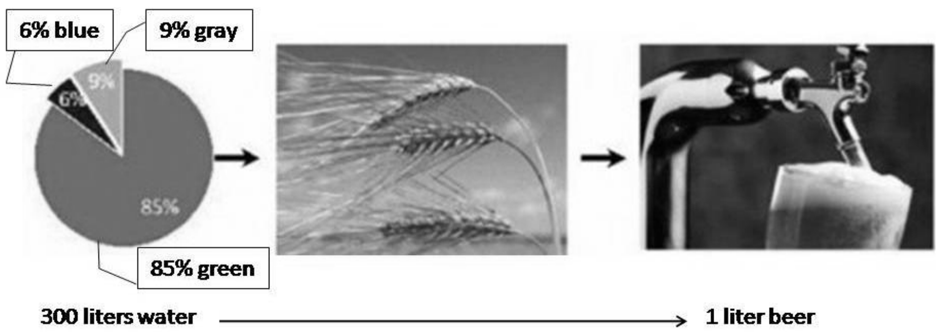

Figure 2. Proportion of blue, green and gray water in beer production.

The greatest consumers of water amongst crops are rice, accounting for over 20% of the total volume of water used in global crop production and wheat (12% of global crop water use). All those should be taken into the account when determinig the national water footprint, as the total amount of fresh water that is used to produce the goods and services consumed by the inhabitants of the nation [14].

4. CONCLUSION

The concept of virtual water links freshwater and soil water, used in the production of agricultural and other goods, regarding it as embodied into the product or service. Therefore, any goods and services trade also implies trade of water contained within them. Internationally, this makes some countries net water exporters and others net water importers. The total volume of virtual water can be expressed as water footprint, that comprises of three parts, blue, gree and gray water, quantifying the amounts of freshwater or rainwater used for the production, as well as the amount of water needed for the assimilation of pollutants, resulting from the production process. Adjusting and balancing those three shares of national water footprint facilitates managing total water resources.

Currently, Serbia does not have any developed virutal water strategy, within its chaotic and non-transparent agricultural production and linked export and import activities.

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SIGNIFICANCE OF WATER RESOURCES IN PRESERVATION OF ENDEMIC FISH SPECIES

ZNAČAJ VODNIH RESURSA U OČUVANJU ENDEMIČNIH VRSTA RIBA

Ivanc, A.[1], Dekić, R.[2],Lolić Svjetlana[2], Janjić Nina[2], Erić, Ž.[2], Ćetković Danijela[2]
aivanc@np.ac.rs,
[1]State University of Novi Pazar, Vuka Karadzica bb, 36300 Novi Pazar, Serbia
[2]Faculty of Natural Sciences and Mathematics, University of Banja Luka, Bosnia and Herzegovina

Abstract: *Water is one of the three key parameters of an environment. Its quality is of crucial significance for land, freshwater and marine habitats. Water resources represent habitats for numerous groups of the organisms giving them the necessary environmental conditions, and some of them are endemic to certain area and its prevention is of a special interest. Water quality of the given water bodies is one of the relevant parameters for the existance of such species that represent exquisite genetic resource, especially endemic species. Minnows are karst endemic fish species and in this study the waters that they are inhabiting were monitored. This was done by monitoring physico-chemical characteristics of the Rivers Sušica, Vrijeka and Mušnica and Klinje accumulation. Results show that Rivers Sušica and Vrijeka in their springs have water that belongs to first class and that can be used as a water supply, while some of the parameters of the River Mušnica and Klinje water reservoir show certain deviations.*
Key words: *water, quality, minnows*

Apstrakt: *Voda kao jedan od tri ključna parametra kvaliteta životne sredine od suštinskog je značaja kako za vodsnabdijavanje stanovništva, tako i za životnu sredinu čiji je sastavni dio. Istovremeno vodni resursi predstavljaju staništa brojnih grupa organizama pružajući im neophodne životne uslove, a neki od njih su autohtoni za dato područje te je njihovo očuvanje od posebnog interesa. Kvalitet vode pojedinih vodotoka predstavlja jedan od bitnih parametra za opstanak takvih vrsta koje predstavljaju i izuzetan genetički resurs, posebno endemične vrste. Gaovice predstavljaju endemične vrste riba kraških, te su u radu praćene vode koje predstavljaju staništa ovih vrsta. U radu je praćen kvalitet vode sa fizičko-hemijskog aspekta rijeka Sušice, Vrijeke i Mušnice, te akumulacije Klinje. Rezultati pokazuju da se rijeke Sušica i Vrijeka u izvorišnom dijelu imaju prvu klasu kvaliteta i da se mogu koristiti za vodsnabdjevanje stanovništa, dok neki parametri vode rijeke Mušnice i akumulacije Klinje pokazuju odstupanja.*
Ključne riječi: *voda, kvalitet, gaovice*

1. INTRODUCTION

The basis of development of every country is presented by its natural resourses. Water is one of the three key parameters of the environmental quality. Its quality is of the crucial significance for the habitat as well as for human population as the sourse of drinking water. Water resources should be observed twofold. On one hand on global level and on the other on national level within its own country where all steps should be conducted to preserve and improve exsisting resources (Hoekstra, 2006). These resources are priceless for development of the overall economy. Also, they are particularly significant for sustainable development of certain area, starting from farming, organic food production and ecotourism. In the same time water resources represent habitats for numerous groups of organisms giving them the necessary environmental conditions. Such water bodies are often inhabited by endemic species which present specific genetic resource and contribute to overall biodiversity.

Endemic species represent very large potencial, so the research of them and their habitats are of a special interest.

Many authors [1], [2], [3] point out the importance of water monitoring. By using it, the data that indicates the state of surface water could be collected.

Physico-chemical water characteristics are one of decisive factors in water quality estimation [4], [5], [6], [7] and are of a great importance for overall economy development.

Many authors emphasize the importance of surface water monitoring [8]. Besides physico-chemical analyses, for complete estimation of water state it is also necessary to analyse its biological component [9].

The goal of this work is to present the quality of water resources in Eastern Herzegovina which are inhabited by minnows, endanegered endemic fish species.

According to earlier used systematics, species were named: striped pijor (*Paraphoxinus metohiensis,* Steindachner, 1901), trebinje minnow (*Paraphoxinus pstrossi* Steindachner, 1882) and popovo minnow (*Paraphoxinus ghetaldii* Steindachner, 1882). Then, they were classified in genus *Phoxinellus*, and had scientific names *Phoxynellus metohiensis* (Steindachner, 1901)*, Phoxynellus pstrossi* (Steindachner, 1882)*, Phoxynellus ghetaldii* (Steindachner, 1882).

Recent systematics classify minnows from this area in two separate genera. *Telestes*, with species *Telestes metohiensis* – striped pijor and *Delminichthys*, with species *Delminichthys ghetaldii* – trebinje and popovo minnow [10], [11].

Before reservoirs and system of canals and tunnels were made, minnows spent the most of the year in underground water. In surface water they used to appear in the spring, in the period when fields of Eastern Herzegovina are flooded with underground water. As the rest of the species that inhabit karst water and have similar life cycle, minnows have specific complex of physiological adaptive mechanisms that provide such way of survival [12], [13].

2. MATERIAL AND METHODS

Water and air temperature, pH values, electroconductivity, concentration of dissolved oxygen, water saturation, turbidity and flow rate were determined right after collecting the samples [16], [17]. Chemical water analysis was done within the 12 hours from the moment of sampling.

Using spectrophotometer HACH DR2800 concentrations of ammonia, nitrate, nitrite, ortophosphates, sulfates and suspended substances were determined. Ammonium concetration was determined using Nessler reagent. Nitrites were determined using sulfanilic acid, nitrates using cadmium, and sufates using barium-chromate reagent. Total suspended substances were determined by photometry.

Water samples for microbiological analyses were taken in sterile dishes in aseptic terms according to prescribed procedure [14], [15]. Samples were transported on ice on temperature of +4˚C.

For determination of the minnows presence surveys field analyses of fish community was performed by electrofishing (Transportable electroshocker IG 600 with power 1.2 kW) and nets with different diameters. Data on appearance and presence of endemic minnow species were also provided by questionnaire distributed to local fishermen.

3. RESULTS

Analyses of physico-chemical water characteristics were conducted on several sites where presence of endemic fish was determined. Research has included Rivers Sušica, Vrijeka and Mušnica, and Klinje water reservoir.

Water quality analysis of the River Sušica was done on the area of Trebinje municipality in site situated on 42˚41' 723" N, 018˚32' 500" E at an altitude of 341 m. Water temperature was in interval from 10.5˚C, recorded in January, to 17.1˚C (in September) (Table 1). In July slightly lower concentration of dissolved oxygen was recorded so the saturation was 69.77%, whereas in September and January was above 90%. In July water from Sušica was almost neutral (pH 7.24), while in the rest of the samples were slightly alkaline. In January pH value of 8.48 was recorded which is very near the upper limit prescribed for drinking water. Turbidity values were extremely low in every sample, and suspended substances were not recorded. Electroconductivity was increasing during the year, with the highest value in September, but did not exceed the allowable values by the Rulebook [18]. Ortophosphates and ammonium, nitrate and nitrite nitrogen were within the allowable range in every sample. Dissolved sulfates were recorded only in March.

Table 1. Physico-chemical characteristics of water from the River Sušica

	23.03.2010.	**04.07.2010.**	**01.09.2010.**	**18.01.2011.**
air temperature (˚C)	16.3	20.1	17.4	14.1
water temperature (˚C)	11.0	16.2	17.1	10.5
concentration of dissolved O_2 (mg/l)	-	6.67	8.54	10.70
oxygen saturation rate (%)	-	69.77	92.10	99.20
pH value	8.27	7.24	8.20	8.48
electroconductivity (µS/cm)	364	467	528	497
turbidity (NTU)	0.00	0.00	0.34	0.07
ammonium nitrogen (mg/l)	0.08	0.00	0.09	0.10
nitrate nitrogen (mg/l)	1.3	0.4	0.5	0.7
nitrite nitrogen (mg/l)	0.019	0.002	0.003	0.013
sulfates (mg/l)	8	0	0	0
orthophosphates (mg/l)	0.02	0.07	0.03	0.14
suspended substances (mg/l)	0	0	0	0

The highest recorded water temperature from the source of the river Vrijeka was 11.2 °C (Table 2) and since it was not significantly increased during warm summer months it could be concluded that temperature of this spring correspond to drinking water. Water is slightly alkaline without significant variation in pH values during the year. The lowest values of concentration of dissolved electrolytes was recorded in January (398 µS/cm) when the spring had much water, while in summer period in time of drought recorded the highest concentration of electrolytes in water (550 µS/cm).

Table 2. Physico-chemical characteristics of water from the spring of river Vrijeka

	River source				River mouth
	23.03.2010	**04.07.2010**	**01.09.2010**	**19.01.2011**	**31.08.2010**
air temperature (˚C)	14.0	21.0	17.1	10	17.1
water temperature (˚C)	11.0	10.5	11.2	9.9	15.6
concentration of dissolved O_2 (mg/l)	-	8.73	9.15	10.19	9.45
oxygen saturation rate (%)	-	82.3	88.4	94.5	101.1
pH value	7.60	7.65	7.71	7.68	8.19
electroconductivity (µS/cm)	438	484	550	398	387
turbidity (NTU)	0.89	0.81	1.99	1.41	7.20
ammonium nitrogen (mg/l)	0.00	0.01	0.00	0	-
nitrate nitrogen (mg/l)	0.6	0.6	0.4	0.5	-
nitrite nitrogen (mg/l)	0.000	0.001	0.000	0.011	-
sulfates (mg/l)	0	0	0	0	-
orthophosphates (mg/l)	0.35	0.15	0.00	0.15	-
suspended substances (mg/l)	2	1	0	1	-
COD	-	-	-	-	2.13

In September and in January were recorded slightly increased values of water turbidity, but they were in allowable range for use as water supply to 5000 inhabitants. Recorded concentrations of ammonium, nitrate and nitrite were far below maximum allowed concentrations, and sulfates were not even recorded. In March was recorded increased concentration of orthophosphates (0.35 mg/l). Also, in water were recorded slightly more suspended substances and before sampling the weather was rainy. Probably washing away the surrounding soil caused slightly muddy water and bringing orthophosphates. In June concentration of orthophosphates was significantly decreased, and in September they were not even recorded. All other parameters during the whole year were in prescribed range for drinking water [18], so it can be concluded that in physicochemical aspect water from source of River Vrijeka can be used for drinking.

Water quality analysis of River Vrijeka was also conducted on site Ponikve, where it originates and where the presence of striped pijor in large number was established. Sampling site was at an altitude of 523 m (43˚03'25" N / 18˚14'76" E). Water temperature during sampling was 15.6 ˚C. Water was tasteless and odorless, and the value of turbidity was 7.20 NTU. Electroconductivity had value of 387 (µS/cm), while oxygen concentration was 9.45 mg/l O_2.

Based on values of these parameters and according to the Regulation on Classification and Category of Water and Water courses [19] this water belongs to first quality class. pH value of

8.19 directs to the same quality class while the value of COD classify the water from this river in the second class. Water oxygen saturation rate had value of 101.1 %.

Large number of striped pijor were also present in River Mušnica, which originates after water runoff from the Klinje water reservoir. Mušnica is the main watercourse of Gatačko field and in that place it receives tributary Gračanica which originates in location Srđevići.

In these researches physico-chemical water quality analyses of Klinje water reservoir, from which the River Mušnica originates, and River Mušnica were conducted.

Klinje is situated on mountainous part of the region, round 6 km north-east from Gacko, along the route Gacko-Foča [20]. Samples for physico-chemical water analysis on site Klinje – dam were collected on 23.03.2010. at an altitude of 1027 m (43˚10'14" N / 18˚35'12" E).

Water temperature was just 4.5˚C. Water was tasteless and odorless, with turbidity value of 1.4 NTU. pH value indicates slightly alkaline water, and recorded electroconductivity indicates low ion content in it. This is confirmed with the recorded low concentrations of iron and manganese.

Table 3. Physico-chemical characteristics of water from Klinje water reservoir and River Mušnica

	Klinje	**Mušnica**
air temperature (˚C)	9	10
water temperature (˚C)	4.5	7.1
pH value	8.32	8.36
electroconductivity (µS/cm)	377	656
turbidity (NTU)	1.4	12.4
ammonium nitrogen (mg/l)	0.1	0.1
nitrate nitrogen (mg/l)	1.2	0.6
nitrite nitrogen (mg/l)	0.024	0.008
sulfates (mg/l)	1	17
suspended substances (mg/l)	2.5	10
Fe (mg/l)	0.03	0.02
Mn (mg/l)	0.01	0.01
PO_4^{3-} (mg P/l)	0.18	0.48

Dissolved nutrients that limits organic production, nitrates and nitrites, were recorded in concentrations that correspond to second quality class, while values of other monitored parameters correspond to first class of surface waters.

Analysis of physico-chemical water characteristics of River Mušnica was conducted in locality Srđevići (43˚10'15" N / 18˚28'60" E) on an altitude of 935 m.

Water temperature was 7.1 ºC which is for 2.6 centigrades warmer than in the upper course. Water was mildly alkaline, with slightly higher value of electroconductivity (656 µS/cm) which indicates increased ion content in it. Concentrations of iron and manganese were relatively low and did not significantly change in regard to Klinje locality. From the observed nutrients only ammonia concentration was unchangeable in respect to Klinje locality.

Concentrations of dissolved nitrates and nitrites were considerably lower in Mušnica, while concentrations of ortophosphates and sulfates were higher. Mušnica in a place Srđevići had considerably higher value of turbidity as well as concentration of suspended substances. Recorded values of concentration of suspended substances and high electroconductivity correspond to third class water. However, samples were taken in March after period of heavy precipitations which by erosion of soil carries into water different particles, muddy it and increase concentration of suspended substances. All that could lead to increased concentrations of ions, sulfates and ortophosphates.

Research of River Mušnica water quality were also conducted in year 2009., and the results showed that this water belonged to second class, where the water was slightly alkaline with relatively low evectroconductivity. Also, during this research higher level of turbidity and coloration by platinum-cobal scale were recorded. Concentration of dissolved oxygen was very high and oversaturation occured. Iron and manganese were recorded in low concentrations, while presence of magnesium was determined.

Although stated water bodies are very relevant water resources, it sholud be emphasized that these resources in the same time represent habitats of indigenous fish species. Some of them are endemic. Special emphasis should be put on the presence of striped pijor and trebinje minnow in large number in some of the monitored watercourses.

During the entire researched period a striped pijor (*Telestes metohiensis*) was present. Its presence was recorded in several localities in every sample. The presence of numerous individuals of this species was determined in River Vrijeka, in lower part of its course, directly before the abyss. Striped pijor was also recorded in River Opačica during 2010, and in significant number in stream Suško, tributary of River Vrijeka in Dabar field. Research in River Mušnica during 2009 also showed presence of this species in a significant number. Its presence was also recorded water reservoir Bileća during years 2004, 2006 and 2007.

There are still a massive appears of this species in spring in most of wells in Fatničko filed, but it is certain that big part of the population stays in Bileća water reservoir throughout the year. The reason that it is little known about minnow biology in the reservoir, in the new environment, is its preference of the deepest zones, were it cannot be collected for obvious reasons – traditional way of fishing is ineffective, and net fishing in the lake is forbidden.

The presence of trebinje minnow was recorded in some of the researched water. A number of large specimens of this species were collected in region of Fatničko field after its outflow, and in significant number in Ljubomir stream [21].

Population of trebinje minnow was declining, and in the previous period had been significantly present in the upper stream of the River Trebišnjica, while the popovo minnow had been registered on several localities in Herzegovina, Dalmatia and Bosnia [22].

The fact that both species inhabiting the water of Eastern Herzegovina are present in the Red book of threatened species indicates the world significance of these endemic species. Two biggest bases of these data, WCMC and IUCN classify them into the first category - the species about which there are no sufficient information and are threatened with disappearance, due to antropogenic environmental changes [21]. In this respect it is necessary to conduct measures that will prevent further habitat degradation and environmental changes, and in that way provide the existence of these species.

4. CONCLUSION

Water quality research on the area of Eastern Herzegovina showed that Rivers Sušica and Vrijeka had the water of first quality class, while the River Mušnica and Klinje water reservoir, and River Vrijeka in the site directly before the abyss had the second class water. This water resources in the same time represent habitats of endemic fish species, of which the striped pijor was determined on a number of sites, while the areal of trebinje minnow was considerably smaller.

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WATER QUALITY OF SOME WATERCOURSES FROM THE VRBAS WATERSHED

KVALITET VODE NEKIH VODOTOKA SLIVA RIJEKE VRBAS

Dekić, R.[1] , Ivanc, A.[2], Ćetković Danijela[1] , Lolić Svjetlana[1]
dekicr@pmfbl.org
[1]Faculty of Natural Sciences and Mathematics, University of Banja Luka, Bosnia and Herzegovina
[2]State University of Novi Pazar, Vuka Karadzica bb, 36300 Novi Pazar, Serbia

Abstract: *Estimation of water quality based on physico-chemical parameters is of a great importance and shows current state of the watercourses. Physico-chemical analyses were conducted monthly durign the year 2005. on two watercourses of Vrbas watershed, Rivers Suturlija and Jakotina. Suturlija is a tributary of the River Vrbas, while Jakotina belongs to subwatershed of the River Vrbanja. Based on the recorded results categorisation was conducted according to the Regulation on Classification and categorisation of Water and Water courses. Results showed that water from the River Jakotina belonged to first quality class based on the majority of monitored parameter, while some parameters indicated that water from River Suturlija belonged to second class.*
Key words:*water, quality, watercourse*

Apstrakt: *Utvrđivenje kvaliteta vode na osnovu fizičko-hemijskih parametra od velikog je značaja i prikazuje trenutno stanje vodotoka. Fizičko-hemijska analiza vode provedena je na dva vodotoka sliva rijeke Vrbas, Suturliji i Jakotinskoj rijeci po mjesečnim uzorcima tokom 2005. Godine. Suturlija je pritoka rijeke Vrbas, dok Jakotinska rijeka pripada podslivu Vrbanje. Na osnovu dobijenih rezultata provedenih fizičko-hemijskih analiza provedena je kategorizacija u skladu sa Uredbom o klasifikaciji voda i kategorizaciji vodotoka. Rezultati pokazuju da voda Jakotinske rijeke prema većini praćenih parametra pripada prvoj klasi kvaliteta, dok neki parametri ukazuju da voda rijeke Suturlije odgovara drugoj klasi kvaliteta.*
Ključne riječi: *voda, kvalitet, vodotok*

1. INTRODUCTION

Analyses of physico-chemical characteristics are of a great importance for evaluation of water ecosystems and give information about their current state. Physico-chemical, microbiological and biological methods are used for determination of pollution level of surface fresh water [1],[2], [3],[4].

Conclusions about water quality can be made after monitoring physico-chemical water characteristics and their interaction with other parameters. Values and changes of certain parameters can directly or indirectly affect the wildlife in water environmet.

Problems in the area of water intake, processing and quality can be noticed and removed on time by systemic control and monitoring. Constant monitoring and concern about maintaining a positive state of water quality is a condition for successeful water management. These monitoring systems and incentives planning can prevent the runoff of polluted water and dangerous substances [5].

The River Suturlija by its course is situated in the area south-west from Banja Luka, and the mouth into the River Vrbas, as its left tributary, is situated in settlement Srpske Toplice (Gornji Šeher), at an altitude of 159 m [6].

The source of the River Suturlija is situated in the village Goleš, between parts of Pervan settlement in the west and Goleš in the north, at an altitude of 390 m, while the base of the sector is presented with Dedića točak, a hill at an altitude of 466 m.

The entire area that River Suturlija flows through is mainly karst, which is implicated by various relief shapes, such as cracks, sinks and small surfaces and its main course does not flow in the same direction. The upper and lower course flow in the direction west – east, while the middle course, being the shortest, flows from south to north.

The characteristic of this watercourse is that it never dries up, but its water flow rate varies from winter and summer months, when it is very low, to autumn and spring, when the river becomes torrential. The most important tributaries of the River Suturlija are: Rijeka, Golešica, Grabešinac, Dragojević stream and Grubajić stream [6].

The River Suturlija watershed has an area of 67.53 km^2, while the average water flow rate is 1.48 m^3/s [7]. The area of a direct watershed of the River Suturlija has 7.9 km^2 [8]. The length of this watercourse is 18.35 km, and average annual rainfall in Vrbas watershed in the area near Banja Luka is 1057 mm/year.

The source of the River Jakotina is situated in Kneževo municipality, while the biggest part of the watercourse and the mouth into river Vrbanja as its left tributary are situated in Kotor Varoš municipality. The source is at the altitude of 670 m, and the mouth at 260 m. It is a permanent watercourse with a length of 15 km and an altitude difference of 410 m [9].

The River Jakotina watershed has an area of 57 km^2, and the average water flow rate is 0.99 m^3/s. Average water flow rate of the River Vrbanja before the mouth of the River Jakotina is 9.92 m^3/s. The River Vrbanja watercourse to the mouth of the River Jakotina has an area of 455.90 km^2. Water flow rate researches of River Jakotina during the period 1985-1988 shows that the lowest rate (0.037 m^3/s) was recorded in January of 1987., while the highest was recorded on 17.03.1988., and was 12.06 m^3/s [10].

The watershed of River Jakotina has certain smaller tributaries and springs such as: Trešnjevac, Štakanov spring and Sokoljanac, and numerous temporary streams, either. It is necessary to emphasize that the River Vrbanja on its left bank has a bigger hydrogeological basin than orographic, while on the right side the basins match.

2. MATERIAL AND METHODS

Water sampling for necessary analyses was conducted in monthly intervals. Basic physico-chemical water parameters were determined using standard procedures (Official Gazette of RS, No 42 /2001).

3. RESULTS AND DISCUSSION

Values of monitored parameters are present in tables 1 and 2. Water temperature values of the River Suturlija during the year 2005, were in the range from 4 °C (recorded in January) to 22 °C (August). Based on values of dissolved oxygen concentration and water oxygen saturation rate (which was higher than 80.00 in every month) first quality class was established. The highest pH value was 8.38 recorded in July, while the lowest was 7.4. Based on these values water of the first class was recorded in every sample.

Values of nitrates showed sgnificant oscilations during monitored months. So, based on the values of nitrates in samples from April, May, June, October and December indicater water of a second quality class, while the values from July indicated third class. COD had values within the interval from 2.3 mg/l to 9.9 mg/l, while chloride values varied between 8 and 14 mg Cl /l.

p-alkality values were in the interval from 0.2 ml 0.1 N HCl/l to 1 ml 0.1 N HCl/l while m-alkalinity ranged from 0.1 ml N HCl /l to 61 ml 0.1 N HCl/l. The lowest recorded value of bicarbonates was in June (204 mg HCO_3/l), while the highest value was 280.6 mg HCO_3/l, recorded in September.

Carbonate hardness (ml 0.1 N HCl/l) varied from 11 to 15, and values in °d were within the range 10 °d to 14 °d.

Total hardness as $CaCO_3$ had values that corresponded to first quality class, so as the values of phospahtes that were constantly lower than 0.15 mg/l.

Values of suspended substances varied from 1.3 mg/l to 8.2 mg/l and according to this parameter samples from January, February, March, October and December had values that indicate second quality class, and the saple from November corresponded to first class.

Total solids were within the range from 212 mg/l to 281 mg/l, which correspondeds to criteria prescribed for the first class water. Electroconductivity values (from 243.0 µS/cm^{-1} to 429.8 µS/cm¯1) showed that samples from January, February, November and December indicates the second class water, while the rest of them corresponded to first class.

Detergent values were constantly lower than 0.1 µg/l, while phenols were lower than 0.001 µg/l.

Sulfates had values from 11.5 mg SO_4^{--}/l to 15.3 mg SO_4^{--}/l. Values of iron were within the range from 0.003 mg/l to 0.058 mg/l, while manganese values varied from 0.006 mg/l to 0.019 mg/l, which indicates first class water.
Values of calcium varied from 72.32 mg *Ca*/l to 88 mg *Ca*/l, while magensium had values from 1.3 mg Mg/l to 9.8 mg Mg/l.

Table 1. Physico-chemical characteristics of the River Suturlija – monthly values (2005)

PARAMETERS	MONTH											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Water temperature - ºC	4	6	11.5	10	13.5	**13**	**16**	**22**	**17**	10	6	5
Dissolved oxygen – mg O_2/l	11.74	11.65	11.44	9.30	9.80	9.40	8.45	7.58	10.19	9.95	10.23	10.65
Oxygen saturation rate - %	89.89	93.87	105.24	82.66	93.33	89.52	85.78	86.82	105.59	88.28	82.43	94.66
pH value	8.02	7.88	7.80	8.21	7.4	7.6	8.38	8.41	8.25	7.84	8.06	7.87
Ammonia nitrogen- mg/l	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite nitrogen – mg /l	0.003	0.002	0.003	0.004	0.039	0.0	0.005	0.005	0.006	0	0.003	0
Nitrate nitrogen – mg /l	1.2	3.2	2.4	0.6	0.5	0.8	5.7	2.2	2.2	0.4	2.2	0.3
COD - mg $KMnO_4$/l	2.3	2.4	3.7	4.1	6.3	6.6	4.7	4.6	4.3	9.9	6	7.1
Chloride - mg Cl /l	8	12	10	10	14	12	10	8	12	8	10	10
„p“ alkalinity – mg 0.1 N HCl /l	0.3	0.2	1	1	1		-	-	-	1	1	1
„m“ alkalinity – mg 0.1 N HCl /l	61	58	41	42	40	44	42	41	46	41	40	48
Bicarbonates mg HCO_3^-/l	238.4	255.6	220	216.4	212	204	256.2	-	280.6	246	244	234
Carbon. hardness – mg 0.1 N HCl /l	12.44	13.46	12	10.22	13	12	11.76	14	12.88	15	11.2	11
Total hardness - ºd	13.84	15.20	13.64	10.76	11	10	12.68	12.48	10.62	14	12.46	10
Total hardness as $CaCO_3$	247.74	272.08	244.16	192.60	196.90	179	226.97	223.39	190.10	250.60	223.03	179
Orthophosphates – mg /l	<0.15	< 0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Total suspended substances - mg/l	6.5	7.7	6.3	4.4	2.8	3.8	4.9	2.0	2.5	8.2	1.3	5.3
Total solids - mg/l	249	220	270	228	212	215	217	244	225	281	279	256
Electrical conductivity -µS/cm^{-1}	396.6	340.55	392.8	345	411	404	243.0	388.4	350.5	429	429.8	414
Detergents - µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.15	<0.1	<0.1	<0.1	<0.1	<0.1
Phenols - µg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.15	<0.001	<0.001	<0.001	<0.001	<0.001
Sulfates - mg SO_4/l	13.8	15.3	14.21	13.2	12.2	12	11.6	11.7	11.8	12.6	11.8	11.5
Iron - mg/l	0.004	0.003	0.028	0.054	0.05	0.03	0.005	0.004	0.05	0.058	0.050	0.056
Manganese - mg/l	0.008	0.010	0.006	0.063	0.02	0.01	0.006	0.009	0.016	0.019	0.019	0.018
Calcium - mg/l	88.58	84.21	86.54	86	88	82	72.32	76.54	80	88	84	82
Magnesium - mg/l	9.8	1.3	6.2	6.4	8	8	6.8	7.3	7.6	6.2	5.6	9

Table 2. Physico-chemical characteristics of the River Jakotina – monthly values (2005)

PARAMETERS	MONTH											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Water temperature - ºC	3.5	4	5	8	12	11	18	20	15	8.0	6.0	4.5
Dissolved oxygen – mg O_2/l	12.92	13.10	13.84	10.6	9.51	12.67	11.39	9.65	11.12	11.85	12.31	12.40
Oxygen saturation rate - %	96.27	100.30	108.71	89.75	88.46	115.28	120.52	106.74	110.53	100.33	99.19	94.94
pH value	8.20	8.10	8.10	7.97	8.1	8.0	7.94	8.34	8.16	8.20	7.55	7.98
Ammonia nitrogen- mg/l	0	0	0	0	0	0	0	-	0	-	-	-
Nitrite nitrogen – mg /l	0.002	0.001	0.002	0.006	0.006	0.006	0.002	-	0.001	0.008	-	0.002
Nitrate nitrogen – mg /l	1.0	0.9.	0.9	0.7	1.0	0.9	0.6	0.8	0.5	1.6	2.2	1.3
COD - mg $KMnO_4$/l	4.2	5.1	4.8	6.1	8.3	7.6	5.8	8.0	6.32	14.1	3.9	5.4
Chloride - mg Cl /l	7	9	4	12	10	10	8	8	18	6	8	6
„p“ alkalinity – mg 0.1 N HCl /l	0.2	0.1	-	0.3	0.2	0.1	0.1	-	0.3	3	-	0.1
„m“ alkalinity – mg 0.1 N HCl /l	40	32	30	26	34	32	28	31	27	34	36	34
Bicarbonates mg HCO_3^-/l	212	228	186	146	150	148	184	189.1	183	207.4	219.6	192
Carbon. hardness – mg 0.1 N HCl /l	10.32	11.23	9.84	11.2	11	11	9.2	8.96	9.52	10.08	10.08	10.02
Total hardness - ºd	10.11	9.72	8.26	9.76	10	9.8	10.86	9.18	8.22	8.84	10.72	9.83
Total hardness as $CaCO_3$	181	174	162	174.704	179	175.42	194.39	164.32	147.138	160.236	191.88	176
Orthophosphates – mg /l	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Total suspended substances - mg/l	3.4	3.8	3.9	4.2	4.5	4.8	4.1	5.0	4.1	3.6	2.4	1.8
Total solids - mg/l	191	198	198	212	215	180	174	196	192	228	214	201
Electrical conductivity -µS/cm^{-1}	375	312	329.8	315	330	322	343.8	302.5	288	352.0	273.7	300.3
Detergents - µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenols - µg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sulfates - mg SO_4/l	6.2	5.3	5.1	5.8	8.5	10.1	10.8	9.4	8.9	9.2	6.7	3.1
Iron - mg/l	0.02	0.03	0.01	0.026	0.02	0.02	0.042	0.02	0.01	0.01	0.03	0.01
Manganese - mg/l	0.002	0.001	0.002	0.008	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01
Calcium - mg/l	66.5	67.9	69.4	63.6	64	63	69.2	70.3	68.3	67.5	61.5	58
Magnesium - mg/l	4.20	5.1	3.8	3.86	5	4	8.8	6.8	7.4	5.8	6.4	2.5

Water temperature of River Jakotina during the year 2005. was within the interval from 3.5 °C (in January) to 20 °C, recorded in August. Based on the oxygen concentration and saturation values first water class was determined. The same class was indicated by pH values that were in the interval from 7.55 (November) to 8.34 (August).

Nitrate values were within the range allowable for the first quality class, while nitrates expressed as mg/l N had values from 0.6 mg/l to 2.2 mg/l. Samples from October and November corresponded to second class, while the rest of the samples corresponded to first class. First class was also indicated by the values of total solids and electroconductivity.

COD values were within the interval from 3.1 mg $KMnO_4$/l to 14.1 mg $KMnO_4$/l, where the last value was recorded in October. Chloride had values from 4 mg Cl/l to 18 mg Cl/l, values of p-alkalinity were within the range from 0.1 ml 0.1 N HCl/l to 0.3 ml 0.1 N HCl/l, and m-alkality from 26 ml 0.1 N HCl/l to 40 ml 0.1 N HCl/l.

Values of bicarbonates were in the range from 146 mg HCO_3/l to 228 mg HCO_3/l. Carbonate hardness had values from 8.96 ml 0.1 N HCl/l to 11.23 ml 0.1 N HCl/l, while total hardness in °d varied from 8.22 to 10.86.

Total hardness as $CaCO_3$ had values from 147.138 mg/l to 194.39 mg/l, where sample from September had value that corresponds to second class while the rest of the samples corresponded to the first class.

Phosphate values were constantly lower than 0.15 mg/l, while total suspended substances had values within the range from 1.8 mg/l to 5.2 mg/l, which indicates second quality class, except in December where values corresponding to first class were recorded.

Detergents had values lower than.1 µg/l, so as phenols which values during the researched period were lower than 0.001 µg/l.

Sulfate values were within the range from 3.1 mg SO_4/l to 10.8 mg SO_4/l. Values of iron varied from 0.01 mg/l to 0.042 mg/l and manganese from 0.001 to 0.02 mg/l, which indicate first quality class.

Calcium had values from 58 mg Ca/l to 70.3 mg Ca/l, while magneisum varied 2.5 mg Mg/l to 6.8 mg Mg/l.

It can be concluded that water from the Rivers Suturija and Jakotina correspond to I-II quality class based on all monitored physico-chemical parameters according to the Regulation on Classification and Categorization of Water and Water courses (Official Gazette of RS, 42/2001).

Also, it is necessary to emphasize that water from the River Jakotina is of a better quality than the water from the River suturlija, according to conducted analyses because the most of monitored parameters of this river indicated first quality class. Only values of nitrates and total suspended substances in some months indicated the second class water.

In the same time most of monitored parameter of the River Suturlija indicated the second quality class (nitrates, electroconductivity, suspended substances), while based on the values of total suspended substances in certain months corresponded to third class.

It is important to emphasize that the lower part of the river, shortly upstream of the mouth into River Vrbas is under constant anthropogenic influence especially municipal wastewater, since it is located in populated area.

Besides the wastewater that are directly discharged into Suturlija, water quality is also influenced by the River Vrbas considering that in the period of releasing the dam of the power station Bočac the level of the River Vrbas rises which caues significant rise in River Suturlija water level.

Unlike the River suturlija, River Jakotina is under lower antropogenic impact, considering that the biggest part of its course is not located in populated area.

4. CONCLUSIONS

According to results of physico-chemical analyses River Jakotina has the water corresponded to first quality class with slightly deviation of some of the parameters, while water from the River Suturlija corresponds to second, respectively third class. River Suturlija suffers higher antropogenic impact (comunal wastewater) which cause worse water quality than River Jakotina, that is not influenced by similar pressures, has.

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MINERAL WATERS AS A POTENTIAL EXPORT OF SERBIA

MINERALNE VODE KAO IZVOZNI POTENCIJAL SRBIJE

Silvana Ilić[1], Dalibor Miletić[2], Marija Stevanović[3]
[1]Faculty of management Zaječar
[2]College for Management and Business Zajecar
[3]MS Employment, Svilajnac

***Abstract**: More than a decade passed since the commencement of the transition process in Serbia. The achieved results are not in line with the promises and the unfinished transition process burdens the development of Serbian economy. The achieved economic growth over the last ten years of transition was slowed by the global economic crisis. Most problems (unemployment, inflation, modest exports, foreign trade deficit, high and growing external debt) were expressed even before it began. The global economic crisis has only intensified them. Future economic development should be based on higher exports so that Serbia can overcome the economic problems. One of the most important export potentials of Serbia are the natural mineral waters. A significant advantage of Serbia is it's richness of waters, as well as many diverse sources of mineral water. In Serbia, the appearance and springs of mineral water have an important place not only by their number, but as well as for their known reserves and exploitation capabilities. The aim of this paper is to show the mineral water as a strategic resource of Serbia, and to point out the export potential of mineral water in Serbia.*
***Keywords:** natural resources, mineral water, Serbia*

***Apstrakt:** Navršeno je više od jedne decenije od početka sprovođenja procesa tranzicije u Srbiji. Ostvareni rezultati nisu u skladu sa obećanjima, a nezavršeni proces tranzicije opterećuje razvoj privrede Srbije. Kakav takav ostvareni privredni rast tokom poslednjih deset godina trajanja tranzicije, usporila je svetska ekonomska kriza. Većina problema (nezaposlenost, inflacija, skroman izvoz, spoljno-trgovinski deficit, visok i rastući spoljni dug) bila je izražena i pre njenog početka. Svetska ekonomska kriza ih je samo zaoštrila. Budući privredni razvoj trebalo bi da se zasniva na većem izvozu kako bi Srbija prevazišla ekonomske probleme. Jedan od veoma važnih izvoznih potencijala Srbije predstavljaju prirodne mineralne vode. Značajna prednost Srbije je bogatstvo vodama, kao i brojna izvorišta raznovrsne mineralne vode. Na teritoriji Srbije, pojave i ležišta mineralnih voda, imaju značajno mesto ne samo po njihovom broju, već i do sada poznatim rezervama i eksploatacionim mogućnostima. Cilj ovog rada je da ukaže na mineralne vode, kao strateški prirodni resurs Srbije ali i da ukaže na ivozni potencijal mineralnih voda Srbije.*
***Ključne reči:** prirodni resursi, mineralne vode, Srbija*

INTRODUCTION

The importance of mineral water is versatile for economic growth and development. It can achieve both direct and indirect effects on the development of a country or a part of it. The use of mineral water is known throughout history since ancient times. There is archaeological evidence of their use for purposes of cooking, washing and bathing even in prehistoric times. The balneological purposes of mineral water were used in ancient Greek, Roman and Ottoman empires. Mineral water began to be used for other purposes over time, other than balneological purposes.

Today, mineral water is used in over sixty areas and sectors of application. A wide application of mineral water was found in industry, power generation, heating facilities, production in agriculture, greenhouses, balneology, aquaculture and sports and recreational activities. Only 2% of the total water in the world account for drinking water, and the groundwater which include mineral springs is 0.2%. [1] The complex geological structure and hydrogeological favorable relationships caused considerable wealth in mineral and thermal waters in the territory of Serbia and it is known as the "land of mineral water hot springs." [2, p. 5]

1. NATURAL WEALTH - MINERAL WATER

The world is faced with the so far highest recorded crisis of water supply. According to estimates by the United Nations in the mid-XXI century seven billion people will be faced with water scarcity. Population of the planet rises and water resources are shrinking. Besides reducing the amount of available water, the world is imminent and long-term risk of contamination of existing reserves. Every year the Mediterranean countries end up with about 120,000 tons of mineral oil, 12,000 tons of phenol, 60,000 tons of detergent, 100 tons of mercury, 3,800 tons of lead, 2,400 tons of chromium, 21,000 tons of zinc, 320,000 tons of phosphorus, which are simply poured into rivers, seas and other water surface. All these substances are very slowly diluted with fresh water from nearby rivers and the sea. Solids, by contrast, require a very long time to decompose in the water - a few weeks for paper packaging, up to several hundreds of years for plastic. [3]

The World Water Decade is on-going, a global action launched in 2005, called "Water for Life". The aim of this campaign is to highlight the importance of clean water resources of the planet and the importance of water for health, economic development and civilization in general, and to prevent a humanitarian disaster and wars over water. One of the millennium development goals of the UN is to halve the number of people without access to drinking water and hygiene by the year 2015.

For human needs water can be exploited from the surface (rivers, lakes, etc.), or from the ground (wells). The quality of surface and deep waters generally are very different. The deep waters are often burdened by various minerals, whose composition depends on the composition of the rocks surrounding the reservoir. This is especially important when it comes to so-called mineral waters.

"Under the mineral waters we mean ground water which temperature is higher than 20°C, mineralization greater than 1 g/l, which contain certain components in the chemical composition (macro and micro) in the elevated content, increased radioactivity, free and soluble gases, biologically active substances and others, and which by its characteristics are a special class of groundwater." [4, p. 17]

It should be stated that in practice the mineral water is often identified with mineralized water, which is wrong, because on the one hand, there are mineralized groundwater that cannot be treated as mineral, and on the other hand, certain less mineralized waters are treated as mineral because of its specifics.

Regarding the composition of mineral water, it is necessary to determine their chemical composition with physical - chemical methods. In addition, it is necessary to determine the microorganisms, algae and other organic matter in mineral waters, as these components may constitute "biogenic stimulators", and also those are active factors when it comes to the composition of mineral waters and their healing properties. The main characteristics of the composition characteristics of mineral waters are mainly:

1. ionic composition (macro and micro-components and pharmacologically active micro-components)
2. gas composition (free and dissolved gases),
3. radioactive composition of mineral waters (radioactive elements),
4. organic content (organic matter - compounds),
5. microbiological and bacteriological composition (microorganisms, bacteria, algae, etc.)
6. pH and Eh values and
7. mineralization of mineral water. [4, p. 37-38]

According to the method of regulating the amount of carbon-dioxide, mineral waters can be:

1. naturally carbonated - mineral water in which the carbon-dioxide emissions at the source (after decantation) are the same as in the bottle,
2. reinforced with carbon-dioxide from sources - mineral water whose content of carbon-dioxide, which normally originates from the same source, is higher than the content of the mineral water at the source, and
3. carbonated or with the addition of carbon-dioxide - mineral water which has added carbon-dioxide, which does not originate from the same source. [5]

Natural mineral water from which the carbon-dioxide was physically partially or completely removed can be put on the market.

The temperature of mineral water, especially from the balneological viewpoint is of great importance because it is one of the physical properties which is very important when it comes to the healing power of mineral water. According to various qualifications water is considered curative if its temperature exceeds 200°C. In general, waters with temperatures between 35°C to 42°C are best suited for use in balneotherapeutic purposes, because they can be used directly.

Determining and understanding of the physical and chemical properties of mineral water is of very great importance, particularly in exploration of mineral waters and the discovering of the possibilities of their utilization for various purposes.

2. MINERAL WATERS IN SERBIA

Safe drinking water is an unavailable luxury to many people in the world. A significant advantage of Serbia is the richness of the waters, as well as the numerous sources of a variety of mineral water (thermal, mineral and curative). In Serbia, the appearance and deposits of mineral waters have an important place not only by their number, but by their known reserves and exploitation capabilities.

Finland, Canada, New Zealand, UK, Japan, Norway, Russia, South Korea, Sweden and France have the highest quality water, and the situation is most severe in the desert and semi-desert areas in sub-Saharan Africa and Asia. Research conducted by the FAO (Food and Agriculture Organization of the UN), ranked Serbia at the 47th place of 180 countries in terms of quantity and quality of water resources. It means that Serbia doesn't belong to countries which are poor with water, but not as rich as it was thought in the previous decades. [3]

The low level of exploration and exploitation of natural resources (it is estimated that there are about 1,300, they surveyed about 250, the only one in ten of them are exploited), enables Serbia to develop in this area and climb up to the current rankings in FAO. On the other hand, like all underdeveloped countries, Serbia handles these reserves with non-economic and non-ecological behavior, in fact, it is estimated that the loss in terms of irreversible flow away of unused water is as high as 5-10 cubic meters per second. [3]

Mineral water in Serbia can be divided into pannonian, which are characterized by high mineralization and high levels of sodium, chlorine and iodine; descending - that are low in mineralization and were created by collecting atmospheric precipitation; and volcanic, which are the best in quality, because they are formed at great depths, where the unique granite rock compositions are found, from which the water naturally draws high-quality minerals essential to our body.

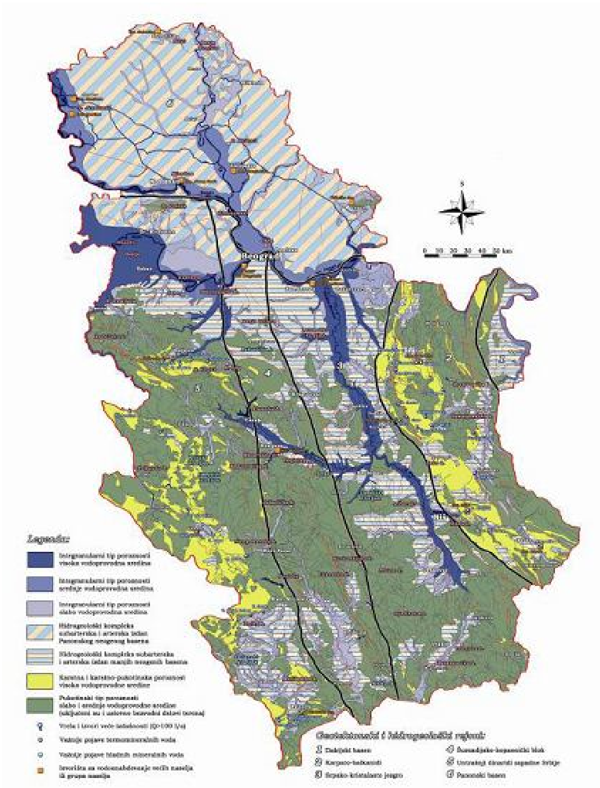

Figure 1. Distribution of mineral, thermal and thermomineral waters in Serbia, [6, p. 124]

Without going into their detailed display, their chemical composition in particular, and for easier review and highlight of some of their specific features in their prevalence of mineral, thermal and thermomineral waters we will display them under certain regions allocated on the basis of geological, tectonic, geomorphologic, hydrogeological and other conditions, or entities. In this regard, we highlight the Dacian basin district (plains of Negotin), Carpathian - Balkans, the Rhodope mass, Vardar Zone, the Dinarides (in Western Serbia) and the Pannonian basin.

Dacian Basin Region. Distribution of this region is related to the extreme northeastern parts of Serbia, which contains the Danube key and plains of Negotin in a broad sense. This district is limited by the Danube from the northeast (From Kladovo to the spring of Timok) and west to the edge Miroč to Deli Jovan. There are no known significant occurrences of these waters in this region, nor were they a subject of significant research, which does not mean that it doesn't have any, so in the future one can expect an appropriate hydrogeological and other research.

Reon Carpathian - Balkanid. Region covers the territory of East and Southeast Serbia, to the boundary on the west edge of the valley of the Great Morava and South Morava. It is the territory on which there are known occurrences and deposits of thermal and mineral waters. Thermal mineral waters are present in the zone of Brestovac Banja, Šarbanovac village, villages of Sumrakovac with Nikolić. As for the thermal waters, their occurrence is related to Gamzigrad Banja, village Grlište, Rgoška Banja, Soko Banja, a village Jošanica, Niška Banja and Zvonačka Banja. In this district, we should mention lesser-known and researched phenomenon of thermal waters, such occur in the valley with Mali Pek by Majdanpek, Kriveljsko Vrelo, the village of Krivi Vir, Pirotska kotlina, Toplik near Zajecar, Suvi Do and Krupajsko Vrelo by Žagubica or by Krepoljin, Sisevca and the like.

According to the gas composition waters of this region belong to the nitrogen waters and the temperature in the range of 21.5°C (Grlište) - 42°C (Soko Banja). Level of exploration in this region is uneven and varies from appearance to appearance. Also, any available alternatives are not yet far from exhausted and their utilization is reduced to the needs of recreation and balneology. It should be noted that water of this region represent a significant economic potential which should be economically valorized.

Rhodope region (Serbian - Macedonian) mass. On the territory of this region there are higher number of occurrences and deposits of mineral, thermal and thermo-mineral waters. Region covers the central parts Serbia and the basin of Great and South Morava. These include the following significant occurrences and deposits of these lines: zone Požarevac, Mladenovca, Smederevska Palanka, Lomnice, Ribarska banja, Toplica (Milan Toplica and Suva Česma), Sijarinska Banja, Tulare, Vranjska banja and Bujanovac.

The appearance of these waters is related to the volcanic rocks. There is great diversity of water. Surveys are not satisfactory when looking at the scope and diversity of the research. There are significant amounts of water with high temperatures 14°C (Lomnica) – 72°C (Vranjska Banja), indicating not only of the prospect of discovering and proving of larger reserves in springs of water that are already known, but in the discovery of new phenomena as well. The degree of utilization of these waters is still low.

Region of Vardar. Significant and large region, which covers the area of Šumadija and Kopaonik on the north of the Danube toward the south of the valley, through Montenegro, then to the east of the rim of the valley of Great Morava, over Jastrebac, Kuršumlija, Podujevo, Vitine and further south towards Kumanovo, and in the west the border goes through the valley of Kolubara west from Čačak, through Čemerno it contains Novi Pazar, Klina until the northern edge of the Šar mountains.

Mineral, thermal and thermo-mineral waters in this region are of a significant extent. Among the major phenomena are: in the general vicinity of Belgrade (settlement Braća Jerković, Leštane, Boleč, Vrčin), Gornji Milanovac (Mlakovac, Brđani, Savinac and others), Gornja Trepča near Čačak, Arandjelovac, Veluće in Trstenik, Vrnjačka banja, Lukovska banja, Kuršumlijska banja, Bogutovačka banja, Jošanička banja, Novi Pazar banja, Rajčinovića banja, and more less known phenomenon which are widely investigated in recent years (eg, Koraćica, and Čibutkovica and Ljig).

This district is one of the most promising regions not only for proving of new reserves but because of the exploration opportunities for the existing reservoir, with water temperature ranging from 12°C (Aranđelovac) – 72°C (Jošanička Banja). The degree of exploatation of mineral, thermal and thermo-mineral waters is uneven and it is probable that we should expect further expansion of exploration and exploitation.

Dinaride region. It occupies the territory of western Serbia, within the borders of previous regions and the border of Serbia to the west, the direction within which it has a wider distribution. Represents the district of significant mineral occurrences and deposits of mineral, thermal and thermo-mineral waters, such as Ovčar banja, Petnica near Valjevo, Banja Vrujci, Roška banja, Visočka banja, Bištanskabanja, Mala Banjica, Čedovo near Sjenica, Dublje near Šabac, Mionica, Obrenovačka banja, Banja Koviljača, Radaljska banja, Prilički kiseljak, Ivanjički kiseljak, Dečanski kiseljak, Pećka banja and other.

It is an important region regarding the number of occurrences and deposits of mineral, thermal and thermo-mineral waters. The water temperature varies from 22.5°C (Obrenovačka banja) - 50.5°C (Dublje). The efficiency of exploitation is also uneven, from disorganized usage to an organized usage in modern medical centers. There are realistic possibilities for planned and systematic research for a more complete and rational exploitation of the potential of occurrences and deposits of mineral, thermal and thermo-mineral waters in this region.

Region of the Pannonian basin. Territorially, the basin containts Pannonian basin, north of the Danube, in the borders of Serbia, although distribution is far beyond our borders. Large mineral water occurrence is characteristic for this district, primarily: iodine bath "Minakva" Novi Sad, Banja Junaković near Apatin, Kanjiža, Bečej, Temerin, Kikinda, Srbobran, Bačka Topola, Omoljica, Melenci and other.

The waters of this region significantly differ in their physical and chemical characteristics from the previously presented mineral, thermal and thermo-mineral waters. The water temperature varies from 18.5°C (Slankamen) – 92°C (Melenci). From what is known about this region, the waters are well researched in terms of the region and distribution, physical and chemical characteristics and exploitation opportunities. Unlike other areas, use of water for not only for medical, recreational purposes, and for heating buildings and settlements is present here. [4, p. 15-131]

As we have seen, the territory of Serbia is extremely rich in occurrences and deposits of mineral, thermal and thermo-mineral waters. One of the most important methods of economic valorization of natural resources is the possibility of bottling mineral water. Bottled mineral water is a significant export potential of Serbia.

3. UNDERUSED EXPORT OPPORTUNITY - MINERAL WATER

According to the Serbian Chamber of Commerce, Serbia is located at the very top of the list of countries with rich sources of quality mineral water. In Serbia, at about 300 springs there are about 25 bottling plants, or factories. In recent years, an increase in the production of mineral water is present and in addition to large systems that exploit this natural wealth there is an increase in the exploitation of springs of small capacities.

The largest producers of mineral water in Serbia are "Knjaz Miloš" from Arandjelovac, "Minakva" from Novi Sad, "Voda Vrnjci" Vrnjačka Banja, "Palanački kiseljak" from Smederevska Palanka, "Mivela" from Veluće, "Bambi" from Požarevac, "Voda-voda "from Subotica,"Bi voda "from Vranje... Total production of all plants for bottling mineral water is over 400 million tons of liters a year, and water plants in Serbia employs about 10,000 people. We will demonstrate the production of natural mineral water in Serbia in the period since year 2000.

Table 1. Production of natural mineral water in Serbia in the millions of liters [7]

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
330,3	333	415	490	515	539	580	651,3	650,3	635,2	635	640

We will show the displayed data graphically, in order to monitor the trends in the production of mineral water in Serbia.

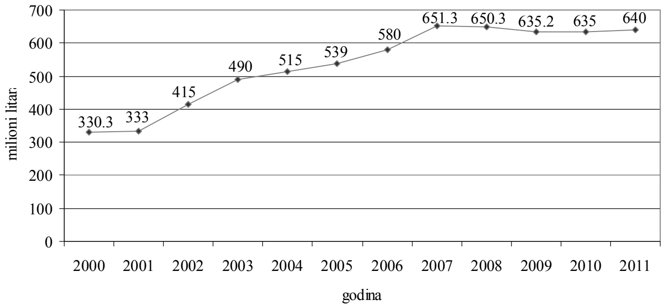

Figure 2. Production of natural mineral water in Serbia [7]

The graph and the data from Table 1 clearly show that in the observed period there has been an increase in production of mineral water in Serbia. Better said the production has doubled. From the graph it can be clearly seen that the maximum production was achieved in 2007 and then it came to it's reduction. The tendency of decrease in production after 2007 is the result of the deteriorating economic conditions in Serbia, caused by both the world and domestic economic crisis.

Mineral water is a strategic product of Serbia, however, it is difficult to export. Serious export requires a production capacity of 200 to 300 million liters a year, and only the company Knjaz Miloš currently meets this requirement. A major problem in the international market is the retail price of the product by which we are far from competitive. Most of our waters don't have a brand in the international market, for what it takes decades. However, Serbia has many factories that manufacture mineral water.

Export to international markets is present in the market of mineral water as well as import of water from abroad. Approximately 85% of Serbian mineral water is sold to neighboring markets, and it is necessary to invest more seriously in marketing and product branding for placement on the world market. The following table will show imports and exports of mineral water in 2009. and 2010.

Table 2. Import and export of mineral water in 2009 and 2010 (in USD) [8], [9]

Mineral waters – in total	2009.	2010.
Import	1.021.812	3.143.874
Export	17.488.540	43.261.660

The presented data clearly point to the fact that in the observed years there was an increase in imports and exports. At the same time, at the mineral water market there is a surplus in foreign trade. The following graphic will show the most important trade partners of Serbian producers of mineral water.

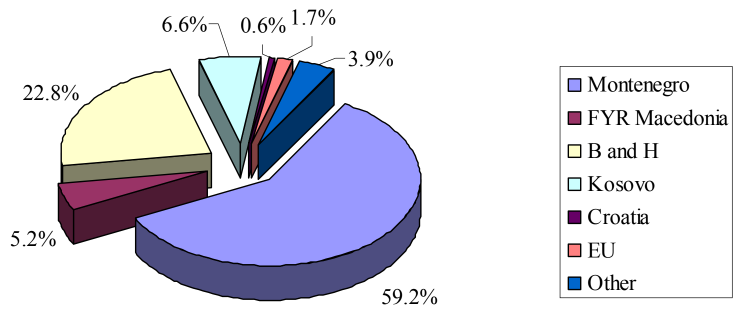

Figure 3. Exports of mineral water by countries in 2010 [10]

Regarding exports, the data presented clearly point to the fact that over 90% of the production of mineral water is exported to the countries of former Yugoslavia. The most important foreign trade partners were Montenegro, which exports about 60% of production, Bosnia and Hercegovina, with about 23% of exports and Kosovo with about 7% of total exports.

Factories that are operating in Serbia are expanding their capacities each year and conquering new markets. In the future we may expect greater penetration on the largest European and world markets where competition is far more serious.

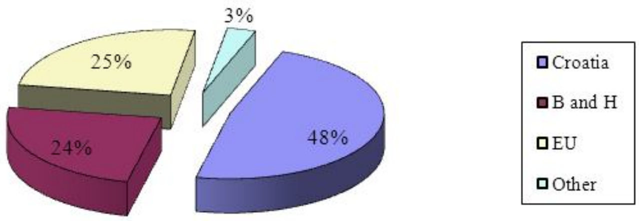

Figure 4 Imports of mineral water by countries in 2010 [10]

The fact that in addition to a multitude of local producers, import of mineral water is present shows that there is a very developed market of mineral water in Serbia. Data shown from Figure 3. show that about 75% of the imports are from partners from former countries of Yugoslavia, Croatia with up to 48%, Bosnia and Hercegovina with 24%. 25% of the total imported mineral water from the area originates from EU.

CONCLUSION

During the last decade of the XX century, it became indisputable that the drinking water supply and environmental protection issues are major challenges for sustainable development of mankind today. Part of analysts believe that the strategy of world events will determined by the cartel which will in the meantime manage to put the largest stock of fresh water on Earth under their property. People in Serbia, on average, consume about 300 liters a day, while in Europe the consumption ranges between 120 and 150 liters of water.

Serbia is a country that has significant springs of mineral, thermal and thermo-mineral waters. Natural mineral water is distinct from other drinking water in its natural state, and mineral content, oligoelements and other ingredients that are desirable for the organism. As we saw a multitude of manufacturers are present in the market of mineral water, but also one of the few markets in which foreign trade creates surplus. Although there are a large number of producers of bottled mineral water it is necessary to create a strong brand in order to increase exports in the future.

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MINE WATER MANAGEMENT IN THE BALKAN REGION

UPRAVLJANJE RUDNIČKIM VODAMA NA BALKANU

Milan Trumić[1], Maja Trumić[1], Grozdanka Bogdanović[1], Dragan Randjelović[2]
[1]University of Belgrade, Technical faculty in Bor, Serbia
[2]RTB Bor, Serbia

Abstract: *Environmental problems related to pollution by mine waters and mining activities are just one of the aspects that require special attention. Years of poor management, financial strain and lack of environmental consciousness have left a daunting legacy. The first step in solving the problem is to develop an Action Plan. Action Plan is intended to identify the institutional, technical, legal and socio-economic gaps related to the mine water management, focusing on environmental needs of the Balkan countries. This manuscript provides the guidelines for the development of the regional Action Plan for three hot spots: Vares (Bosnia and Herzegovina), Probistip (FYR Macedonia) and Bor (Serbia).*
Key words: *mine water, pollution, Action Plan*

Izvod:*Uticaj rudničkih voda i rudarskih aktivnosti na zagađenje životne sredine su samo jedan od problema koji zahtevaju posebnu pažnju. Loše upravljanje rudnicima, nedostatak finansija i ekološke svesti, ostavili su teret budućim generacijama. Prvi korak u rešenju problema je razvoj akcionog plana. Akcioni plan ima za cilj da indetifikuje institucionalne, tehničke, pravne i socio-ekonomske nedostatke koji se odnose na upravljanje rudničkim vodama. U radu su date smernice za razvoj regionalnog akcionog plana za tri Balkanske zemlje: BiH, Makedoniju i Srbiju.*
Ključne reči:*rudničke vode,zagađenje, akcioni plan*

1. INTRODUCTION

During the past ten years, South-eastern Europe has experienced upheaval and instability. As attention focused on other issues, the region's rich natural environment, already under pressure from decades of urban and industrial pollution, became increasingly degraded.

Fortunately, the momentum in Balkans has shifted. Reconstruction efforts are underway and protection of the environment is an emerging priority. As the Balkan countries undergo broad transformation of their democratic institutions, environmental protection is evolving alongside economic development.

Environmental problems related to pollution by mine waters and mining activities are just one of the aspects that require special attention. The Balkan region is very rich in mineral rock deposits. This has caused the expansion of mining and manufacturing of the primary products that has increased several times in the past few decades. However, years of poor management, financial strain and lack of environmental consciousness have left a daunting legacy.

This Regional Action Plan (RAP) is intended to identify the institutional, technical, legal and socio-economic gaps related to the mine water management, focusing on environmental needs of the Balkan countries. This is done on the example of already recognized three hot spots: Vares (Bosnia and Herzegovina), Probistip (FYR Macedonia) and Bor (Serbia). The priority areas and actions identified through the RAP shall serve as a basis for future actions in the field of mine water pollution control. It is to hope that the recommendation contained in this report will catalyze action and help improve the state of environment in the region.

2. ENVIRONMENTAL CONTEXT OF MINE WATER PROBLEMS IN THE BALKAN REGION

Mine waters (a term encompassing all natural waters emanating from a mine site including waste rock piles and tailings dam leachates) are part of the water cycle but are rarely treated as such. This is despite the fact that short- and long-term pollution from active and abandoned mines is still one of the most serious threats to the water environment in many countries.

The impacts of the mining activities on environment arise at almost all stages of the mining cycle: preparation of mining location; excavation, separation and processing the ore; dewatering which is undertaken to make mining possible; and seepage of contaminated leachate from waste rock piles and tailings dams.

Problem of mine water pollution does not end with the completion of mining activities, on the contrary, it can last for centuries after the closure of the mine. The problem with abandoned mines arises as a result of flooding of workings after extraction has ceased. Ground waters, whose level is artificially lowered during excavation, can get to their original level which causes the flooding of mine pits and discharge of mine water to river valleys and rivers.

The Balkan region is very rich in mineral rocks and the mining activities reach back as far as to the prehistoric period. Today, several thousands deposits of most diverse mineral materials and over many tens of thousands of yet unexplored occurrences can be found in the Balkans countries.

The economic growth is still the main criteria for social development. This is the reason why the environmental principles are often neglected in the consumption of natural resources and the process itself leads to environmental destruction. There is growing awareness of the environmental legacy of mining activities that have been undertaken with little concern for the environment. The price that we have paid for our everyday use of minerals has sometimes been very high. Mining by its nature consumes, diverts and can seriously pollute water resources.

On the whole territory of BiH, Macedonia and Serbia, as well as in the other countries in the region, many problems resulting from pollution with mine waters and mining activities have been observed. Several active and abandoned mines are recognized as hot spots in the region (Figure 1) being a potential threat to environment and health of local residents, and influencing the quality of life in these areas.

The main problems observed and being result from this type of pollution are:

- a danger to the health connected to the presence of toxic materials in waters;
- a danger to the health caused by uncompleted rehabilitation of mining sites, connected to inhaling and swallowing of mining dust containing cadmium, lead, mercury, silver, etc blown by the wind from the mining site;
- aesthetical pollution of water streams caused by change of water colour as a result of presence of iron, aluminium and arsenic hydroxide salts, those which in turn cause destruction of the aquatic life and prevent use of water for drinking purposes and recreation;
- a danger to the health caused by large-scale accidents as a result of instantaneous release of large quantities of mine wastewater;
- a danger connected to use of contaminated water and soil for agricultural production;
- fast corrosion of equipment, buildings and concrete constructions.

Figure 1. Hot Spots in BiH, Macedonia and Serbia

A complex political situation and negative business surrounding created conditions in which mining industry is now in a very complicated and hard situation. In the previous period, the production in many mines has completely ceased resulting in a loss of markets. At present, many of them cannot expect to be competitive on foreign markets having in mind that they possess old technology and inadequate infrastructure. Additionally, years of poor management, financial strain and lack of environmental consciousness have left a daunting legacy.

Changes in laws, technologies and attitudes have begun to address some of the most immediate threats posed by mineral development, but there are still many areas that need to be addressed. While there have been improvements in mining practices in recent years, significant environmental risks remain. These impacts depend on a variety of factors, such as sensitivity of local terrain, the composition of minerals being mined, the type of technology employed, the skill, knowledge and environmental commitment of the company, and finally our ability to monitor and enforce compliance with environmental regulations.

3. LEGAL, INSTITUTIONAL, SOCIO-ECONOMIC AND TECHNICAL GAPS IN MINE WATER MANAGEMENT

The analysis of the current situation in three Balkan countries, Bosnia and Herzegovina, Macedonia and Serbia, has shown that the prevention and management of the impacts of mining activities is at the very low level.

When observed from the legal aspect, generally speaking, regulatory activities start with licensing. Mining activities and installations which have or might have impacts upon the environment have to be licensed by a regulatory body. The activity and/or installation that is understood as potentially harmful has to be defined by the law and its impact to the environment has to be mitigated by enforcement of rules and standards set up within environmental regulations.

As a second step, the regulatory bodies need to have the authority to enforce legalisation and conditions set in the granted licenses and permits. To avoid or to diminish the harmful effects on public or private interests, the authority in charge of enforcement must be able to take rapid action to stop activities in violation of law or to force transgressors to take certain measures. In order to assess the level of enforcement of the established environmental law, agreements, rules and standards, successful monitoring is required. This includes water quality monitoring, monitoring and supervision of activities and their impacts, compliance with the terms and conditions set up in licences and permits, safeguarding of public interest, etc.

Unfortunately, the two recent mining accidents in Europe which occurred in Spain (Aznalcóllar, 24-25/04/98), and in Romania (Baia Mare, 01/2000) have demonstrated the inadequacy of the current institutional, technical and legislative framework for environmental protection from mining activities not just in Balkan countries but in the European Union countries too. Mining accidents involving dam failures are not unusual in the world, but they always provoke major environmental and socio-economic long-term impacts (Table 1). The results of the analysis of the current situation in the three Balkan countries have pointed out to on some key legal, institutional, socio-economic and technical gaps related to the mine water management.

Table 1. Some recent mining accidents involving dam failures
(adapted from EC COM(2000) 664 final)

Date	Location and mine	Type of mine	Impact
1992	Summitville , Colorado, USA	Gold	complete loss of aquatic life along 25km stretch of the Alamosa River

1993	Ecuador	Gold	24 people died, masses of sludge buried a gold miner's settlement
1994	Harmony Gold mine, South Africa	Gold	17 people died, 80 houses were destroyed
1995	Omai Mine, Guyana	Gold	2.5 million^3 of cyanide solution from the mine contaminated the river Essequibo, with massive loss of aquatic life
1996	Marinduque Island, Phillippines	Cooper	3 millions tonnes of poisonous sludge from a copper mine flowed into the river Boac flooding 20 villages
1998	Boliden-Apirsa Aznalcóllar, Spain	Zinc, silver, lead, and copper concentrate s from a pyritic ore body.	the dam of the tailings pond was breached (over a distance of 50m). About 3 million m^3 of sludge and 4 million m^3 of acidic waters flooded the adjacent environment (4500 ha of land was polluted including the river Guadiamar).
2000	Sasar/ Baia Mare, Romania	Gold	An estimated 100,000 m3 of mud and wastewater containing 126 mg/l of cyanide entered the Lapus river via a de-watering channel. It then flowed into the Somes (Szamos) river and from there to the Tisza river and the Danube upstream of Belgrade where it finally entered the Black Sea. This acute trans-boundary pollution (affecting the countries of Romania, Hungary, Federal Republic of Yugoslavia) had a deleterious impact on biodiversity, river ecosystems, drinking water supply and socio-economic conditions for the local populations.

3.1. LEGAL ASPECT – MINE WATERS IN LEGAL FRAMEWORK

Regulation of mine waters is mainly concentrated on mineral processing waters and waste rock pile and tailings dam leachates. The environmental aspects of mine drainage have been neglected in comparison with the attention paid to safety aspects. Awareness of the acid-generating potential and toxicity of mine drainage exists but, referenced documents and practice show that some pollution reduction measures have been implemented with main aim to improve safety of employees or to use water for other purposes. Impacts of mine drainage on the environment and pollution reduction measures have not been well researched. Regulatory framework has concentrated on the end-of-pipe treatment of processing plant wastewater as pollution reduction measure.

Analyzing the problem of environmental regulation of mine waters in Europe, it is possible to observe differences in addressing the same issue. Namely, only United Kingdom, Czech Republic and Austria have legal framework explicitly addressing mine waters. In other countries, mine waters are mainly treated in laws on mining and waters (Germany, Hungary, etc.) or are not treated at all. It is observed that countries which suffer from polluted mine waters do not necessarily have the most comprehensive regulations and vice versa.

Legal framework mainly addresses wastewaters generated in technological process of mineral ore separation and tailing wastewater. Environmental dimension of waters leaching from mine pits is neglected. There are no laws, strategies or activities addressing environmental problems of abandoned mining sites. Not even a single legal obligation related to land cultivation is being implemented in practice. There are no other legal obligations concerning control of pollution by mine water as well as decontamination of closed mine sites. The remediation and recovery of these mining areas can be the first step to avoid mine water problems, but under current conditions this does not seem to be economically feasible for mining companies.

Mining is one of the industrial activities in BiH, Macedonia and Serbia requiring EIA.

In the licensing process, mine is required to obtain water management agreement if it is determined that the mining activities will have impact on water regime. Additionally, water management agreement is issued for ore processing and not on the whole process of mineral ore exploitation.

And while BiH brought new set of environmental laws that are harmonized with EU environmental laws and directives, Macedonia and Serbia are still to face this challenge. In BiH, even though the laws are adopted, their real implementation cannot be expected soon due to the lack of implementing bylaws. However, due to the fact that mine waters are not very well regulated in EU countries too, after harmonization of national laws with those of EU, this issue will still remain unresolved.

3.2. INSTITUTIONAL ASPECT – MINE WATER MANAGEMENT

The analyses of institutional structure in region show the general presence of sectoral approach to environmental problems of mine waters and mining activities. This sectoral approach is the main characteristic of present institutional and legal system. Practically no communication between relevant ministries is existing in regulating process. Mining companies are only partially involved in the regulatory process, mainly during drafting of mining laws or submission of request for license.

The existing legal system and responsibilities granted to relevant institutions are established so that mine water management practically does not exist. There is no institution responsible for environmental impact of abandoned mines, neither is that the responsibility of mining companies.

Even when the law foresees payment of “polluter pays” fees as well as the re-cultivation, the fees are not paid and re-cultivation of closed mines is not carried out due to lack of strong administrative body that would exercise the control. As a consequence, there is no efficient inspection mechanism for control of compliance with the terms and conditions given in licenses and permits to mining companies. The dispersion of responsibilities in the field of water and environment in different ministries and sectors is an additional problem when solving issues of mine waters and their impact on environment.

Institutions on different levels do not undertake any steps toward challenge of sustainable development. The plans of state structures are not based on sustainability of resources and environmental care. Practically, there is no integration of economic, social and environmental goals. Therefore, the priority task would be to create plans and policies that will unify industrial development and environmental care.

3.3. SOCIO-ECONOMIC ASPECT – CURRENT SITUATION IN MINING INDUSTRY

Детаилед аналIсес оф тхе стате оф тхе мининг ин тхе регион схоњ тхат мост оф тхе цуррент оператинг минес аре нот профитабле, њхицх мигхт бе а цаусе фор тхеир перманент цлосуре. Тхе маин реасонс аре тхе лацк оф финанциал ресоурцес, редуцед поссибилитI то маркет минерал ресоурцес, сурплус оф њорк форце фор еџистинг левел оф продуцтион, хигх левел оф амортизатион оф ељуипмент анд фацилитиес, анд инадељуателI ељуиппед анд оутдатед маинтенанце цапацитиес.

However, it is also unclear who will be responsible to take care of mine waters and prevent other environmental impacts in such a bad economic situation. Knowing that, in the next several years, most of the mines in region will not be capable to undertake any improvements of their environmental performance, they will need a help of international community to build capacities in environmental protection. It is also necessary to remove all existing market and political deficiencies that had been opening the way for overexploitation of resources and higher pollution intensity.

Lack of financial resources is also reflected through the fact that economic instruments for environmental protection in the region are still in the embryonic stage. The existing economic mechanisms in the field of environmental protection and improvement are mainly fees, taxes, insurance, premiums, contributions, credits and other economic forms fostering the protection or limiting the degradation of the environment. Although these resources collected from e.g water protection fee should be used to implement the measures for protection of water from pollution and wastewater treatment, in practice, that is not the case.

3.4. TECHNICAL ASPECT – SURFACE AND GROUNDWATER MONITORING

ГенераллI спеакинг, мониторинг оф сурфаце анд гроунд њатер љуалитI то идентифI импацтс оф индустриал ацтивитиес ис инадељуате анд ис маинлI цонсистинг оф аналIсес тхат цаннот адељуателI дефине енвиронментал импацт оф мине њатерс. Мониторинг оф еффлуент љуалитI ис басед он детерминатион оф поллутион eљуивалент (ПЕ). Тхис сIстем оф цонтрол, фоцусед он соурце оф поллутион, ис нот аппроприате фор тхе детерминатион оф поллутион цаусед бI мининг ацтивитиес. Фор тхе пурпосе оф поллутион детерминатион фром мининг ацтивитиес, аналIсес он хеавI металс анд радиоацтивитI њоулд бе релевант, хоњевер, тхеI аре нот инцлудед ин тхе метход фор детерминатион оф ПЕ.

Ин БиХ, тхе мониторинг ељуипмент ис алмост цомплетелI дестроIед дуринг тхе њар ацтивитиес, со тхат тхе иуррент ацтивитиес он њатер љуалитI мониторинг аре броугхт то минимум. Мониторинг оф гроундњатер љуалитI хас невер беен верI њелл естаблисхед со тхат тхере ис но цлеар ундерстандинг оф импацт оф мининг ацтивитиес он гроундњатер енвиронмент. Ас а цонсељуенце, тхе онлI аваилабле дата аре тхосе он љуалитI оф еффлуент анд соме еарлиер љуалитI аналIсес оф сурфаце њатерс.

Ин Мацедониа, тхе фрељуент мониторинг доес нот инцлуде импортант анд релевант параметерс суцх ас хеавI металс. Хоњевер, тхе љуалитI оф трансбоундарI риверс ис мониторед њитхин тхе регионал Нетњорк фор меасуринг тхе љуалитI оф стреамс ин Еастерн Мацедониа. Тхе фоллоњинг аре мининг релевант риверс: Тополница, Злетовска, Каменица, Тораница анд Крива Река. Тхе мониторинг ис перформед 4 тимес а Iеар аццординг то тхе адоптед Vугославиан стандардс. Ан абсолуте приоритI ис то интродуце мониторинг оф мерцурI анд арсениц, ас њелл ас то адопт Мацедониан Њатер ЉуалитI Стандардс тхат њилл бе ин аццорданце њитх Еуропеан анд Њорлд стандардс.

Ин Сербиа, Њатер Лањ пресцрибес мониторинг оф дисцхаргед еффлуент анд итс импацт он рецеивинг енвиронмент. XIдро-метеорологицал Институте оф Сербиа мониторс тотал оф 59 пхIсицал-цхемицал анд 5 биологицал параметерс инцлудинг хеавI металс. Ин тхе ласт 30 Iеарс, ривер њатер љуалитI сигнифицантлI њорсенед, деградинг фром ИИ цласс оф љуалитI то тхе ИИИ ор ИВ цласс.

4. PRIORITY ACTIONS AT REGIONAL LEVEL

When observed in general, management of mineral resources in the Balkan region is faced with the following problems:

- There is no integrated approach to planning of use of natural resources
- There is no institution with clear competences to provide responsible development of energy and mineral resources in a safe, environmentally sound manner.
- There is evident lack of coordination among existing institutions during regulatory processes
- There is no control of use and management of land and water resources
- There is no management of abandoned mines.
- There is no data base on environmental problems caused by mining activities

- There is no technical support to mining companies towards sustainable use of mineral resources

In order to achieve sustainable development of mining industry in the Balkan region, institutional capacity should be built up though cooperation between different actors. The approach applied has to be both **comprehensive** – taking into account the whole system of different mineral materials – and **forward-looking**, setting out long-term as well as short-term objectives.

If the minerals sector is to contribute positively to sustainable development, it needs to demonstrate continuous improvement of its social, economic, and environmental contribution, with new and evolving governance systems. The sector needs a framework within which it should judge and pursue any development. The sector needs capacity building in environmental protection that is the key for environmentally sustainable development.

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THERMAL MINERAL WATERS OF GAMZIGRADSKA SPA AS UNDERUSED POTENTIAL FOR DEVELOPMENT

TERMOMINERALNE VODE GAMZIGRADSKE BANJE NEDOVOLJNO ISKORIŠĆEN POTENCIJAL RAZVOJA

Nebojša Simeonović,
Megatrend univerzitet, Fakultet za menadžment Zaječar

Abstract
The nature of the Timocka Krajina is endowed with natural resources. An important place is occupied by thermal mineral springs, which are located in the spas in the area. A special place among spas is taken by Gamzigrad spa in the area of Zaječar. Its thermal waters have been known since ancient times.This paper addresses the current research and the use of thermal water of Gamzigrad spa, and will point to further research in order to valorise the underused resource of thermal waters.
***Key words**: Gamzigrad spa, thermal mineral water, the river Crni Timok*

Izvod
Priroda je Timočku Krajinu obdarila prirodnim resursima. Značajno mesto zauzimaju termalno mineralni izvori, koji se nalaze u banjama i banjicama na ovom prostoru. Posebno mesto među banjama zauzima Gamzigradska banja na području opštine Zaječar. Njene termalne vode poznate su od davnina. U radu su obrađena dosadašnja istraživanja i korišćenje termalnih voda Gamzigradke banje, i ukazaće se na dalja istraživanja u cilju valorizacije nedovoljno iskorišćenog resursa termalnih voda.
***Ključne reči**: Gamzigradska banja, termomineralne vode, Crni Timok*

1. UVOD

Gamzigrads Spa is located in the valley of the Crni Timok 11 kilometers from Zajecar on the road to Paracin, at an altitude of 160 meters. On all sides it is surrounded by wooded hills which are covered with coniferous and deciduous trees. In geological sense, it belongs to the Timok eruptive area and this area covers a territory from Majdanpek in the north to Bucje in the south. Gamzigrad Spa is located in a meander of the Crni Timok and thermal mineral water sources are located in the riverbed and its banks. The settlement is located on the left and right banks of the Crni Timok. The spa is connected with the city center of Zajecar with a highway that is the main highway to Paracin and connection to Corridor 10, the traffic artery of Serbia.

Near Gamzigrad Spa, the Crni Timok is flowing through the winding gorge with squeezed meanders going from basin of Sumrakovac and Sarbanovac in the west to the Zajecar basin in the east. The Crni Timok gorge runs from the cape Kulma to Zvezdan. The gorge is popularly known as “Baba Jona”. The Crni Timok, popularly called the Black River, rises in the form of Krivi Vir spring in the village of Krivi Vir in the municipality of Boljevac. The Crni Timok from the source flows through the Krivi Vir basin, Jablanica gorge, basin of Sarbanovac and Sumrakovac, “Baba Jona” gorge and the Zajecar basin. In hydrographic terms, the area of

Gamzigrad Spa belongs to the Danube catchment, and in the narrow sense it belongs to the Timok catchment.

The area of Gamzigrad Spa has a specific climate in relation to the rest of Serbia, because of its geographical position. The impact on the climate comes from cold currents from the Carpathian mountains and the Homolje mountains and openness to the Negotins plain. The whole area is characterized by continental climate. Based on years of air temperature monitoring, the area of Zajecar is classified as the coldest in eastern Serbia. Summers can be very hot and winters cold and long. According to the data concerning monthly and annual rainfall for this area, the maximum rainfall is in the spring months. Gamzigrad Spa has a mild continental climate with the hottest months from July to September.

The area surrounding Gamzigrad Spa belongs to the Timok eruptive area, which was built from the volcano sedimentary formations that were created during the Upper Cretaceous. The dominant place in the geological structure of the Gamzigrad Spa surrounding area belongs to the Lower Cretaceous and Upper Cretaceous formations. In addition, there are also younger Neogene and Quaternary sediments. The oldest rocks discovered in the wider area are the Lower Cretaceous limestones.

Complex geological tectonic conditions have enabled deep siphonal water circulation and the formation of mineral resources in Gamzigrad Spa.

In the bed of the Crni Timok and on its banks, are the thermal mineral water springs. People consider them “sacred springs” and “holy water”. According to tradition, a woman froze and could not move any body part. After a few baths she recovered, and the sources were called “holy”. For these reasons, sick people used to carry out pre-bathing rituals, leaving small gifts or coins, believing that they will be healed by paying to the water.

The existence of thermal springs and their healing effect has been known for a long time, because only a few kilometers away, in the fourth century, the Roman emperor Gallery built a royal palace, “Felix Romuliana”, today a known late ancient site, which is classified as a world heritage. At the site, they found clay pipes and the remains of Roman baths, which prove that thermal water was then used, while in the spa itself there are no material traces from the Roman period.

Gamzigrad Spa healing springs were first mentioned in Turkish documents dating from the fifteenth and sixteenth centuries as can be seen in the book by Dusanka Bojanic Lukac, PhD, “Vidin i Vidinskiяt Sandzak prez XV do XVI vek”, which mentions “the healing springs of Gamzigrad Spa”. The first written records of Gamzigrad Spa originate from 1835, when baron Herder, exploring the mineral resources of Serbia, pointed to the healing springs at the village Gamzigrad. Similar notes were made in 1863 by Kosta Popovic, who was writing about a group of Lyceum professors who traveled around eastern Serbia and visited Gamzigrad Spa. The first treatments started in 1890 and were done by Professor Sima Lozanic whose analysis puts the spa among indifferent baths with alkaline earth waters. The first doctor in the district of Zajecar, dr Ogevan Macaj, noted that many came to bathe in the spa to be cured of a fever, and most of them came for hygienic reasons because the water was warm and was used for bathing and laundry.

At the beginning of the last century, the spa was primitive, people used to bathe in the open, there was only an occasional hut of sticks covered with mud. The first spring capping was done by the enterprising farmers from the surrounding villages in 1925, and along with wells and pools, they began to build facilities to accommodate visitors. The use and exploitation of the mineral springs was taken over by the municipality of Gamzigrad in 1927. The first administration of the spa was performed by dr Milivoj Milic, the first spa physician.

The development of organized spa resort began in 1930 when Gamzigrad Spa became part of the Moravian provinces. These were the first steps of the spa's health tourism and first brick buildings began to rise. On the Timok, a wooden bridge was built, also an inn "Lipov lad", and apartments for patients' accommodation. At that time started the building of the pool on the springs near the Timok.

The real development of the spa comes after the Second World War, when in 1954 The District People's Committee makes a decision on the protection and organization of the spa. Then they adopted the general urban development plan. Water supply system was built as well as a new bridge on the Crni Timok, and a railway station was relocated on the narrow track Zajecar - Paracin. They set up a pump on a borehole and brought hot water to the bathroom, which was arranged in the shape of a sunken ship on the bank of the river. The hotel "Castrum" was built.

The spa boomed in 1978 when Zajecar Medical Center built and founded the Institute for the Prevention, Treatment and Rehabilitation of Peripheral Vascular Diseases and Vibration Diseases, unique of its kind in Serbia.

Thermo-mineral waters are used today in the Institute for Rehabilitation in Gamzigrad Spa for treatment and rehabilitation of vascular and vibration diseases. The Institute carries out rehabilitation of peripheral vascular diseases as well as general rehabilitation. The first includes organic and functional disorders of the arteries, vibration disease, peripheral venous blood vessels diseases and lymphatic systems disorders, and the second one, connective tissue diseases, articular and extraarticular forms of rheumatism, orthopedic diseases, post-traumatic conditions, neurological disorders, gynecological disorders and childhood anomalies.

The Institute is implementing a treatment of occupational diseases of vibration disease, as a consequence of certain devices. The Institute has specialist physiatrist clinics, a diagnostic office, cardio-pulmological office, biochemical laboratory, and therapeutic block. They also use mud packs to treat rheumatism, sciatica, injuries and skin diseases. The Institute has accommodation capacity of 200 beds, with indoor thermal pools, provides services and treatment options for patients from all over the country.

A small portion of the thermal water is used to heat buildings of the Institute and catering company "Romulijana". The capacity of the company, which includes 150 beds in comfortable single and double rooms and suites and restaurant capacity of 600 seats, form the basis for further development of spa tourism.

2. RESEARCH RESULTS FOR THERMO MINERAL WATERS IN GAMZIGRAD SPA

The first important hydrogeological research began in the period from 1964 to 1967. Then they conducted hydrogeological and hydrogeochemical testing of the wider area of Gamzigrad Spa. The research was conducted by “Geoinstitut” from Belgrade, and they included: hydrogeological features, conditions of formation and chemical composition of the groundwater in volcanic and hydrothermal rocks.

In 1973 and 1974 the company “Georad” from Zajecar was doing investigating work for the water supply of the spa in these studies two exploration wells were drilled: B1 with the depth of 150 meters and B2 - 220 meters deep.

In 1975, the company “Geosonda” from Belgrade, drilled a well of 303 meters.

In 1976 and 1977, The Institute for Water Management “Jaroslav Cerni” from Belgrade conducted hydrogeological studies of the Crni Timok alluvium below the confluence of the Suva Reka in Timok. As a result of these studies, a spring for water supply of Gamzigrad Spa was opened.

In addition to these institutions that were doing research, for a wider knowledge of hydrogeology of Gamzigrad Spa, a significant research was conducted by: N. Milojevic and Veselinovic, from 1967 to 1976 and it is related to the thermal waters of Gamzigrad, Nikolicevo, Sarbanovac and Brestovac spas.

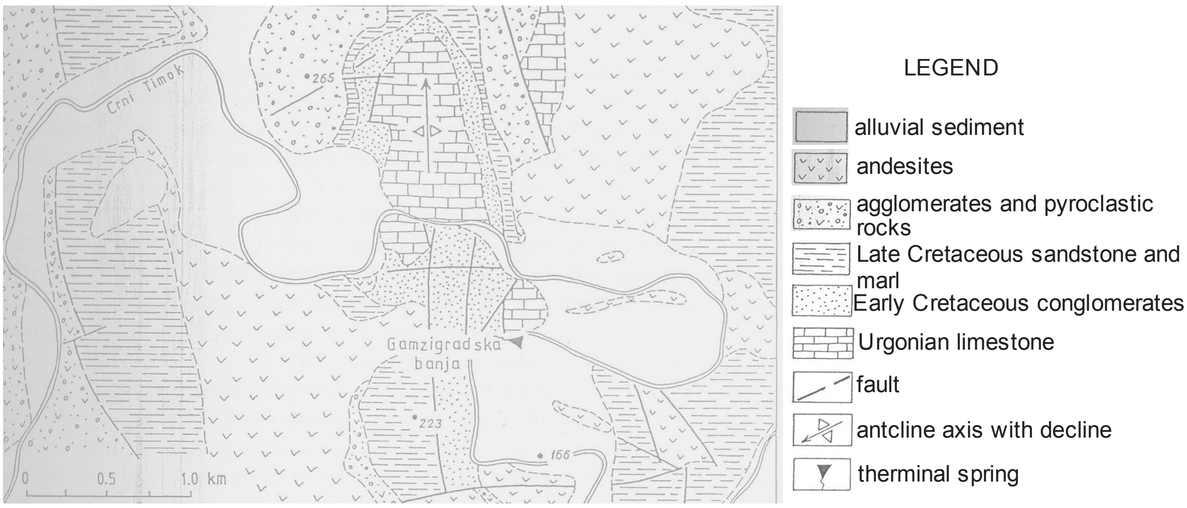

Figure 1. Geological map of the Gamzigrad Spa area (Veselinovic et al., 1975)

In the period from 1981 to 1985 a significant research was conducted by Veselin Dragisic, PhD. This research included the conditions of formation, existence and movement of ground water with special reference to the volcano sedimentary complex.

Exploration well B1, drilled by "Georad" from Zajecar in 1973, was later converted into exploitation well.

Five thermal springs are characteristic for Gamzigrad Spa with temperatures of 32, 41°C and 6°C and one spring of drinking water with 17°C. Spring abundance is 5*l* per second. The water has radioactive elements radium and uranium. The reaction of water is 7.2, and is considered neutral and does not affect the acidity in the body. Total mineralization is insignificant, with the absence of iron, with the increased content of chlorine, calcium and sodium. Healing properties lie in the contents of rubidium, barium, phosphorus, copper, fluorine, as well as in the increased temperature.

In the river bed, the springs abundance is 2.5*l* per second to 2.8*l* per second, temperature 41°C and can be used only at low water levels. Springs at the river bank where the Bath was built have abundance from 2.5*l* per second to 5.5*l* per second, temperature 37°C - 40°C. The springs are located in the bed of the Timok from the old hydroelectric power plant to the bridge on the river Timok. Water efflux is accompanied by gas. In 1956 and 1957 at these locations were drilled 10 shallow probes and 6 deeper probes and in most of them the presence of mineral water was confirmed.

Previous investigations indicate that the abundance, temperature, and chemical composition of Gamzigrad Spa thermal waters have influence on the water level of the Crni Timok and karst aquifer levels very close to the spring. The research also suggests that in Gamzigrad Spa and its surroundings, structurally geological relations of rocks of different permeability and location are such that they form two water-bearing horizons, which are separated by watertight marl sedimentary series.

In the shallower water-bearing horizon, which is composed of less cracked limestone, there is cold water of lower abundance. It is fed with water from the surface streams and precipitation. The deeper water-bearing horizon is also composed of limestone, but much thicker. These waters are warm because they run through warm andesite mass and as such come to the surface. The thermal mineral waters of Gamzigrad Spa, by their chemical composition, fall into hydrocarbon class of complex cationic composition. By their gas composition, the waters belong to the nitrogen type of water and they are slightly radioactive. Today, the Spa uses two thermal water springs. The most important exploration - exploitation well BG-1, was drilled in 1975 and 1976 and with the fall of 2.3 meters gives 20*l* per second, water temperature 42°C. This well supplies water to the Institute for rehabilitation.

3. OPPORTUNITIES FOR VALORISATION OF GAMZIGRAD SPA THERMAL WATERS

Based on these findings it is evident that Gamzigrad Spa has excellent natural conditions for the development and greater use of natural resources, which is reflected in the thermal water reserves. The previous use of the spa's thermal waters served only for balneological purposes.

Previous studies, preliminary designs and studies indicate that a wider area and the spa itself have all the hydrogeological conditions for the abstraction of large quantities of warm thermal water. This conclusion is suggested by the latest research in the nineties. These studies indicate that in this area a volcanic activity took place and that on the surface of the earth, the volcano poured huge amounts of lava, which resulted in subsidence of the terrain and the sinking of parts of the volcanic coupe, which created collapsing calderas (depressions of circular and ellipse shape), where the rocks sink to various depths. In 1988, east of village Metovnica, I. Djakovic identified remains of the volcanic cone by performing a microstructure analysis. According to him, it is a line that is the most interesting in the hydrogeological sense for further research, to create warmer thermal waters. The research suggests that in the area of Metovnica a vast collapsing caldera was formed. The springs of Gamzigrad and Nikolicevo spas are located on the edge of the caldera.

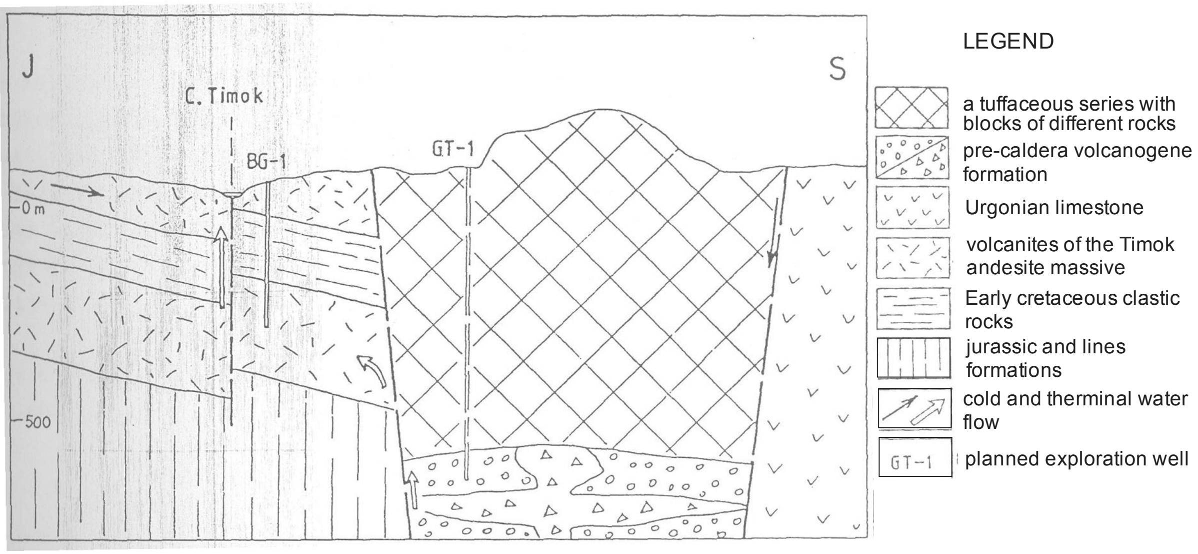

Figure2. A schematic model of Gamzigrad Spa's hydrogeological structure (according to hydrological research by ,,GEOHIDROEKSPERT" Novi Sad,1995.)

Hydrogeological studies from 1995 point out that an exploration well should be drilled to the depth of 600 meters where it is expected that the water temperature reaches 80 to 100°C, the amount of 30 to 50 liters per second. If the exploratory drilling obtains good results, it would later be turned into exploitation well.

These amounts of water and these temperatures, in addition to the balneological needs, would be used as geothermal energy.
Geothermal energy would be used for:

- heating of the existing facilities and future capacity in the spa,
- construction of outdoor and indoor pools,
- heating of Zajecar, a city only 11 km away,
- in agriculture (for the construction of greenhouses and warm garden beds in the spa itself and along the Timok valley to Zajecar)

4. CONCLUSION

- Gamzigrad Spa is situated in rarely favorable natural conditions, and from the geographical and hydrogeological aspects, it has all the requirements for greater and faster development.

- The first and most important function of thermal mineral waters of Gamzigrad Spa is the use of their natural components in the treatment of diseases and injuries. Professional medical personnel and built capacity within the Institute for rehabilitation, form the basis for further development of health tourism.

- In order to further evaluate the potential of Gamzigrad Spa thermal waters, further research should be done and more reliable data collected concerning the quantities and characteristics of the mineral waters, which would be used as geothermal energy in addition to the previous balneological use. This way the potential of thermal waters spa would be fully exploited and the spa itself together with Zajecar would achieve faster and greater development.

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HUMAN RESOURCE MANAGEMENT IN SUSTAINABLE AGRICULTURAL PRODUCTION

UPRAVLJANJE LJUDSKIM RESURSIMA U ODRŽIVOJ POLJOPRIVREDNOJ PROIZVODNJI

Lazar Ružičić[1] , Tamara Ružičić[2], Ljiljana Kostadinović[1], Tamara Galonja-Coghill[1]
[1] Megatrend university, Faculty of biofarming Bačka Topola, R Serbia
Megatrend university, Graduate School of Business Studies, Belgrade, R Serbia
Corresponding author: dr Ljiljana Kostadinović, e-mail: latimak@tippnet.rs

Abstract: *This paper presents the basic principles of modern management of human resources in agricultural production, and the current state of Serbian management in order to review the problems and deficiencies that occur in business and producing healthy food in our country. Also reviewed are the ways of modern business world successful companies in the field of agriculture and the possibility of their use in our conditions. It points to the shortcomings of our management and personnel problems that occur in human resource management in agricultural production, as well as possible solutions, which consist in the application of modern concepts of management in agricultural production. In this way, would facilitate further development of Serbian agriculture, but also companies that are directly or indirectly related to agricultural production.*
Key words*: management, human resources, agricultural production.*

Apstrakt: *U radu su dati osnovni principi modernog menadžmenta ljudskim resursima u poljoprivrednoj proizvodnji, kao i trenutno stanje srpskog menadžmenta sa ciljem da se sagledaju problemi i nedostaci koji se javljaju u poslovanju i proizvodnji zdrave hrane u našoj zemlji. Prikazani su i savremeni načini poslovanja uspešnih svetskih preduzeća iz oblasti agrara i mogućnost njihove primene u našim uslovima. Ukazano je na osnovne nedostatke našeg menadžerskog kadra i probleme koji se javljaju u upravljanju ljudskim resursima u poljoprivrednoj proizvodnji, kao i moguća rešenja koja se sastoje u primeni savremenog koncepta menadžmenta u poljoprivrednoj proizvodnji. Na ovaj način obezbedio bi se dalji razvoj srpskog agrara, ali i preduzeća koja su na direktan ili indirektan način povezana sa poljoprivrednom proizvodnjom.*
Ključne reči*: menadžment, ljudski resursi, poljoprivredna proizvodnja.*

3. INTRODUCTION

Human resources are one of the most important, and also the most expensive and complex resources in the organization. Successful management of human resources is reflected in the successful operation of the organization, e.g. agricultural holding. Human resource management deals with the design of formal systems in an organization or farm in order to ensure effective and efficient use of human capital to achieve objectives of the organization. "Human capital" is the total value of human resources of the organization that is directly linked to the performance and the competitive advantage of the organization. The human resources contribution to the organization can be positive or negative, depending on the human resources management policy of. Business organization is effective when the policy of human resource management in line with the overall strategy of the organization. The management is certainly one of the most difficult and complex professions one can deal with, because it primarily deals with people, who are individuals, driven by their own interests [1].

There is no developed practice management in Serbia, and it is far behind the management in the developed Western countries and Japan. Moreover, the management is not given much importance, because it is still under high level of politicization and ideologization.
Management in agricultural production includes all activities that provide the necessary labor force (number of workers for certain types of work and their qualification structure). Specifics of management in agricultural production are:

- Due to the seasonality of agricultural production on the farm there is a permanent, temporary and seasonal hired labor.
- The knowledge that workers in agricultural holdings should have are specific (the importance of public funding of research nad development).
- Managing structure must be organized as a multidisciplinary group. .

Having designed a long-term development strategy is very important for the economy of any country. Strategic management must pay special attention to the study of relationships within the agricultural system. From the standpoint of modern agricultural production, management has been studied as a function of decision making both at macro and micro level.
The aim of agricultural and food production should be optimisation of the ratio between profit and healthy food production. This balance is not easy to achieve but is the one that modern agricultural and food production management should aim for. Having profit as the only driving force could have adverse effects on healthy food production.

2. MANAGEMENT IN SERBIAN AGRICULTURE

Management in agriculture, as well as its organisation, must be constantly examined and adjusted. The basic prerequisite for agricultural production is land. Ownership over land has major impact on the models that can provide sustainable agricultural production, as well as human resources that may be engaged in the production. In this respect, agriculture is a very complex activity, containing different lavels of operating systems, such as farms, social, cooperative and private bodies, with different models of organization. Also, there is a big difference in the size of farms, which significantly affects the management itself [1].

Two types of companies deal with agricultural production in Serbia. Tthere are large companies created from agricultural conglomerates that tend to consolidate land holdings and facilities for processing agricultural products and food production, and operate as an agricultural and industrial group with its own production, sales, marketing, etc. On the other hand, there is a significant proportion of private properties operating as small or medium-sized enterprises, in which family members act as managers, but are also the direct producers. These two types of farms are in direct competition in which small farms are struggling to survive. The food industry is the only branch of manufacturing industry which is export oriented and whose exports far exceed the imports [2].

In order for management to emerge as sole activity (being the proper way of development), the size of the farm should be such that it can organize self-management. The problems of self management organisation occur in small farms. Small farms are facing the fact that the farm owner is both manager and direct manufacturer. Having large number of participants in agriculture, make the transfer of macro-managerial decision very difficult. These manufacturers learn about strategic decisions, and guidance on the development of agricultural production, at seminars, courses and from advisory services.

The problem of managerial decisions transfer in our country is not afequatly solved. Small farms are the main obstacle to the existence of an independent management activity, and even greater fragmentation of the farms in our agriculture pulls a brake on the further development of management. Opposite to agricultural fragmentation, there is a process of concentration within industrial activities, enabling the joint stock companies management to act solely. That way, management becomes the fourth development factor, together with traditional production factors: land, labour and capital.
We have already concluded that in small family farms, the ownership and management merge. Tthe development of large-scale agricultural production leads to concentration agricultural land and, to a large extent, its centralization. This causes the separation of ownership from management [3].

Within this framework, human resource management in local agriculture goes two ways: in the large farms and small private farms. A set of human resources in agriculture includes not only the labor necessary to perform agricultural work, but one which provides technical coordination, organization and management of all resources in agriculture. Human resources as a factor in agricultural production have a decisive impact on economic activity, from both quantitative and qualitative aspects [4].

The globalization of the world food market strongly pressurise the domestic food industry with low prices and high quality is are expected to lower prices while increasing the quality of its products. In addition, and apart of the foreign policy orientation towards European integration, the standards adopted in the European Union are the parameters that must guide all producers who wish to perform in this market. The efficiency of agricultural production and development of the firm depends on the quality of the product, because it offers products that are of uniform quality quickly realized the market. Lack of quality systems means eliminating of companies from the world market trends. Therefore, improvement of the quality system is a key prerogative for successful cooperation with the world. The continuous improvement of cost management system is of particular importance, ensuring a safe and acceptable profit for the company. In this respect, agricultural enterprises in our country are far behind companies in many countries. The application of quality standards in agricultural activities is difficult because of all the factors that determine the yield in agriculture, low turnover, the importance of manufacturing to public health and social peace, rivalry between traditional and modern technology, especially on family farms. In Serbia, the introduction of standards and more difficult due to problems securing adequate quality of raw materials [5].

Basic human resources in the agriculture of the Republic of Serbia consist of individual farmers, farm family members and experts, agronomists, veterinarians, agricultural economists, etc. To better understand the real situation regarding human resources in agriculture in Serbia, the available economic potential should be compared with the agriculture of economically developed countries. For example, in the process of modernization of French agriculture, which is dominated by family labour, there were about 800 thousand active farmers in 2002, compared to about 4 million in 1960. As a result of a well-equipped machine park, the number of permanent employees is around 141 thousand, whose work makes up about 11% of the total work in agriculture, while seasonal workers perform about 8% work. On the agricultural area of 29. 555 thousand hectares, which is 5.2 times larger (ie. 5.8 times larger - excluding Kosovo) compared with agricultural land in Serbia, agriculture in France employs 1.5 times more active population and 2 times more employees than our agriculture [4].

Studying the problem with the theme of labor, it is necessary to emphasize the role of experts, whose number and qualifications are important factors for the progress of modern agricultural production in Serbia. Based on available statistics, Serbian agriculture had 6. 991 specialists with higher education and 3.221 professionals with college degrees, in 1998. Knowing that Serbia has 5.107 thousand hectares of agricultural land, it is obvious that one expert covers 730.5 ha, and one specialist with higher education 585.5 ha of agricultural land. Table 1 shows the level of qualifications of employees in agriculture.

Table 1. Level of qualification of employees in agriculture of Republic of Serbia [6], [7], [8]

Specification		Level of qualification								
		total	university	college	high school	elementary	highly skilled	skilled	semiskilled	unskilled
Total	1998	1844783	214635	136850	492478	105201	99555	450117	133359	212587
	2004	1313830	198806	107312	378952	66656	86957	270617	91933	112596
Agri-culture	1998	92301	6991	3221	25147	5804	2469	21561	8235	18873
	2004	60632	5158	2116	16769	4410	2091	13658	5636	10792
Portion of agriculture in total jobs (%)	1998	5,0	3,3	2,4	5,1	5,5	2,5	4,8	6,2	8,9
	2004	4,6	2,6	2,0	4,4	6,6	2,4	5,0	6,1	9,6
Employee structure in agri-culture (%)	1998	100	7,6	3,5	27,2	6,3	2,7	23,3	8,9	20,4
	2004	100	8,5	3,5	27,7	7,3	3,4	22,5	9,3	17,8

The problems Serbia face in agricultural human resources managment are:

– problems regarding demographic structure of rural population (lack of of working-age population in rural areas and unfavorable trends in this regard, as it is, above all, the age structure)

– problems regarding educational structure of rural population (low level of education, unfavourable educational structure, small number of farmers who had undertaken purposefull agricultural education, view that education ends upon reaching majority)

– problems associated with demands of agricultural production modern conditions (simultaneous processes of financial management, keeping up with scientific developments and European quality standards of production, management of human resources in terms of engaging the workforce to support the permanent and seasonal jobs, strategic planning)

– problems related to the possible use of European funds for development in this area (derived by the previous three types of problems).

These problems are shared by countries in the region, as well as certain areas within the European Union. The way of solving problems within the European Union is directing the funds for the improvement of certain regions or activities. The European Union so far reached the stage of abolishing massive bureaucracy, leaving all the work planning and design to national institutions and local communities. this sense, Serbia is in a vicious circle and can not reacch the funds because local institutions do not have the human resources to formulate concrete and comprehensive development projects. Because of that, the state institutions have to mediate, but in a specific way - not by bureaucratic adoption of policies noone can implement, or by direct management, to which the population is accustomed, but the massive financial burden on the administration, but with strategic planning for various types of support that, acting together, can positively affect permanent lifestyle changes of the agricultural population, their income and way the farmers are perceived.
Management of human resources must first be addressed at the macro level, which has not been the case. As for the micro-plan, by the nature of ownership relations in agriculture, landowners will have to invent their own solutions, while agricultural enterprises should align to similar organizations in Europe and worldwide [9].

3. POPULATION MIGRATION - REDUCTION OF HUMAN RESOURCES IN AGRICULTURE

The migration of population from rural to urban areas is a worldwide trend that can be very accurately monitored since the midst of 20th century. The reasons for this phenomenon are twofold. In less developed countries agriculture is related to the much lower income than the income which can be achieved in towns. In some countries, the rural population engaged in agriculture, live below the poverty level. However, in developed societies, migration to the cities can be explained by the prestige of living in urban areas, and the possibility of getting rich quick, or overcome the problem of employment loss. In 1950, only 29% of the world population lived in urban areas, at the end of the 20th century this percentage increased to 47% and is expected to increase to 61% by the year 2030. At the end of 20th century, urban population grew by an average of 2,2% every year, and rural only by 0,4%, half of which (0,2%) was the population from urban areas going to work to rural areas (commuters) [10].

Population growth in cities is at an average of 4 to 5% annually. The increase of population in urban areas is most affected by the infrastructure (water, roads, railways, air transport, etc.) and employment opportunities. In addition, population growth in urban areas is affected by the development of technology and services. The significance of these data is in showing that human resources in rural areas are diminishing. In addition, the education specialises the population for particular professions, so that the rural population, which is not primarily engaged in agriculture, finds more difficult to adapt to this type of work, if the need arises. On the other hand, the global availability of information is a factor that can and does contribute to continuing education and a poses a strong support to the adaptation ability to market conditions of the rural population engaged in agriculture. The farm organizations in small and medium-owned land must be significantly different than it was before. Since the farmers are expected to produce high yields per unit area of land (to keep the price of the product relatively low), soil is getting exhausted, and massive fertilizing is required (again raising the price of products), type and order of planting crops in some areas have to be carefully planned based on scientific knowledge and market needs, not based on tradition and custom, to which the older generations usually rely on.

The modern farmer is expected to be informed about the achievements in agriculture, to follow and implement new knowledge and standards and to plan investments in tools and equipment. In other words, the owner of the farm has to think like a manager in agriculture, to plan its finances, make informed decisions about production, hire labor, and improves technological processes. This requires a high level of education, which in our country is not customary in farming population, so that the efficiency of their work is relatively small, as shown by some studies [12].

4. DISADVANTAGES OF OUR MANAGERIAL STAFF

Serbian manager is not trained to work independently in the free business conditions. He is hastily trained for bureaucratic management of people and life in the bureaucratic enterprises. The numerous achievements of developed countries in the West and East are missing and are still not being implemented in Serbian practice of governance and organization [1].

Our schools educate only engineers of technical professions or exclusively economists [13]. Serbian managers should get more education in etics, norms of behavior, interviewing skills, rules of communication, information, stress management and other disciplines essential for modern managers, since it is a way to become more successful and competitive, makes is easier to achieve higher goals and profitability of the company. Lack of knowledge in the field of economics such as cost, financial techniques, accounting and bookkeeping is a flaw that comes at a high price, especially when in communication and service contracts with foreign companies. A large number of Serbian managers can not read the balance (balance sheets and income statements), which creates problems in the rapid adoption of strategic decisions. They therefore do not know where the money came from and where the money went, without printed and described financial and accounting transactions. Lack of knowledge of foreign languages is a peculiarity of our managers. This prevents direct communication with managers from the West, and also generates high costs in doing business with foreign partners, since an interpreter is required. The average age of the Serbian top management is 46 years. Women and young people are not adequately presented in managerial positions, which is a serious problem that needs to be overcome as soon as possible. The studies that were done for the purposes of certain state agencies and businesses, as well as chambers of commerce, have shown that Serbia does not quality management and does not do enough to keep at at the contemporary level.

5. POSSIBLE SOLUTIONS FOR EFFICIENT MANAGEMENT IN AGRICULTURE

With modern management in agriculture, the separation of ownership from management will occur. The company owners should leave managerial work to the professionals do the, whose task will not be only to control the capital, but to continually increase it.
The main features that characterize the functional approach to the management of successful companies are:

- elimination of senior staff members and their families who do not accept the hard work
- no employment should be based upon friendship and other prsonal relations,
- placement of trained personnel at managerial positions,
- delegation of management functions to people who have the aptitude and affinity for this position,
- maximum commitment of top management market and customers,
- application of new and proven management methods,
- permanent education of managers, seminars and study visits to the latest scientific journals.

Constant challenge for management should be changes that occur in engineering, technology, consumer behavior, competition, social relations, economic policy and environmental requirements. They should put constant efforts to improve competitiveness in terms of changing business environment, which carries a high degree of uncertainty and risk, because it is a requirement to impose the need to change basic attitudes and principles. The ideal is to have a unique product, but the point is to have the product different from others [1, 3].

The task of top management in agricultural production should be active in three time dimensions: past, present and future. The manager must always have in mind what previously happened, and previous experience on some issues. He must look forward, and always be aware what is happening around him, not only in terms of competition but also his assistants and associates [13].

The basic requirements that arise in connection with the necessary human resources for effective implementation of these technologies, can be expressed through two key dimensions: the quality and quantity of human resources (number of employees). The modern managers need to find motives or means to encourage their associates and other employees to achieve maximum results. Successful preparation for the conduct of market struggle implies a constant connection with the competition. The idea that the competition does not exist or will not appear is the most dangerous [14].

6. CONCLUSION

Management in agriculture in Serbia, seen through the human resource management, is still not at satisfactory level. However, every year some positive changes are being noticed that are reflected in the positive effects of transition and privatization process, the influence of foreign companies to open their factories and offices in Serbia, as well as the impact of management education, which has increasingly gained importance and presence.

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HUMAN RESOURCES MANAGEMENT – CONTRIBUTING TO SUCCESSFUL BUSINESS OPERATIONS OF A COMPANY

MENADŽMENT LJUDSKIH RESURSA – FAKTOR USPEŠNOG POSLOVANJA PREDUZEĆA

Dragan Mihajlovic, Biljana Ilic, Mladjan Maksimovic
Faculty of management Zajecar

Abstract: *Bearing in mind the fact that markets become more competitive, the function of human resources are constantly faced with new and growing challenges. Decline of economic activity, the financial crisis and the accompanying pressures of such developments set new requirements for the human resources experts. Traditional administrative roles, activities and perceptions are no longer acceptable and because of that, the experts in the field of human resources must be transformed into leaders and strategic partners who run and manage a process of transformation, thanks to the ability to initiate new policies and changes. In addition, it is necessary to introduce new ways of learning and to contribute to the creation of an additional quality in your organization. The aim of this paper is to identify the link between enterprise strategy and human resource management*
Keywords: *human resources, management, strategy, transformation, learning.*

Apstrakt: *Imajući u vidu činjenicu da tržišta postaju sve konkurentnija, to se i funkcija ljudskih resursa stalno susreće sa novim i sve većim izazovima. Pad privredne aktivnosti, finansijska kriza i prateći pritisci brzog razvoja privrede, postavljaju nove zahteve pred eksperte za ljudske resurse. Tradicionalne, administrativne uloge, aktivnosti i percepcije više nisu prihvatljive, te se i eksperti u oblasti ljudskih resursa sada moraju transformisati u lidere i strateške partnere koji pokreću i rukovode proces transformacije, zahvaljujući sposobnosti kreiranja novih politika i upravljanja promenama. Pored toga, pred savremene menadžere postavljaju se potrebe i zahtevi za uvođenjem novih načina učenja i stvaranja dodatnog kvaliteta privrednih subjekata. Zbog svega iznetog, u radu se kao glavni cilj nameće identifikovanje veze između Top menadžmenta, strategije preduzeća i upravljanja ljudskim resursima.*
Ključne reči: *ljudski resursi, upravljanje, strategija, transformacija, učenje.*

1. INTRODUCTION

Human resources management is a long-term,overwhelming and also integrative approach, directed both to the potentials, powers, lacks, and chances and risks of the surroundings. The process can be defined as a set of decisions and activities aimed to designed development of human creativity, purposeful to provide competing advantage in a company and strategic aims of business operations. Human resources management proscribes general direction that the company intends to follow in order to, thanks to its employees, achieve before-mentioned aims. The strategies of human resources management, which are in accordance with specific intentions of a company, are concentrated on what to be done, or, better to say, what should be changed in the company.

The strategy can be a direction for taken measures to move within the management of changes. On the basis of undertaken actions, the management, as well as professional personnel determine and solve the issues related to the resources of the company. The strategy of human resources management helps the management to determine priorities and define the vision of the model of human resources management, the most important one of all. Therefore, human resources management represents one of the most significant functions of management. Besides Top management, who, by the style of conducting, contributes the assigned aim to be achieved, successful business operation depends on the capacity of working people. Without such a quality, even the least demanding strategy cannot be applied effectively. Human resources of each company are unique. This uniquiness does not arise only from the fact that the employees in each company are assigned to different positions, but also from specific synergie which is a result of combination with other resources. Each company should have human resources programme plan, containing estimation of needed personnel and required qualifications for the period of a few years ahead, all based on strategic plan" [1]. As a result of historical and development changes in all segments of social and state happenings, there appear numerous innovative solutions aimed to make the life and work of individuals easier.

2. IMPORTANCE OF HUMAN RESOURCES IN A COMPANY

Each modern company has to be efficient, so that it could survive in nowadays turbulent business conditions. Its efficiency is reflected in capability to provide products and services to satisfy consumer's needs. To be competent, the company has to find the right way to manage human resources, since the employees are not only one of the most important (people provide products and services partly or completely) but also the most expensive and, sometimes, most problematic resource. Regarding the fact that the significance of human resources are becoming increasingly greater, adequate management, being the concern of higher levels of management bodies, are becoming strategic interest of a company. Since a man is the center of each work, as well as the most importanmt factor of generating new additional value, so as the human resources management becomes the factor of crucial importance for development of each business endevour. The process of management primarily means managing with people who, individually or as a team, contribute to attaining the aims of the company. Human resources enable usage of complete potentials of the company, therefore, the man himself has to be on the first place in each economic entity. The „sector of human resources has the main role in developing responsibility, increasing productivity and efficiency of each sector respectively, it connects teams and people, enhances and makes the process easier" [2].

As the company could answer to requests of modern age, it is necessary for its management to do good-quality and efficient selection, that is, „selection of right people for the job and to use efficiently the potentials of the employees, to motivate workers, eliminate absences from work, introduce fair remuneration, system of promotion, and makes decisions based on minute's information. Professional selection of the employess enables them to be well-assigned, on the basis of their capabilities, aptitudes and motivation for work. Listed activities, characterizing the way of thinking of a modern company, are in the domain of work of human resources manager. Since, each organization has requirements referring to the conditions under which each employee carries out his job in an optimum way, having at the same time a high level of satisfaction, it is possible to achieve these requirements only if „ideal" work atmosphere has been established in the company. If we take into consideration the fact that nothing is „ideal“, we can say that competence in managing with „optimum“ work atmosphere is as important as technological knowledge on improving productivity.

Optimum work atmosphere is achieved by numerous systems of motivation and remuneration, what Compensation & Benefit Specialist is in charge of. The employed in the Human Resources Sector work on promotion of the „lifelong learning“ conceipt. It actually supports proper and on-time selection of education and training of the company employees. The employed who are in charge of such education are called Education Specialists. Human resources managers have to be familiar with the basis of work psychology, legal regulations relating to work and work relations, health insurance and health protection, social welfare and work safety. They also should know the laws and legal regulations, the company internal rules (the Statute, Rule-books, contracts, collective contracts). They are in charge for creating personnel records, calculation of salary of the employed and reports at requested criteria [3]. The role of the Sector of Planning and Organizing Human Resources is not the same as former Personnel Affairs Service; the role of the latter was taken over by the Human Resources Sector [4].

3. HUMAN RESOURCES MODELS PLANNING

Human resources planning, often called labour planning, has traditionally included the number of employees, level of their qualifications and types of the positions in a company. Figure 1 shows the traditional model of human resources planning.

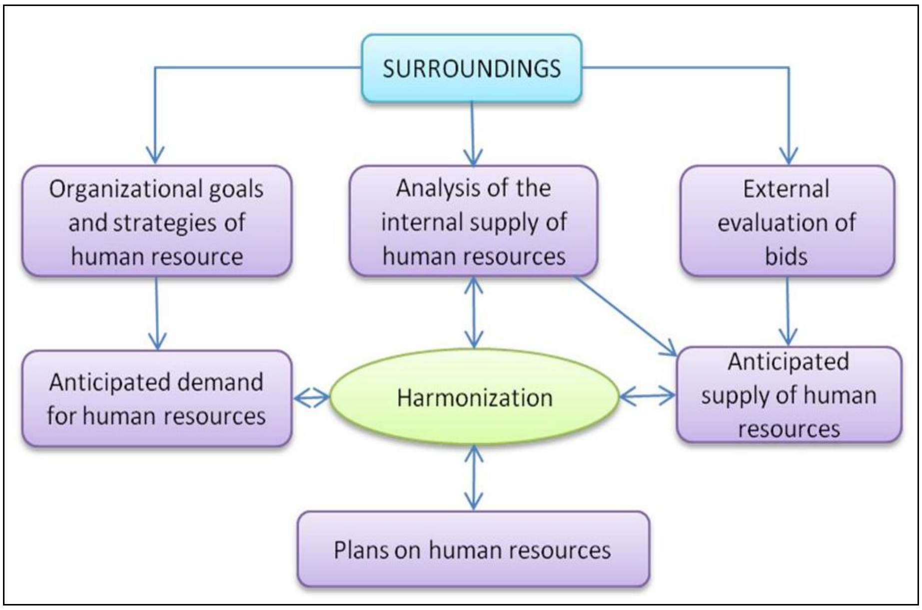

Figure 1. Model of traditional human resources planning[5]

The picture shows that traditional planning of human resources means emphasising the balance between anticipated labour offer and demand, aimed to provide the right number, right workers, and, primarily, right time. The Figure 2 shows sligtly improved human resources model, so-called Integrated Model. This model tries to unite all aspects of planning, involving not only traditional human resources model but also the relations, culture and systems from the surroundings [5].

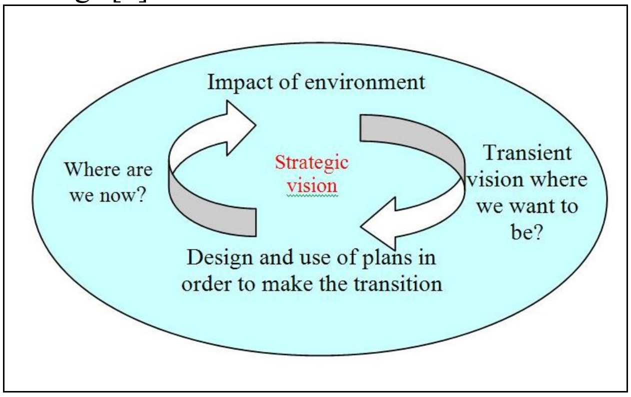

Figure 2. Integrated Model of Human Resources Planning [5]

The Integrated Model points out to „where you want to be in future“, the thing taken over from the answer to strategic vision „where the company is at the moment“ and „what is to be done to achieve aims“, acting within the surroundings of the company [6].

4. MOTIVATION CYCLE

Motives and motivation are the terms taken over from psychology and represent factors encouraging to make an individual peform activities, provoking definite behaviour, keeping it steady and directing it to attain a certain aim [7]. There are various theories of motivation. The theory of psychoanalyses insists on biological, subconscious, externally-provoked attractions, while humanist psychology insists on conscious motives [8]. Modern cycles of motivation, regarded from the aspect of a company, can be best represented as shown on Picture 3. It can be observed that the first phase of motivation cycle involves motiv originating, initiating activity at the employee towards the definite aim. In the second phase of the cycle, these activities make a certain result, while, in the third, last phase, the worker's satisfaction with the result is evident, regarding the fact that logical cause of the result is a prize. The prize for achieved results is most often expressed in money. It is assumed that the workers'satisfaction with effects of their own endevour, meaning the prize, causes creation of motives. That is how the circle closes and a new motivation cycles begins.

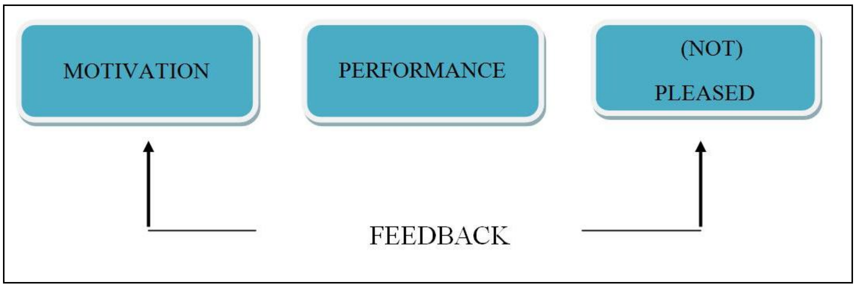

Figure 3. Motivation Cycles Model [4]

However, in modern practice, there has appeared certain modifications of such motivation cycle. Actually, big company managers, intending to use up as much as possible psychological and physical capacities of the employees (especially in the process of production), keep them in the state of permanent suspence, so that the employees could work „more and better“. Thus, when the worker in the second phase of the motivation cycles achieves a certain result, which might match proscribed norm, based on new ideology of suspense, he does not get any prize, that is, award for his work, but the information from his manager that the given task has been correctly performed, however, the same could be carried out better and in a better-quality way. The result of such attitude of a manager causes the situation in which the prize for the effort cannot be maximum but below the expected one. On the other hand, the employee, eager to make greater earnings, and convincing his superior that he is capable to work more efficiently, does additional efforts. „This aspect of motivation may have very bad consequences if the manager „lacks a sense of proportion“. He should stop with such motivation. If this motivation cycle is kept on repeating, it may lead to complete loss of motivation for work, to apathy and lasting dissatisfaction. It is best, after two cycles of so-called negative motivation, in the next cycle, to try to replace the last phase with satisfaction instead of dissatisfaction. It means that the employee should be awarded by adequate, high , prize for the result“ [4].

5. MEASURING MOTIVATION

As it has already been said, motivation represents the process of initiating human activity which is directed to attaing certain aims. The employees with unclear aims or without any aims, are apt to work slowly, they carry out their tasks poorly, show lack of interest, and complete less work than the employees whose aims are clear and challenging. However, one of the basic problems to be examined, as well as aplication of the strategy of work motivation, is how to measure motivation. There are varied strategies to intiate certain behaviour with employees, such as positive impuls, negative impuls, sanction or lack of reaction [9]. However, the question is how to find out how much the employees in a company truly motivated. As far as measuring motivation is concerned, the three most efficient techniques have proved to be:

1. Questionnairing employess what motivates them;
2. Estimating the employees’ behaviour in changed, various work situations;
3. Measuring endevour or, better to say, those elements of ucinak (employees’ performances) under direct control of the workers.

It is easiest to apply questionnaires, as a technique for measuring work motivation. It is enough to make questionnaire which will, besides conventional, standard data, such as: sex, age, work experience of the examininee and alike, contain seven-level scale on which the number 1means „completely unmotivated“, the numbers 2,3,4 and 5 – „partly motivated“, and the number 7 – „very motivated“. The examinees circle the number on the scale according to their own sense of level of personal motivation. Estimation of workers’ behaviour,as a technique of measuring motivation, is much more delicate than the previous one. It can be explained that the same range of engagement, on the same machines, the same workers in different conditions fulfil their duties differently. It turns out that the estimation of workers’ behaviour can be done by making conclusions based on simple observation of workers' acting in changed conditons of work. However, more precise results can be achieved by collecting data through interviews, questionnaires and from personal files of the employees [10]. Although measuring the result represents the most exact technique of measuring work motivation, it is not, however, the most reliable technique. To norm work belongs to a very sensitive area of management action, therefore, mistakes are very common. The danger of mistakes is two-sided: first, if the norms are too low, and second, if they are too high. In both cases, there are loss in work efficiency: in the first case, worker will easily achieve proscribed norm, it could be after 3 or 4 hours, meaning that he will acheive full result with a half of his real capacities. In the second case, the worker cannot achieve 100% of the norm, he will be less paid, and, if other positions in the same work process are normed properly, he will be so-calle „bottleneck" in that process. Accordingly, it is very important to establish truly nedeed endevour that the worker is able to give during the eight-hour-long work day. Different jobs require different endevours. However, how much endevour an individual invests, depends on the level of his work motivation. That is how, by measuring endevour (the greatest possible result for the definite work task and its deviation), it is possible to measure the level of work motivation of an individual" [2].

6. MEASURING MOTIVATION ON A CONCRETE EXAMPLE IN A COMPANY

To support before-mentioned theoretical considerations with a practical example, some investigations of measuring motivation in the company AD Zeleznice Srbije were carried out. In the orgasnizational unit „Human Resources Affairs Service" of the AD Zeleznice Srbije, it was applied the questionnaire technique on the sample of 200 workers assigned to different positions. All examinees are of different demographic characteristics. The following five factors were taken into consideration [11]:

Financial stimulation

1. Improved work conditions
2. Improvement of interpersonal relations
3. Enrichment and enlargement of the range of business
4. Participation in decision-making

Based on obtained results of work motivation measurement, it was concluded that, among the employees of the company, there is no much motivation. The graph 1 clearly shows the relation among the motivation factors of the employees of the AD Railway Srbia. Darkened parts display unmotivation, while open, bright parts show motivation [11].

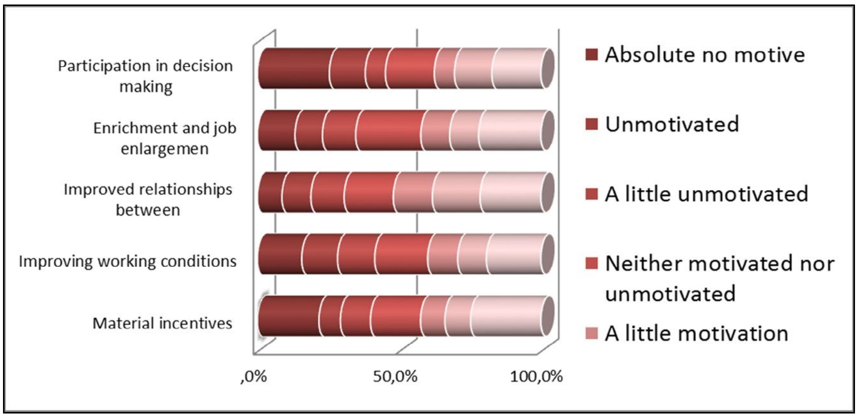

Figure 4. Motivation relation per each factor

The graph reveals that almost 40% of the workers are without a motive or are not motivated in the process of decision-making, while over 40% of them are very little motivated. What was not surprising and what was certainly expected from the results, is that, when it is about financial stimulation, workers were highly motivated. They are also averagely more motivated when it is about improvement of interpersonal relations.

The graph 2 shows the Block plot diagram of motivation factors of the employed in the AD Zeleznice Srbije, on the scale from 1 to 7 [11]. The mean line in the filled area explains most often motivation value, while the filled area itself (95%) represents other values, that is, oscilations in motivation factors. The T line starting from one and the other side represents all other deviations in motivation of the employees.

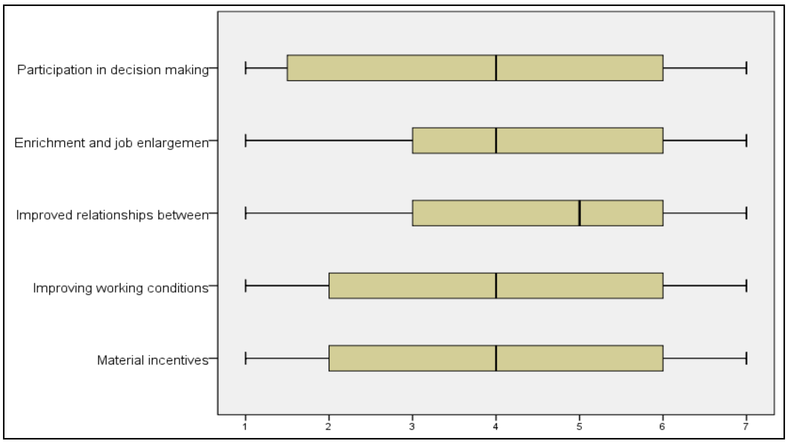

Figure 5. Box plot diagram of motivation factors on the scale from 1 to 7

The graph clearly shows that the greatest motivation of the emplooyees is in improvement of interpersonal relations. Healthy interpersonal relatios contribute to improvement of the company culture. According to opinion of many people, the company culture is a set of common values, norms and expectations which form the behaviour of the employees in companies, primarily the way the employees enter interpersonal relations, how they treat clients, how they perform their work tasks, and what results they achieve. [12]

This datum can be observed more wide, from the aspect of improving communication between the employed and their superiors, and also from the aspect of better communication among the employees themselves, on all levels in the company.

7. CONCLUSION

All before-mentioned lead to the conclusion that human resources management in modern business operations is becoming crucial for finding out original solutions in the sector of production and service, both because of satisfying more and more requirements of the trade, and improving competition state of the company. By involving all processes of planning and human resources development in long-term policy of the company, it is possible to ncrease innovativeness and achieve high development aims of a company.This Paper tries to support the fact that people, the employees, their permanent development and their capacities, are becoming chief bearers of success in business. Thus, good-quality human resources management leads to better results in business, improvement of management, growth of work results and loyality of the employed, increased number of innovations and creation of new business atmosphere in which those innovations could become a starting device of the development. The motivation of the workers is the process which should be improved, especially in the copmpanies in which the workers are totally or very little motivated in relation to many business issues. All these cannot be done without healthy company culture, that is, culture in which the worker could have free communication both with his superiors and other employees.

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RESEARCH INTO THE MOTIVES AND HABITS OF CONSUMERS OF CIGARETTES

ISTRAŽIVANJE MOTIVA I NAVIKA KORISNIKA CIGARETA

Igor Trandafilovic, Milan Dzigumovic, Srdjan Zikic
Faculty of management Zajecar

Abstract: *Altered state of the environment that produces discomfort or more or less permanent damage, called pollution. Pollution seem all that dangerous to life or a significant way changes the chemical and physical properties of water, land or air.During phase combustion cigarette smoker inhale only a portion produced by chemical agents, retains part of the filter, a portion is released in to the external environment (passive smoking), while the remaining partis also in the environment through the ashes. Based on marketingresearch carried out among citizens in order to examine the attitudes of citizens about the law banning smoking came to conclusions that will indicate that the success of law enforcement failed to achieve*

Most respondents consumed cigarettes from habit and from satisfaction to 80%, 84% informed about the ban on smoking inpublic places, 74% know that smoking affects their health, while 60%consumed 15-25 cigarettes a day.

Keywords: *filter cigarette, cigarette smoke, pollution of the environment.*

Apstrakt*:Izmenjeno stanje životne sredine koje proizvodi neprijatnost ili manje ili više trajnu štetu, nazivamo zagađenje.Zagađenost čini sve ono što je opasno za život, ili na značajan način menja hemijsko-fizičke karakteristike vode, zemljišta ili vazduha.Tokom faze sagorevanja cigarete pušač udahne samo deo proizvedenih hemijskih agenasa, deo zadržava filter, jedan deo se ispušta u spoljnu sredinu (pasivno pušenje), dok se preostali deo iznosi takođe u ambijent putem pepela. Na osnovu marketing istraživanja koje je sprovedeno među sugrađanima sa ciljem da se ispitaju stavovi građana o Zakonu o zabrani pušenja došlo se do zaključaka koji će ukazati na to koje uspehe je sprovođenjem zakona uspelo da se postigne.*

Većina ispitanika konzumira cigarete iz navike i iz zadivoljstva čak 80%,84% je informisano o zabrani pušenja na javnim mestima,74% zna da pušenje utiče na njihovo zdravlje,dok 60% konzumira 15-25 cigareta dnevno.

Ključne reči: *opušak od cigarete, dim od cigarete, zagađenje životne sredine.*

1.INTRODUCTION

Environmental Protection is primarily moral obligation for humanity because it is survival resources without which I could not live that there is a world on the planet.In this work we came to data that the protection of the environment to the population who consume cigarettes is quite relative thing. In our country the law prohibited smoking in indoor public and working space and penalties are sharp.law is trying to influence awareness to environmental protection and respect for law, however, in this survey shows that it is not reduced cigarette consumption entry into force of the law and the awareness of the environmental protection of already increase in cigarette prices.

Marketing is the science and art creation and maintenance of customers and profits. His goal is attracting new and retaining existing customers offer and delivery superior value and satisfaction.This is the process of planning and the creation of ideas, products and services and for determining their price, promotion and distribution in order to be conducted exchange that meets targets individuals and organizations, or the execution of business activities that direct products and services from the manufacturer according to consumers and

users.Marketing deals with needs of the people and finding ways satisfaction these needs. Marketing begins and ends with own premises.
Marketing is a science which deals with all the activities and the planning and implementation of the concept, price, promotion and distribution ideas, goods and services. The goal is to create marketing quality of which is better than competition in the longer term, which is an important participant in the consumer.
Marketing research is increasing success and reducing the risk in a business company by issuing placement marketing decisions based on collected true marketing information. Defining goals and research it is necessary to make clearly distributed nearer in the process research, because the objectives are based on an entire research process. Marketing research define opportunities of business and the risk that they wear,and quality planning, organization and control.
Marketing research consists of five phases: [1, p.89]

- Defining problems and research objectives.
- The compilation plan research.
- Collection of information.
- Analysis information.
- Presentation of results.

The first phase research means to marketing manager and marketing researcher define problem and agree goals research. Second phase is the safest way finding a way to collect necessary information. The third phase is a collection of information and it is the most expensive phase marketing research and with it the statistic provided and mistakes. The fourth phase is the conclusion based on collected data. The fifth phase is the presentation of results. Obtained results researcher is a interested parties.
Marketing as well as scientific discipline dealing with the study all the activities, actions and the actions of which depends on effectiveness and efficiency exchange, or economic stability system of national economy and culture of life social community. [2, p.3] Management or marketing activities is a continuous process - initiating, implementing and directing marketing activities with regard to consumer needs, the economy and society in the long term and acquisition of get. [3, p.11]
The selection of this survey has shown that marketing to follow Law on the prohibition of smoking and the protection of the environment of population who consume cigarettes low, because the respondents do not know marketing campaign, which it shows except for the pack of cigarettes, while the marketing campaign in the consumption cigarettes are widespread.

2. THE GOALS, METHODOLOGY SURVEYS, AND ANALYSIS OF RESULTS

In order to be interviewed research citizens views on the impact advertising and advertising ban on smoking in purchase cigarettes it is necessary to set goals on the basis of which will be later through methodology research form a poll with the relevant issues, and so come to certain results:

- Examine paragraph citizens according to awareness of law on the prohibition of smoking in public places .
- Examine paragraph citizens according to awareness of cigarette consumption.

- Examine reason,quantity and time consuming cigarettes .

Research has been done in the time from 05.10.2011. - 07.10.2011. type research views of citizens impact advertising and advertising ban on smoking in purchase cigarettes.

- Sample - consists of N=100 Nis citizens
- Criterion -between the ages of 18+
- Instruments - specially designed a non-voting list
- Techniques – Surveys

Possibility to a major innovation offered a response or is given thepossibility correspondence f reeresponse. Statistical processing of the data-derived from the given presentedin tables and diagrams, determined as the percentages and undereach is introduced with a short comment.
The demographic structure of respondents were: male while 52% of females 48%.
85% of respondents live in urban settlements, 12% in the suburb,while 3% of respondents live in rural areas.
59% of respondents had 18-29 years, 32% of 30-45 years, 9% wereover 45 years.
37% of respondents were from the college and university graduates,while 63% were from high school.

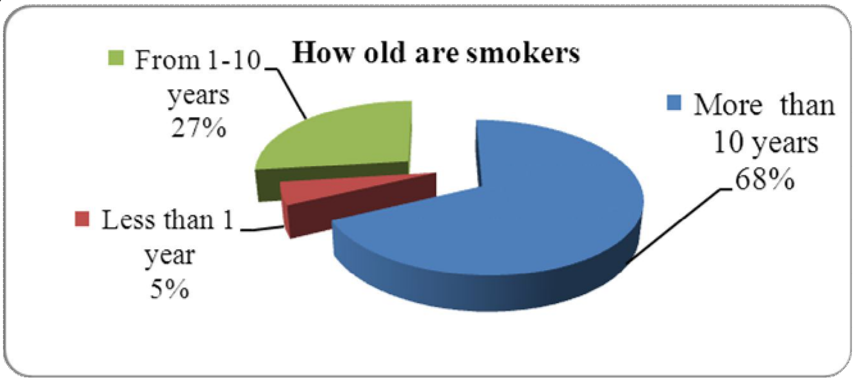

Figure 1. How old are smokers?

How old are smokers: 5% of cigarettes consumed less than 1 year, 27% consumed between 1-10 years, while 68% of respondents consumed more 10 years, of which

Gender	Education level	Less than 1 year	From 1-10 years	More than10 years
Men	30%Middle school 22%High,Higher	4%respondents 3%Middleschool 1%High, Higher	20%respondents 15%Midd school 5%High, Higher	28%respondents 12%Middle school 16%High, Higher
Women	33%Middle school 15%High, Higher	1% respondents 1%Middle school	7%respondents 2%Middle school 5%High,Higher	40%respondents 30%Middle school 10%High,Higher

Testing market is for instance education, respondents by sex and by years of cigarette , which has shown that the biggest number of interviewees consumed 1-10 whatever,male 28% is 12% Secondary education while 16% or high or higher education, while the female 40% of the respondents 30% Secondary education while 10% or high or higher education.

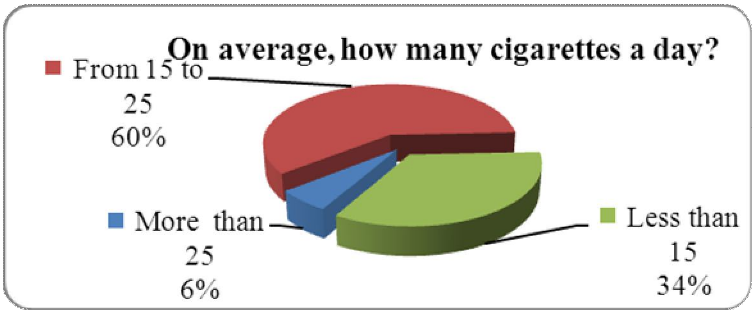

Figure 2. On average, how many cigarettes a day?

On average, how many cigarettes a day? 34% Of The respondents smoke less than 15 cigarettes a day, from period: 15-25 years smoke cigarettes per day 60% of the respondents, while more than 25 cigarettes a day smoke 6% of the respondents of the:

Gender	Education level	Less than 15	From 15 to 25	More than 25
Men	30%Middle school 22%High, Higher	20%respondents 15%Middle school 5%High, Higher	30%respondents 14%Middle school 16%High, Higher	2%respondents 1%Middle school 1%High, Higher
Women	33%Middle school 15%High,Higher	17%respondents 13%Middle school 4%High,Higher	27%respondents 17%Middle school 10%High,Higher	4% respondents 3%Middle school 1%High,Higher

Market research is executed by the level of education and sex of respondents and the amount of daily cigarette consumption, which showed that the majority of subjects consumed 15-25 cigarettes a day, males 30% to 14% of secondary education and 16% higher or high education , 27% of female respondents of which 17% secondary educated, while 10% higher or high education.

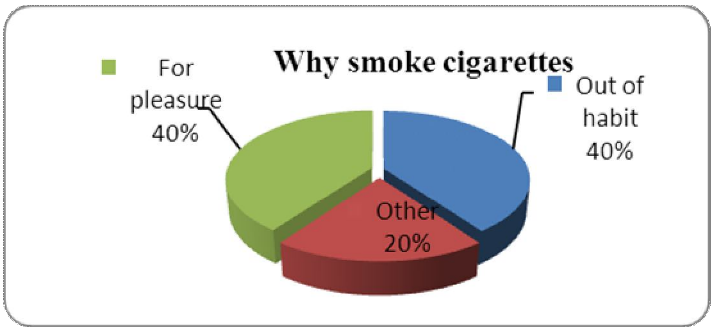

Figure 3. Why smoke cigarettes?

Why smoke cigarettes? 40% of respondents consumed cigarettes out of habit, 40% for pleasure,while 20% of cigarettes consumed for reasons other than this are:

Gender	Education level	For pleasure	Out of habit	Other
Men	30%Middle school 22%High,Higher	15%respondents 5%Middle school 10%High,Higher	25%respondents 20%Middle school 5%High,Higher	12%respondents 5%Middle school 7%High,Higher
Women	33%Middle school 15%High,Higher	25%respondents 20%Middle school 5%High,Higher	15%respondents 12%Middle school 3%High,Higher	8% respondents 1%Middle school 7%High,Higher

Market research is executed by the level of education and sex of respondents and the reason for the consumption of cigarettes, which showed that most respondents consume cigarettes out of habit and males 25% to 20% with secondary education vocational, 5%higher or high education, and satisfaction of female respondents 25% of which is 20% with secondary education, while 5% higher and high education.

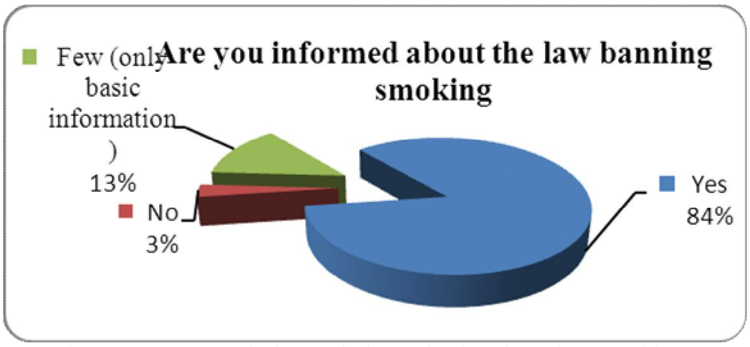

Figure 4. Are you informed about the law banning smoking?

Are you informed about the law banning smoking? 84% of respondents said they were informed about the lawprohibiting smoking, 13% are poorly informed , while 3% gave the answer that I have not informed about the law banning smoking from this are:

Gender	Education level	Yes	No	Few
Men	30%Middle school 22%High,Higher	43%respondents 24%Middle school 19%High,Higher	2%respondents 1%Middle school 1%High,Higher	7%respondents 5%Middle school 2%High, Higher
Women	33%Middle school 15%High,Higher	41%respondents 28%Middle school 13%High,Higher	1%respondents 1%Middle school	6% respondents 4%Middle school 2%High,Higher

Market research is executed by the level of education and sex of respondents and the information about the smoking ban legislation, which showed that most of it and informed, males 43% to 24% with an average vocational education, 19% higher or high education,women's 41% of half of which is 28% with secondary education,while 13% higher or high education.

How the information through the media about the smoking ban affected your habits in the consumption of tobacco products? 55% of respondents said that information through the media had no influence the consumption tobacco, 31% responded that they had little impact, while 14% said they had a lot of influence.
Have you changed your habits in consumption of cigarettes in the last period? 52% of respondents did not change their habits in consumption of cigarettes, while 48% of respondents changed their habits.
If you change your habits if it is due: 67% of respondents have changed their habits because of the price,12% of the smoking ban because of the quality of 6%, while 15% hadchanged their habits for some other reason.
Does your family and close environment is active smokers? 85% of respondents said that their neighborhood is active smokers, 15% of respondents said no active smokers in its vicinity.
If the previous answer is yes, whether they changed their habits since the adoption of the smoking ban?41% of respondents gave that response in and around smokerschanged their habits, 33% that did not change habits, 26% is little changed their habits.

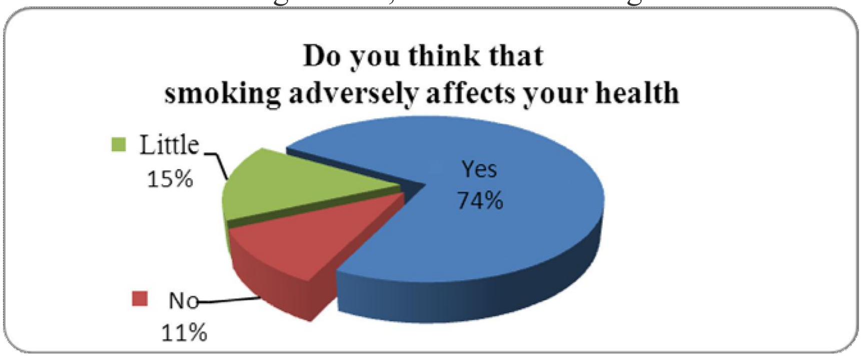

Figure 5. Do you think that smoking adversely affects your health?

Do you think that smoking adversely affects your health: 74% of respondents felt that smoking adversely affects the health,15% think that smoking a little detrimental effect on health, while 11% of respondents gavean answer a that smoking does not affect adversely the health of whichare.

Gender	Education level	Yes	No	Little
Men	30%Middle school 22%High,Higher	40%respondents 25%Middle school 15%High,Higher	6% respondents 4%Middle school 2%High,Higher	6%respondents 1%Middle school 5%High,Higher
Women	33%Middle school 15%High,Higher	34%respondents 23%Middle school 11%High,Higher	5% respondents 3%Middle school 2%High,Higher	9% respondents 7%Middle school 2%High,Higher

Market research is executed by the level of education and sex of respondents and the harmfulness of tobacco consumption, which showed that most respondents felt that smoking adversely affects the health of male and 40% to 25% with an average vocational education, 15% higher and higher education, and 34% of female respondents of whom 23% with secondary education and 11%higher and higher, education.

Do you think that this kind of propaganda against the pace consumption of tobacco products in the future significantly affect the number of smokers? 71% of respondents to this question gave a positive response, 29%of respondents said that in the future, not the pace of propaganda against the consumption of tobacco product will significantly affect the number of smokers.

3 . CONCLUSION

Marketing research is a very important tool for reducing the risk and uncertainty in the decision-making marketing decisions. You inform us when booking marketing, in particular the area marketing which taught marketing services. In service establishments activities product is a service. In the process of service delivery are participating employees and the customer and what will the effect be achieved depends on the ability to the buyer services employee in providing services. Based on marketing research that was conducted among fellow with the aim to examine opinions of citizens on the Law on the prohibition of smoking to conclusions, which will point to the successes that the implementation of legislation failed to achieve.

Conduct polls, grouping and data processing and analysis of results occurred until the next conclusion:

1. To explain to fellow importance of introducing law on the prohibition of smoking and his preventive use.
2. To explain to fellow importance of introducing law on the prohibition of smoking and his preventive use.
3. Make an additional effort in quality marketing presentation which its message edukcate population that is not consumed tobacco products

That the habits and satisfaction factors that are most in smokersand the biggest reason the smoking habit. Smokers who want to leave cigarettes as well as education of all citizens to use tobacco products in general and not start must have support for environment and society as a whole, a good (interesting, which is attracting attention) marketing, as well as an active application of the Law on the prohibition of smoking in a whole.

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ORGANIZATIONAL CULTURE - KEY ELEMENT OF EFFICIENT KNOWLEDGE MANAGEMENT PROGRAM

ORGANIZACIONA KULTURA – KLJUČNI FAKTOR EFIKASNOG PROGRAMA MENADŽMENTA ZNANJA

Vesna Simic
Municipal assembly of Knjazevac

Abstract: *Dynamic changes and survival of companies in terms of modern business demand creation of such corporative culture that encourages organizational changes and continuous learning. Since organizational culture influences thoughts and behavior of employees, the subject of this work is organizational culture from the point of its influence on efficiency of knowledge management system application in a company. Considering that organizational culture is the most significant factor of efficiency determination of knowledge management, this paper will point out that only a culture consisting of: orientation towards people, learning, sharing knowledge, team work, orientation towards results, innovation, willingness for risk and changes, can have positive effect on knowledge management.*
Key words: *knowledge, knowledge management, organizational culture, organizational changes, competitive advantage*

Apstrakt: *Dinamične promene i opstanak preduzeća u savremenim uslovima poslovanja zahtevaju kreiranje takve korporativne kulture koja podržava organizacijske promene i kontinuirano učenje. Činjenica da organizaciona kultura utiče na razmišljanje i ponašanje zaposlenih, predmet ovog rada je organizaciona kultura iz ugla njenog uticaja na efikasnost primene sistema menadžmenta znanja u preduzeću. Uvažavajući činjenicu da je organizciona kultura najznačajniji faktor koji determiniše efikasnost upravljanja znanjem u preduzeću, u radu će biti istaknuto da samo ona kultura čiji sadržaj čine: orjentacija prema ljudima, učenje, deljenje znanja, timski rad, orjentacija prema rezultatima, inovativnost, spremnost na rizik i promene, može imati pozitivan uticaj na menadžment znanja.*
Ključne reči: *znanje, menadžment znanja, organizaciona kultura, organizacione promene, konkurentska prednost*

1. INTRODUCTION

Opinion on existence of organizational culture influence on company's performances prevails both in organizational and managerial theory and practice. Special influence of organizational culture is emphasized in the process of initiation and implementation of organizational changes. Each company should shape its own system of values, beliefs and norms, which will be attractive enough and acceptable for everyone in the company, and that is the very point of organizational culture concept. By accepting the ruling system, employees get more involved with company's development and other goals, and in such manner they acquire competitive advantage which can not be copied [1]. That is the reason why organizational culture of a certain company is often compared to personal credibility – hard to build, but easily destroyed. The main characteristic of every change in modern company derives from a fact that knowledge is the basic development resource, and the man is its bearer. Based on previous, it can be said that in terms when uncertainty is set as bound reality, the only secured source of lasting competitive advantage is knowledge. Since the largest share of organizational knowledge is in the heads of employees, and having in mind that corporation culture influences the employees' way of thinking and behaving, it is necessary to review the influence of organizational culture on knowledge management efficiency. Therefore, organizational culture is a managerial term that is hard to measure, but its arrival to a company, regardless of the size, is quite visible. Achieving efficiency of knowledge management system in a company is presented in this work, through organizational culture characteristics.

2. ORGANIZATIONAL CULTURE AND KNOWLEDGE MANAGEMENT CONCEPT

Organizational culture is created in a process of collective problem solving faced by members of a group or organization. [2]. Unique definition of organizational culture doesn't exist. Most definitions point out its cognitive dimension, i.e. values and norms as a base [3]. Singular agreement on definition of culture doesn't exist, but there are consensuses on how organizational culture should be described in terms of values, norms and practice [4]:

- *Values* point to beliefs of company's members and that is more valuable than what they have or do. It is important to distinct acclaimed values that are talked about, but don't affect behavior, from values that truly motivate behavior in a company.
- *Norms* present shared beliefs on how people should behave in a company, or how to do their job. Those are expected behavior patterns.
- *Practices are* formal and non-formal routines used to get the work done. Formal or non-formal practice has a specific role and rule.

Culture exists on different organizational levels. Values are deeply incorporated, norms and practices more visible to identify by employees. Beside all differences, it can be said that organizational culture is pattern of beliefs, expectations, ideas, values, aspects and behaviors shared by members of one company [5]. In order to apprehend the importance of organizational culture for reaching competitive advantage for a company, it is necessary to inspect its basic functions:

1) Meaningful factor when reaching strategic decisions;
2) Important for company's business as a determinant of its ability to adapt to surrounding changes;
3) Presents coordination mechanism;
4) Efficient mechanism of employees behavior control;
5) Significantly reduces conflicts in a company;
6) Good motivator.

Strength of organizational culture can be defined through three criteria, and those are [6]: width, depth and range. The strength of organizational culture usually considers its depth, which is the strength of influence on certain members of company. Nevertheless, its development is also important, such as the number of covered aspects, values and assumptions that determine its width. Since company's organizational culture is never accepted by everyone that is employed, range is also important for its strength, which is the number of members that accepted it. Not proven, but widely accepted assumption is that strong culture leads to company's success.

Knowledge management is a newborn interdisciplinary business concept of collective knowledge which final goal presents efficient implementation of knowledge in decision reaching situation. As a process, knowledge management involves people, technology and processes as mutually connected and overlapping parts. Concept of knowledge management can be defined with three components: information, people and information technology. Generally, it means that knowledge management demands finding of unique information technology from one, and creative and innovative human capacities, from the other side. Some advantages of management knowledge are visible at start, while others are very hard to define. For a company to get as many advantages from knowledge management, knowledge must be widely available, and mutual share of knowledge must be a foundation for cooperation [7].

The essence of knowledge management is in following: how to improve process of creation of new knowledge and how to thoroughly use existing knowledge which constantly gets outdated. Considering the fact that human resources present main bearers of organizational knowledge, it is vital to distinguish the treatment of such resources – whether they are players of strategic value or just an expense. Having in mind that organizational culture is a key subject in knowledge management system, efficient program of knowledge management demands corresponding culture that shares knowledge. In such surrounding people should be rewarded for knowledge sharing, and participating in the process is reward itself. Since change of organizational culture is not an overnight process, greatest challenge is how to make people share their knowledge instead of keeping it for themselves. In order to achieve this, it is necessary to change people's attitude and behavior. Traditionally, employees guard their knowledge because they believe, with reason, that sharing the knowledge means loosing the advantage and one's position in a company. According to their opinion, knowledge is power, and no one wants to loose it. Knowledge management system should make knowledge sharing attractive enough to make it last, not only for a company, but for individuals as well. Company that develops the right combination to motivate its employees to cooperate and share their knowledge, is on the best way to introduce a successful knowledge management system.

Basic characteristics of organizational culture ready to introduce knowledge management concept are [8]:

- Top management that sees knowledge as a main asset of a company and starts initiative and support for knowledge management processes;
- Company focused on development and exploitation of acquired knowledge;
- Clearly defined techniques and processes of knowledge management;
- Creation, share and use of knowledge as a natural part of organizational processes and consisting part of everyday work process;
- Availability of knowledge to all those who can contribute to it or use it;
- Communication channels and technology infrastructure which encourages knowledge management activities.

Based on previous, one can come to conclusion that best way to overcome human barriers to knowledge management program, is to implement it in organizational hierarchy. It is crucial for success of the program. Also, it is important to determine which from the offered program values is most important for the company. That depends on where the greatest potential for company's progress is set, considering determined strategy of development. Regardless of area company's focused on, principles of knowledge management must be in-built in organizational structure in order to achieve the optimal level of success. Share of knowledge in a proper way and seeking new ways to barrier demolition and implementation of knowledge management in organizational structure, will provide for users to fully exploit all benefits of knowledge management [9].

3. ORGANIZATIONAL CULTURE IN FUNCTION OF KNOWLEDGE CREATION IN A COMPANY

It is often thought that strong culture is by itself positive and imperative of business success. But, whether organizational culture is going to affect process of knowledge management in a positive or negative way depends on consisting values and beliefs as well as environment. Type of influence of organizational culture on knowledge management depends mainly on its content, not strength. Culture can positively affect motivation and dedication of employees, ease coordination and company functioning control, but, on the other hand, strong organizational culture with wrong presumptions, values and beliefs, disharmonized with environment, can have negative effect on company's success [6]. Some cultures create space and knowledge, while others are closed for knowledge or any kind of change. Charles Handy distinguishes four basic types of culture [10]:

1) Power culture
2) Role culture
3) Task culture
4) People culture

Basic characteristic of power culture is its orientation toward leader. Central value in this type of culture is authority, or belief that all decisions should be made in one place and that there must be a distinctive difference between those who decide and those that execute. Loyalty is primary value, not knowledge. Such are cultures of small family-owned business, as well as political parties, where everything is subordinated to power of one man and his unanimous friends. The person "in charge" is usually measure of truth and knowledge. Having in mind characteristics of power culture, it is obvious that it doesn't encourage growth and proactive doing, but obedience and sub ordinance.

In *role culture*, that is characteristic for set and bureaucratic organizational systems (public services, administration services and the like), procedures and rules are more appreciated than knowledge and changes. Power in this type of culture is derived from hierarchy position.

Task culture has best conditions for encouraging, development and creation of knowledge. It is characterized by project teams and can be found in companies where every task demands original and creative approach. Many call this type of organizational culture *achievement culture*. It relies on presumption the sole purpose of a company is to deal with assignments. Everything is work-oriented. People are not appreciated by their position in company's hierarchy, but according to their ability to attribute to completion of task. Power is derived from competency. Therefore, this culture accentuates results, and people are valued by their contribution to success. In other cultures, knowledge management concept is hardly applicable. That especially refers to those companies with culture of role and culture of power.

People culture (culture of support) is of a kind that is hard to find in a company. This sort of culture is based on assumption that purpose of company is to enable its members to reach their individual goals and interests. Focus is on individuals and their interests, while goals of company as an entity are entirely neglected.

Based on Charles Handy's typology, conclusion imposes that knowledge creating organizational culture would be the one where communication and coordination are emphasized, where employees don't keep their knowledge to themselves and knowledge sharing is encouraged and rewarded [10].

4. CHANGE OF ORGANIZATIONAL CULTURE

There is widely spread opinion in management theory and practice that organizational culture can be managed and everyone it refers to should be responsible for it. So, redefining organizational culture performances is something that should be done in order to create presumptions that would, in the long run, enable efficiency enlargement of company. It is all about dynamic process which includes development of existing performances of organizational culture that positively affect success of knowledge management process on one, and timely creation of new dimensions, on the other hand.

Changes of organizational culture towards reaching efficiency of knowledge management system are organized in several phases [11]:

1) *Identification of existing culture features* - in this phase it is necessary to get acquainted with existing values and beliefs in a company as well as identify areas that negatively affect success of knowledge management. Unless key and critical aspects of organizational culture for creation of knowledge are not analyzed and precisely described, there is no chance of successful and quality change.
2) *Defining characteristics of desired culture* - this phase is for distinguishing shared values, assumptions and norms of behavior which would in a best possible way help to achieve efficiency in company's knowledge management. When the goals are determined, next step is to define what needs to be done in order to make a change, as well as what are main obstacles for it.
3) *Identification of obstacles when acquiring desired culture* - with identifying main obstacles for change of organizational culture and their removal, we practically enter the most important phase, developing the strategy of change, improving and

promoting company culture which presents consequences of introducing new corporative culture.

4) *Developing strategies of change, improvement and promotion of company's culture* - reviewing relevant literature, three basic strategies are necessary to manage company culture [11]:
   - *Strategy of indoctrination* - starting point is assumption that changes of people's conscious is on the first place, while change of their behavior comes second. Realization of this method requires use of more methods which can be grouped in two basic groups which are symbol manipulation and conviction or learning.
   - *Strategy of cognitive dissonance* - based on change of behavior of employees which leads to change of their consciousness.
   - *Strategy of replacing people* - foundation of employees' attitude change. In this case, instead of changing elements of culture, this strategy changes their composition. People whose personal system of values and beliefs are compatible with desired cultural profiles are accepted, and those who can not fit in with aiming culture are removed. The last phase of change of organizational culture is monitoring and evaluation of changes.

It is a fact that organizational culture is sociologic category and as such presents inert system hard to change, while every essential change understands changes of its cognitive content. For top management to be able to control organizational culture, it is necessary for managers to be aware of organizational culture importance and to thoroughly study existing organizational culture and its strength. Only in extreme situations, when company is facing a deep crises business situation, it is justified to make radical changes of organizational culture which must be, even in that kind of situation, planned and timely run.

5. IMPLEMENTATION PROBLEMS OF KNOWLEDGE MANAGEMENT CONCEPT

Every change of organizational culture towards implementation of knowledge management concept is very complicated process, followed by many problems and hardship. One of the most significant problems is the problem of knowledge sharing. There are multiple reasons for people preventing them from sharing their knowledge with others employed in the company [12]:

- There is no satisfactory gratitude, nor reward for sharing knowledge;
- People are competitive by nature, believing the knowledge they have enlarges their strength;
- There are no adequate means and tools to gather and categorize knowledge;
- People are not familiar whether anyone would be interested in what they know;
- Individuals don't share their knowledge since they are not fully aware of what they know.

Having in mind previously said, to have a successful implementation of knowledge management, it is necessary to create organizational culture which would initiate, encourage and stimulate team work, trust and knowledge sharing between employees. Also, everyday encouragement and improvement of as many interactions among employees, within a team, between teams, between employees and managers on every level, is vital. Another important thing when implementing knowledge management concept is problem of workers' motivation. For organizational culture to support and motivate worker to apply knowledge management concept, it is important to enable [12]:

- *Personal development* – possibility for individual to achieve his full potential;
- *Operational autonomy* – working environment where workers can complete task they are given;
- *Completion of task* – ability to perform the job on the level and by standards and quality to which an individual can contribute;
- *Money* – earning salary as a reward for contribution.

In order to respond to every challenge of knowledge management concept, organizational culture needs [10]:

- *High level of autonomy for individuals;*
- *Respect for skill, knowledge and talent;*
- *Reduction of bureaucratic behavior;*
- *Awards for active sharing of knowledge;*
- *To support communication and coordination between both individuals and groups;*
- *To build climate of trust and respect.*

To evade problems of implementation of knowledge management concept, company requires organizational culture that will promote knowledge as most important source of competitive advantage and power. It is not about knowledge just for the sake of knowledge, but knowledge that can be applied, create innovation and competitive advantage. What is important is knowledge that has strategic importance for the company and enlarges its value.

6. CONCLUSION

In reaching economic performances and by that we mean competitive advantage, organizational culture has a dominant role. This influence is especially manifested in processes of initiation and realization of organizational changes. Process is successfully implemented when organizational culture is based on values expressed through change preferences. Otherwise, before starting the change process, it would be necessary to realize its redefinition and adaption.

Knowledge management is defined as a set of processes which manage creation, growth and reinforcement of knowledge in order to achieve organizational goals. In knowledge management context, great importance can only have such corporative culture that promotes high autonomy level for individuals, respect and reward for knowledge, talent and skill, sharing knowledge, decentralization, participation of employees in decision making, cooperation, flexibility, excellence. Also, these previously mentioned positive characteristics of organizational culture represent guidelines to eventual redefinition of corporative culture content in terms of acquiring efficiency of knowledge management system in a company.

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THE POLICY OF ENGAGEMENT AS A MANAGER OF HUMAN RESOURCES AND EFFICIENCY OF THE COMPANY IN SERBIA

POLITIKA ANGAŽOVANJA MENADŽERA KAO LJUDSKIH RESURSA I EFIKASNOST PREDUZEĆA U REPUBLICI SRBIJI

MSc Marko Pavlović[1] , MSc Mladen Stamenković[2] MSc Radica Pavlović[3]
Prof.dr Slobodan Stamenković[3],
[1] High Professional School for Entrepreneurship, Belgrade, mail: mpavlovic@aeb.vssp.edu.rs
[2] Faculty of Economics, Belgrade
[3] Graduate School of Business Studies,

***Abstracts**: Managers as well as human resources and high valuable assets of any company is characterized by high professionalism, expertise, knowledge and high level of education, skills, abilities and responsibilities, and all that is contrary to improvisation, amateurism and routinization. Necessary knowledge and skills acquired through continuing education and prakse.Just these human resources are in charge and responsible for the success of the company and its market position. Also, managers who manage all tangible and intangible resources including companies and other human resources. From which activity depends on the fate of the company, employees and even the development of the economy as a whole. Accordingly, management will analyze the situation in the Republic of Serbia and its implications on the efficiency of the same company.*
***Key words**: Managers, human resources, enterprise efficiency.*

***Abstrakt:** Menadžere kao ljudske resurse i kao visokovrednu aktivu svake kompanije karakteriše visoka profesionalizacija, stručnost, visok nivo znanja i obrazovanja, veština, sposobnosti i odgovornosti, odnosno sve ono što je suprotno improvizaciji, amaterizmu i rutinizaciji. Neophodna znanja i veštine stiču se putem permanentnog obrazovanja i prakse.Upravo ovi ljudski resursi su odgovorni i zaduženi za uspeh kompanije i njenu poziciju na tržištu. Takođe, menadžeri su ti koji upravljaju svim materijalnim i nematerijalnim resursima kompanije uključujući i ostale ljudske resurse. Od od njihovih aktivnosti zavisi sudbina preduzeća, zaposlenih pa čak i razvoj privrede kao celine. Shodno navedenom, analiziraće se stanje menadžmenta u Republici Srbiji i implikacije istog na efikasnost preduzeća.*
***Ključne reči:** Menadžeri, ljudski resursi, preduzeće, efikasnost.*

1. INTRODUCTION

Business and industry companies in each country and in the Republic of Serbia is primarily dependent on the available factors of production: land, capital and labor. The traditional understanding of work and labor means human activity directed at the conscious and organized action of man through physical and mental abilities of nature by means of work in order to create financial and other resources for the direct or indirect meet human needs. In the modern context, the term labor is replaced by the concept of human resources with the emphasis increasingly placed on the knowledge economy to achieve above average results than the commercial capital as a determinant of competitive advantage. Taking into account the characteristics and requirements of modern tendencies and trends in the global market can be said that human resources are invisible assets and businesses as human resources managers have a key role to achieve superior business results and competitive advantage of companies as they are the ones who manage all the resources available to the company regardless of size and availability of capital and other tangible and intangible assets exclusive of them depends on the efficiency of their use which is manifested in the final success of the company and its market position. In the context of the above will be considered Serbian state management and efficiency of business operations in Serbia.

Since the effectiveness of managers can only be measured efficiency of enterprise in which they operate and what is needed for adequate education, knowledge, skills and abilities of future work includes appraisal, to analyze the situation in the Serbian management to consideration of critical success factors and general management (primarily through selection) this specific and important category of human resources in companies.

2. SERBIAN STATE MANAGEMENT - LEVEL OF EDUCATION

A number of issues that occupy the economy and businesses create a need to review the situation in the Serbian context of their management education as it is only through this process can acquire the most appropriate knowledge needed for effective management services in the increasingly complex and turbulent conditions with a number of risks and hazards posed by the environment.

The totality of change and revitalization of the Republic of Serbia and its future socio-economic development [1] requires new, modern, efficient and effective management, based on the multidisciplinary management education and knowledge in a particular field economic and financial management techniques, methods and instruments. This especially becomes more important in conditions where the global economic crisis has left devastating effects of domestic companies by sticking to a vicious circle of lack of liquidity.

A number of studies and analysis indicate that Serbia does not have adequate management that is able to quickly and effectively respond to the key challenges posed by the environment [2]. According to the Labour Force Survey in 2010. year [3] a total of 2.396.244 persons employed 124 813 of them (5.2%) with interest of legislators, officials and managers (Table 1).

Table 1: Number of employees in the workplace legislators, officials and managers by level of education [1,2]

Level of education	No. employees	%
No school	-	-
Incomplete primary school	431	0,35
Primary school	5.094	4,1
Medium school	61.172	49
High school	15. 409	12,34
Faculty, Academy,	42.707	34,22
Total	124.813	100

As can be seen in the table in leadership and responsible positions dominated by employees with secondary education (49%) which is a very high percentage especially if one considers that this figure accounts for half of employees in managerial and responsible positions and was higher than number of employees with higher education. The situation is even more dramatic if we look at the number of employees in these positions who have a primary and incomplete primary education. Cumulatively, the total number of employees in managerial and responsible jobs without higher education is 65.78% which is an extremely high percentage. Although the percentage of this category of qualification run is simply unacceptable that in a modern and complex business conditions, which require a range of multidisciplinary skills to people with inadequate education level perform a range of management and responsible functions.

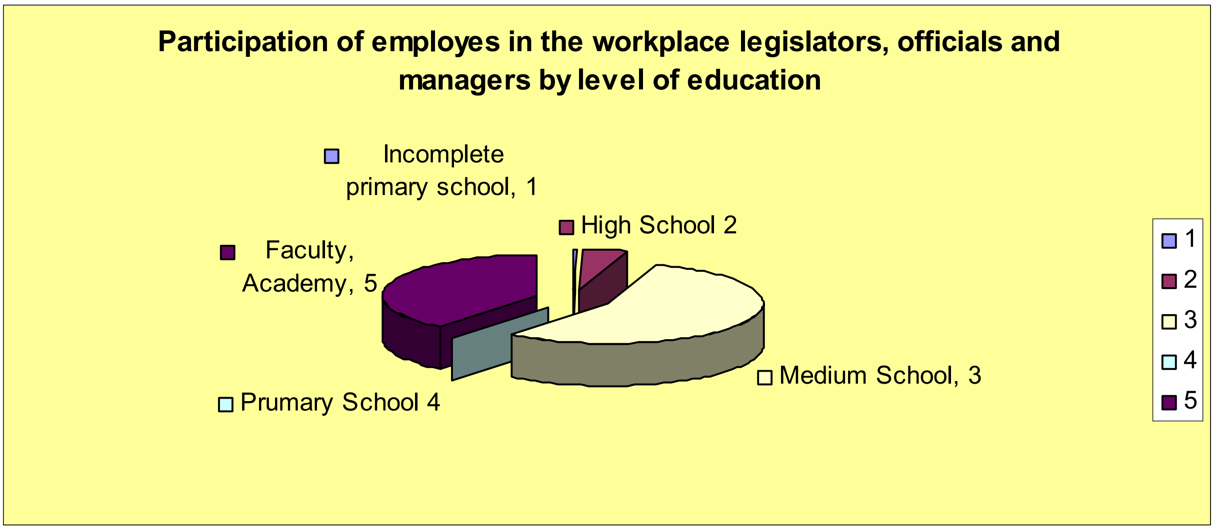

Figure 1: Participation of employes in the workplace legislators, officials and managers by level of education

3. IMPLICATIONS OF THE EDUCATION PROFILE OF SERBIAN BUSINESS MANAGEMENT AND EFFICIENCY OF COMPANIES

Companies doing business in the Republic of Serbia in a very unfavorable economic environment characterized by high inflation, the decline in employment, the decline in purchasing power, lack of liquidity of the economy and the high pressure of foreign competition fueled by inadequate exchange rate policies of the state. In such conditions, knowledge of economic and financial postulates are the *conditio sine qua non* that is placed in front of today's managers in order to overcome potential crises and failures, adequate management of business portfolio and maintain business performance. The results of the financial performance of companies in Serbia are given in Table 2.

Table 2. The success of business enterprises in Serbia, 2008-2010 [4]

u 000 din

Position	2008.	2009.	2010.
Total revenues	6.781.782	6.328.036	7. 116.539
Total expenditures	6.791.428	6.409.342	7.184.563
Loss	**9.646**	**81.306**	**68.024**

The data in Table 2 show that the period of 2008-2010. The Serbian companies operated at a loss. In 2009. year, the company operated at a loss of 81 306 million dinars as compared to 2008. year loss increased by a whopping 843%. U 2010. year the company also operate at a loss that is smaller than the previous year 13 282 million, or 83.66% lower but is still 705% higher compared to 2008. year. Based on the data presented is not difficult to see that Serbian companies do not operate efficiently and that the coefficients of efficiency and profitability on a reasonably low level. Cost-effectiveness ratios were observed in all years is less than 1 (in 2008 - 0.99, in 2009 - 0.98, in 2010 - 0.99) and overall profitability ratios show a negative return on assets employed.

In addition to efficiency analysis should be noted that according to the National Bank of Serbia Blocked businesses in early 2011. totaled 63 031 (of which 23 609 39 422 companies and entrepreneurial activities) [5] ,as compared to the total number of registered businesses in the 331 164 indicates that one in five business subject to the phase lock. If we add the fact that in Serbia in 2099 the company bankrupt, that in 2011. year 8893 the company whose accounts have been blocked for two continuous years, acquired a condition for going into bankruptcy automatically to thecourt day arrives more than 25 proposals for bankruptcy, the Agency for Business Registers, only on this basis, every day extinguished by 30 companies, it is not hard to see and make judgments about the importance of proper management of the knowledge based primarily on economics and finance .

Given the condition and characteristics of the economy and companies in Serbia, it is necessary to analyze the available personnel in the educational function of a promising improvement of Serbian management and retrospective utilization of this valuable resource in terms of the recent past and the solution is a doubt whether the recruitment of human resources, or random is the result of conscious activity.

Serbia has the highest rate of unemployed with higher education by 13.1%, compared to other countries. The 27 European Union countries, the average unemployment rate of higher education is 5.6%. Above average unemployment rate is: Serbian (13.1%) Croatia (8.8%) and Slovakia (6.6%) [6] .The total number of unemployed university graduates, high school or academy is 44 911, of which 35.1% of those seeking work for more than four years, 44.7% of those who lost their jobs due to company closure (ownership transformation, bankruptcy and liquidation), ie. with work experience. Structure of unemployed university graduates, academia and high school by age is shown in Table 3.

Table 3. Structure of unemployed persons who have completed high education by age in 2010. [2]

The age	Percent
20 - 24	12,3
25 – 29	33,8
30 – 34	18
35 - 39	5,8
40 – 44	5,7
45 – 49	7,5
50 – 54	5,4
55 – 59	9,4
60 – 64	1,7
65 and more	0,4

Comparing data from Table 3 with data from Table 1 can be reached to the conclusion that Serbia has a large number of people without higher education employed in workplaces legislators, officials and managers (82.106) with one hand while the other 44.911 working-age population with a high education does not even work. Number of unemployed educated people can absorb 55% of employees in managerial positions with the vast majority of those who have work experience. So on the basis of the presented indicators could be concluded that still lacks an adequate number of highly educated personnel for leadership positions in Serbia, but we should not lose sight of the fact that there is a higher population working and whose jobs are not substantially related to the profile of higher education and whose number is not entered into this analysis (for example: work at the counter in banks, low demanding administrative work, etc..). It should also be taken into account that in many companies and institutions working in managerial positions, as already pointed out, people without higher education, while in those same companies that employ highly educated people working on the so-called regular administrative duties. In addition, it is people who are employed in these highly responsible positions are the ones who make decisions about future employment in the enterprises where they work, so the question of whether those without adequate education, the criteria are effective in recruiting, selecting and hiring new people. These data clearly illustrate the situational picture management in Serbia, which is in all material respects reflects the operations of the company and the situation in the Serbian economy.

4. CONCLUSION

The unfavorable economic environment in Serbia is mostly caused by inadequate macroeconomic policies and in part uneducated and unprofessional management. In our country, on the one hand the total number of employees in managerial and responsible jobs is 65.78% without higher education while on the other hand the total number of highly educated people who were unemployed was 44 911.

Enterprises of the Republic of Serbia in the period 2008-2010. The loss-and below the efficiency of one fifth of the economic entity is under blockade. In Serbia, missing Managers with good knowledge of financial management and enterprise data as evidenced by the large number of companies that go bankrupt as well as data on the liquidity of Serbian companies.

The negative implications of the Serbian state management of enterprises and the whole set of changes and revitalization R. Serbia and its future socio-economic development requires new, modern, efficient and effective management, management based primarily on education and knowledge in a particular sphere of economic and financial management techniques, methods and instruments.

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NEW TECHNOLOGY WORK FOR IMPROVING QUALITY OF HUMAN RESOURCES

NOVE TEHNOLOGIJE U FUNKCIJI UNAPREĐENJA KVALITETA RADA LJUDSKIH RESURSA

Slobodan Stamenković[1],
Radica Pavlović[1]
Marko Pavlović[2] ,
Mladen Stamenković[3,]
[1]Graduate School of Business Studies, Požarevac
[2]High Professional School for Entrepreneurship, Belgrade
[3]Faculty of Economics, Belgrade

Abstract: *Technological change versus the previous practice of the basic factor of economic growth in transition countries. Complex technological change should be incorporated into the educational, legislative and institutional arrangements in order to produce the desired result in the management of human resources. Human Resources as the bearers of business activity and innovation have to acquire new knowledge, through a process of education, the use of new technologies, new products, new ways of communication and culture, and analyzes the processes between the changes in technology - science and education - transition - economic growth.*
Key words: *technology, transition, education, human resources, economic growth.*

Apstrakt: *Tehnološke promene nasuprot dosadašnjoj praksi predstavljaju osnovni faktor privrednog rasta zemalja u tranziciji. Kompleks tehnoloških promena treba biti inkorporiran u obrazovne, zakonodavne i institucionalne aranžmane kako bi dao željene rezultat u upravljanju ljudskih resursa. Ljudski resursi kao nosioci poslovnih aktivnosti i inovacija moraju sticati nova znanja, kroz proces obrazovanja, za upotrebu novih tehnologija, proizvodnju novih proizvoda, načina komuniciranja i nove kulture, te su analizirani procesi na relaciji tehnološke promene – nauka i obrazovanje – tranzicija – ekonomski rast.*
Ključne reči: *Tehnologija, tranzicija, obrazovanje, ljudski resursi, ekonomski rast.*

1. INTRODUCTION

Entering into a new technological era opened the doors to new production orientation and appearance of a wide range of new technologies. The term of the new technology are: microelectronics, computer science, artificial intelligence, telecommunications and manufacturing automation (robotics), biotechnology and genetic engineering, new industrial materials, alternative energy, lasers, etc.. The main features of origin, development and implementing new technologies in modern industrial society and business are the interconnection and mutual influence of new technologies, the universal character of the new technologies - are spread across all industries and service industries, changing their mode of production and new technologies accelerate the process and beyond internationalization of production and division of labor and the increasing interdependence of producers worldwide. Due to lack of information on technology, uncertain benefit or high cost of learning, enterprise investments in new technologies may be relatively low. At the system level failures may result from weaknesses in the relationships and interactions between different actors in the national innovation system. The effects of globalization are reflected in the company's operations so that they want information relevant to business enterprises, not only from their own country but from around the world, and we want to focus more intensively involved in the modern forms of business such as the Internet business. Technological sophistication in Serbia is assessed as extremely low. Economists agree that the constant innovation source of competitive advantage, but point out that lack the resources for them. Own research is almost non-existent (except pharmaceuticals). There are no subsidies for research and development activities. The solution can be seen in foreign direct investment (FDI). Technology Index, the index value of 3.16, our country is far behind all the countries in transition (near the Ukraine, with an index value of 3.68). The countries of the region, the worst is Bulgaria, with a significantly higher value index of 4.32. The weakest sub-index in the index (relative to other countries) is related to information and communication technologies (2.15, ie 75. Place) and only slightly better innovation sub-index (1.79, ie 65. Place).

Be sure that the problem in Serbia to introduce new technology brings to the fore, and it is often a question of our willingness to adopt new enterprise application to the modern working, looking for new technologies, the resulting change in the concept of production (large-scale, hierarchical, giants - the diversity of economies, flexibility, versatility and diversity of small and medium enterprises). The next show is the basis of change required.

economies of scale (ekonomija obima) → ***economies of scope (ekonomičnost obima)***

Management of new technologies and innovation as the key resource of modern business, the most important part of strategic management in modern companies. Question of the concepts, techniques, tools and management processes are the basis of successful technological innovation is the key issue of success management new technologies and innovations, as well as modern business firm as a whole. The technological revolution and information-technology paradigm, a complex of activities of science, knowledge and information as the core of the center, have changed the fundamentals of business activity on a global scale and create prerequisites for a new economic and social context, which is commonly referred to as a knowledge society, information society, digital economy, network economy or e-conomics. New technologies in the field of information and communication, especially the Internet, according to an editorial in the new era.

2. NEW TECHNOLOGY - CHANGE OF DIRECTION

Performing basic technological processes of each company is a key task and necessary element of all employees. Therefore, it is a human work invested and the presence of human resources as the foundation technology of work. The functioning of the system and organization of work and activities of the technological process it is impossible to imagine without the proper support of qualified human work. Access to new technologies is still far from reality for the vast majority of people employed, especially because the greater part of the Serbian industry reaches only the second level of technological potential, the scale of 1 to 15 Without the participation of foreign capital of our company can renew their programs on average within 20 to 25 years. She involving foreign accumulation and management can do for 3 to 5 years. Technical backwardness of our economies of the industrialized countries of Europe is about 5-6 years of technology, which is the time dimension is equivalent to 30-35 years. Many countries, especially the most marginalized rural population, to a large extent been omitted from the information revolution because of the absence of basic infrastructure, high cost of their construction and development, lack of new technology, and certainly lack the basic knowledge of computers in the mainstream English language on the Internet and generally speaking failure to recognize the application of new technologies. Development of technology to the extent that changes once the basics of basic physical work becomes replaced with the machine during operation of machinery, to a certain intellectual activities of man have changed with the work of new information technologies, particularly the introduction of computers in all aspects of human activity, especially in technological processes work. Thus, the historical development of work is significantly changed, which is reflected in a series of changes.

3. CONSEQUENCES OF APPLICATION OF NEW TECHNOLOGY IN THE FIELD STAFF

The impact of technology on employment and employment is also manifested through the disappearance of certain jobs and occupations with labor market with the simultaneous emergence of new businesses and creating new jobs. Certainly one of the important consequences of the introduction of new profiles that knowledge, skills, and even entirely new occupations that need to be educated in the educational system. Therefore, the agents of change in the educational system of each country are facing serious task, particularly because a slow and cumbersome system of education in Serbia is a typical example of how hard it comes to the introduction of new professions in education. The changes caused by the introduction of new technologies in the field of personnel are:

- The necessity of increasing the qualifications of employees - it will be almost completely shut down the need for unskilled labor force,
- The need for retraining - a new, additional qualifications,
- The necessity of universality of qualifications - should be more flexible human resources in organizations,
- Reducing the working week - more time for employees,
- The need for creativity employees - new technologies require less routine and more complex tasks,
- Flexible positions - not necessarily always stay in the organization - can be a work at home, on the ground, in a network of computer systems.

Human resources are a significant factor in the technological system and are a key segment in the application of new technologies and their adaptation to changes caused by new technological elements are the basis of technological development. Human resource management is therefore dominated by the applications of new technologies and the impact on jobs and employment. Of these the people we are working with or will work, depends on how successful we will be and how much care and satisfaction will make us work together. Although it seems that everything is clear and understandable, the fact is that many organizations are facing great difficulties caused by the inappropriate choice of people and staff to the wrong setting, they are not suited jobs - which is actually a consequence of lack of preparation and human resource managers. It is obvious that the proper work in this area is necessary, above all, strategy and planning for future recruitment of staff for custom application of new technologies - new competencies of employees, as well as the adoption of the essential elements of selection and recruitment.

4. EDUCATION STAFF

The system of education of staff is an important part of any national policy. Therefore, great attention is paid to specific occupations, skills and knowledge required are necessary to work in terms of new technologies. Of course the big question is how that works, given the increasing technological changes and rapid technological development. This problem is particularly present in the transition conditions. Characteristics of staff as the input of the technological system are:

- Continuing education of staff - the subject of policy, especially in qualifying, re-training within existing organizations, in line with new technological elements in the work process.
- The quantity of personnel - the main question is how long it takes employees by introducing new technologies? Advanced technology and the changing structure of employment often requires reducing the number of officers, while higher requirements to the quality of human resources.

Analysis of work in every organization and company are the basis for the application of new technologies, which in turn means that it must determine the total value of capital, labor, equipment, resources and staffing and then determining the technological level of work in increasing productivity, which is expected with the introduction of towards new technologies and more - the expected number of employees and their qualitative structure. Adaptability to work in technical equipment, innovation, new machinery, computerization, networking - all these new demands placed upon employees and the receipt of new workers. It is often the case that these are obstacles that seem insoluble. Modern management knows the key term - permanent education. As the modern organization - the "learning organizations", so the current and future employees must constantly learn.

There are a number of key issues for survival in today's turbulent market, and especially how the education of staff and where the reasons for low levels of their quality. A common reason is the education system itself, which is a slow time for change, then the resistance of the very people who do not want to adapt to new educational needs. It is also important that the organizations themselves respect the principle of lifelong learning - that is, until now, required a visionary thesis of "lifelong learning". Certainly this applies to the management itself and the companies no longer a rare picture that managers in training, training that are tailored to the introduction of new technologies, their implementation and the possibility of transmission of new knowledge and to employees. An elementary example of the necessity of continuing education computer education, which is becoming an imperative for all workers and managers, of course. Today's society is evolving in the Information Society. This technology becomes a tool in the service information, and information - knowledge, power and money. Speed and efficiency of application of information technology and the adoption of the staff will become the main factor for the development of growth companies. The educational structure is a very important indicator of success of one sector of the economy. The higher the level of education, especially in sectors in which new technology is present, which largely depends on a skilled workforce, it is and its very favorable development. Research shows that managers of companies with new technologies tend to have higher education, in 80 percent of cases. Over two thirds of employed university graduates. So the percentage of highly educated people is a competitive advantage in this sector. Employees in these companies are relatively young with an average of 35 years. This is an effect which is very important: the requirements for higher education, as well as the relatively young employees (it is very difficult to find in the labor market top managers of mechanical, electrical and graphic profession of higher education with a strong knowledge of new and modern technology work).

4.1.METOD EMPLOYMENT IN ENTERPRISES WITH IMPLEMENTED A NEW TECHNOLOGY

Enterprises are available to different methods of finding the work force. Most commonly applied methods are vacancies, labor market and recommendations, which most companies and uses. From the most popular method of selection testing and interviewing candidates. Personality profile in the selection of personnel for the performance of which requires knowledge of the new technology is extremely important. Most of the business is extremely important that the level of education of employees is as high as possible, then come the knowledge and experience and any of the companies with new technology. Conditions are often computer skills, foreign language, knowledge of the newer machines.

4.2. INVESTING IN EDUCATION

So often lately was going to training in other countries where it has implemented a new technology work in the same multinacional company. Also interesting is the recruitment of adequate staff, who agreed in advance with many colleges. The most common type of training the workforce in local economic practices are certainly seminars, language courses, as these are prerequisites for future implementation of the recent achievements in the work of the company. Payment of fees on specialist studies (bachelor, master and PhD) is ready to finance small businesses. According to the conclusions of the Commission for the Education of the Council of Europe (Lisbon 2000), we set forth the goal that the European Union to become the most prosperous and dynamic community with an economy that is based on knowledge and education. One of the most important initiatives in the world today is certainly the concept of lifelong learning, which has become a major determinant of social, economic and educational policies in the world. Its feasibility depends on the competence of individuals to find orientation in IT. It points to the fact that the initiative in Europe down to create a technical infrastructure and computer literacy of citizens. Technological development has destroyed many obstacles and requires a lot of exploitation of human resources as well as excellent knowledge of IT skills, and through them to get opportunities to build literacy. In this context it is certain that education is becoming strategically important activities causing pressure on university students, massification of education and changes in relation to the question of who teaches. More and more people are included in the higher education system. This tendency is characterized by the category of "nontraditional" students, or employees, people who have left the idea of a job for life, and that it is training and renewal of knowledge involved in the education process. This leads to the massification categories of distance learning, which provides greater accessibility and availability of education, flexibility, individualized and active learning, which leads to confirm observations - allowing many people to reach the level of computer literacy for the 21st century.

In the UNESCO study in 1994. The claim that the "digital gap or gap" that because of the rapid advancement of new technologies creates the danger of division and inequality, not the gap between rich and poor. The largest gap occurs within societies, between those who know how to use new technology and those who do not possess the necessary skills and knowledge. It must be noted and globalization as a process of great importance to developments in the world. As the process of interdependence of countries in almost all areas, contributed to the competition of thoughts, ideas, knowledge and made a great impact on the development of information society of today's world. At the global labor market is a significant demand for the top professionals in the IT field, which will contribute to the development of society as a whole. Tendencies of changes in higher education and its harmonization effort is also a result of technological development and progress. Modern achievements have been reached today with the joint cooperation of different social segments, with the participation of powerful companies and high application of knowledge and new technologies. Modern science is characterized by joint projects of different universities that have implemented means of transnational companies and are used in all developed economies. The participants in such projects on a global scale are becoming leaders in the field they are dealing with, primarily contributing to the development of their national economy, raising the competitiveness of its educational institutions and personnel, but also contributing to the development of mankind in general.

World Declaration on Higher Education emphasizes the crucial role of higher education in building a society based on principles of democracy and equality. The future of every young professionals based on knowledge and education as a single category, which is the premise for the success of any society. In designing the curriculum of ITS have been accepted world standards of education in the field of computer science, as well as their experiences from many years of working in the field of IT education. From world-accepted standards in the field of computer science education, embedded in the curriculum of ITS, stands out from the Computing Curricula, standards developed in the United States, by the most renowned international IT associations such as IEEE-CS (Institute for Electrical and Electronics Engineers - Computer Society) and ACM (Association for Computing Machinery). The development of this document, which contains more than 200 pages, was done for more than ten years. This standard takes into account the dynamic and steady development trend of the changes in the IT field, constant new market demands and needs of society in terms of planned economic development. The main objective of this document was the harmonization of traditional university education system, with all the dynamic development of IT technologies and increasingly complex demands placed upon future graduates by potential employers. Went a similar path and Europe by forming associations of professionals in the field of IT technology CEPIS, which is similar to the United States, created a standard for education in computer science called EUCIP Syllabus. This standard is being used in EU countries, also aims to reduce the lack of qualified staff in the EU. This standard also provides a detailed description of each subject and content of educational programs for them. The life of a successful educational institution follows the existence of feedback and to work with the stock exchange, market and their own students, with that after graduation they do not lose connection, but their work is monitored through their suggestions and recommendations to modernize and supplement the curriculum. With the labor market to follow the market needs (short and long term) for the IT staff. In addition to numerous (quantitative) requirements, will be carefully monitored and the need for new occupations (quality requirements), which had never been recorded. That way you can react immediately in order to supplement the curriculum areas that relate to new occupations. Computers and the Internet have changed our world, but their ultimate impact will be much more significant than was the case until now. How is technology being developed, will play an increasingly important role in education, business, government, economy and society.

5. IMPACT OF NEW TECHNOLOGY ON PRODUCTIVITY

Productivity is a measure of economic efficiency which shows how effectively economic inputs of size (inputs) are converted into output values (outputs) of the system. Economic growth in each country or in certain areas of activity (production of goods and services of all kinds) can be achieved in two ways to increase the number of employees in the production of goods and services and increasing the productivity of existing employment. Increase in productive labor and capital spear in industrial and other systems reduce unemployment in each country. In order to create conditions for economic growth in each country it is necessary to know the basic influence on the growth of labor productivity, such as the introduction of new equipment in production processes, improvement of infrastructure, human capital movements, the introduction of new technologies and the like. The main criterion for assessing the business and other ventures to ensure economic growth is considered to be realized productivity of labor and capital in industrial systems, certain sectors of manufacturing and service industries and the country as a whole.

Labour productivity is certainly one of the basic indicators of the application of new technologies in the enterprise. The ratio of the total products and invested labor, that labor productivity is constantly increasing since the low demand for human labor required per unit. It is thus a tendency to increase the productivity of human labor and the consequences of the application of new technology features:

- Reduce the need to invest one's work-a result of scientific and technological progress;
- Replacement of direct investment of human labor by-using other resources-using modern and sophisticated means of work (new machines and devices).

The barriers that exist in the application of science and new technologies are characteristic especially in information technology. Frequent computer illiteracy, especially among women and endangers the principle of gender equality in employment. On the other hand the use of other resources (in this example a computer) might impact the old principle of saving jobs. Therefore, the already mentioned principle of lifelong learning as a way out there again. To requests for use other resources instead of direct human labor could be applied - the necessary first of all training, training and education, and added (is not uncommon for people supplementary education in the 50 years of age). Information and communication technologies have led to increased employment, and indirectly to increased productivity. Modern employers becomes a key issue in productivity work and accepting the overall changes in the business-especially in the exploitation of new technological developments. The development of production, even the service system must include a different human labor, adapted to new technological demands.

6. CONCLUSION

Today in Europe - where unemployment is high in many countries there is widespread support for a shorter working week of 35 or even 30 hours, because of technological advances, there is no longer enough work so that all workers have jobs full time. The proposed solution assumes that each worker works fewer hours (with the same wage per hour) in order to be able to hire more workers!

The argument that technological progress causes unemployment is certainly not true. Very great improvements in living standards that developed countries have made during the twentieth century have brought about a rise in employment, but also an increase in the unemployment rate (may occur in the labor market). In the U.S., the domestic product per capita after 1900. was increased 6 times. Japan and the United States, the countries with the highest heights of productivity, the lowest unemployment rates among the OECD! The question is where the fears of technological unemployment? Probably coming from so far neglected dimension of technological progress, structural changes in the economy triggered by technological progress. For some workers, whose skills are no longer in demand, structural change can actually mean unemployment or lower wages, or both. New machines and new methods of production require highly skilled workers, now even more than in the past. The development of computer workers requires increasing computer literacy.

New methods of production require that workers be more flexible, more adaptable to new tasks and new modern machines. The conclusion imposes itself: the impact of new technologies on employment supports the fact that the current or future employees expect a new commitment, new knowledge, new skills and maximum education. Employment declines in some sectors, which is the natural consequence of new technologies that require fewer workers, while creating new jobs in industries where knowledge is the application of new technologies is necessary. The new global economy requires highly specialized workers, who must be well educated, flexible and highly motivated, and willing to adapt rapidly to current market demands. Workers are faced with increasing stress and changing conditions in the light of accelerating technological and structural changes. New technology and global exchange of information have the potential to change the world of work even more than the industrial revolution.

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ON THE REASERCH OF CAUSE OF POOR DECISION MAKING IN THE MANAGEMENT PROCESS

ISTRAŽIVANJE POGREŠNIH ODLUKA U UPRAVLJANJU

Zoran Čeganjac[1], Jelena Kostadinović[2], Milutin Đuričić[3], Zagorka Acimovic-Pavlović [4], Ljubiša Andric[5]

[1] Umetnička škola, Užice, Srbija,
zorancega@ptt.rs
[2] PTT, Užice, Srbija[2]
[3] Fakultet za Industrijski menadžment, Univerzitet Union Beograd
[4] Univerzitet u Beogradu, Tehnološko-metalurški fakultet, Beograd, Srbija
[5] Institut za tehnologiju nuklearnih i drugih mineralnih sirovina Beograd, Srbija

Abstract: *Starting from basic determinants to define the term of human fault as an event, and a typical human behaviour, we can comprehend all the complexity and diversity of this phenomenon. Causality criteria prevail there, as well as the nature of the event itself. In the scientific sense, research object has interdisciplinary character. Scientific crossroad can be located between social, natural and humanitarian sciences.*

Key words: *frequency, cause, analysis, poll.*

Apstrakt: *Polazeći od osnovnih determinanti ljudske greške kao događaja, i tipičnog ljudskog ponašanja, možemo shvatiti svu složenost i raznovrsnost ovog fenomena. Kriterijumi kauzalnosti preovladavaju, kao i priroda samog događaja. U naučnom smislu, istraživački objekat ima interdisciplinarni karakter. Naučna raskrsnica se nalazi u preseku interesovanja društvenih, prirodnih i humanitarnih nauka.*

Ključne reči: *učestalost, uzrok, analiza, anketa.*

1. INTRODUCTION

Human life, and especially his crucial intentional activity –work, is infused with minor or major mistakes. Studying frequency and causes is highly important for an efficient and productive work in all spheres of human life. Analysis methods differ and are dependant on a concrete research objective.

With this kind of ethno-psychological approach to the nature of human fault and with this way of contemplating the same, there is a doubt whether it is possible to control so deeply enrooted human habits. To control a human habbit to make mistakes is the same as to control one's entire life.

2. HUMAN FAULTS

They are the consequence of a number of reckless, uncontrolled and undesirable deeds, and they may have minor or major consequences for one's overall behaviour and health. In that sense, some human faults may be imperceptible and momentary, and some may be fatal for the fate of its actors, witnesses or those affected by such circumstances. In any case, regardless of their causes, reach and thoroughness, consequences of human fault are an inseparable companion of one's entire life.

As a valuable and significant phenomenon, human fault deserves a more engaged approach not only by practice in which it is manifested, but also by the science itself. With its utilization value and social significance in particular, this notion deserves that.

With multiple causality and even wider consequences, these, so frequent, phenomena deserve a multidisciplinary approach of discovery, analysis and interpretation. Scientific curiosity and scepticism should and must be more often focused on this notion, its causes and its favourable and adverse consequences. Scientific crossroad might be located in the field of interest of social, natural and humanitarian sciences, especially in that of organization of work, occupational medicine, occupational and organizational psychology, ergonomy, ecology. In that effort, an interest may be found in scientific-expertised fields such as safety at work, management science, information studies, occupational studies, phorensic sciences and activities.

3. RESEARCH

The process of decision-making, i.e. management in general, is related to its carriers, i.e. humans; therefore, the approach is oriented to the human side. Success of business decisions and efficiency of their implementation are caused by absence of wrong moves, regardless of their origin.

Either the latest studies, carried out during the last decade of the past century, keep the same direction in treating the issue of causality of human fault within an organization. So, based on self–obtained results, Van der Schaf (1992) concludes that "each time a manager, foreman, procedure or an equipment part behaves in an unexpected way, thereby preventing productive system from prospective collapse or re-establishing the safety and reliability levels required, these positive deviations may be found, reported and analysed in order to improve quality insight in the functionality of the system in general".

Operational determination of the subject of research referrs to the relation between frequency of wrong decision-making and occupational, personal and social characteristics of the doers.Concrete subject of research is a cause-consequence relation between individual and organizational particularities of the employees and their perception of human faults within the organizations they work in, as well as attitudes towards these notions, especially those created during the process of business decision-making. The subject of research is thus oriented not only to the fault frequency, but also to its weight (damage).

The carriers of notion being the subject of reasearch are those employed as executives or managers , engaged at different levels of this activity. In fact, operationally active population is included, engaged in both private and public sectors , from various economic and non-economic fields.

3.1. OBJECTIVE

The aim of the research, carried within the scope of our study, is, in a social sense, rising of excellence of a complex activity of business decision-making and management and organization in general. Thus determined objective is derived from the subject of research and it represents a suitable social justification.

In the scientific sense, the aim of the research in this work, although it was methodologically positioned for analysis of cause-consequence relations between dependant and independant variables, is mostly positioned in the sphere of a scientific description with a tendency to be scientifically classified and typologized.

3.2. HYPOTHESES

General hypothesis in this research is based on the assumption that some of individual and organizational characteristics of the employed people in and out of the economy influence their perception and attitude towards human faults in decision-making. Already at the research design stage, which will be contained in our phD dissertation, several special, i.e. individual hypotheses were derived from the general hypothesis.

4. RESEARCH METHODS

Data collection required to conduct the research was done by the examination method as a basic research method, common for the issue of organizational behaviour of humans.

The research included the employed population in Serbia; mostly the employed from the regions of Uzice, Pancevo, Cacak and Belgrade were sampled. The polled belong to various educational, living and status categories.

During a long lasting procedure of data collection, the total of 823 questionnaires was applied. In the research, the examination method was applied as a basic research method, i.e. data collection method; and, in the scope of its techniques, a poll with a standardized questionnaire in which a closed type of items prevailed. Raw data obtained were checked by technical and logic control and then processed with suitable statistic models (parameters) of descriptive statistics and conclusive statistics. Final statistical data processing was carried out by a multiple corelative analysis and by the analysis of difference significance.

The poll was carried out with a suitable customized questionnaire, with a conventional data collection procedure. The questionnaire consisted of the questions used to define individual and organizational characteristics of employees.

Data processing procedure was conducted with application of adequate statistic procedures and parameters of descriptive statistic methods and statistic conclusive methods. All of that was aimed to check the established hypotheses by analysing the significance of the statistic indicators obtained and of their differences.

Descriptive statistic methods include those statistic methods which deal with collection, classification and analysis of statistic data. Its aim, but also its reach, is to describe the observed notion or process in the measuring domain. During research data processing, arithmetic mean value, mode and mediana were applied as a common methods of descriptive statistics. A bit more complex statistic methods of calculating the variance and standard deviation were also used. In further data processing, statistic analysis was derived by calculating corelation parameters (C coefficient) , which was tested by a conventional H2 test and its df significance. The entire procedure of statistic processing was carried out by application of an impressive software package of statistic measures (PSSB).

5. RESULTS

In the concrete research, many working and business organizations different in size, excellence and ownership were sampled.

In the concept approach of presentation and interpretation of the data obtained, a usual procedure was chosen., meaning that the results were interpreted in the functional context of verifying the given hypothesis and their variables.

Data collection, i.e. the poll, was carried out by a standard procedure. Depending on actual situation, the questionnaires were applied either individually or in a group , with a lower (2-4) or a higher (10-15) number of the polled. All the polled were instructed as usually, with special information that the research results would be exclusively used for scientific purposes.

Raw scores collected by the research were processed by primary techniques of descriptive statistics. Frequency distributions were given including their percentile processing with valid and cumulative percentiles. The data were further graphically shown in histogram columns through their modified grafical version of a circle (cake).

CONCLUSION ON RESEARCH RESULTS

According to the answers obtained, the cause of faults should be mostly looked for in human nature, habbits, carelessness, stressful reactions (36,21 %). A significant share of the faults made is attached to infavourable working conditions (20,53 %), but also to insufficient training of workers (16,28 %).

The polled being qualified higher, those elder and more experienced more frequently point to stress and motivation, while the younger and less qualified at inferior managing levels point out working under pressure and poor communication. It is particularly characteristic that the polled employed at managing job positions more often point out stress as the cause of human faults in a working situation.

It is common for all groups that participants agree that the factors causing faults in decision-making are: bad conditions within the organization, working uder stress, poor motivation and negative atmosphere in general. An encouraging fact noticed during analysis of the data collected is that the employed people are aware of the presence of faults and of their influence on productivity and efficiency of the enterprise they work in. This can be a good incentive for the managers of immediate and higher level and for the managers in general, because various workshops, trainings and improvement of the business atmosphere within the organization may be used to significantly reduce the level of emerging faults and thereby improve efficiency and effectiveness of the organization.

PROSPECTIVE RESEARCH RESULTS LIMITATIONS

Collected and analysed results of the conducted research undoubtfully confirm the basic assumption that individual and organizational particularities of the employees influence their attitude towards the faults made. It means that either separate and individual hypotheses have been verified by the results obtained. Although the research results confirmed majority of explicite and implicite assumptions, on that basis, it is not suggested to draw conclusions on a direct influence of individual and organizational characteristics of the employees on the way of their perception of human faults created within organizations, as well as on attitudes towards the same.

The limitations are derived from noticed incertainty of basic attributes of the notions being the subject of reasearch. It primarily referrs to human fault which concept has not beeen precisely defined, but vaguely placed in the instrumentation for data collection. Such human fault incertainty could have been especially reflected to an estimate of the polled, i.e. employees. It is similar with the other notions which were methodologically classified in both dependant and independant variables in the research. Due to that, it is necessary to note that the conclusions presented are observed in the context of limitations imposed by the draft and the conducted research procedure.

The sample of 823 polled taken from the population of operationally active population is relatively numerous for this kind of study, allowing application of key techniques of statistic treatment, i.e. it enables relative credibility of the results obtained. Anyway, due to the sample taken being specific, especially with regard to the time of research (poll) , the results of our research may relatively certainly be extrapoled to notions, i.e. employees in a highly turbulent transitive situation. Limited validity of the data obtained is also due to certain sample disbalance per some individual and organizational particularities. This is due to the lack of a pre-research procedure, which exploring function would have provided more adequate sample systematization to population but also to the processing of the data obtained.

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THE IMPORTANCE OF CONFLICT MANAGEMENT IN INTERNATIONAL NEGOTIATIONS

ZNAČAJ MENADŽMENTA KONFLIKTA U MEĐUNARODNOM PREGOVARANJU

Srđan Žikić[1], Igor Trandafilović[2], Zoran Stojković[2], Vladan Milojević[2]
[1,2] Faculty of Management Zajecar

Abstract: *One of the most important activities of internationally oriented manager is negotiation. Successful international negotiation is possible if managers understand the rules and cultural differences of participants from different parts of the world, and the goal of negotiating is exchange of views and ideas, the pursuit of agreement, positive and creative communication. Successful international negotiation is possible if participants understand the rules and cultural differences from all over the world. Negotiation is a social process and as many cultures and countries in the game, the process becomes more complex. Because of the large cultural differences and lack of understanding, conflict is an integral part of international negotiations. In order to achieve effective international negotiations and maintain good human relations, skills of effective management conflict are essential. The results of research, which included a sample of 75 respondents in the internationally oriented companies, showed that cooperation is a dominant strategy in interpersonal conflict management.*
Key words: *international negotiation, conflict, conflict management*

Abstrakt: *Jedna od najvažnijih aktivnosti međunarodno orjentisanih menadžera predstavlja pregovaranje. Uspešno međunarodno pregovaranje je moguće ukoliko se razumeju kulturne razlike i pravila učesnika iz različitih krajeva sveta, a sam cilj međunarodnog pregovaranja predstavlja razmena mišljenja i ideja, težnja za sporazumom, kreativno i pozitivno komuniciranje. Uspešno međunarodno pregovaranje je moguće ukoliko se razumeju kulturne razlike i pravila učesnika iz različitih krajeva sveta. Pregovaranje je društveni proces i što je više kultura ili zemalja u igri, taj proces postaje složeniji. Zbog tih velikih kulturnih razlika i nerazumevanja, konflikti predstavljau sastavni deo međunarodnog pregovaranja. Kako bi se postigli efikasni međunarodni pregovori i održali dobri međuljudski odnosi neophodne su veštine efektivnog upravljanja konfliktima. Rezultati istraživanja, koje je obuhvatilo uzorak od 75 ispitanika u međunarodno orjentisanim kompanijama, pokazali su da saradnja predstavlja dominantnu strategiju u upravljanju interpersonalnim konfliktom.*
Ključne reči: *međunarodno upravljanje, konlikt, upravljanje konfliktom*

1. INTRODUCTION

Negotiation is a complex form of communication which consists discussions, debates, conflicts and communication. The aim of negotiating is exchange of opinions and ideas, the pursuit of agreement, positive and creative communication. Many experts argue that successful negotiation results achieved by those people who have the knowledge, skills and personal characteristics that are necessary for the negotiation, but also those who have worked out a plan of negotiations.

Today's managers spend much time in their daily work by negotiating with employees, with supervisors or with external stakeholders. The most important factor in the success of the negotiation is certainly preparation. Conflict in organizations is an important element in human relations and conflict management today represents an important managerial skill for the normal functioning of the company (1).

In business, negotiation is usually associated with two areas: the first area is commercial, and the other area is human relations in companies. In preparation for the negotiation it is important to avoid the false assumption that members of other cultures perceive, think and judge in the same way. Negotiation process is complicated enough even when it includes people from the same cultural environment. When it includes people from different culture, international negotiation becomes more complicated because there are many differences in lifestyles, expectations, languages, cultural values, formal procedures and so on. Given the above facts the aim of this paper was a determination of the primary strategy in managing conflict in international negotiations in international oriented companies.

2. TERM AND TYPES OF NEGOTIATION

Generally speaking, negotiation is an integral part of human communication. We often use negotiation when we are not aware of it. Negotiation is something we all do, almost daily. Successful business negotiation is affected by many factors and requires knowledge of several disciplines. Negotiation is a discussion between two or more participants who are trying to find a solution to their problem. For Fischer and Yuri, the well – known professors from Harvard University, negotiation is "the primary means to get from others what we want, two-way communication aimed at reaching an agreement when you and the other side have some common and some conflicting interests." They believe that we are all in some way negotiators (2).

In recent decades the importance of negotiation records a dramatic increase in academic and professional circles. Many new theoretical works, case studies and researches are published in this field. The universities organize courses in negotiation, and consultants in this field are more in demand. Negotiation has become an important element of successful business at the time of global business environment. The need for improving our negotiating skills come from an increasingly complex life and work in today's fast technological changes. More than ever before, individuals are involved in different transactions with different institutions.

All negotiations are not the same. Negotiations can be divided into several different types, depending on the objectives, time, relationship of the participiants and the potential conflict. According to the results, negotiations are usually divided on distributive and integrative negotiations, while Michael and Sandra Rauza add one more category, destructive negotiation.
Distributive negotiations - both negotiating participiants strive to win, and usually gain of one side means the loss of other.
Integrative negotiations - the goal is that both sides get what they want, to be satisfy.
Destructive negotiations - both sides are trying to win, regardless of the danger of losing (3).

3. INTERNATIONAL AND INTERCULTURAL NEGOTIATION

Interest in international negotiations was present for centuries, but at last twenty years it has grown. Today people often travel and business is more international than ever before. For many people and organizations international negotiation has become the norm and integral part of life. Numerous books and articles about the complexities of international negotiations between people from other countries, cultures or regions were written. Negotiation is a social process and as many cultures and countries in the game, the process becomes more complex (4).

The activities of many companies often extend the border of parent state and the world is entering in era of global activity, which includes the world's global manufacturing, distribution, and a large number of multinational mergers and acquisitions, as well as the emergence of global strategic alliances. Successful international business is possible if business people understand the cultural differences and rules from all over the world. First of all, it is naive to enter into international negotiations and business, believing that people are pretty much the same and behave at the same way wherever they are (5).

The process of international business negotiation can be divided into five stages: the preparation, build relationships, exchange information related to the job, assurances, concessions and agreement. Sometimes the process takes place in one day with interlaced phases of negotiation, and sometimes protracted negotiations for several weeks or longer. International business negotiation is significantly different from negotiation in the domestic environment, and requires a different and expanded knowledge on various issues. Six characteristics of international negotiations are formulated at which it differs from negotiation with local partners:

- different laws
- different currencies
- participation of government (the presence of the state bureaucracy can often hinder the process of political negotiation)
- sudden and drastic changes in circumstances.
- negotiators face a very different ideology, particularly related to the concept of private property, profit, and individual rights.
- different cultures have different values, perceptions and philosophy and usually use different languages (6).

4. CONFLICT AS AN INTEGRAL PART OF THE INTERNATIONAL NEGOTIATIONS

It is not unusual that international negotiations become quarrelsome to the extent that they interrupt. In extreme cases, the conflict intensify and interpersonal relationships become strained and even dirty. The difficult resolve negotiations are defined as the negotiations that have come to the "dead end". It is a situation of conflict where there is no quick and simple solutions. In this case the participitians can not reach an agreement that would satisfy their desires and expectations.

Impregnable negotiations can last a very long time. Putnam and Wondolleck say that this kind of conflict in negotiations differ on four dimensions:

- the division - the degree to which conflict divides people
- the intensity - the degree of involvement, and emotional commitment of the participants of the conflict
- the spread - the degree to which conflict pervades the social and private lives
- the complexity - the number and complexity of the problem, the number of participants involved and the extent to which it is impossible to solve a problem if you are simultaneously addressing several other (2).

Using two dimensions of cooperation (the degree to which one side attempts to satisfy the interests of the other) and selfishness (the degree to which one side attempts to satisfy their own interests), identified the five orientation behavior in managing conflict:

Competition - a selfish and uncooperative behavior, when one side seeks to achieve certain goals, regardless of how it will affect other side. This struggle can be represented as a "victory - defeat."

Cooperation – a cooperative behavior, where each side of the conflict wishes to fully meet the interests of all sides and, therefore, appears that the cooperation of mutual benefit. The behavior of the sides to the conflict is aimed at solving problems, with a number of alternatives considered, and therefore this approach to conflict resolution referred to as "win-win."

Avoidance - a selfless and non-cooperative behavior, when there is a lack of interest or desire to avoid open display of dissent. Bypassing means that sides to the conflict accept the physical separation and if it is not possible, the conflict can not keep their differences.

Adaptation - a selfless and cooperative behavior, when the conflict in trying to appease his opponents, and are willing to put their interests above the interests of the opponent.

Compromise - a middle ground, where both sides in the conflict have to give up on something to reach a compromise. In these situations there is no clear winner or loser (7).

5. SAMPLE AND METHODS

Research conducted in Zajecar, during november and december 2011th year, included a sample of 75 respondents employed in internationally oriented companies "United Serbian Breweries" (formed by joining Heineken and Efes) and the Company for Roads "Strabag". As a basic research instrument was an anonymous questionnaire: "What is your conflict-handling style?" (8). The questionnaire contained 15 questions to determine the primary strategy in managing interpersonal conflict, as well as issues relating to the general information of the respondents (gender, type of education, age).
The aim of the research was a determination of the primary strategy in managing and resolving conflict during the negotiating of employees.

6. RESEARCH RESULTS

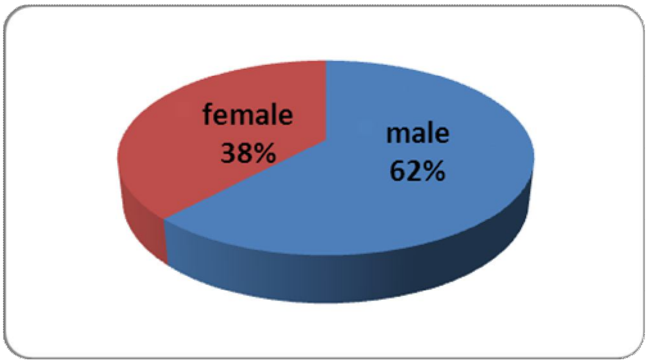

Figure 1 Distribution of respondents in relation to gender

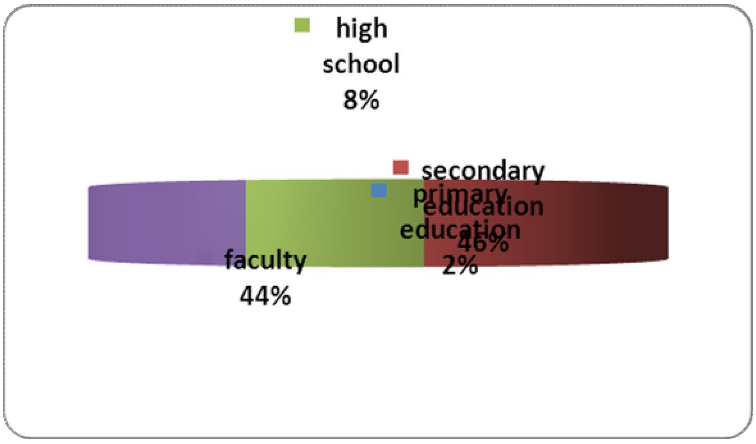

Figure 2 Distribution of respondents in relation to level of education

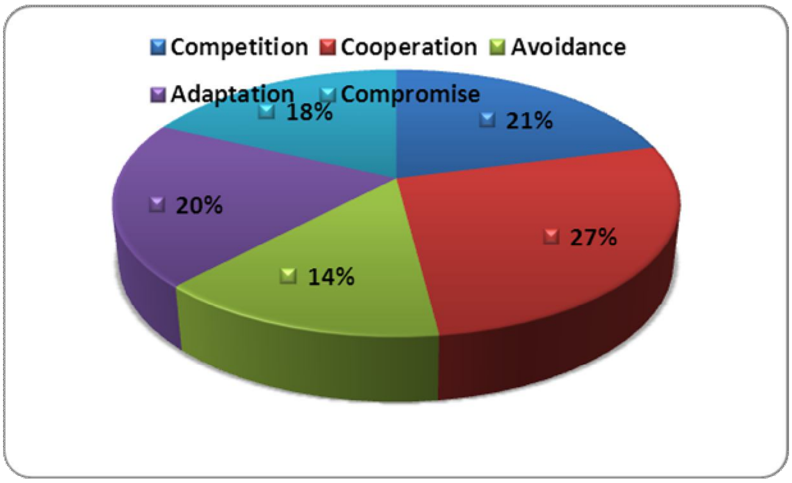

Figure 3 Conflict management strategies

Table 1 The responses to the questionnaire " What is Your Conflict-Handling Stale"?

	Rarely				**Always**
	1	2	3	4	5
I argue my case with my coworkers to show the merits of my position	**77.14**	20	2.86	/	/
I negotiate with my coworkers so that a compromise can be reached	/	5.71	**28.57**	25.71	40
I tra to satisfy the excpectations of my coworkers	/	/	8.57	17.14	**74.29**
I try to investigate an issue with my coworkers to find a solution acceptable to us	/	/	2.86	42.86	**54.29**
I am firm in pursuing my side of the issue	/	/	2.86	40	**57.14**
I attempt to avoid being „put on the spot" and try to keep my conflict with my coworkers to myself	**34.28**	22.86	22.86	8.57	11.43
I hold on to my solution to a problem	/	/	5.71	31.43	**62.86**
I use "give and take" so that a compromise can be made	**31.44**	17.14	40	5.71	5.71
I exchange accurate information with my coworkers to solve a problem together	/	/	2.86	17.14	**80**
I avoid open discussion of my differences with my coworkers	5.71	**54.29**	20	11.43	8.57
I accommodate the wishes of my coworkers	11.43	34.29	**45.71**	5.71	2.86
I try to bring all our concerns out in the open so that the issues can be resolved in the best possible way	/	/	/	22.86	**77.14**
I propose a middle ground for breaking deadlocks	/	17.14	**68.57**	2.86	11.43
I go along with the suggestions of my coworkers	8.57	8.57	**51.43**	31.43	/
I try to keep my diagreements with my coworkers to myself in order to avoid hard feelings	25.71	**37.15**	28.57	8.57	/

7. CONCLUSION

Negotiation means making agreement through dialogue and seek solutions to problems that is common to both negotiating parties. Today negotiation becomes increasingly important managerial skills, because managers spend more than 50% of working time in communicating with employees, supervisors or external stakeholders. People from different cultures behave differently during the negotiation process, because they do not perceive the same stage of the negotiation process. Negotiation on an international scale is very complicate and can often leads to interpersonal conflicts. Such conflicts can be solved by appropriate methods and techniques and direct towards the achievement of effective negotiations.

The results showed that cooperation is dominant strategy in managing interpersonal conflict in the group of respondents. Cooperation is an approach to conflict resolution "win - win", where each side in the conflict wants to fully meet the interests of all sides. These results were expected because of the collectivist and feminine values of our national culture, where in the first place the prices are good relationships and harmony with the social environment.

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THEORETICAL ASSUMPTIONS OF AGENCY PROBLEM

TEORIJSKE POSTAVKE AGENCIJSKOG PROBLEMA

Maja Andrijašević[1]
Vesna Pašić[1]
[1]Faculty of Management, Zajecar, Megatrend University Belgrade

Abstract: *The theme of this paper is the problem of efficiency of corporate governance in the narrow sense, in literature marked as "agency problem" and is usually connected to joint-stock companies where segregation of ownership and entrepreneurship occurs. Agency problem leads to generating agency costs consequently leading to reduced efficiency of corporative governance and downfall of company market value.*
Key words*: agency problem, stockholders, manager.*

Apstrakt: *Predmet ovog rada je problem efikasnosti korporativnog upravljanja u užem smislu, u literaturi označen kao „agencijski problem"i uobičajneo se vezuje za akconarska preduzeća u kojima dolazi do podvajanja vlasništva od preduzetništva. Agencijski problem vodi nastajanju agencijskih troškova, što ima za posledicu smanjenje efikasnosti korporativnogu upravljanja i pad tržišne vrednosti preduzeća.*
Ključne reči: *agencijski problem, akcionari, menadžer.*

1. INTRODUCTION

By separating the function of governance from the function of ownership, establishment of a special type of moral hazard occurs which is called principal – agent problem. Managers can do business according to their own interests and not according to the interests of the shareholders since they are less motivated to increase profit. The wish of a manger to maximize his own benefit does not naturally lead to the decisions that maximize the value of a society.

The theme of this paper is the problem of efficiency of corporate governance in the narrow sense, in literature marked as "agency problem" and is usually connected to joint-stock companies where segregation of ownership and entrepreneurship occurs. Agency problem leads to generating agency costs consequently leading to reduced efficiency of corporative governance and downfall of company market value. At the theoretical level there are three such problems: [1, pgs. 5-25]

- **1st,** *conflict of interests of shareholders and management* – which is rather consequence of dispersed shareholding and inability of shareholders to affect the management than separation of governance from ownership.
- **2nd,** conflict of interest of the *majority shareholder and minority shareholder* which is basically solved by promotion of rights of minority shareholders.
- **3rd,** problem related to the issue of *mono-interest (interest of shareholders) or multi-interest concept of a company* (corporation) with several different holders of interest (risk).

In this paper the greatest attention will be paid to the first type of agency problem. The essence of this problem is formulated by the question how the owners (shareholders) can control the company management (managing or the executive board - managers) that, as a rule, is not the owner or is but not up to a sufficient extent from the ownership control standpoint. Such a problem is regularly present in joint-stock companies, while, as a rule, is not present in ownership-ruled companies where there is no separation between professional management and the owner.

2. AGENCY THEORY

Traditional approach to studying of the problem of corporate governance is based on agency theory which is considered to be a useful instrument for understanding the basic problem of corporate governance – the relationship between the owner and the manager in modern corporations. Stimulus for development of the theory was studying of the relationship between ownership and control function in big companies, in early seventies. *Michael Jensaen* and *Wiliam Meckling* were the initiators of the theory. In its basic form, the agency theory is linked with the problems which can occur in any cooperative relationship when one party (principal) has the contract with the other party (agent) to make decisions on behalf of the principal.

In a company context, the agency theory identifies the agency relationship as a contract in which one party, the principal, delegates the specific task to the other party, the agent, which performs the task on behalf of the principal. Therefore, the relationship between the principal and the agent has the main role in it. The principal is the one who delegates the task, invests the funds and expects their return with the increased value. The agent is the one who accepts to perform the task for the principal and he is awarded and paid according to previously defined obligation. According to the assumptions of the agency theory, the agent, with his activities, tends to maximize both his objectives and economic objectives of the principal. In a corporation context, the owner is the principal, and the manager is the agent. Managers take actions whose consequences are born by corporation owners. If both parties want to maximize the benefit then there are reasons due to which the agent will not always act in the interest of the principal which consequently leads to the agency problem. The objective is to find the optimal contract between the principal and the agent. [2, pgs.65-79]

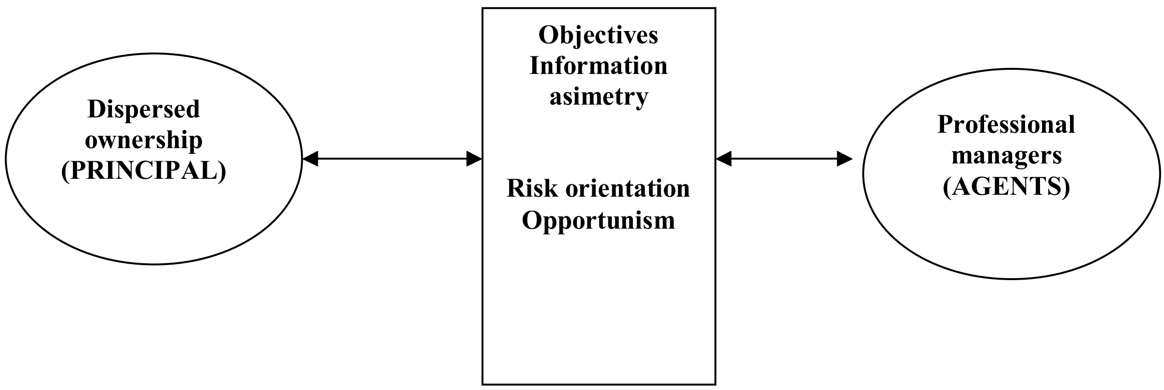

Figure 1.: Agency Theory model

According to the agency theory, the wealth of the principal will not be maximized because the agent and the principal: [2, pgs.65-79]

1. Have different objectives
2. Have different approach to the information (the principal cannot follow the activities of the agent and know the information that the latter has)
3. Have no equal tendency towards risk

The interests of the principal and the agent vary since each of them will tend to maximize his benefit. Opportunism is a selfish acting of the agent according to the assumption that all individuals tend to maximize their own benefit. The greater information asymmetry the more likely the agent's opportunistic behavior is. Control and binding the agent with contract are two basic approaches that can serve as counterbalance to opportunism. *Arrow* distinguishes two basic sources of the agency problem: [3, pgs.303-307]

1. Hidden actions (moral hazards)
2. Hidden information (adverse selection.

With the development of the company these relationships become more complex and the management appears as the main agent of the owner and takes his role in relation with the employees and other stakeholders. The owners hire competent managers who will manage their business, but the agency problem occurs due to the tendency towards risk and different goals. However, the positions of the management are not that safe although it plays the superior information role. Firstly, management depends on ownership structure. In case of concentration of ownership in the hands of big shareholders having the key impact on the company operation, the risks of abusing the management positions are lower.

The situation is different in case of ownership dispersion since the real impact of small shareholders on company operation is small. In such a case, small shareholders will rather choose to sell their shares than to oppose the abuse of the management. Secondly, performances of the company position at the stock market are transparent, which means that they are under continuous control of the existing and potential investors. Among other things, obligation of publication information significant for a company operation and availability of financial reports to general public reduce the possibility of abuse by the management. Thirdly, management efficiency is reflected through stock price trends. Fourthly, development and application of modern measurement concepts imposed greater responsibility on management referring to the necessity of efficient management of capital thus reducing space for abuse.

Therefore, this theory is a solid basis for overviewing interests, objectives and relationships of shareholders, management and employees, as well as many processes within an organization.

Table1.: Theoretical assumptions of agency theory

1.	**Manager**	**Agent**
2.	**Management approach**	**Economic approach**
3.	**Manner of behavior**	**Individualistic** **Opportunistic** **Self-orientation**
4.	**Motivation**	**Own objectives**
5.	**Interests of manager and principals**	**Divergent (different)**
6.	**Organizational structure**	**Structure of monitoring and control**
7.	**Owner's approach**	**Risk aversion**
8.	**Basis of owner-manager relationship**	**Control**

Source: [4, page.3]

Agency theory is based on an economic model of human behavior. Economic model of human behavior assumes that the interests of the agent and the principal are divergent and therefore the agency theory deals with studying of contracts and development of an efficient system which will provide that the agent acts in the interest of the principal having in mind, above all, information asymmetry and different tendencies towards risk. Compensation motif has the main role in the agency theory. However, the researches warn that compensation awards make managers oriented towards extrinsic motivation thus reducing the possibility of functioning of intrinsic motivation in future.

Table 2.: Review of psychological and situational mechanisms in agency theory

Psychological mechanism		**Situational mechanism**	
Motivation	**Lower level (physical, security, economic)**	**Manager psychology**	**Orientation towards control**
Social comparison	**Other managers**	**Orientation towards risk**	**Mechanism of control**
Identification	**Low level of commitment**	**Time frame**	**Short-term**
Power	**Institutional (legitimate, awarding)**	**Manner of behavior**	**Economic behavior**
		Approach to work	**Individual**

Source: [5, page.37]

The table shows that relationship between the principal and the agent, above all, depends on their behavior. Manager's actions are defined by his personal characteristics and his perception of a situation while principal formulates his behavior having in mind situational factors, as well as psychological profile of the manager. Psychological profile of the agent complies with the profile of the principal and that is why control mechanism is needed – to control opportunistic behavior of the manager and to minimize agency costs. Existence of agency costs reduces efficiency of corporate governance and downfall of a company market value.

3. THE FIRST AGENCY PROBLEM

The first agency problem is characteristic for dispersed shareholding where shareholders have small percentage of participation in total capital and therefore they have really small voting power and ability to effectively control the work of management. One owner of a small part in the property of corporation has no interest to monitor management since the costs of such an activity will be too high for him and has also no possibility to impact behavior of the manager since his part in the ownership is negligible. Therefore natural position of a small owner is the one of a free rider where he expects from other owners adequate, positive impact on management directed towards efficiency, from which he will also gain profit without any effort or cost. And since the ownership is dispersed, all owners behave in the same manner – they passively wait for the work to be done by someone else, and if there were no solution to the problem, the owners would be without any impact on the management. [6, page 15]
In such a situation management can, with its actions, influence the reduction of a company value by increasing the agency costs which represents the root of the first agency problem. In the beginning the problem has been solved in the manner that the agent was adequately awarded for efficiently performed work. At the same time, the principal is supposed to be familiar with the nature and method of work of the agent so that he can easily control his work and the achieved results. Implicit is the assumption that the actors in this relationship have the same information (symmetric information). However, the problem actually occurs due to asymmetric information because the principal does not have complete information on what the agent does and he cannot control him completely and without any costs. Absence of control over the company's operation is considered to be one of the most important problems in agency manner of operation. The management has the task to manage the assets of the owner so that it can continuously provide increase of the assets. However, the managers have some of their own objectives (maximizing their own earnings, maximizing the managerial impact, increase of their own image, etc.) which might lead to opportunistic and disloyal behavior of managers towards the owners. Higher participation of managers in the ownership offers them more freedom to strive towards their personal interests without any fear to be punished.

The situation when managers managing the company, prioritize their own interests to the detriment of the interests of the owners, represents the so called agency problem. In recent years, this problem has become exceptionally acute particularly after the scandal which shook the American finance system referring to the bankruptcy of the energy company "Enron" due to the immoral operation of the management. Unfortunately, the "Enron" case is not alone in the world when it comes to the immoral behavior of the manager and emphasized agency problem. The existence of the agency problem affects the following decisions of management members [7, page 35]

- What effort to make in performing their duties,
- What conveniences to provide for themselves;

- What strategic and business opportunities to take.

When making each of these decisions, management members do not have to be led by the interests of shareholders. For example, when making the first decision, one should take into account the fact that the management bears the costs of its work and does not enjoy all benefits that joint-stock company has, so, it is logical to assume that they will not make optimal effort in performing their duties. Opposite to it, management enjoys all benefits it provides for itself and therefore is motivated to increase them. Management can also make numerous business and strategic decisions ruled by its own interests and not by the interests of the company it manages. For example, an inefficient management can take numerous measures to defend from taking over, by which it strengthens its own position no matter whether the public offer for taking over is favorable for the shareholders of the target company. In that way, positive effects of corporative control market serving as a protection of shareholders are reduced

However, under the conditions where there is information asymmetry the shareholders are not able to adequately monitor the work of management. The occurrence of information asymmetry is consequence of the fact that the shareholders as the principal and management as the agent find themselves in unequal position referring to the availability of information. When the objectives of the agent and the principal does not coincide there is the problem of moral hazard, the situation where the agent upon making contract with the principal behaves differently than under the circumstances when the contract has not been signed. This problem occurs in the situation when the principal wants to get maximum surplus from the work of the agent and the latter does not do his work in the best possible way or refuses to do it at all. Efficient solving of the agent problem, i.e. reducing the agency costs to an acceptable level affects the efficiency of corporate governance. The question is how the owners can make the management to make creation of value their primary interest. The problem is particularly serious in the situation of great dispersion of ownership and when the manager does not have ownership interest in the company. Agency costs are great in both cases.

Two unsatisfactory but theoretically possible solutions to the agency problem are: [7, page 39]

1. Constant and comprehensive monitoring of the management by shareholders
2. Strictly and comprehensively defined contract between the manager and the shareholders

An insoluble problem occurs in both cases. Firstly, the shareholders cannot adequately perform monitoring over the work of the management due to the existence of information asymmetry. Secondly, comprehensively defined contract cannot be formulated due to the inability to predict all relevant situations in which a management member can find himself when performing his tasks. To mitigate negative impact of agency problem and stimulate managers to work in the interest of the owners numerous measures are taken such as the following ones: [8, pgs. 1-12]

1. Establishing supervising authority to control the work of manager,
2. Relating awards for managers with the profit of shareholders
3. Concentration of ownership
4. Publishing information and financial transparence

5. Other measures that can stimulate managers to work for the interest of shareholders.

The stated measures to mitigate negative impact of agency problem fall into internal mechanism of corporate governance.

4. CONCLUSION

Opportunistic and inefficient behavior of managers towards the shareholders can lead to the collapse of the company and threatening the shareholders and other interest groups of companies. Out of these reasons it is needed to take various measures by which negative impact of the agency problem can be mitigated. There is no one single measure by which it is possible to completely eliminate the problem, but it can be mitigated by various extrinsic and intrinsic mechanisms of corporate control.

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STRATEGY FOR SUSTAINABLE DEVELOPMENT IN EDUCATION REPUBLIC OF SERBIA

STRATEGIJA ODRZIVOG RAZVOJA U OBRAZOVANJU REPUBLIKE SRBIJE

Andjelija Plavsic[1], Jane Paunkovic[2], Milica Paunovic[3], Aleksandra Cvetkovic[4]
[1, 3]College of Business and Management Zajecar, [2, 4] Faculty of Management Zajecar

***Abstract**: For many nations, the path to a sustainable future for their citizenry begins with greater access to basic education. Those nations whose people average less than six years of public education are in no position to develop more than an agrarian or extractive society. Education is essential for improving the capacity of these people to address environmental and development issues, which are inextricably tied to sustainable development. Simply providing more education, however, is not the answer for creating a sustainable society. Current global consumption patterns show that the most educated societies leave the deepest ecological footprints. An appropriate basic education, therefore, should be reoriented to include more knowledge, skills, perspectives, and values related to sustainability than are currently included in most of today's schools*
***Key words:** sustainable development, education, strategy*

***Apstrakt:** U mnogim državama, početak staze koja vodi do održive budućnosti za njihovo stanovništvo jeste ozbiljniji pristup osnovnom obrazovanju. One države čije stanovništvo u proseku ima manje od šest godina javnog obrazovanja nisu u poziciji da se razviju u nešto više od agrarnog ili proizvođačkog društva. Obrazovanje je ključno za poboljšanje kapaciteta ovakvih nacija radi posvećivanja pitanjima zaštite životne sredine i razvoja, koji su neraskidivo povezani sa održivim razvojem. Ipak, jednostavno obezbeđivanje dodatnog obrazovanja nije rešenje za stvaranje održivog društva. Trenutne globalne potrošačke navike pokazuju da najobrazovanija društva ostavljaju najdublje ekološke tragove. Odgovarajuće osnovno obrazovanje, stoga, treba preorijentisati kako bi uključilo više znanja, veština, perspektiva, a vrednosti koje su u vezi sa održivošću su trenutno uključene u većinu današnjih škola.*
***Ključne reči:** održivi razvoj, obrazovanje, strategija*

1. INTRODUCTION

Пресервинг тхе енвиронмент ис унтхинкабле њитхоут тхе аппլицатион оф тхе цонцепт оф сустаинабле девелопмент. Тхе басис оф тхис цонцепт ис тхат тхе пресент генератион неед то енабле то тхе футуре генератионс гратифицатион оф тхеир неедс тхроугх тхе пропер усе анд аллоцатион оф натурал ресоурцес. Он тхе отхер ханд, тхис цонцепт доес нот неглецт тхе социал сегмент, бут тхе фоцус ис јуст он тхе пеопле анд тхеир роле ин тхе сустаинабле девелопмент оф тхе кноњледге ецономI анд инцреасинг ањаренесс анд едуцатион он сустаинабле девелопмент. Тхе терм ”сустаинабле девелопмент” њас фирст пресентед ин1982 он Тхе Цонференце оф тхе Унитед Натионс ин Наироби.

2. THE SUSTAINABLE DEVELOPMENT STRATEGY

The objectives of the sustainable development concept are divided as follows:
1. economic goals (growth in production, closing the gap between rich and poor);

2. environmental goals (environmental quality, climate change, the "ozone hole", waste, etc.);
3. social objectives (education, standard of living, health and social insurance);
4. spatial objectives (balancing urban-rural and territorial configuration of economic activity); cultural goals (normative foundation of eco-development with respect to local economic, cultural and social specifics). [1]

The strategy of sustainable development must harmonize its three basic elements:
1. sustainable development of economy, industry and technology;
2. sustainable development of society based on social balance and
3. protection of the environment.

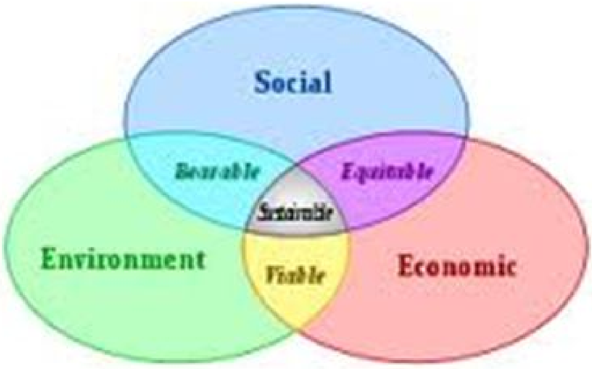

Figure 1. The main elements of sustainable development [2]

Sustainable Development of the Republic of Serbia includes the formulation and implementation of strategies for sustainable development, which will, in the long run and in a quality manner, ensure the fulfillment of all aspects of life, ie, economic, social, environmental and institutional frameworks.The main objectives and priorities of this strategy are:
1. membership in the EU;
2. development of a competitive market economy and balanced economic growth, fostering innovation, creating closer links between science, technology and entrepreneurship, increase capacities for research and development;
3. development and education of people, increasing employment and social inclusion, creating more jobs;
4. development of infrastructure and balanced regional development;
5. protection and improvement of environment and rational use of natural resources. [3]

The SWOT analysis is an essential step, which clearly indicates what is it that we can and must seize in the future, but what is it that constitutes a danger to the further development.

STRENGTHS	WEAKNESSES
- A good geographic position of the country; - Potentially skilled labor force; - The established legal basis of democratic and open society; - The reform processes started in most of the sectors; - Private sector growth; - The establishment of trust on the regional level and raise of the Republic of Serbia reputation in the region; - Increased awareness of the need for sustainable development planning at the local level; - Reducing the current imbalance in financing of social and pension-disability Insurance funds; - High degree of biological diversity; - A variety of natural resources; - High degree of cultural infrastructure and cultural values; - The existence of expert and financially significant diaspora; - Preserved natural environment in industrialized areas.	- Insufficient level of citizens general trust in the institutions; - High degree of difference regional development; - A slow privatization process; - Insufficient number of "greenfield" investments; - Lack of investment in economic development; - Lack of transportation and utility infrastructure; - Continuing brain drain, also after 2001; - A very low rate of GDP spending on Education and Science; - Low rate of GDP allocations in the social protection field; - Lack of consensus on the further regionalization and decentralization directions; - Ethnocentrism in the part of the ruling elite; - Adverse socio - economic status of the young people; - Low level of citizen participation; - Unplanned exploatation of natural resources; - Excessive pollution of air, water and land; - Poor waste management practices; - Lack of incentives to reduce pollution.
OPPORTUNITIES	**THREATS**
- Integration into the EU; - Inclusion in EU funds; - Cooperation with the Diaspora; - The introduction of EU norms and standards which ensures the quality of the environment; - Completion of the privatization process; - Further development and strengthening of democratic institutions in the fields of social development; - Reducing corruption and increasing transparency levels; - Strong political will to implement legal reforms; - Increase public-private partnerships; - The introduction of cleaner production; - Improvement of energetic efficiency, rational use of raw materials and reduction of traffic intensity.	- A growing level of intolerance and social division; - Rising unemployment, poverty, debt and slow economic growth; - Lagging behind the region due to unresolved political issues; - Possibility of a new isolation (open or hidden); - Unresolved issues and the fight against corruption and organized crime; - Unfavorable demographic trends; - Possible lack of political will to implementation of legal reform; - A lack of public awareness and under-developed public awareness; - The principle of "not in my backyard"; - Lack of investment in infrastructure construction; - Launching of industrial production with obsolete technologies (creating a paradise for pollutants); - Increasing levels of traffic using the poor quality fuel.

Figure 2. SWOT analysis [3]

3. SUSTAINABLE DEVELOPMENT IN EDUCATION

Education for sustainable development means implementing the content of sustainable development into the education system, and also knowledge-based economy. It includes a set of adequate knowledge in different areas, and their eventual implementation, as well as a high level of cooperation between schools, businesses, universities, government and other stakeholders. On this basis, the Strategy recommends a system of sustainable education in the Republic of Serbia which will be:

- competitiveness in accordance with scientific, economic and technological resources of the Republic of Serbia;
- available to all, especially children and members of socially vulnerable groups;
- flexible and in line with market needs;
- sufficiently attractive and in line with the socio-economic changes;
- included in the European system of education;
- modern financed, European-based model system of financing;
- based on modern management system, certification, licensing and accreditation.

In order to achieve the preconditions for a new system of sustainable education, current education system must as soon as possible should be promoted. We need to motivate and support all stakeholders to work on the development of education for sustainable development and the integration of content on sustainable development in the formal education system, through all the relevant subjects, as well as through informal forms of education. [3]

Education for environmental protection, that is, education for survival, that is, education for sustainable development:

- Must cover all levels of education, from preschool through elementary and directed to the university, after the diplomatic and permanent. It should be entered into all forms of teaching in school, in the multiple activities outside of school and student organizations;
- It must go on in organizations, through training of workers in certain jobs, in order to reduce the possibility of damaging the environment in the work process;
- It can not be reduced to training people for passive protection, but should be directed to a positive attitude, the training of citizens for a planned environment development with all its resources and human creations;
- Knowledge and understanding of the environment must be exhibited in all classes where it is appropriate: in the subject of nature and society, biology, chemistry, physics and geography, etc..;
- This education is essentially multidisciplinary and inter-sector and it provides an integrated approach in the educational process;
- The curriculum should include the issue holistically, stressing the historical or developmental approach. [4]

During the implementation of education for sustainable development, it is necessary to process the following areas:

a) improvement of basic education,
b) redirecting education towards sustainable development,

c) raising public awareness and
d) promotion of different forms of training [5].

Education for sustainable development is a long process that begins in early childhood and continues through higher and adult education, and even beyond the boundaries of formal education. Lifestyle and attitudes as values are established at an early age, and the role of education is of particular importance for children. As the study covers the various roles that are taken in life, education for sustainable development should be viewed as a "living" process. It should permeate the curriculum at all the levels, including vocational education, teacher training and continuing education of professionals and decision makers. Higher education should significantly contribute to education for sustainable development in developing knowledge and expertise. Education for sustainable development should take into account the various local, national and regional circumstances, and the global context, trying to strike a balance between global and local interests [6].

The following table shows a higher education institutions in Serbia that have programs in ecology and sustainable development.

4. INVESTING IN SCIENCE AND EDUCATION IN SERBIA

Based on the strategy adopted in Lisbon in 2000 AND the Action Plan in Barcelona 2002 The decision was made to increase spending on research and development. Although the budgetary allocation in the country, after the nineties, have raised from 28 million euros in the year 2001 to 100 million euros in 2008, it's still not enough (chart 1.) [7]

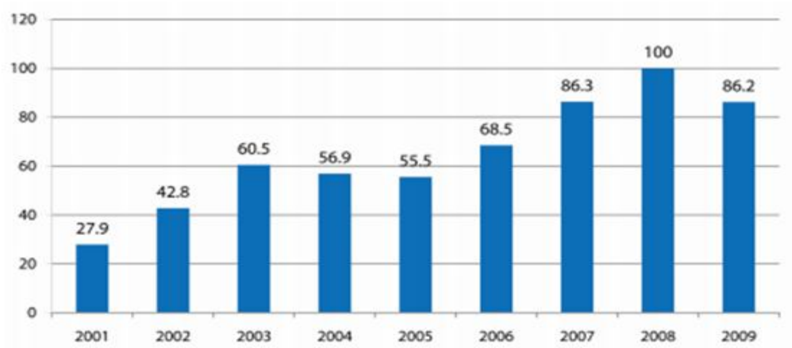

Chart 1. Budgetary allocations for science (in millions of euros without NIP)

When looking at a percentage of expenditures for science in the GDP, in 2003 it reached 0.3% of GDP and have been stagnating at that level so far (chart 2). [8]

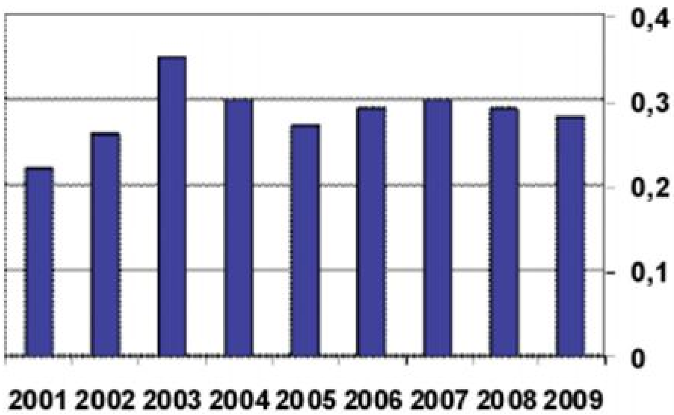

Chart 2. Budget investment in science (as a percentage of GDP)

Some countries such as USA, Sweden, Germany, Switzerland and China have already achieved investments in science in amount of two-thirds of total investments. In Japan, the economy has reached a share of 76.1%. Even countries in our region have significant private sector investment in science: in the Czech Republic as much as 54% allocation for science comes from the industry, in Estonia it is 38.5%, 39.4% in Hungary and in Romania 37.2%. The consequence of this trend is the fact that scientific researches are not only placed at universities and government research institutes, but it has also enabled a large number of scientists employed in the private sector where some of the world's most advanced researches are held.

5. CONCLUSION

The vision of Education for Sustainable Development (ESD) is a world where everyone has the opportunity to benefit from quality education and learn the values, behaviour and lifestyles required for a sustainable future and for positive societal transformation.Education for sustainable development is a continuous process that lasts a lifetime, to be constantly improved, and above all apply. The survival of future generations, and their further development is not possible without a healthy environment and sustainable development. How people are the main driving force of all this, their role is clear and unambiguous. It is therefore necessary to strengthen the awareness of people, and a first step towards it is the education for sustainable development through lifelong learning and investment in science.

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ECOLOGICAL MANAGEMENT FUNCTIONING IN THE ENVIRONMENT PROTECTION

EKOLOŠKI MENADŽMENT U FUNKCIJI ZAŠTITE ŽIVOTNE SREDINE

Biljana Ilić[4], Dragan Mihajlović[2], Dragica Stojanović[3]

Faculty of management Zajecar[1]
Park Forest Kraljevica b.b.

Abstract: *Protection and improvement of the environment are the most important aspects of the processes and knowledge of modern management. Without the implementation of such processes, any human activity can have profound effects on survival and further development of society and even humanity. Today's business trends, as well as modern methods of communication required of managers and modern management to be on a global scale. Such management, in addition to solving the economic problems certainly have to be familiar with environmental issues. Development of environmental management system is a social process that leads with its implementation to transformation of traditional management into the new management, raising the level of sustainability of economic development of whole society. Therefore, active attitude towards human resources increases the quality of life, decreases energy consumption, which leads to rational use of resources and to the development of a new social consciousness. The basic right of all future generations is the right to a healthy environment. Thus, the relationship of the natural, and social goods, ensures further growth and development, and human survival.*
Keywords: *environment, management, environmental management, sustainability and development*

Apstrakt: *Zaštita i unapređenje životne sredine predstavljaju najvažnije procese sa aspekata savremenog upravljanja i znanja. Bez implementacije takvih procesa, svaka ljudska aktivnost može imati dalekosežne posledice na dalji opstanak i razvoj društva, pa i samog čovečanstva. Današnji poslovni trendovi, kao i načini komuniciranja zahtevaju modernog menadžera, odnosno moderan menadžment na globalnom nivou. Takav menadžment bi pored rešavanja ekonomskih problema svakako morao biti upoznat i sa problemima životne sredine. Razvoj sistema ekološkog menadžmenta predstavlja društveni proces koji svojom realizacijom dovodi i transformiše tradicionalni u novi menadžment, podižući stepen održivosti ekonomskog razvoja društva u celini. Samim tim, povećava se i kvalitet života aktivnim odnosom prema ljudskim resursima, utiče na smanjenje potrošnje energije, što dalje vodi racionalnoj upotrebi resursa i razvoju nove društvene svesti. Pravo na zdravu životnu sredinu, predstavlja osnovno pravo svih budućih generacija. Dakle, pravilnim odnosom prema prirodnim, ali i društvenim dobrima, moguće je obezbediti kako dalji rast i razvoj, tako i opstanak čoveka.*
Ključne reči: *životna sredina, upravljanje, ekološki menadžment, održivost, razvoj*

1.INTRODUCTION

In addition to conventional ways and economic demands, each business operation involves some specific features. Economies of developed countries as well as those in the process of transition are held accountable for the environment protection for future generations. In modern business, the aims of successful development of any business entity has to be tied to successful implementation of ecological management and sustainable economic development. Ecological effects of modern civilization are increasingly becoming the key factor not only in

[4] biljana.ilic@fmz.edu.rs

business operations of economic entities, but also in survival of economy and society. That is why it is necessary to change consciousness of unlimited of natural resources, meaning that they cannot be inexhaustible and used free of charge [1]. The company management team has to understand that, in modern trade economy, connecting ecology with economy, in addition to economic responsibility, involves moral responsibility, as well, for achieving a good-quality life. What is necessary is to direct all powers of social consciousness to alliance of strategy of sustainable development and concept of ecologic management. These two directions must not, in any way, be performed partially; they should be coordinated on the global level, so that, the consequences of human activities in future would be reduced, the fact which would enable sustainable development.

2. SUSTAINABILITY

Sustainable development includes each development in the preserved environment, satisfying current needs of mankind, without negative effect on possibility of satisfying needs of future generations. On the Conference held in 1992 in Rio de Janeiro, under the auspices of the UN, it was concluded that mankind was facing rising problems of increasing population on the planet Earth, pollution of the environment, and exhaustion of natural resources. It was adopted the Agenda 12, titled “Healthy Environment and Steady (Sustainable) Development”, relating to the local, regional and global level. Experts in economics and ecology are increasingly point out the fact that natural resources have been used up without control, so that future generations will inherit completely degraded and exhausted natural resources [2].

Modern mankind is faced both with the consequences of rapid economic development and with those of application of modern technologies. Using-up both nonrenewable and renewable sources without any plan, rapid economic development, based on needs of the population and available resources, endangers wholesome biosphere [3]. Using-up natural resources per head is much greater in developed countries than in under-developed ones. However, there are opposite statements. Holing [4] states that what makes sustainable development be steady today, need not be so in near future, because the nature itself reacts causing natural disasters, on which man cannot effect. All before-mentioned tell us that using natural resources and preserving and improving the quality of the environment should have quite different treatment.

Saving and, finally, taking care of natural resources, meaning in a wide sense, an integrated environment protection, as well surmounting technological differences, have to be considered as a part of activity during production. It, primarily, means that a significant part of the gross social income should be invested in economical use of resources, avoidance of waste products, their re-use, and their final taking care of. What the nature has done with the resources free of charge, a man has, through economy, with appropriate use of knowledge, time and financial means, to do now by his own [5]. Accordingly, ecology, functioning on behalf of sustainable development, besides capital (subjects of labor and means of labor) and labor, becomes equal element of the process of labor.

3. ECO - MANAGEMENT AND ECONOMIC GROWTH

Based on all before-mentioned, it is quite clear that economic growth is highly affected the environment, meaning that economic activity contributes to causing damage in certain segments of the environment. Moreover, the damage has to be compensated, most fairly by the one who made it. The environment expenses have to be calculated into the cost price of the product, while they should, through selling price, be further paid by consumers. On the other side, means for covering all expenses should be appropriated. This procedure is neither easy nor simple, because it is hard to predict external expenses. Involving external expenses, those for the environment pollution, may not be welcome by all participants in making and distributing profit. Economically, the participant would want to keep the existing state since, in the sharing process with the nature, less part belongs to them. However, since ecologic problems occur basically because of the economic growth, it is necessary to expect partly decrease of gross social product, profit, as well as, the possibility to satisfy requirements of all participants in the process of economic activities on behalf of the nature [6].

Therefore, permanent economic growth would cause exhaustion of the natural resources and endanger the environment, otherwise, it would enable creation of greater gross social product and profit, and, thus, more possibilities for appropriating funds for reclaiming damage in nature by the growth. However, if it was possible to reclaim damages in nature only by additional economic growth, then it would be the question of whether such additional economic growth is justifiable or not. How much and whether it is truly necessary if it is dedicated only for reclaiming damage to the environment, and not to welfare of the whole society? This could be called a phenomenon of "backlash". It is quite certain that this economic growth would be neither justifiable nor necessary, particularly if additional gross social product could not cover occurred damages in nature. Facing the situation in which it is necessary to balance certain values, there is new "ecologic management which would have duties and responsibilities to solve conflict relations." Managers should take an active part in business activities, so that they could solve conflict relations of economics and ecology. Table 1 shows main factors which make equal economic growth with preservation and improvement of the environment. These relations place the economy on the same level with improving the quality of life and business profitability. On the contrary, there are rational using of natural resources and compensation of arisen damage [7].

Table 1. Conflict relations of economy and ecology

Economic objectives	**Environmental Goals**
1. Growth of the economy	1. Improvement and environmental protection
2. Economies of scale	2. Improving quality of life
3. Business profitability	3. Rational use of nat. res. /compens.of damage

The most favorite state between conflict groups is the state in which the level of regeneration or restoration is greater that the value of exhaustion of resources. On the contrary, if it is not the case, particularly during a long period of time, even the renewable sources, due to permanent reduction of its mass, may become nonrenewable. Therefore, nonrenewable sources as well have to be used in ultimately rational way, that is, in sustainable way.

Exploitation of these sources need to be coordinated with their growth, possibilities of substitution, as well as recycling [8]. We have to point out also that emission of waste products must not be greater than the capacity of the eco system is. Having in mind all before-mentioned, we can conclude that it is necessary for modern management teams to be educated, conscious and always willing and ready to harmonize the business aims with ecology, without opening to doubt the issue of the environment protection, regardless the possibility of achieving much greater results to the detriment of its preservation.

4. AIMS OF ECO - MANAGEMENT

Strategic planning of ecologic management integrates potentials for managing changes in space, but also long-term time horizon, taking the role of a catalyst for harmonizing public, social and private interest. The concept of ecological management functioning as sustainable socio-economical development, with aims to be realized in modern conditions of business operations and life, becomes the basis for planning further development of the human society. There are a lot to be said about each of the aims of ecologic management, however, the common thing for all is their essence and pursuit to the environment preservation. Table 2 shows so-called "Rules of Eco-management" as well as the consequences occurring when they are not respected [9].

Table 2. Rules and consequences of eco-management

Rules of ecological management	***Consequences***
The rule of substitution *Non-renewable resources can be spent in so far as they can make up for renewable substitutes.*	*If the consumption of nonrenewable resources is reduced, the next generation will disappear and exist in very limited quantities.*
Rule of reducing *Quantities used renewable resources should not exceed the amount of their reproducibility.*	*If people increase the growth of renewable resources over the regeneration of growth, it will be followed disappearance of species.*
The rule of assimilation *Emissions of harmful substances should not exceed the absorption capacity of the environment - ecological capacity.*	*If it does not take measures for drastically reducing of environment, then the environmental absorption capacity will be locally and globally exceeded.*

The basic aims found in the base of the ecologic management can be classified as follows:
1) Prevention and solving ecological problems;
2) Establishing borders;
3) Establishing and keeping in function institutions which efficiently support ecologic research, monitoring and management;
4) Warning to incidents and identifying possibilities to overcome them;
5) Maintaining and, if possible, improving existing resources;
6) Improving the quality of life.

Identifying new useful technologies or policies Aimed to apply as much as possible the conceipt of sustainable development, economic entities should take into consideration the four basic attitudes:
1) *Legal Attitude* – considering legal regulations and other rules defining this area;
2) *Trade Attitude* – including ecologic component while doing trade business;
3) *Attitude of the stakeholders* – taking into consideration the aims of many stakeholders when it is about the issue of ecology, among which there are consumers, economic entities, society, etc.;
4) *Dark-green Attitude* – based on the principles of so-called deep ecology.

5. INSTRUMENTS OF ECO - MANAGEMENT

Built-up as a special scientific discipline and skill of managing with various ecologic issues on the level of a company, region, or even the whole state, ecology management owns, besides aims to be achieved, different aspects of instruments which it uses. The eco-management instruments can be classified into the following categories: [10]
- *Organization and legal instruments* – institutionally legal measures to influence direct on the pollutant's behavior through regulation of production processes, prohibition of emitting pollution, as well as establishing so-called ecologic administration.
- *Administrative instruments* – closely connected with the previous and refers to establishing eco-standards and norms for emission of polluting substances, through agreements of local authorities and economy, and sanctions for violation of established norms.
- *Instruments of voluntarism* – agreements and conventions concluded among various subjects on different levels, such as local, regional and international, through the mechanism of volunteering and convincing.

Economic instruments of ecology management involve various duties, subventions and reimbursements, starting from the principle "pollutant pays". They are classified into four groups: [11]
1) Duty on pollution – it is about taxes and similar payments imposed to pollutants differing from each other according to the quantity of polluting matters emitted into the environment.
2) Subventions – the forms of financial aid given to economic entities to reduce pollution in future.

3) The system of deposit and reimbursement – it is imposed to the pollutant to pay a certain amount of tax in advance; it is so-called deposit for possible ecologic damage made to the environment. The deposit is paid back to the pollutant if positive action has been realized.
4) The system of permits exchange – the latest economic instrument where the competent ministry or ecology administration issues definite number of permits or the “right to pollute” in a certain region, and then allows development of trade on which pollutants mutually sell and buy right to pollute.

As it has already been mentioned, listed instruments belong to the category of the most efficient measures because of one simple reason: they represent the expenses for the one(s) who pay(s). It, therefore, influences on reduction of pollution and on the pollutant as well, and this, indirectly, leads to the environment preservation, as well as to sustainable development.

6. ECO - MANAGER FUNCTIONING ON BEHALF OF THE ENVIRONMENT PROTECTION

Managing the environment properly is one of the basic tasks of current and future managers. The process of acquiring skills by people dealing with this scientific discipline is conditioned by education and training. An ecology manager can perform the following roles: [11]

1. *Regulator* – manager’s behavior is not only created by others but he, on the other hand, influences the behavior of other people;
2. *Innovator* - managers strive for creating changes, and also try to adapt to the changes other people have made;
3. *Catalyst* – innovations, that have been accepted, have to, as much as possible, fulfill demands for the efficiency growth;
4. *Authorized caretaker* – manager has to be thrifty to consumption of resources;
5. *Mediator* – mediates between system demands and the environment demands;
6. *Leader* – should, through scientifically-based techniques of managing but also through emotional closeness with the subordinates, motivate them to perform their tasks with maximum of their abilities.

If we take into consideration the model of Adizes an ideal manager, we can conclude that one person cannot possess all needed qualities, better to say, there is no ideal manager [12]. Eco-management is a part of good business practice with all subjects of business who have a clear strategy but also the aim based on permanent improvement of the process. Subjects dealing with planning of sustainable development of, for example, cities/towns, find it is a challenge and way for proving, orientation for new approaches, new philosophy, new way of thinking, critical and scientific approach, readiness and qualifications for changes, for leaving halfway approach, undertaking business and other endeavors with better efficiency and with general affirmation of efficient practice [13]. Methods and instruments for managing the environment are systematized means for providing information on the environment but also help at making decisions on ecologic result of current or planned activities, aimed to protect and improve the environment, that is, realization of aims of sustainable development. These means can be used

by all social subjects, both from the private or public sector, in all fields of activities and all levels, from the local through regional, national and to international and global.
A great number of means of eco-management are applied in practice, that is, management of ecologically sustainable development. Some of them are used as legal obligation, some are standardized on the basis of national or international standards, and their application is voluntary, while the others are in the phase of development and improvement. Methods and tools can be classified in various ways, depending on interpreting sustainability [10].

In some approaches to sustainable development, the instruments are more technical, oriented to determining ecologic capacity of the space and influence of people's activities on the environment, while in other approaches, besides technical tools, a significant role belongs to political means, which aim to create conditions for adequate participation of the public into the processes of decision making on the environment and development.

7. CONCLUSION

Business operations in global economy has to be based on the principles of social responsibility and coordinated with the demands to preserve and improve the environment. It is necessary to define the directives of sustainable development, that should establish balance between the aims of economic development, from one side, and the social development, on the other side, taking into consideration the need for protection of the environment. Such way of activity should influence business subjects, so that we could deal more seriously with satisfying aims of a greater number of stake holders in our surroundings. Near future points to the necessity to involve the concept of social responsibility into business practice. To educate managers to protect the environment means to add morale principles and to form new system of values of a man towards the nature and surroundings, so that a man could be a user of nature, not its master without limitations.

Harmony of ecological trace of future generations with the capacity of the environment will depend on good-quality ecologic education and bringing-up, primarily locally, affecting each individual, then wider, from regional to global level. If sustainable development represents the way of thinking how to organize life in a good-quality way, including the changes of social values, it is, therefore, naturally appearing that education should improve and increase the quality of life of an individual and the whole community. Accordingly, if the environment protection is the aim which enables satisfying of needs of current and future generations, then knowledge is a significant possibility to achieve this.

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GENDER EQUALITY AND ENVIRONMENT

RODNA RAVNOPRAVNOST I ZAŠTITA ŽIVOTNE SREDINE

Milica Paunovic, Andjelija Plavsic[1]
[1]College of Business and Management Zajecar

Abstract*: Although there are many theoretical concepts and practical implications of gender relations and sustainable development, and so environment, theoretical work and practical activities are rare when it comes to the impact of gender on environmental management. At first glance, it may be said that in the environmental management there is no room for gender equality and women's position and that the area is "gender neutral". However, everything that includes resources, community activities and decision making is important for the position and benefits of both men and women. In this paper we try to point out the importance of gender equality and gender impact on environmental management.*
Keywords: *gender equality, environment, sustainable development, environmental protection, eco-feminism*

Apstrakt*: Iako postoje mnoge teorijske koncepcije i praktične implikacije rodnih odnosa i održivog razvoja, pa i zaštite životne sredine, teorijski radovi i praktične aktivnosti su retke kada se radi o uticaju roda na upravljanje zaštitom životne sredine. Na prvi pogled može se reći da u upravljanju zaštitom životne sredine nema prostora za pitanja rodne ravnopravnosti i položaja žena i da je ova oblast „rodno neutralna“. Međutim, sve što podrazumeva resurse, aktivnosti zajednice i donošenje odluka značajno je za položaj i beneficije kako muškaraca tako i žena. U ovom radu pokušaćemo da ukažemo na značaj rodne ravnopravnosti i uticaj roda na upravljanje zaštitom životne sredine.*
Ključne reči*: rodna ravnopravnost, životna sredina, održivi razvoj, zaštita životne sredine, ekofeminizam*

1. INTRODUCTION

The issue between gender and development can be considered as a starting point for the theoretical, but also ideological and political activities in the area of achieving gender equality, as well as the prerequisites of development. The influence of women and gender relations on sustainable development today is undeniable, as well as identified differences in relation to the environment and the impact of women and men on the environment.

The relationship of environmental protection and human survival on planet Earth is differently viewed by women and men. Despite the great attention to this issue in recent decades, at local, national and international level, many people remain confused or inadequately informed. In some countries the problem is compounded by a lack of educational materials and media that are available for people of all educational levels, thus preventing the mobilization of public action for environmental protection. This applies in relation to gender differences of the human impact on the environment.

2. GENDER AND ENVIRONMENT

Gender is a social construct, respectively, expectations, behaviors and attitudes that are associated with male and female. Gender refers to the psychological, social and cultural differences between men and women. It is associated with socially constructed notions of masculinity and femininity; it is not necessarily the product of one's biological sex. [1] Sex, on the other hand, is a biological givnes and as such almost invariable, while gender and gender roles may change through time and space. Thus, the role and status of women and men are not the same in Serbia, Canada, or Iran, or the same in the Middle Ages, 1911. or 2012.

Gender equality means equal visibility, strengthening the participation of both sexes in all spheres of public and private life. Gender equality is contrary to gender inequality, not gender differences, and aims to promote full and equal participation of women and men in society. [2]

Women and men have different gender roles and related activities, and a different attitude toward public health and the environment. Most previous studies of the assessment of damages to the environment had not introduced a gender perspective and had not equaly evaluated the contribution of men and women to the environmental protection. In order to integrate gender perspectives in environmental protection and sustainable development initiatives it is important to:
1) reduce the negative impact of certain economic and social activities on the environment by raising awareness among men and women regarding the links between their established patterns of production and consumption (including energy, water and bio-resources);
2) minimize consumption of natural resources by promoting innovative gender-responsible solutions to environmental problems within the framework of national sustainable development strategies;
3) accelerate the promotion and environmental development of cost-effective technologies and methods, and their widespread use by men and women by providing economic incentives.[3]

In the framework of international organizations, along with gender mainstreaming[5], the impact of gender has been identified, along with gender relations and roles in the management of natural (and other resources) and the importance of a gender perspective. It is a strategy for achieving gender equality and global development generally accepted by the Member States of the United Nations since the mid nineties.[2] In addition to gender mainstreaming, the question of gender and the environment is reduced to the following: 1 gender permeates the interaction of people and nature and all use of nature, knowledge, assessment and so on. 2. Gender roles, responsibilities, expectations, norms, and division of labor shape all forms of human relationship to nature. [4]

Key activities in the field of gender equality and environmental protection and sustainable development include:

- implementation and further development of methods for the systematic integration of gender perspectives and specific gender issues in interdisciplinary environmental research;

[5] gender mainstreaming is defined by the United Nations as a strategy that takes into account the interests and experiences of women and men, and integrates them into the processes of formulation, implementation, monitoring and evaluation of policies and programs in all political, economic and social spheres, so that women and men achieve equal welfare, and inequality does not play.

- the development of gender relations within the concept of social relation to nature;
- development and application of impact assessment in men and women in the research and public policy areas;
- the introduction of gender mainstreaming in these areas;
- providing scientific expertise for implementing and monitoring the implementation of gender equality in the field of environmental protection;
- impact assessment of programs and measures for environmental protection and sustainable development of women and men, boys and girls.

At the first world conference on women, "Women and Environment" in the 1975th (Mexico City), the public was first introduced to this subject. Only recently the government and development agencies have become active in this field and began to discuss issues of gender equality in their programs of environmental protection and natural resource management. They have concluded that it is necessary to actively promote women's participation and to integrate gender issues in environmental policy and action, as these are key determinants for the implementation of the commitments of the Beijing Declaration and Platform for Action (1995), The World Summit on Sustainable Development (2002) and the Millennium development Goals. However, discriminatory practices, prejudices and attitudes are still rooted in these areas:
- gender differences are evident in the use and management of natural resources, and unequal relations in the family, community, society certainly affect women's access to resources;
- gender differences are evident in terms of knowledge and expertise in the field of environment, knowledge of specific resources and environmental problems;
- gender differences are evident in the accountability and governance, ownership of assets, resources and rights to financial resources;
- gender differences are evident in the perception of the environment and the perception of the nature and severity of environmental problems.

All the above clearly demonstrates the need to implement actions and programs that contribute to gender equality in the areas of environmental protection and sustainable development.

3. WOMEN AND THE ENVIRONMENT

Ignoring the role of women is still a tendency in unsustainable societies. The index of inequality between the sexes compares countries on how to allocate their resources and opportunities among their male and female population. The index shows that countries can not prosper if women are neglected. Investing in women and children - their education, health, enterprise and jobs - have multiple positive effects on the economy. Women are key to sustainable development in all countries. [5]

The whole section (section 4) of the Beijing Declaration and platform for action, is dedicated to women and the environment, in which, among other things, is emphasized the necessity to enable women to influence decision making in this area. Women have a crucial role in the development of sustainable, ecologically clean production and consumer habits and approaches to managing natural resources, as recognized in the Conference on the natural environment and the development of the United Nations and the International Conference on population and development.

Through the management and use of natural resources, women provide existential support for their families and communities. As consumers and producers, as well as those who care and educate members of their families, women play an important role in promoting of sustainable development - with their concern for the quality and sustainability of life for present and future generations. Governments have expressed their commitment to creating a new development paradigm, which would integrate environmental sustainability in relation to equality between the sexes.

Women still are not usually present in all places of political decision making and management of natural resources and environment, their conservation, protection and rehabilitation, and their experience and skills in advocacy and monitoring of appropriate natural resource management too often remain marginalized in decision making bodies, as well as in educational institutions and agencies related to environmental protection in managerial positions. They are rarely trained for professionals who manage natural resources, experts in the field of agriculture, forestry, sea and lawyers in the field of ecology. Even in cases where women are professionally trained in these areas, they are often not sufficiently present in the institutions, in the properties in which they could make political decisions at national, regional and international levels. Often women do not participate equally in the administrative, financial and corporate institutions, whose decision-making in the most direct way is affecting the quality of the environment.
On the other hand, women often play an important role, taking the lead in promoting of environmental ethics and reduced resource use. In addition, women's contribution to managing natural environment, including campaigns among the youth and masses for the protection of the environment often takes place at the local level, where the decentralized action on environmental issues is needed most. Women, especially indigenous women, have specific knowledge of ecological relationships and managing fragile ecosystems. In certain regions, women are the most stable members of the community, as men often seek work in distant locations, leaving women to preserve nature and provide adequate and sustainable allocation of resources within households and communities. [6]

Beijing Declaration and Platform for Action defined the following strategic objectives related to the impact of women in environmental protection:
- actively involve women in decision making at all levels on issues of environment, because women do not have equal access to decision-making bodies and access to places for the policy formulation;
- incorporate issues of interest and perspectives related to gender policies and programs for sustainable development;
- strengthen and establish mechanisms at the national, regional and international level in order to assess the environmental consequences of development policies on women.

4. ECOFEMINISM

Different attitudes of men and women to nature and the environment is problematic even in the philosophy, in the ecofeminism, political and social movement that is running parallel between the relationship of people to nature and men to women. Combining the words ecology and feminism, ecofeminism includes the idea that women's subordination and subjugation and destruction of nature are closely linked. In ecofeministic literature, ecofeminism is often described as the belief that the environment and feminism are intrinsically linked. Another definition suggests that discrimination and oppression are based on gender, race or class and are directly related to the exploitation and destruction of the environment. [7]

The very term ecofeminism was first used the Francois d'Eaubonne in her book "Feminism or Death" in 1974. She has defined it as a potencial that women possess in order to encourage ecological revolution that would ensure the survival of the planet Earth. Four years later, the concept of ecofeminism was mentioned by American radical feminist Mary Daly in the book "Gyn / Ecology" and since then it extends all over the world.

For years before the term ecofeminism even existed, naval biologist and natural scientist Rachel Carson embodied the movement through her work and writing. The focus of her writing was the idea that although people are a small part of nature, they have a tremendous opportunity to change it. Rachel Carson was deeply concerned about the use of synthetic pesticides (called DDT) and their potential for long-term negative effects. Her book of 1962, "Silent Spring", pointed to the harmful psychological effects of pesticides and effects of environmental pollution, prejudicing to the conduct of government and calling for change in relation to nature. [8]

The connection made between women and nature is evident. But while some ecofeminists see the link between women and nature as an empowering, others believe that it is imposed by patriarchy and degrading. One that sees this relationship as empowering, generally confirm that women are closer to nature because of their position of the mother or one who takes care of the house. As a result, they concluded that because women take care of their families and homes, will be more aware of environmental issues than men. One that sees this relationship as abusive, in general say that men will continue to exploit women and nature, because they are seen as eternally fertile and able to provide an endless life.

5. SOME EXAMPLES OF WOMEN'S ACTION FOR THE PRESERVATION OF THE ENVIRONMENT

In many cultures, women have historically had the primary role in gathering food, fuel and water for their families and communities. Because of this, they also had a huge interest in trying to prevent or nullify the effects of deforestation, development of barren soil and water pollution.

The first historically recorded action of women who wanted to protect nature occurred about 300 years ago when, in Rajasthan, India, a woman Amrita Devi protested against the felling of trees that would serve to build a palace for the Maharaja. Amrita Devi belonged to the "Bishnoi" community, which is known for its love of nature. In 1974, group of about thirty women from the Himalayas in northern India has teamed up to save more than 10.000 square miles of forest. Harvesting of Himalayan forests has caused the creation of landslides, floods and high soil erosion and forced women from surrounding villages to climb over the mountains to gather firewood. Now it is known as the Chipko movement, which in Hindu means "stick to", and name reflects the practice of women who protested putting their arms around the trees marked for felling and refused to remove. This practice and term later became popular in other parts of the world and are popularly called, "hugging a tree". The movement has attracted much public attention in mid-1970s, mainly under the leadership of Gaura Devi, fifty years old illiterate women. [7]

Vandana Shiva was participating in Chipko movement during the '70s and is considered one of the most significant ecofeminists of today. Vandana Shiva is trained as a doctor, but had began her work as an environmental protector and ecofeminist activist while she participated in the Chipko movement. In 1988, her book "Staying alive: women, ecology and development" has become almost an ecofeminist bible. Also, this book has opened a discussion about women's efforts for environmental protection in the countries of the so-called Third World. Vandana Shiva has formed an organization that directly confronts the dangers of pollution and environmental hazards in India. She leads Research Foundation for Science, Technology and Ecology (RFSTE), through which she begins an initiative to explore environmental sustainability called Navdanya, which means "Nine harvest". In a letter released by her Navdanya Web site, Shiva wrote: "For me, ecology and feminism have been inseparable".[7]

In Kenya, Green Belt Movement movement was founded by Wangari Muta Maathai. It was launched on Earth Day by the National Council of Women in 1977th and was responsible for planting 20 million trees. Their environmental campaign organized the mobilization of thousands of women who have planted indigenous trees. The movement spread to other countries through the Pan-African countries of Green Network. This movement involved women's organizations fighting to preserve the environment and improve quality of life for women. Professor Wangari Muta Maathai was awarded the Nobel Prize winner in 2004th for her activist work in the field of environmental protection. While she was active in the National Council of Women in the 1976th, Wangari Muta Maathai presented her idea to plant trees to preserve the local natural environment and improve the quality of community life. As the interest grew, Wangari Muta Maathai has developed her own local tree-planting activity in the "grassroots" organization that has spread to other African countries and eventually became the Green Belt Movement. Wangari Muta Maathai has helped women to plant more than 30 million trees on farms in their community and school yards. When receiving the Nobel Prize, said that the movement was there to "inspire people to take responsibility for their natural environment, for a system that manages them, their lives and their future." [9]

Around the same time that the Green Belt Movement ended, Love Canal disaster in New York City has sparked attention. Love Canal, a village located in Niagara Falls, was built on land adjacent to earth filled with chemical waste. In 1978, some twenty years after the settlement was built, chemical waste began leaking through the ground and gradient slopes and streets in this neighborhood. Many families have reported unexplained chronic illnesses that were later associated with chemical waste. President Jimmy Carter immediately declared state of emergency and hundreds of families from Love Canal settlement were moved and received compensation for their houses from the government. In 1979, The U.S. Environmental Protection Agency (EPA) reported an alarmingly high rate of birth defects and miscarriages that occurred in families that lived in the settlement of Love Canal between the 1974th and 1979. As a result, Congress approved the Superfund, or Comprehensive Environmental Response, Compensation and Liability Act, which held polluters accountable for the damage of environmental pollution.

Resident of Love Canal, Lois Gibbs became worried about her children when they began to exhibit chronic, unexplained illnesses. Lois Gibbs became an activist 1978th and started to work for a settlement through an effort to explore local health issues. She helped to form an association of local people and write reports for the city government og Niagara Falls, complaining of a strange smell and the presence of unidentified substances. However, city officials were slow in responding. As the investigation continued, a lot of people stepped forward, telling the story of unexplained illnesses, miscarriages and defects in newborns. Through the population and activism study, eventually it was discovered that the settlement actually lies on tons of chemical waste. Based on her experience and desire to help others, Lois Gibbs founded the Center for Health, Environment and Justice. [7]

In Japan, in 1950, Nakabaru and Sanroku women strongly protested against the construction of industrial facilities and power plants in the region Tobata. The result of their protests and actions were significant measures for pollution prevention taken by the local authorities and corporations.

The women's organization "ACAO Feminina gaucha Democratica (ADFG)", was founded in Brazil in 1964, and later developed into the "Friends of the Earth Brazil." Their main goal was to promote social change for equal opportunity, and since 1974, it has become actively involved in environmental protection, mainly through the protests against the use of toxic chemical substances in agriculture, and by lobbying for the protection of the environment through law.

In Thailand, Tunjai Deetes established the "Foundation for Development", which initiated a sustainable development in 28 villages in five tribal groups. As a result of her leadership and dedication, many tribes have developed good models of community care, and now serve as national models of sustainable agriculture and conservation of natural resources.

Erin Brockovich-Ellis is an American environmental activist, known for the fact that, despite the lack of formal legal education, played a key role in the celebrated case of Californian company's lawsuit against Pacific Gas and Electric Company (PG & E), which in 1993 paid record compensation for polluting the water of Hinkley. That case later served as a plot of the film "Erin Brockovich".

6. CONCLUSION

For strategic activities that are essential for helathy management environment, a comprehensive, multidisciplinary and multisectoral approach is required. Women's participation and leadership are essential to every aspect of this approach. If the policy of sustainable development does not include women and men equally, in the long term it will not be successful. It is necessary that women participate actively in decision making and management at all levels with the creation of knowledge and environmental education.

Women's experience and contribution to ecologically healthy natural environment must therefore be of particular importance on the agenda for the twenty-first century. Sustainable development will be a hazy goal, if we do not recognize and support the contribution of women in managing of natural environment. In the work of solving the lack of adequate recognition and support of women's contribution to the conservation and management of natural resources and preserving the environment, government and other officials should promote an active policy of directing a gender perspective into all policies and programs.

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SURVEY OF ATTITUDES OF CITIZENS ON THE ECOLOGY AND ENVIRONMENTAL PROTECTION

ISTRAŽIVANJE STAVOVA GRAĐANA O EKOLOGIJI I ZAŠTITI ŽIVOTNE SREDINE

Igor Trandafilović, Zoran Stojković, Srđan Žikić, Vladimir Stanojević

Abstract: *From the first day of creation of mankind, people were creating waste. At the beginning these were small quantities of organic waste, which they were* burying *into the ground, throwing into pits ... With growing and development of social community, the problem was becoming bigger. In Zajecar, and Serbia in general, for many years there is a problem of overloaded containers, scattered bags, paper, and plastic bottles in the streets, in parks. Maybe the problem lies in inefficiency of state authorities or unconscientiousness of citizens, or something else, in any case, all this creates a very "dirty" image of our city and Serbia. Serbia and its citizens have to be aware of any problems incurred by negligence of people and environment pollution. Therefore, this research is about examining the attitudes of citizens in Zajecar, and therefore their awareness of environment condition and environment protection.*
Key words: *research, ecology, environment, environment protection*

Abstract: *Od prvog dana nastanka čovečanstva, ljudi su stvarali otpad. U početku su to bile male količine organskog otpada, koji su ljudi su zakopavali u zemlju, bacali u jame...Sve većim širenjem i razvojem društvene zajednice, problem je postajao sve veći. U gradu Zaječaru, pa i Srbiji uopšte, već dugi niz godina je prisutan problem prepunih kontejnera, razbacanih kesa, papira, pa i plastičnih flaša na ulicama, u parkovima. Možda je problem u neefikasnosti državnih organa ili nesavesnosti građana ili nečemu trećem, u svakom slučaju sve to stvara veoma „prljavu" sliku našeg grada i Srbije. Srbija i njeni građani moraju da budu svesni svih problema koji nastaju nemarnošću ljudi i zagađivanjem životne sredine. Zbog toga je ovo istraživanje usmereno ka ispitivanju stavova građana u Zaječaru, a samim tim i njihove svesnosti o ekologiji, odnosno stanju i zaštiti životne sredine.*
Ključne reči: *istraživanje, ekologija, životna sredina, zaštita životne sredine*

1. INTRODUCTION

It is very important to monitor the marketing environment in order to stay in touch with products and marketing practices. Marketing managers often inflict tasks of marketing research, developing formal studies on specific problems and possibilities. These tasks may require market research, product test preferences, sales forecast by regions or exploring promotional activities.

This research includes field research on attitudes and opinions of citizens on the ecology and environmental situation in the local community in which they live. The study, which was attended by100 participants, was conducted through questionnaires.

2. MARKETING RESEARCH

Marketing research is the systematic planning, collecting, analysing and reporting on information relevant to specific marketing situation that organization is dealing with. There is a difference between marketing research and market research. Market research - a research of specific market - is just one part of marketing research [1, p. 114].

The primary purpose of marketing research is to increase success and reduce risk in business, by making the right marketing decisions based on collected real marketing information.

Reducing the risk to the lowest level ("calculated risk" of 10percent) requires complex (integrated) marketing research [2, p. 86].

3. REASONS OF CONSUMER BEHAVIOR RESEARCH

For marketing experts, it is important to understand and predict how and why individuals make buying decisions, so they can make better strategic marketing decisions.

Consumer preferences are changing and becoming diversified. Even in industrial markets where the demand for products and services is always more homogeneous than in end-consumer markets, consumers express different preferences and less predictable behavior. To meet the needs of specific groups of consumers the best they can, marketing experts apply market segmentation which means division of markets into smaller, homogeneous segments for which they can create specific products and/or promotional campaigns [3, p. 26-27].

4. MARKETING RESEARCH PROCESS

Effective marketing research consists of five phases:

- defining the problem and research objectives
- preparation of the research plan
- collection of information
- analysis of information
- presentation of results

The first phase of marketing research implies that the marketing manager and marketing researcher define the problem and harmonize research objectives. The second phase of marketing research (compiling the research plan) refers to finding the most efficient way for collecting necessary information. Gathering information is the most expensive phase of marketing research and the most susceptible to errors [2, p.89-107].

The best known are the three basic methods of collecting primary data:

1) examination (survey)
2) observation
3) experiment

In the survey if researchers want to ask consumers about their purchasing preferences they can make direct contact, by mail, telephone or online. Each of these methods has advantages and disadvantages that must be evaluated by researcher when he/she chooses a way of contacting [4, p. 19-22].

Penultimate phase in the process of marketing research (information analysis) is to draw conclusions based on collected data. Without creative analysis, it would be completely wasted efforts made in previous stages of research.

In the last phase (presentation of results), the researcher obtaines the results to an interested party. The researcher has to present the main results that are important for major marketing decisions wich management is facing with [2, p. 108].

5. RESEARCH - SURVEY

In this survey have participated 100 interviewees, of wich 44% are male and 56% are female.

Subjects were divided by occupation (employed, unemployed, pensioners, college students and high school students). The study included 20% of each group of occupations.

Number of respondents by education is: 16% (faculty), 54% (high school) and 30% (elementary school).

Of the total number of respondents who have finished faculty, 44% are employed, 25% are unemployed and 31% are retired.

Of the total number of respondents who have finished high school, 24% are employed, 26% are unemployed, 13% are retired and 37% are college students.

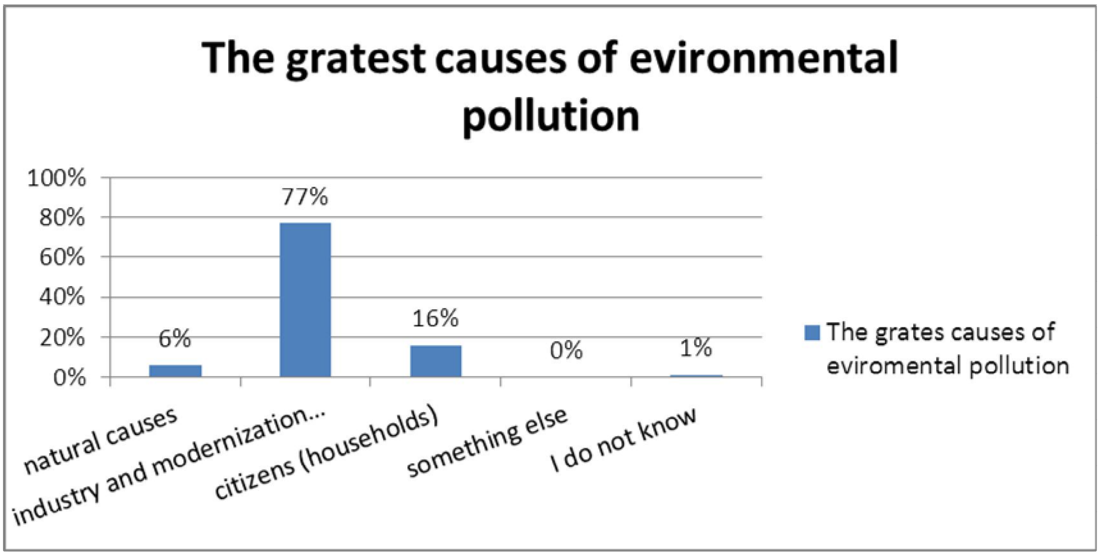
Of the total number of respondents who have finished elementary school, 7% are unemployed, 27% are retired, 66% are high school students.

Number of respondents by age is: 22% (15-19), 27% (20-30), 15% (31-40), 7% (41-50), 14% (51-60), 9% (61-70), 6% (more than 70).

6. FINAL RESULTS SUMMARY

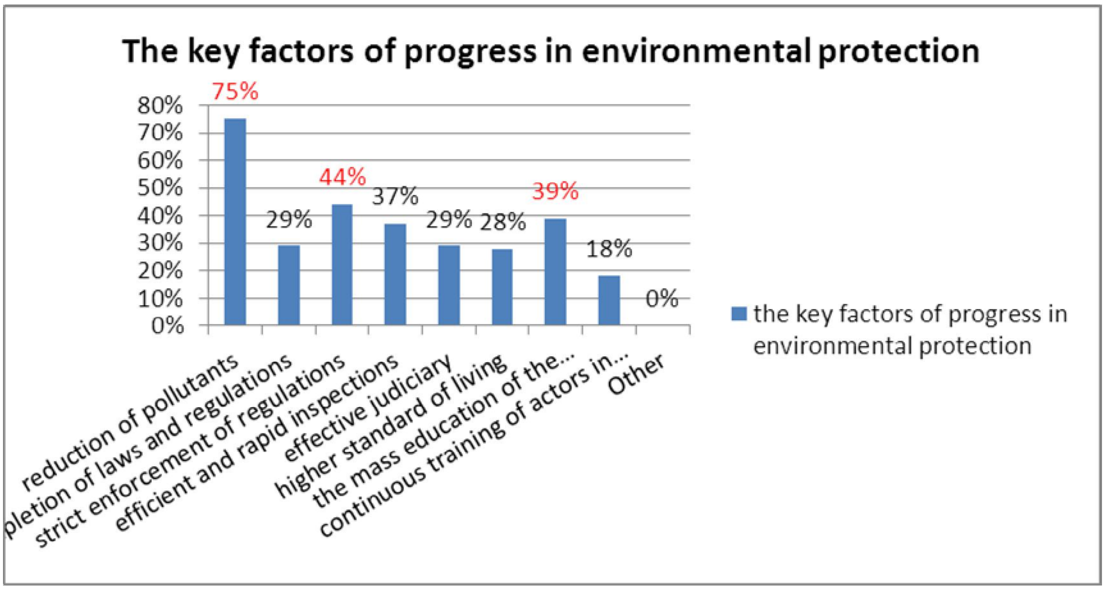
In the first question for most of respondents **the protection of the environment** is a requirement for high living standards and quality life (47%). For 23% of respondents environmental protection is a debt to next generations, and 20% of respondents chose requirement for sustainable development.

According to the majority of respondents (77%) the biggest causes of pollution are industry and modernization (plant and factory waste, transportation, nuclear waste, etc..) (Picture 1).



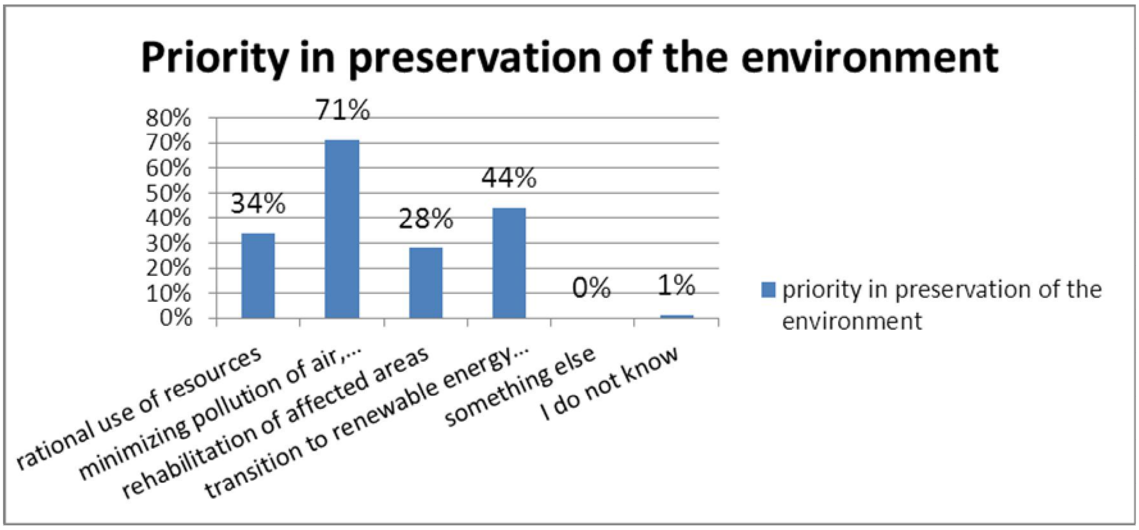
Picture 1. Opinion on causes of environmental polution

Respondents believe that **the three most important factors of progress in environmental protection** are: reduction of pollutants (75%), strict enforcement of regulations (44%) and mass education of the population (39%) (Picture 2).



Picture 2. Opinion on key factors in environmental protection

The largest number of respondents think that **ecology should be financed from** the state budget (59%) and 34% of respondents believe that it should be financed from local budgets (special funds). Respondents believe that the **priority in preserving the environment** is: minimizing air pollution, water and soil (71%) and transition to renewable energy and raw materials for production (44%).

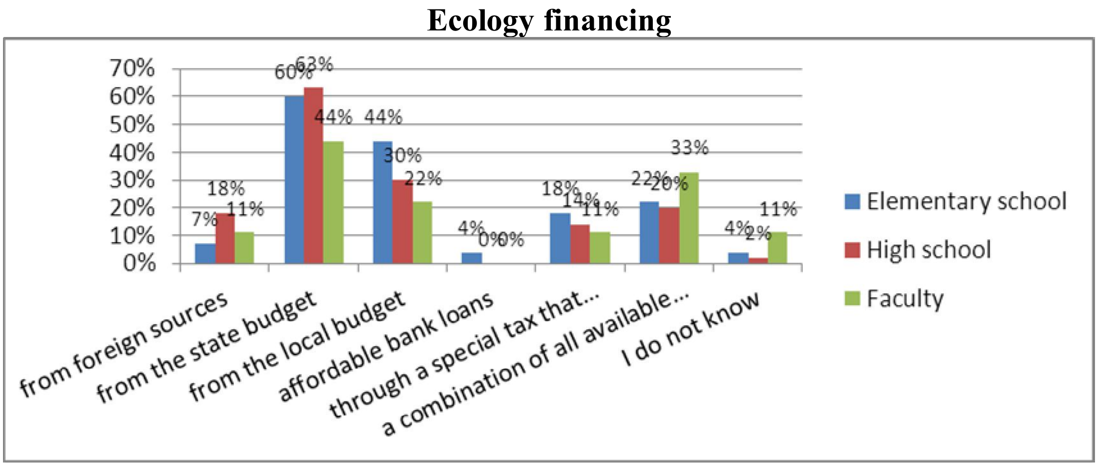


Picture 3. Opinion on preservation of the environment

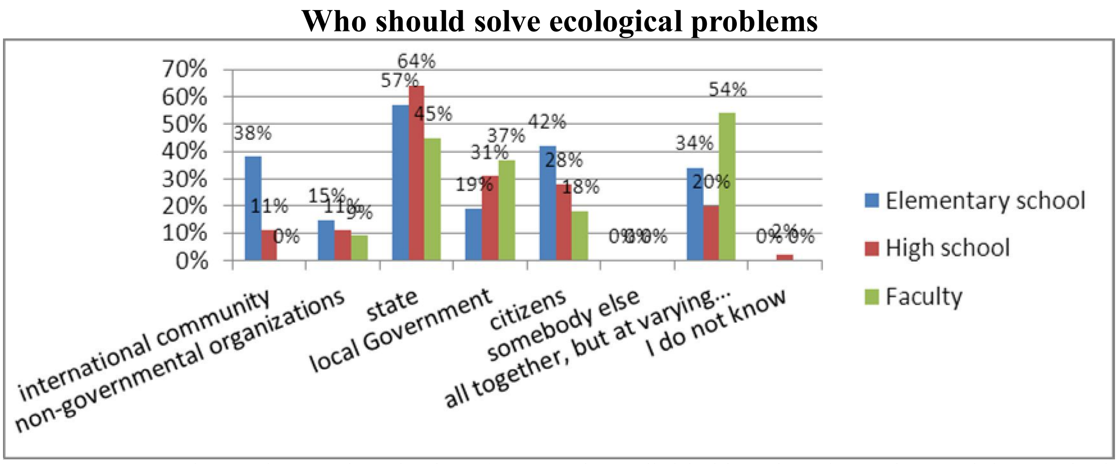
Respondents are mostly afraid of water pollution (64%), air pollution (48%) and climate change (48%). Respondents believe that **the air in their area is mostly polluted by** transport (39%), industry (28%) and individual heating (20%). Nearly all respondents agree that **environmental protection contributes to** social development (94%). To the question **who should solve environmental problems**, most respondents answered: the state (60%) than citizens (32%) and all together, but at different levels and in a specific way (30%). Almost all respondents believe that **the waste management system** should be improved (90%), but there are those who don't care about it (8%). When asked **if they had ever participated in an eco-action**, 40% of respondents said that there isn't any environmental organization in their neighborhood, while 25% said they occasionally participate, and 23% do not participate, because they don't have time. Only 7% of respondents said they regularly take part in this. A third of respondents (30%) would **participate in an action of collecting trash in public areas in their neighborhood** without any conditions; the same number (30%) would participate, but if all the neighbors gather; 23% of respondents would participate only if the local politicians would join them and 17% would not participate at all, because they believe that there are people who are paid for it. Almost all respondents believe that **the state doesn't care enough about the ecology** (95%).

By crossing certain results obtained in the survey we came to the following additional results.

Most participants at all levels of education believes that ecology should be financed from the state budget. Even 44% with primary school believes that ecology should be financed from local budgets. 33% with higher education believe that ecology should be funded by a combination of all available sources (Picture 4).



Picture 4. Comparative review of the atitudes of respondents divided by education about financing ecology

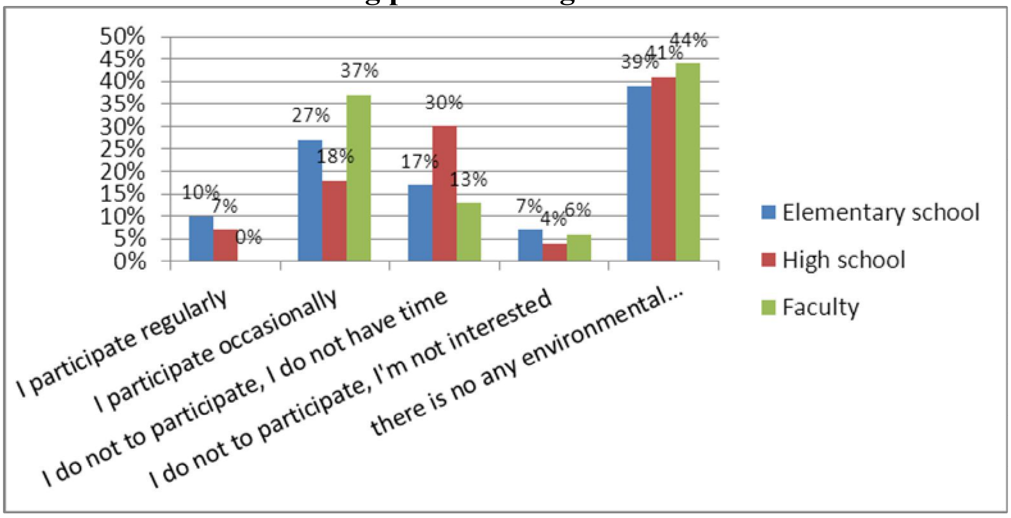


Picture 5. Comparative review of the atitudes of respondents divided by education about solving ecological problems

Most of respondents with primary and secondary education believe that the state should solve environmental problems, which coincides with their opinions about ecology financing. Almost half of respondents with primary education believe that citizens need to solve environmental problems. Most of highly educated respondents believe that environmental problems should be solved together, but in different levels and in a specific way (54%) (Picture 5).

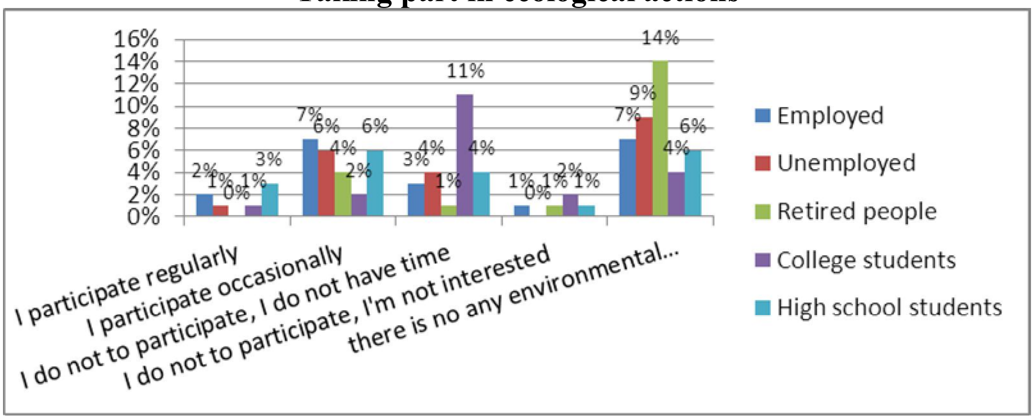
Most of the respondents sad that there is no any environmental organization in their vicinity and it is the reason why they do not participate in environmental actions. Most respondents who participate occasionally are with higher education, compared to others , especially high school graduates. But there are those who regularly they do not participate in environmental action, but not highly educated participants. Most respondents who said they do not participate in environmental actions, because they do not have time are secondary educatedand they are mostly students (37%) (Picture 6).

Taking part in ecological actions



Picture 6. Comparative review of the atitudes of respondents divided by education about taking part in ecological actions

Taking part in ecological actions

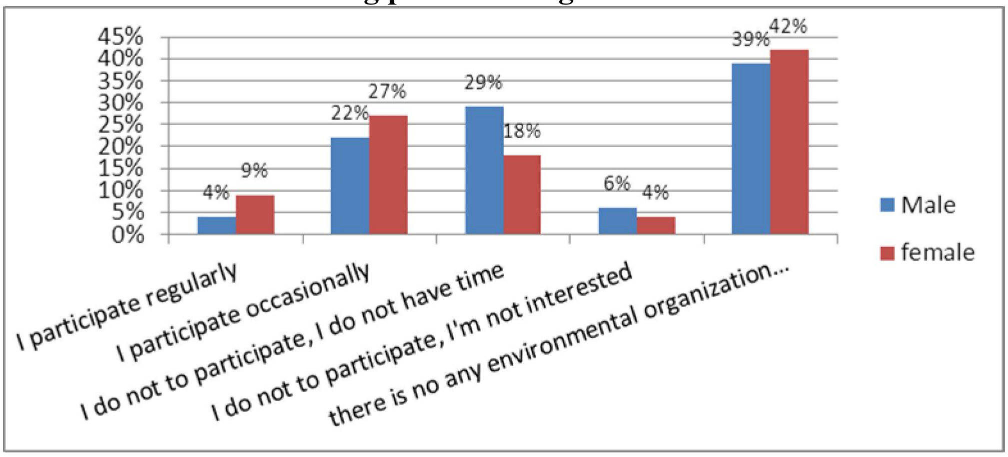


Picture 7. Comparative review of the atitudes of respondents divided by occupation about taking part in ecological actions

The largest percentage of those who do not have time to participate in environmental actions are students. After all there is a small number of respondents who regularly participate, but about 6% of all categories take part in this occasionally. As expected, only few retired people sad they do not have time, but most of them sad that there is no any environmental organization in their vicinity (Picture 7).

Men and women have answered mostly same on this question, but there are little more women who participate in ecological actions, occasionally or regularly (only 5% more) (Picture 8).

Taking part in ecological actions



Picture 8. Comparative review of the atitudes of respondents divided by gender about taking part in ecological actions

7. CONCLUSION

Most respondents believe that the state is the most obliged to resolve environmental problems and to finance ecology. Also, almost all respondents felt that the state does not care enough about the ecology. The largest number of respondents felt that the biggest polluters of the environment are industry and modernization (plant and factory waste, transportation, etc..).

Almost one hundred percent of the respondents think that the state does not care enough about the environment wich is confirmed by full containers that are often seen in Zaječar and Serbia. But the fact is that, in many places along the roads in Serbia, there are scattered piles of bags and bottles, which means that citizens are not enough self-critical, because only 16% of them indicated that people are the biggest causes of environmental pollution.

Almoust all respondents divided by education and occupation and by gender have similar attitudes. The only observation is that respondents with higher education, responded more strongly than others to questions about financing the ecology and who need to solve environmental problems (the combination of all available sources and all together, but at different levels and in a specific way).

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EUROPEAN UNION AND FINANCING OF PROJECT INFECTIVE MEDICAL WASTE MANAGEMENT IN THE REPUBLIC OF SERBIA

EVROPSKA UNIJA I FINANSIRANJE PROJEKTA UPRAVLJANJE INFEKTIVNIM MEDICINSKIM OTPADOM U REPUBLICI SRBIJI

Silvana Ilic[1], Milorad Sakan[2]
[1]Faculty of Management Zajecar
[2] Managing director of PTM Sabac

Abstract: *The main goal of the project funded by the European Union is to present the amount of infective medical waste generated and treated in public health institutions. Project's mission was, based on quantitative tracking indicators of the process of infective medical waste management, to enable the analysis and evaluation of possible waste amount on the account of strategic planning of further activities such as utilization of human and technical resources and dynamics of collection and treatment of the waste. The project started in early 2009 and ended in October 31 in 2011 providing that the monitoring is done by the end of 2012.*
Keywords: *Project, health care institutions, infective medical waste*

Apstrakt: *Osnovni cilj projekta koji je finansiran od strane Evropske Unije jeste da prikaže količine infektivnog medicinskog otpada generisanog i tretiranog u državnim zdravstvenim ustanovama. Projektni zadatak je bio da se na osnovu kvantitativnih pokazatelja praćenja procesa upravljanja infektivnim medicinskim otpadom omogući analizu stanja i procena mogućih količina otpada radi strateškog planiranja daljih aktivnosti poput iskorišćenosti ljudskih i tehničkih resursa i dinamike prikupljanja i tretmana otpada. Projekat je započet početkom 2009. i završen je 31.oktobra 2011.godine s tim što se monitoring vrši do kraja 2012.godine.*
Ključne reči: *Projekat, zdravstvene institucije, infektivni medicinski otpad*

1. INTRODUCTION

Situational analysis of medical waste management in public health institutions in the Republic of Serbia was made in 2006 and early in 2007 it indicated a lack of proper waste management system. Accordingly, the Ministry of Health of the Republic of Serbia beginning with June 2007 elaborated a national system for safe medical waste management on the basis of the facts on waste generated in certain institutions, and on the basis of existing system of public health institutions in the Republic of Serbia (Regulation on the system of health institutions). The project aim is to introduce uniformed system of infective medical waste management in all health institutions of the public sector. The Ministry of Health, through the donation of EU provided 78 systems for sterilization of infective medical waste, as well as machines for the granulation of sharp objects. Based on determined operational model, there is a division of institutions/places for infective medical waste treatment into 2 categories:

1. A central place for treatment (CPT), that will process its own waste, as well as waste from allocated health institutions,
2. Local place for treatment (LPT) responsible for safe treatment of their own waste.

Also, institutions with the infective waste being taken for treatment are known as PG institutions (PG-place of generation).

The report includes generation of infective medical waste from the institutions in which were they, during the project of the Ministry of Health „Technical assistance for medical waste management “, arranged or as places of treatment i.e. places of waste generation. In 55 is installed system for infective medical waste processing, on the teritory of the Republic of Serbia. As a method of infective waste treatment, the sterilization of waste by autoclaving is chosen, 78 Getinge autoclaves are installed, with previously installed 9 Sintion autoclaves in institutions in the territory of Belgrade. For operational reasons Serbia is during the process divided into three regions: Vojvodina, central and southern part of the Republic. Within these regions there is respect about distribution of institutions by the principles of Administrative districts, in accordance with the Regulation on the plan of health institutions system („Official Gazette RS“, no. 42/2006 and 119/2007).

Each administrative district has at least one 1 CPT. Most often it is general hospital in central city district. The exceptions are counties where there are tertiary level healthcare institutions i.e. clinical centers, where health center or institute for public health in the central city of the district takes over the function of CPT.

2. GENERATION OF INFECTIVE MEDICAL WASTE IN PUBLIC HEALTH CARE INSTITUTIONS - BY ADMINISTRATIVE DISTRICTS [1]

According to the project „ Technical assistance for medical waste management in Serbia“, new system of dangerous medical waste management includes 55 health care institutions in which 78 autoclaves and shreders is installed. The equipment is generally installed in stationary type institutions, where the treatment of generated infective waste is carried out, as well as the one from regional health centers.

I Administrative district of Northern Backa
Central place of treatment for this district is General hospital in Subotica. In the system of i.m.w. treatment by sterilization, it is treated 11467.35kg of waste originating from other healthcare institutions, and with the waste from the general hospital it makes 54170.63 kg i.g. 54.17 tones of infective medical waste. This amount of waste is sterilized during 2809 autoclave cycles, so that on average, 15.2 kg of waste is sterilized per one cycle.

II Administrative district of Middle Banat
Central place of treatment for this district is General hospital in Zrenjanin. The total amount of waste sterilized in CPT over this period is 68867.8 kg (68.87 t), and that is done by the 2414 autoclave cycles, i.g. 24 kg of waste per one cycle.

III Administrative district of Northern Banat
Informations are collected from 2 stationary health care institutions: HC „Gere Ištvan in Senta (CPT) and GH Kikinda (LPT). In CPT is altogether treated 10029.66 kg of waste during

367 autoclave cycles, which is on average 18.51 kg/ per cycle.

HC Kikinda – During the period of examination in this stationary institution is generated 25631kg (25.63t) of waste, and based on the daily dynamics it means 70.2 kg/per one day. This amount of waste is treated in 1127 autoclave cycles, which is on average 22,74 kg/ per cycle.

IV Administrative district of Southern Banat
By the arrangement of CPT/LPT institutions it is established that CPT is GH Pančevo, and LPT GH Vrsac. Health center **„**Juzni Banat**"**, Pancevo**.** In the health center is treated only their own infective waste. Within 7 months of work it is generated 17276.4 kg of waste (17.28 t), which is sterilized during 612 cycles. Daily dynamics of waste generation is 70.2kg, while is 28.23 kg of waste treated per one cycle.

General Hospital Vrsac**.** During the examination period in this stationary institution is generated 14714.2 kg (14.7t) of waste, which is on the daily dynamics 40.3kg/per one day.

V District of the West Banat
CPT for the district of the West Banat is General Hospital in Sombor**.** In CPT is altogether treated 55180.51 kg (55.18 tones) of waste, during 3220 autoclave cycles, which is on average 17.14 kg per one cycle.

VI Administrative district of Southern Backa
In this district are formed 3 places for waste treatement, of which the Institute for Public Health of Vojvodina and Clinical Center of Vojvodina are central places (CPT), and Institute for Cardiovascular Diseases in Kamenica is local place for treatement (LPT) of infective medical waste.

In the system for infective medical waste treatment in ICVD, during 1796 cycles, is altogether treated 39452,02 kg (39,45 tones) of waste. The average mass of waste per one cycle is 22 kg. In the system for infective medical waste treatment in CCV altogether is treated 114544,34 kg (114,544 tones). Institute for Public Health of Vojvodina generated 13927 kg of infective medical waste, which is on average in the system for infective medical waste treatement altogether treated 13988 kg (13.98 tones) of waste, during 522 cycles of sterilization. The average mass of waste per one cycle is 26.8 kg.

VII Administrative district of Srem
CPT for the district of Srem is General Hospital in Sremska Mitrovica. In CPT is altogether treated 25301.6 kg (25.3 tones) of infective waste during 700 cycles of sterilization, while the average amount of waste per one cycle is significantly higher than the recommended values for Getinge autoclave (25.0kg) and is 36 kg/per cycle.

VIII Administrative district of Macva
In this administrative district are formed 2 central places for infective medical waste treatment: General Hospital Sabac and General Hospital in Loznica Marin. During the examination period in the district of Macva is treated 123584 kg of waste (123.584 tones).

IX Administrative district of Kolubara
CPT for this district is General Hospital in Valjevo. In the system for waste treatement by sterilization, is treated altogether 91388 kg (91.39 tones) of waste, during 2491 autoclave cycles. The average mass of waste treated per one cycle is 36.7 kg. The average mass of daily generated waste in general hospital is 222.56 kg/per day.

X Administrative district of Podunavlje
In this administrative district are formed 2 places for infective medical waste treatment: General Hospital „Sveti Luka" in Smederevo (CPT) and General Hospital „Stefan Visoki" in Smederevska Palanka (LPT). During the examination period in the district of Podunavlje is treated 97089 kg of waste (97.089 tones).

XI District of Branicevo
In this administrative district are formed 2 places for infective medical waste treatment: General Hospital in Požarevac (CMT) and General Hospital in Petrovac na Mlavi (LMT).
In the system for waste treatement by sterilization, it is treated altogether 41591 kg (41.59 tones) of waste, during 1345 autoclave cycles. The average mass of waste treated per one cycle is 30.9 kg. The average mass of daily generated waste in general hospital is 98.5 kg/ per day.

XII District of Šumadija
In this district are formed 2 places for waste treatement, Clinical Center Kragujevac, as central place (CPT), and General Hospital Aranđelovac as local place (LPT) for infective medical waste treatment.

Clinical Center Kragujevac. During the examination period, in this institution is altogether generated 101 529 kg (101,53 tones) of infective medical waste, while the average daily mass of waste is 278,2 kg/per one day. This amount of waste is treated during 2353 sterilization cycles.

General Hospital Arandjelovac, in the system for waste treatement by sterilization, is treated altogether 9745 kg (9.74 tones) of waste. The average mass of daily generated waste in general hospital is 32.4 kg/per day.

XIII District of Pomoravlje
In this district are formed 3 places for waste treatement, of which the Health Center in Paracin and General Hospital in Cuprija, as central places (CPT), and the General Hospital in Jagodina as a local place (LPT) of infective medical waste treatment. The altogether amount of generated and treated i.m.w. in regulated waste flow in this district is 74,93 tones.

XIV District of Bor
In this district are formed 3 places for waste treatement, of which the General Hospital in Kladovo and General Hospital in Negotin, as local places (LPT), and the General Hospital in Bor as central place (CPT) of infective medical waste treatment. The altogether amount of

generated and treated i.m.w. in regulated waste flow in this district is 39909.16 kg (39.91 tones).

XV District of Zajecar
CPT for this district is General Hospital in Zajecar, while the local place of treatement is General Hospital in Knjazevac. The altogether amount of generated and treated i.m.w. in regulated waste flow in this district is 14.26 tones.

XVI District of Zlatibor
CPT for district of Zlatibor is General Hospital Prijepolje, while the local place of treatment is General Hospital Uzice.Waste treatement is noted for the period april-september 2009. Within six-months work of the system, it is treated 24844 kg of waste generated in the hospital itself, during 584 sterilization cycles. The average amount of waste treated per one cycle is 42,54 kg. The average mass of daily generated waste in general hospital is 135,76 kg/per day.

XVII District of Morava
CPT for this district is General Hospital in Cacak, while the local place of treatement is General Hospital in Gornji Milanovac. The altogether amount of generated and treated i.m.w. in regulated waste flow in this district is 69,657 tones.

XVIII District of Raska
CPT for this district is General Hospital „Studenica“ in Kraljevo, while the local place of treatement is General Hospital in Novi Pazar. The altogether amount of generated and treated i.m.w. in regulated waste flow in this district is 28.605 tones. (for the period february – june 2009).

XIX District of Rasina
Process of infective medical waste management in this district is noted only in General Hospital in Krusevac, which is also, at the beginning of the project named as pilot- institution for thid district. In the system for waste treatment by sterilization, during 2000 cycles is treated altogether 38827 kg (38,83 tones) of waste, so that per one cycle is sterilized on average 19,41 kg of waste. The average mass of daily generated waste in general hospital is 142.23 kg/per day.

XX District of Nisava
Due to the size and importance of this district, and when the dynamics of creating i.m.w. is in question, two CPT institutions are assigned to this districs: Clinical Center Nis and Health Center Nis. In the systems for waste sterilization in this two institutions altogether is treated 47.70 tones of this waste.

XXI District of Toplica
CPT for this district is General Hospital in Prokuplje, which began treating their own and

infective waste from other places in march of 2009. In the system for waste treatment by sterilization, during 973 cycles is treated altogether 23258 kg (23,26 tones) of waste, so that per one cycle is sterilized on average 23,9 kg of waste. The average mass of daily generated waste in general hospital is 62,82 kg/ per day.

XXII District of Pirot

CPT for this district is General Hospital in Pirot. In the system for waste treatment by sterilization, during 611 cycles is treated altogether 18452 kg (18,45 tones) of waste, so that per one cycle is sterilized on average 30,2 kg of waste. The average mass of daily generated waste in general hospital is 41,27 kg/per day.

XXIII District of Jablanica

CPT for this district is Institution of of Public Health in Leskovac, while the local place of treatement is General Hospital in Leskovac. During 280 cycles is treated altogether 7185,43 kg of waste, which is on average 26,66 kg per one cycle.

General Hospital Leskovac. The hospital itself (since March 2009) generated 19687,8 kg (19,69 tones) of waste, which is treated during 591 sterilization cycles, so that per one sterilization cycle is treated on average 33.31 kg. The average mass of daily generated waste in general hospital is 64,76 kg/per day.

XXIV District of Pcinje

CPT for this district is General Hospital in Vranje. In the system for waste treatment by sterilization, during 2035 cycles is treated altogether 26940 kg (26.94 tones) of waste, so that per one cycle is sterilized on average 13,24 kg of waste. The average mass of daily generated waste in general hospital is 73,65 kg/per day.

XXX The city of Belgrade

Due to its numerous healthcare institutions of all the three types of health care, the city of Belgrade in this project is considered as a special unity, and in this case is not followed the usual procedure of 1 district – 1 CPT/LPT institution. The project involved 11 healthcare institutions as places for waste treatement.

1. Special Hospital for Internal Diseases, Mladenovac - The hospital in the system for waste treatement by sterilization, during 1251 cycles treated altogether 18584,5 kg (18.58 tones) of waste, so that per one cycle is sterilized on average 14,85 kg of waste. The average mass of daily generated waste in general hospital in SHID is 42,74 kg/per day.

2. CHC Bezanijska Kosa – Altogether, within 12 months of work the system treated 31278,25 kg (31,28 tones) of waste, during 1040 autoclave sterilization cycles, so that the average mass of waste sterilized per one cycle is 30,28 kg. The average mass of daily generated waste in CHC is 85,7 kg/per day.

3. Institute for Health Protection of Mother and Child „Dr Vukan Čupić“- Altogether, within 12 months of work the system treated 17032,3 kg (17.03tones) of waste, during 785 autoclave sterilization cycles, so that the average mass of waste sterilized per one cycle is

21,7 kg. The average mass of daily generated waste is 46,66 kg/per day.

4. Institute for Public Health of Serbia „Dr Milan Jovanović Batut" - In the system for waste treatment by sterilization, during 384 cycles is treated altogether 12142 kg (12.14 tones) of waste, so that per one cycle is sterilized on average 31.62 kg of waste. The average mass of daily generated waste in IPHS is 47.8 kg/per day.

5. HC Novi Beograd – In the period of examination it is realized 759074 of visits, and within that is generated 3837.3 kg of infective waste. This amount of waste is treated during 789 sterilization cycles, so that the average mass of waste per one cycle is 4.9 kg. The average mass of daily generated waste in health center is 31.98 kg/per day.

6. CHC Zvezdara – In the system for waste treatment by sterilization, during 1679 cycles is treated altogether 35862,53kg (35,86 tones) of waste, so that per one cycle is sterilized on average 21,5 kg of waste. The average mass of daily generated waste in CHC Zvezdara is 74,08 kg/ per day.

7. IOSB Banjica - Institute for Orthopedic Surgery Banjica in its system for sterilization treats only their own infective waste. This activity in IOSB started a bit later than in other institutions, in June 2009, so that the informations are presented for only 7 months of the system operation. Altogether is generated and treated 26191 kg (26,19 tones) of waste, during 752 autoclave sterilization cycles, so that the average mass of waste sterilized per one cycle is 34,83 kg. The average mass of daily generated waste in IOSB is 122 kg/per day.

8. Institute for Cardiovascular Diseases Dedinje - Institute for Cardiovascular Diseases in its system for sterilization treats only their own infective waste. This activity started a bit later than in other institutions, in July 2009, so that the informations are presented for only 6 months of the system operation. Altogether is generated and treated 14294 kg (14,29 tones) of waste, during 433 autoclave sterilization cycles, so that the average mass of waste sterilized per one cycle is 33 kg. The average mass of daily generated waste in ICVD Dedinje is 77,68 kg/per day.

3. FINAL REPORT ON GENERATED AND TREATED INFECTIVE MEDICAL WASTE

1. Altogether generated and treated of i.m.waste = **1 629 264** kg i.m.w. **(1 629,264**t**)**
2. Waste generated by the CPT/LPT institutions = **1 381 486.5** kg i.m.w.,
3. Waste collected and treated for MS institutions = **249 477.5** kg i.m.w.
4. The report includes informations about i.m.waste management from **147** public health care institutions in Serbia on the territory of **24** administrative districts and the city of Belgrade:
   - **89** health centers,
   - **6** health centers with local hospital,
   - **34** general hospitals,
   - **13** institutions of tertiary level of health care
   - **5** institutes/departments of public health.

4. CONCLUSION

After decades of neglecting the problem of generating and waste disposal within the health system of Serbia, the project that has just been completed achieved a lot in the specific field. The achievement of the project, mainly, includes:

- Wider range education of health care workers and associates in the field of infective medical waste management for the level of technicians, managers and menagers for i.m.w. management
- Installation of the system for infective medical waste treatment by the process of sterilization (78 autoclaves in 55 healthcare institutions)
- Donation of special vehicles for infective medical waste transport
- Awareness of healthcare workers about the necessity of consistent implementation of the principles of good practice in the field of medical waste management.

Deficiencies of the project that can threaten viability:

- Indistinct hierarchy in the process of reporting, defined bylaw on medical waste management,
- The time course of the project not being coordinated with passing a law about medical waste management, as well as bylaw decisions that follow it,
- The project was completed without sending previously involved institutions legally defined sequence of activities and financial obligations that each of them have to fulfil toward the Ministry of Environmental Protection and Spatial Planning in order to obtain the permission for waste treatment. It is not taken into account that, after running out of the amount of material supplied according to the project rules, many institutions will not be able to purchase it in the same continuity,
- Deficiencies concerning sustainability of financial activity for the established project.

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SUSTAINABLE DEVELOPMENT IN THE FUNCTION OF REACHING A COMPETITIVE ADVANTAGE

ODRŽIVI RAZVOJ U FUNKCIJI DOSTIZANJA KONKURENTNE PREDNOSTI

Slavica Ostojić [1], Dobrinka Veljković [2], Dejan Ilić [3]
[1] Faculty of Business Studies, Požarevac,SERBIA,
ostojicslavica@yahoo.com
[2] Faculty of Business Studies, Požarevac,SERBIA,
dveljkovic@megatrend.edu.rs
Faculty for education of executives (FORKUP), Novi Sad, SERBIA,
dejanilic@sbb.rs

Never lower a fund of natural capital
below a limit that provides sustainable returns unless
you currently have good substitutes for production services.
(Herman Daly – the founder of ecological economy)

Abstract: *The purpose and relevance of this work refers to the necessity of development and introducing new and superior processes on the market with a constant satisfying of customer needs. A constant aiming at alternative energy sources determines contemporary environment along with continuous productivity growth and intensifying competition both among organizations and overall nations. One of the areas in which Republic of Serbia and local organizations must strengthen their competitive position is agriculture, and one of the alternatives is exactly the development of biofuels, as means of fuels of the future. It is only possible to keep pace with global competition if we use a proactive way of thinking.*
Key words: *sustainable development, agriculture, biofuels*

Apstrakt: *Cilj i značaj ovog rada je da se ukaže na neophodnost razvoja i uvođenja na tržište novih i superiornih procesa i proizvoda uz konstatno zadovoljenje potreba potrošača. Neprestana težnja za alternativnim vidovima energije determiniše savremeno okruženje uz konstantan rast produktivnosti i intenziviranje konkurencije i to ne samo između organizacija već i između čitavih nacija. Jedan od glavnih pravaca u kom Republika Srbija ali i domaće organizacije moraju jačati svoju konkurentnu poziciju na globalnom tržištu predstavlja oblast poljoprivrede, a jedan od alternativnih pravaca je upravo razvoj biogoriva, kao jednog od vidova goriva budućnosti. Takvim proaktivnim razmišljanjem je jedino moguće uhvatiti korak sa globalnom konkurencijom.*
Ključne reči: *održivi razvoj, poljoprivreda, biogorivo, konkurentnost*

1. INTRODUCTION

Competitiveness is sustained growth of the productivity driven by quality of strategy and business operations. On the competitiveness affect together the macroeconomic and microeconomic environment. The level of competition determines productivity - a measurement of ability to produce goods and services using their own existing human, financial, natural and other resources. Productivity determines economic standard of the state or region, income from capital, preservation of national wealth. Productivity depends on the value of products and services (e.g. their uniqueness, quality) and the efficiency with which they are produced.

In today's global economy, characterized by high degree of openness and integration a key role plays a competitive advantage in high developed and in countries in transition.

Wealth is created in all economies on the microeconomic level by business enterprises. Due to the emergence of many barriers to international trade, reducing costs in transportation and communications, all countries and their enterprises, compete in a global market.

Application of scientific research directed towards finding alternative forms of energy, improvement of production systems and open approach to developing superior products consistently must be in the focus of the economic structure in the Republic of Serbia.

Fossil fuels, especially oil is a limited source of energy for which the long term, its price tends to increase. On the other hand, other energy sources (traditional and alternative), in the foreseeable future will not be able to economically expedient way to replace oil. Unexpectedly rapid changes in the prices of fossil fuels have imposed the need for fast finding alternatives. Besides, alternative means of fuel substitution, with no changes in engine design [7].

"When determined average yields and land holdings of 350,000 hectares for the production of raw materials for biodiesel in Serbia can be produced annually from 212 800 250 600 t of biodiesel," [8]. However, the real potential for biodiesel production was significantly lower. If we look at participation in oilseed sowing structure of Serbia, we can conclude that over 90% of oil crops produced in Vojvodina, while in Central Serbia, growing rapeseed, sunflower and soybean, represented about 1 % of arable land.

2. COMPETITIVNESS AND COMPETITIVE ADVANTAGE

The concept of competitive advantage and a sustainable growth simultaneously affect both macro and micro economic environment. Further speaking, the level of competition is determined by the level of productivity, or measure of the ability to produce goods and services using its own human, financial and natural resources. Root competition is in the nature of the environment in which organizations operate. The procedure for establishing competitive advantage includes the following stages:

- Identification of key success factors in a specific field in order to concentrate on the factors of a business sector where the company sees an opportunity to achieve lasting competitive advantage;
- Exploitation of area in which a company has a relative superiority;
- Changes of critical success factors influencing the accepted assumptions about the ways in which business is conducted in a specific field or in a particular market;
- Entering at a new markets and new product development.

The purpose is to maintain a competitive advantage in an enterprise which has a relative advantage to the competitors trying hard to follow and it is improving. [1] These four stages of the constant pressure to stimulate innovation. The theory of competition strongly affects the way in which governments and organizations in developed, transitional and developing countries move through the competition. Competitiveness is a set of factors and conditions that enable and encourage the exchange of successful investments. These are the country's capacity to export, its success in the exploitation of natural, material and human resources in the production process, and market presence, living standards, as well as international treaties and agreements, and membership in various international organizations.

In the focus is the competitiveness of economic entities, with respect to the competitiveness of economic agents the ability to successfully engage in international processes. In this regard, studies have shown that co-ordination and concentration of functions and activities of research and development, production and marketing are essential prerequisites for the creation of competitive advantages of economic entities on the international market.

So it could be stated that economic agents are successful, profitable organization that was established and the necessary precondition for international competitiveness, but also not necessarily sufficient, unless supported by appropriate measures economic, fiscal and monetary policy.

3. PARADIGM OF SUSTAINABLE DEVELOPMENT

Developing and promoting awareness on the significance of preserving natural foundations of economic, social and every other development has been successfully implemented for several decades now. An actual takeoff and efficient impact has been achieved since the respective UN bodies have involved solving this problem as a part of the regular schedule.

Sustainability issue is now becoming one of the fundamental, not only practical, but also philosophical questions that must be a starting point in each and every people's activities defined. *Sustainability* itself integrates previous experience, present working practice and a vision of future which cannot and must not be only a mere extrapolation of the present. *Development* must be available to everyone, because the opposite will jeopardize even the most developed ones. More closely, as long as submission and destruction technologies are being developed, there will be no actual sustainable development. The quality of new development paradigm implies not only integrating the most important economic and ecological criteria, but also makes a special 'methodological synergy' including the following:

- *anthropocentric approach,* with the emphasis on people and their responsibility for sustainable development
- *long term aspect,* referred to as multitime synthesis
- *spatial comprehensiveness,* going from local to global, including every working and living area
- *the transparency of objectives,* starting from the so-called micro objectives (maximizing company turnover and success of eco-system reproduction), so-called

macro objectives (national economy growth and survival of all living beings), to the objective involving sustainability of economic-ecologic-ethical system.

In other words, sustainability as a strategic objective implies optimization of a number of interactions between nature, society and economy, according to criteria and ecology, not only economy.[5]

Sustainable development should be a method that provides comprising economic and ecological factors in all branches of economy. This method is used for coordinating economic objectives, scientific-technological approaches and the method of utilizing natural resources. Sustainable development implies permanent environmental protection and achieving socially viable economic and social development. In global terms, it implies structural changes in economy, thus creating conditions for slowing down and withholding excessive utilization of natural resources and energy sources. [3]

The concept of sustainable development constitutes permanent basis for coordinating utilization processes and natural resources protection. The process of sustainable development means that one establishes production development and productivity growth reproduction, protection and improvement of natural resources. This can be accomplished if the concept of sustainable development is applied on global level and throughout departments: sustainable industry, sustainable agriculture, sustainable development of people's settlements and other departments in social and economy development. [3]

3. NONRENEWABLE RESOURCES

Currently, world oil production sums up to approximately 20 billion of barrels annually. Oil is the ultimate (nonrenewable) source, but the reserves are limited, so the price is about to rise in next 50 years, and using oil in everyday transportation or electricity production should be considerably decreased. 'Shell Oil' forecasts that the production will be at the peak in 2030, while World Resource Institute says it will happen between 2007 and 2014, and that the circumstances will involve higher world demand.
Is it that by using oil we punish our children, depriving them of plentiful oil reserves? As a matter of fact, doesn't using any nonrenewable source violate our sustainability criteria?

The response is negative if we, as a society, can somehow compensate for decreasing natural capital by using the generated one. In that case, oil is not actually a unique source. Markets may seem as strong social mechanism for replacing natural capital by the generated one. Oil quantity will continue to go down, while the price will be higher and will encourage companies to search for and develop new technologies with the similar activities.[4]

4. SUSTAINABLE RESOURCE UTILIZATION

The difference between GDP and NNW, as a result of resource depletion, must be 'saved' in order to secure sustainability. The saving may be in a form of investments in the generated capital (investing money in college fund). However, if the modern generation is too oriented towards consumption and refuses investments, the gap in saving should be solved by putting certain quantities of natural capital aside, thus lowering GDP.

If we assume that GDP is $12,000 per capita, we see that NNW is only $8,000 per capita. In order to provide sustainability, we can do the following: (1) save $ 4,000 per capita by investing in generated capital, or (2) preserve the natural capital.

Alaska, rich in oil, has been giving a part of the profit from oil taxes to the Permanent Fund. The income from the Fund (above the amount needed for reinvesting in order to keep Fund unimpaired) is annually paid to all Alaskans, which is approximately $900 per capita annually. Alaska makes great investments in generated capital, as well – roads, telecommunication, education. Fund and higher quantity of generated capital cannot fully compensate resource depletion to Alaskans. However, it is a great example of modern generations making resource utilization sustainable .[4]

5. RENEWABLE ENERGY SOURCES

In 2001, Republic of Serbia has introduced a reform of energy sector and its harmonization with EU laws, verified by Kyoto protocol in September 2007. This protocol has certified that bioenergy from renewable energy sources is one of the most important factors in future development of energy and economy departments [9]. There is a great energy potential coming from renewable energy sources in Republic of Serbia.

Apart from other available, renewable energy sources, biomass potential makes 80 % of total renewable sources which equals oil production of 2.4 million of tons annually. The majority of biomass comes from agriculture. Beside effects regarding production of energy itself, using renewable energy sources leads to significant positive effects such are investing in this industry production, contributing to environmental protection, rural development and promoting future social and economic development.

Current annual production of total biomass in Serbia amounts to approximately 12.5 million of tons, 1.56 million tons of oil from agriculture respectively. Other then oil, fermentation also gives biogas, methane which can be transformed into electricity, heating energy and energy for machines and generators. During the process of agricultural production, there is a great quantity of waste that can be used as biomass. If biodiesel was produced from oilseed rape on the surface of 200,000 hectares, significant quantities of biodiesel would be made, and it could cover more than 5 % of national need for fuels. 'Biodiesel can be made from various renewable sources such as vegetable oil (soy or other crops), recycled food fat, or animal fats' [2]. 'Apart from getting biodiesel out of oils of soy, oilseed rape and sunflower, lately it has become popular to use castor, due to its potential'[6]. 'Produced biodiesel has advantages over other oilseeds, because, besides high quality, it has the lowest freezing point, so it can be used longer during cold weather, without expensive additives for improving oil flow and stability' [6].

6. OIL CROPS IN BRANICEVO REGION SOWING

Branicevo region, by far one of the most famous ones in Serbia because of its 160,000 hectares of arable land and convenient agro-ecological conditions for vegetable production, is famous for its traditional growing of the most common crops, such as corn and wheat. In the last few years (2005-2008), there was an increase in winter wheat land from 19,040 hectares to 33,750 hectares on account of reducing corn land that makes 50% of the arable area. Therefore, a change in sowing structure is emphasized when it comes to farm crops that make the largest per cent of arable land, while oilseed rape, sunflower and soy crops did not undergo any significant changes during the above mentioned period.

Considering increasing production costs, namely costs of input and winter wheat land growth, the result is, to the extent, reduced investments in aforementioned production as opposed to investments in other types of production. As for Branicevo region sowing structure, sunflower was sown on 4,000 hectares in 2009, soy on 800 hectares, and oilseed rape on 600 hectares in 2008/09. Oil crops on arable land of agricultural manufacturers in Branicevo region make only 3.3 %. 'It means that Vojvodina cannot expect considerable expansion of oilseed land, that is, the largest part (app. 90%) of potential land for growing raw material for biodiesel is located in central Serbia' [8].

The biggest barriers in modifying sowing structure in Branicevo region, when it comes to increasing the number of oilseed crop land, are found in distinguished tradition of growing corn and wheat, size degradation in farm households, great migration of people from countryside to towns and abroad, elder citizens in rural area not motivated for digression from traditional ways of handling agricultural production, obsolescence in agricultural machinery, serious economy situation of farm households which is further shown in reducing physical scope of production, low reproducing capacity of agriculture and low level of market production.

In order to increase surface capacity with oil crops in Branicevo region, it is necessary to undertake a number of measures that would alleviate the impact of limiting factors. 'We need specific, yet encouraging, complex measures in production areas dealing with raw materials for biodiesel, production and distribution of biodiesel, market status and relationship with customers' [8].

7. FACTORS OF BIODIESEL DEVELOPMENT IN REPUBLIC OF SERBIA

Biodiesel, as a renewable energy source, will be used by most of the countries in one or two-decade time, because fossil fuel supplies are slowly diminishing.
In order to increase production of raw material for biodiesel and its wider implementation in Republic of Serbia, the following factors are the most important ones:

1. unification of all elements important for biodiesel production,
2. expanding oil crop land in central Serbia,
3. education of agricultural manufacturers, encouraging measures in producing raw material for biodiesel, as well as biodiesel production and distribution,

4. creating favorable market state,
5. informing potential users about its advantages,
6. investing in production equipment (they can be of smaller capacity which enables less distance between biofuel consumers and greater dispersion of manufacturers of raw material for biodiesel),
7. promoting awareness of positive effects in its implementation,
8. cost effectiveness,
9. maintaining legal and financial system in Serbia that will make biodiesel more payable than fossil diesel in retail trade[6]

If we work harder and better in future, we will gain the following benefits:

- by switching from fossil fuels to biofuels, we decrease country's dependence compared to the countries rich in fossil energy-generating products,
- ecological benefit from using biodiesel (less environmental pollution),
- by preventing further degradation and improving environment, we will have new, more conscious approach to environmental protection and maintain more quality and healthier way of living. [5]

Development of new products, especially the idea of development and implementation of alternative energy must be practiced constantly in order for whole nation to be successful and prosperous.

8. CONCLUSION

The main objective of this paper is to raise awareness of managers in the Republic of Serbia on ways of achieving competitive advantage and the importance of sustainable development. The Republic of Serbia or any profitable organization that operates in this area should be a competitive position based on the following four grounds.

The first ground represents improving the competitive position of foreign direct investment. However, this type of investment is profitable only in the short term, for the simple reason that in this case the previous practice of management remains the same while the only novelty is the inflow of funds.

Another 6round represents improving the competitive position of the adoption of entirely new technologies. This aspect of the case, most related to the adoption and application of foreign know-how. Third ground is a way of building long-term competitive position as a management practice enhances mastery of the new and sophisticated technology.

The fourth and most important ground for achieving a competitive position is the development of partnerships and encouraging greater presence of foreign organizations in the Republic of Serbia. In this way, in addition to direct foreign investment and new technology, implement the new knowledge or "know-how." At the aforesaid order in the Republic of Serbia transferred the best examples of global business practices from which managers should learn the local area and promote profitable business operations of their organizations.

The concept of sustainable development can be understood in different ways. One way is to be considered viable state in which resources are used so that the production capacity of mankind to be preserved. The fact is that the needs of future generations to us unknown, and it is now impossible to think about the level of benefits that will provide some natural resources for future generations. The concept of sustainability combines three main goals: a healthy environment, economic efficiency and social equity. Sustainability is based on the principles that meet the needs of the present without compromising the opportunities in the future.

World oil reserves are constantly decreasing, relative price of oil rises, and it is forecast that this raw material will not be considered a commercial product in the middle of 21st century. Therefore, more and more countries gradually increase the percent of biofuels thus creating new policy of supply.

As for Republic of Serbia, there is a production of biodiesel from oilseed rape, soy and sunflower. The aim is to intensify potential research of renewable energy sources because of their verification, defining technology, introducing stimulating measures and standards in order to encourage utilization of renewable sources. In order to increase the production of alternative fuel, it is necessary to introduce changes in agricultural policy that reflect respective financial aid for production of energy crops.

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SUSTAINABLE DEVELOPMENT ON MOUNTAIN GOLIJA

ODRŽIVI RAZVOJ NA PLANINI GOLIJI

Leposava Jovanović[1], Ivana Avramović[2], Marina Malenović[3], Mladen Jovanović[4]
[1]Faculty of Management Zajecar, leposava.jovanovic@fmz.edu.rs
[2]PhD student, Faculty of Economics Niš,University of Niš, Serbia, ivanajovanovic@rocketmail.com
[3]PhD student, Faculty of Economics Niš, University of Niš, Serbia, marinavujicic@rocketmail.com
[4]Master student, Faculty of Management Zajecar, mladennb@yahoo.com

Abstract: *Today, at the global level, and also at the local level, the key issues are have we the right to destroy and exploit all natural resources, that we have inherited, and what we leave to the future generations. Concept of sustainable development should show us how to meet the social and economic needs and interests of citizens, in a quality manner, and, at the same time, reduce unfluences that threaten or damage the environment and natural resources. The objectives of economic development in the market economies are trying to achieve more dinamic economic growth, that would't disturb the ecological balance.*
Key words: *sustainable development, natural resources, environment.*

Apstrakt: *Kako na globalnom tako i na lokalnom nivou ključno pitanje današnjice je, imamo li pravo da uništimo i iskoristimo sve prirodne resurse koje smo nasledili, i šta pri tom ostavljamo budućim generacijama. Koncept održivog razvoja treba da nas usmeri kako na kvalitetan način zadovoljiti društveno ekonomske potrebe i interese građana sa istovremenim smanjenjem uticaja koji prete ili štete životnoj sredini i prirodnim resursima. .Ciljevi privrednog razvoja u tržišnim privredama leže u nastojanju da se postigne što dinamičnija stopa privrednog rasta, a da se istovremeno ne naruši ekološka ravnoteža.*
Ključne reči: *održivi razvoj, prirodni resursi, životna sredina.*

1. INTRODUCTION

One of the prejudices views the protection of the environment as conflicted with the interests of economic development – growth in gross domestic product and living standards, opening new job posts. Practices of the most developed countries, as well as those still developing, during the last decade proves the contrary: the traditional concept of development directed towards both the growth of production and the growth of consumption of natural resources has reached its limits. So called "external expenses" producing pollution, depletion of recourses and the deterioration of human health begin to outweigh the benefits brought by further development. "The objectives of economic development in the market economies are trying to achieve more dinamic economic growth, that would't disturb the ecological balance" [1,p. 281.], and thereby ensure the rational use and preservation of good-as-host of natural resources. Today, the most developed countries more and more invest their capital in the protection of the environment, energy savings and other recourses, as well as in the development of environment-friendly technologies. It is precisely those areas that are fruitful when we talk about numerous new job posts. Less developed countries have no choice but to follow in their footsteps.

2. CONCEPT OF SUSTAINABLE DEVELOPMENT

The concept of sustainable development is actually a new strategy and philosophy of social development, which combines concern for the wildlife on the planet Earth while preserving natural resources, social and environmental challenges, and to stand as a challenge that every society humanity as a whole. In considering the long-term prospects for survival and progress of humanity belongs to the central concept of "sustainability" or"sustainable development" except that the question is how is it possible "keep"something that is subject to constant change because "development" involves a change, ie. growth, stagnation or decline.

Sustainable development does not put aside the importance of economic growth as the process of increase of community’s material funds. On the contrary, sustainable development always implies the economic growth, however, not any economic growth, nor at any price, but only such that brings new quality to the environment, which, first and foremost, means the stabilisation of population growth, protection of natural resources and energy potentials, especially non-renewable ones. In that sense, the concept of sustainable development starts from the interaction among economy, technology and ecology in a way that for the first time foregrounds preventive and anticipatory protection of the environment (prevent and not treat), as well as a long-term and intergenerational approach, which makes it the new developmental paradigm in the fullest sense.“[2,p.148.]

3. ON GOLIJA – MOUNTAINS BEAUTY OF SERBIA


Figure 1. Lake Okruglica on Golija


Figure 2. Golija in winter

Golija is the highest mountain of south-western Serbia. Gentle, rich in forests, planes and pastures, it lays on the ground shaped like a Latin letter S, 32 km long. Rivers Moravica and Studenica are the representative symbols of Golia. Finding its way through the mountain, from its source to its mouth, Studenica made a deep recess in the bed of a narrow valley with several small and short gorges. River basins of Moravica and Studenica with its many tributaries are the main carriers of geomorphological processes and forms of relief. The highest peak of Golija is Janko's stone (Jankov kamen), 1833 meters high. Its top, but also the tops of the Black top (Crni vrh) (1725 m), the Radulovac (1785 m) and the Hill of Bojovo (Bojovo brdo) (1748 m) offer a remarkable view of the expanse of Golia's forests, pastures, meadows, and even farther, of the tops of Kopaonik and outlines of the Komovi mountains and the Prokletije mountain range. Golija is one of the few mountains in Serbia, where glacial phenomena were recorded, but no reliable evidence found. However, this area is characterized by the refugial character of its habitat, which allowed the survival of tertiary flora. Golija, together with the mountain Tara, is a tertiary flora refuge in Serbia and it is important as a centre of genetic, species and ecosystem diversity in the Balkans and Europe.

Surrounding cultural heritage is also highlighted by its beauty. Monuments of great importance dating back to the XII, XIII and XIV centuries, monasteries such as Studenica, Brezova, Gradac, Kovilje, Preobraženje and Pridvorica, are cultural and historical values of Golija.

3.1. FLORA AND FAUNA

According to the estimates made by the ecologists, flora of Golia makes 25 per cent of all the plant world of Serbia, mostly cultivated and kept by highlander elderly households in 32 villages and 150 hamlets. Floristic biodiversity of Golija builds about 900 taxa of flora. Golija is the kingdom of maple (Acer heldreichi) which survived the ice age, and built here its most beautiful and best preserved deciduous and deciduous-coniferous forests. In addition to maple, holly (llex aquiifolium) has special botanical significance, as well as the endemic species: Allysum markgraf, Allysum jancheni, Pancicia serbica, Viola elegantula and Verascum adamovicii. Types such as Pančić's anthrax (Pancicia serbica) and Adamović' thyme (Thymus adamovici) are characteristics of local endemics and are species of international importance for the preservation of biodiversity. Preserved deciduous and deciduous-coniferous forests of primeval type, as well as forests of conifers, especially subalpine spruce, are included in botanically significant areas on Golija.

Due to the presence of 95 species of birds, Golija is one of the most important European ornithological mountain centres. So far, 45 bird species belonging to a group of natural rarities have been recorded and about 90 species of candidates for the "Red Data Book of birds of Serbia" registered, which proves the great importance of Golija as a biosphere reserve for preservation of biodiversity in birds.

The hedgehog, the alpine shrew, the mole rat, the hazel dormouse, the weasel, the brown bear and the wolf are just some of the 22 animal species that "live" on Golija, and species whose hunting is permitted within the grounds of "Čemernica", "Grabovica" and "Golija" are the deer, the wild boar and the rabbit. In the view of protection, especially in terms of natural rarity, apart from the weasel, for which a permanent protection has been established on the basis of the Law on Hunting, nine more species are deemed important including the wolf, the fat dormouse, the squirrel and the marsh shrew. However, in the Republic of Serbia all protected and endangered species are being hunted at large, even within the boundaries of national parks!

3.2. BIOSPHERE RESERVE

In July of 2001, the government of the Republic of Serbia issued a regulation that puts the area of Golija Mountain under the protection as “Golija” Nature Park and enlists it in the first category of protection as a natural recourse of great importance. At the same time the

government has adopted a Master Plan and the Special Purpose Spatial Plan of the Nature Park, which ultimately determines the guidelines for the development of this mountain range towards a modern winter tourist centre which, according to international experts, by its location and beauty is reminiscent of the Austrian Kitcbil. The nature park with its natural and generated valuables completely met the criteria necessary for nominating "Golija" Nature Park for the Biosphere reserve in compliance with the MAB programme (Man and the Biosphere Programme), so that one part of "Golija" Nature Park, covering 54 804 h, was declared to be "Golija-Studenica" Biosphere reserve, in the light of decision made by the UNESCO Commission in October of 2001. According to UNESCO programme, "Man and the Biosphere", biosphere reserves are areas of terrestrial and coastal ecosystems which are internationally recognized within the programme.
The park area in divided into three-level safety zones[3]: Habitats of natural rarities of plant and animal species, as well as specific plant communities are considered localities that fall under the I degree protection regime. The second degree protection regime covers the areas where it is necessary to undertake exceptional measures of improvement in order to preserve the original natural recourses, i.e. areas where greater human intervention is necessary to ensure the conditions for the survival and advancement of natural recourses. The third degree of protection allows selective and limited utilization of natural recourses and controlled intervention and activities on sites that are harmonized with function of a protected natural recourse.

3.3. SPATIAL PLAN OF NATURE PARK GOLIJA

The government of the Republic of Serbia finally produced a Spatial plan for the area of the Golija Nature Park designated for a special purpose on 7th April, 2009. This plan is of major importance for five municipalities of Morava, Raška and Zlatibor districts. The spatial plan brought by the Republic of Serbia denotes area of Golija mountain as a tourist region rich in activities of international and national importance, within which the tourist region and the nature park coexist simultaneously. In compliance with the development strategy of tourism in Serbia, the area covered by the plan is situated in one of the four clusters – the cluster of South-west Serbia.

Analyzed strategic fulcrums of the destination clearly indicate that it is necessary to redirect the attractive and relevant, natural and cultural space of Golija towards a quality restructuring and the subsequent repositioning on the tourist market where it will be displayed. The proposition of competitive market positioning of Golija tourist destination is a result of strategic fulcrums, defined potentials, international demands of competitive positioning, as well as tourist attractions of Golija.

Considering its attractiveness, potential and capacities, Golija mountain could undergo "green field" development of the mountainous area, that would be based on the principles of moderate and sophisticated concept of condominization[4] (mountainous development of Vrhovi resort – Odvraćenica).

3.4. PRESERVATION AND PROTECTION OF GOLIJA

Reasons and aims of protection include preservation and improvement of biodiversity, geological heritage and landscape features for scientific research, educational, recreational, tourist, cultural and other needs and purposes. Law on Environmental Protection represents the real basis for determining the general / public interest for designation of the protected areas.[5] Within the protected areas, three-level protection regimes apply; protection regime if the first degree, functioning as the regime of strict protection following the model of preservation of “wilderness”, encompassing only 6.5% of total protected area on the territory of the Republic of Serbia, protection regime of the second degree, functioning as the regime of intermediate protection following the model of “semi-wilderness” or “buffer zone” which includes 21.2% of total protected area, and the protection regime of the third degree, operating as the regime of loose protection with the supervised utilisation of natural recourses and the area that comprises of 72.3% of total protected area. Apart from above mentioned reasons, conditions for sustainable socio-economic development and mountain planning are guaranteed by goals and protective measures.

Certain problems have been registered in following the condition of natural recourses, environment and human activities in national parks and other protected natural recourses. Illegal construction, excessive exploitation of mineral resources and the use of other natural resources (forests, land, water and water facilities), inadequately established municipal infrastructure (a disorder of the waste water filtering system, waste removal, inadequate water supply systems, etc.), unregulated and excessive traffic, noise, air pollution etc. are the highlighted problems. All this indicates the internal drawbacks of the protected areas management systems, as well as the incomplete and untimely institutional and material support coming from the competent bodies of the state administration and local government.

Illegal construction, that not only endangers natural and cultural recourses and the quality of the protected environment, but also produces numerous difficulties (irrigation and sewerage, electric energy, waste collection and evacuation and others), presents the burning issue in management of national parks and other protected natural recourse. Illegal construction does not only desecrate the beautiful landscapes of Golija, but, if it continues, it may also revoke its Nature Park status. The whole area of Odvraćenica (the top of Golija) is a fen, so the special risk comes from the septic tanks situated next to the "wild" holiday homes, whose contents are mixed with groundwater in the mountain areas that are under the protection of UNESCO.

Besides buildings and illegal use of water sources affecting the desecration of natural beauty, flora and fauna of Studenica, a very clean river rich in trout and rare fish species, is also in danger.

In addition, it is being neglected that Golija is a protected natural recourse of the first category, lying on 75.183 hectares of ground, and that, since October of 2001, a part of this protected recourse has been partitioned into a biosphere reserve Golija-Studenica by the UNESCO Commission’s decision. Nevertheless, it is well known that the regulation brought by the Government of Serbia prohibits clear cutting and deforestation on such sites. Damage inflicted to nature through investors' acts of arbitrary behaviour undermines the system of environmental protection and demonstrates the impotence of the state to preserve the ecological public interest.

4. CONCLUSION

By pervasive trends of industrialization and technology, people are persistently violating the environment not realizing that by destroying their planet, they actually destroy themselves. The ultimate goal of technical improvements in a consumer society is to increase the amount of pressure of population onto nature, which will ultimately lead to increased depravation. Great number of people, with numerous objects and waste – but deprived of food, water or nature for it has been processed into billion of unnecessary things. Examples of intact and unpolluted nature, that must be preserved, are rare. Golija Mountain is a true example of healthy and preserved environment. It is intact, magical, clean, beautiful and unique. Golija is a magnet for all tourists, especially passionate lovers of hitchhiking and gathering of fungi, medicinal herbs and wild fruits, skiers and hunters. The area of Golija Nature Park is under renovation and infrastructural furnishing to meet the needs of tourism and recreation.

The area of Golija will succeed through innovative, but *sustainable development*, providing long-term benefits to all key subjects and, first and foremost, to all the dwellers of this area. Taking into consideration recourses and attributes of the area, the Master Plan proposes that the particular market positioning of Golija be based on the abundance of natural and cultural recourses, as well as the history, tradition and the identity of the destination because it enables integration of these elements and its moulding into differentiated experiences, products and activities. The proposition envisions mid-term and long-term market positioning using four key tourist attractions of this area – the magic of nature, life in the mountains, history and culture, as well as the activities available on the mountain.

In the most technically developed countries, pollution is only invisible at first glance because it is redirected in ways and to places that are out of sight, or is exported.

It is only to be expected that our citizens, in time of transition towards the consumerist society, following the footsteps of other "wealthy" citizens, rapidly swap natural recourses for worthless things, "status" symbols, aiding drastic destruction and pollution. Our goal is, indeed, welfare, but not at the cost of destroying valuables and cultural heritage. Therefore, it is not factories that pollute the planet, but the cause lies in the weakened minds of consumers who incite the unnecessary production creating the goods of lesser value that is, nonetheless, being bought. Technology is only the tools- outcome and the usage of technology depends solely on us. Thus, technology cannot save the world.

Following strong European ecological movements, we should raise awareness of the necessity of protecting the planet and preserving what we possess.

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THE INFLUENCE OF AGRICULTURAL BIOTECHNOLOY ON THE QUALITY OF THE ENVIRONMENT

UTICAJ POLJOPRIVREDNE BIOTEHNOLOGIJE NA KVALITET ŽIVOTNE SREDINE

[1]Jelena Bošković, [1]Veselinka Zečević, [1]Tamara Galonja Coghill, [1]Zdravko Hojka,
[1]Gordana Dozet, [1]Lazar Ružičić, [2]Dragana Vukašinović, [1]Mirela Matković
[1]Megatrend univerzitet Beograd, Fakultet za biofarming Bačka Topola
[2]Faculty of Life Sciences, Copenhagen University, Copenhagen, Denmark

Abstract: *Biotechnology and the introduction of genetically modified crops (GMCs) provide new opportunities for increasing crop productivity and tackling agriculture problems, such as diseases, pests and weeds, abiotic stress and nutritional limitations of stopple food crops. Plants with novel traits enabling the production of pharmaceuticals are also being generated. As GMCs are being adopted in various locations with different ecosystems, agriculture, biodiversity, and agriculture practice, a scientifically based understanding of the environmental effects of cultivations of GM crops would assist decision markers worldwide in ensuring environmental safety and sustainability. The most important enviromental assessment of GM crops is their putative invasiveness, vertical and/or horizontal gene flow, other ecological mechanisms, effects on biodiversity and the impact of presence of GM material in other products.*
Key words: *biotechnology, genetically modified crops (GMCs), enviroment, plat protection, HRCs, HTG, gene flow, biodiversity.*

Apstrakt: *Biotehnologija i uvođenje genetski modifikovanih biljaka otvara nove mogućnosti povećane produktivnosti i rešavanje problema u poljoprivredi, kao što su bolesti, štetočine i korovi, abiotički stres i nutritivna ograničenja prehrambenih žitarica. Stvaraju se i biljke koji poseduju nove osobine, koje im omogućuju produkciju farmaceutskih proizvoda. Pošto su genetski modifikovane biljke uvedene u različite lokacije sa različitim ekosistemima, poljoprivredom, biološkim diverzitetom i poljoprivrednom praksom, naučno razumevanje uticaja ovih biljaka na životnu sredinu bi pomoglo u donošenju odlučujućih markera širom sveta, u cilju obezbeđivanja bezbednosti i održivosti životne sredine. Najznačajnija procena genetski modifikovanih biljaka odnosi se na njihovu navodnu invazivnost, vertikalni i horizontalni prenos gena, druge ekološke mehanizme, efekte na biodiverzitet, kao i uticaj na prisustvo genetski modifikovanog materijala u proizvodima.*
Ključne reči: *biotehnologija, genetički modifikovane biljke (GM)***,*** *životna sredina, zaštita biljaka, HRCs, HTG, protok gena, biodiverzitet.*

1. INTRODUCTION

Throughout the history of plant breeding, new combinations of genes have been introduced, superficial chromosome manipulation performed, as well as additions, supstitutions, production of lines with specific chromosomes, chemical and radioactive treatments for inducing mutations and rearranging chromosomes, cell, tissuee and embryo cultures developed, and also *in vitro* fertilisation and protoplast fusion in order to enable discovering interspecii and genus hibridisation. Integrations of these technologies greatly contributed to yields and adaptations to the environment [1,2], parasite and pest resistance increase and quality increase, demanded by food industry and consumers. Molecular biology and genetic engineering development enabled efficient modification of cultivated plant specii. These technologies may have adverse effects on the environment [3], human health and economic level of poverty increase. In the forthcoming period, more attention should be paid to commercial and economically justified use of GM crops in agricultural food production [4]. In most countries, there is an ongoing debate on the importance level of sustainability, globalisation, etics and socio-economic approach as the parameters to be included into GM risk assessment.

2. HORIZONTAL GENE TRANSFER

Horizontal gene transfer (HGT) is the transfer of genetic material between cells or genomes belonging to different species, being different to usual reproduction, where genes are transferred vertically from parent to offspring only within species or between relatives. The bacteria are involved in the exchange of genes between different species in nature. This is accomplished in three ways: by conjugation when genetic material passes between the opposite cells, by transduction where genetic material is carried from one cell to another by infectious viruses and by transformation when the genetic material of cells is taken directly from its environment [5]. Successful horizontal gene transfer must be joined into cellular genome, or to be maintained stable in the recipient cell. In some cases, the foreign genetic material that enters the cell, especially from other species, will be removed before it is incorporated into the genome. Under specific environmental conditions that are not yet scientifically incomprehensible, foreign genetic material avoids being removed and incorporates into the genome. Horizontal gene transfer is well known in bacteria, but in recent years, this phenomenon has become more recognizable in higher plants and animals. Basically, this process happens in the entire biosphere, and bacteria and viruses are used as intermediaries for the transfer of genes, gene sets (gene pool), reproduction and recombination [3,6]. There are many potential routes for horizontal gene transfer in plants and animals. Transduction is expected to be the main way because there are many viruses that infect plants and animals. Recent research in gene therapy indicate that the transformation is potentially very important for mammals cells, including humans. Direct transformation is not so important for plant cells that have protective cell walls. However, soil bacteria belonging to the genus Agrobacterium are able to transfer T (tumour) segment of its induced tumour (Ti) plasmid into plant cells in the process of conjugation. However, viruses and other genetic parasites, such as plasmids or transposons, have a special genetic signals and probably a possible structure that allows them to avoid degradation. Viruses have genetic material that is protected in the protein layer. They remove their protein layer to penetrate into cells and may allow the creation of many more copies, or to move directly into the cell genome. Plasmids are free particles are usually circular in shape, so that genetic material can finally be held in a cell separate from the cellular genome. Transposons (*jumping genes*) are blocks of genetic material that have the ability to insert into or out of the genome, with or without their multiplication, and to be retained in the plasmids for further breeding. Thus, these genetic parasites function as vectors for horizontal gene transfer, and it is also clear that the transfer of genes regulated by the internal characteristics of organisms, particularly related to specific environmental conditions [1, 6].

3. RECORDING TRANSMISSION OF HORIZONTAL TRANSGENIC DNA

It is believed that once integrated transgenic DNA into transgenic or modified organism becomes so stable as the organisms that possess DNA. But there are both direct and indirect evidence against this assumption. Probably the transgene DNA spreads more, as was found for the expansion of horizontal gene transfer. Transgenic lines are basically unstable, and often do not interbreed. Certain molecular data prove the structural stability of transgenic DNA in relation to its location, locus of penetrating into the genome and the arrangement of genes in future generations. Actually transgenes can be stabilized in successive generations or lost entirely. Gene for tolerance to herbicides introduced into *Arabidopsis* with a vector, can be 30 times more oriented to avoid the spread as the same gene that is derived by mutagenesis. If this can happen with a secondary horizontal gene transfer via insects visiting the plants for pollen and nectar, the results which indicate that pollen can transfer transgenic DNA to bacteria in the intestine the larvae of bees were announced [6]. It was experimentally confirmed that the secondary horizontal transfer of transgenic and gene markers of antibiotic resistance in plants created by genetic engineering in soil bacteria and fungi. Transfer into fungi is easily achieved by co-cultivation, since the transfer to bacteria was obtained by re-isolation of transgenetic DNA or total DNA of transgenic plant. Successful transfer of kanamycin gene marker for resistance to soil bacterium *Acinetobacter* was obtained using extracted total DNA from homogenised plant leaf in numerous transgenetic plants: *Solanum tuberosum* (potato), *Nicotiana tabacum* (tobacco), *Beta vulgaris* (sugar beet), *Brasica napus* (rapeseed) i *Lyopersicum esculentum* (tomato). It was assessed that about 2599 copies of kanamycin resistance genes were sufficient to transform one bacterium, regerdless of the presence of 6 million spirals of plant DNA. However, natural environmental conditions are widely unknown and unpredictable, so the research by some scientists on synergistic effects could not be ignored in this case. Ttransgenic DNA would be free in the rhizosphere, which is also a critical point of the environment. Other scientists have found that the results of horizontal transfer of kanamycin resistance gene to *Acinetobacter* were positive just by using 100μl of homogenized plant leaf. Genetic material taken from the dead and living cells persists in all environments, is not broken down or destroyed fast, as it was previously anticipated. This leads to the assertion that sand, humic acid components and plant remains allow infection with several microorganisms in the soil. Transformation of bacteria in soil by absorbing DNA in the sandy clay was confirmed by experiments with microorganisms. Thus, horizontal gene transfer is the leading phenomenon, which has occupied an important place in the evolution of specii, and continues today. Horizontal gene transfer is a regulated process, limited by the specific barriers and mechanisms that reject and inactivate foreign genetic material.

4. PLANT PROTECTION AND GMCs

Main considerations of the use of genetically modified crops (GMCs) in plant protection, focus on the possibility of insertion resistance to insects, fungal and bacterial pathogenes, viruses, with the emphasis on the problem of long-term resistance [7]. Pest plant protection by genetic modifications is the use of Bt toxin originating from Bacillus thuringiensis (successfully used as spray during many years) inserted into numerous plant specii: tomato, tobacco, cotton etc. Pea lecithin has been shown to protect against insect attack in transgenic potato and tobacco. Ttrypsin is also a protein inhibitor in field pea. GM plants provide great opportunities for environmental benefits by reduced pesticide application, the development of resistance in pests. These advantages can be quickly negated. There are strategies to reduce exposure to pests transgenic products, and lower the resistance level and the application of limited transgene activity [8]. It was shown that the application of transgenetic resistance to viruses through indirect protection of cap-protein is possible and can be used as method for wide range of viruses and hosts, for example, expression of TMV cap-protein of mosaic tobacco virus in potato and tomato resistant to PVX and PVY [5]. The application of genetic modification in supression of fungal and bacterial plant pathogenes was also developed. It is necessary to seek for strategies of multiple resistance (pyramiding resistance genes) to various virulents of plant parasites [4, 9].

5. PLANT TOLERANCE AND RESISTANCE TO HERBICIDES (HRC)

Much work has focused on increasing the tolerance of cultivated plant species to herbicides, which was tested around the world. Herbicide resistance can be achieved by increasing the protective mechanisms, adoption of herbicide reduction, demotion or reduction in susceptibility. Herbicide-tolerance genes are widely used as markers in the selection of transgenic plants. If the genes of different tolerance to herbicides, developed or built in the same plant species, they could condition creation of weeds that contain multiple resistance genes [10]. Hybridization of plants resistant to herbicides (HRC) with populations of wild relatives of these plants seem complex to control, especially if they are already known as a weed and if you have resistance to widely applied herbicides [9, 11].

6. NON-CULTIVATED POPULATIONS OF TRANSGENETIC PLANTS AND GENE FLOW

The possibility of introduction of transgenic plant will mostly depend on their ability to adapt to new environment. For many crops is known to form a temporary uncultivated population, and includes species such as canola, alfalfa, radish, carrot, rye, clover, sugar beets, chicory, beet, cabbage, some of whom are indigenous, while others are probably imported for cultivation. In some cases, crops, eg. rye, and the difference between the uncultivated natural populations is unclear, as in the case of other types of settlement is not extensive and probably has no adverse impacts on uncultivated plant species. Possibilities of gene transfer from the experimental fields with GM plants via pollen will depend on the degree of sexual compatibility between GM crops and wild relatives, and the possibility of obtaining pollination and seed [12]. The frequency of this phenomenon will be important to spatial isolation between GM plants and suitable recipients who depend on the method of pollination, wind or insects, isolation in time or season of flowering. The experiments are performed to determine the dose of cross pollination between the potato and non-GM potatoes planted at different distances from each other. These results are well aligned with each other, and both show that the transgene movement outside of experimental GM fields is negligible below 10 m, and are reconciled and low doses of cross pollination, which is commonly found in potato.

In contrast, in oilseed rape compatible selfpollination was presfoundent, and it can produce large amounts of seeds pollinated by wind and insects. Long-distance pollination events are probably caused by insects: air borne pollen can be detected 30-50 m from the rapeseed plant, but it decreases with distance. Experimental field-type experiments using either GM or non-GM plants can provide useful information indicating the required insulation spacing required to avoid the release of the transgenic. However, work on natural populations indicate that the situation could in fact be more complex, a sub-division of the local population can strongly influence the introduction of transgene in wild populations [1]. Interpretation of results is also complicated, highlighting the importance of calculation of the dose changes with a distance from experimental GM fields, rather than the absolute percentage of GM seeds at a given distance from the plot. Moreover, gene flow may depend not only on crops but also on variety, location and season [13]. Experiments on the gene flow of populations of wild radish suggest that the size of the donor and recipient populations play an important role in gene flow. That would be great sources of pollen, such as the introduction to a wide range of GM genes could have a significant impact on small wild population of compatible plants. It was perceived that they present considerable variation in estimates of gene flow is probably due to local-position and the effect of pollinators. Other researchers have found similar effects in populations of Cucurbita and rice. The global group has identified three grain crops that have sexually compatible weedy relatives that are likely to be subject to transfer genes in agricultural systems. Ccross pollination and production of fertile hybrids vary from case to case. If the selected features have positive benefit, introgression of new features into an existing weed populations is possible. The risk of environmental damage depends on the habitat of weeds. In the crop-weed complexes considered in this study, where habitat of weed relatives is limited to agricultural systems, there is no possibility that the new feature threatens natural ecosystems [14, 15].

7. HIBRIDISATION

Weed ecology and evolutionary biology are very important in assessing the prospects of accidental crossing of transgenic resistance to harmful organisms in the population of agricultural weeds [13]. Model for random transgene transfer has three stages, which lead to the formation of widespread weed populations that carry the transgene. Hybridization between weeds and transgenetic crops is the first phase. The second is the appearance of introgression and adaptation process in which the mechanisms of evolution improves non-adaptible properties in early-generation hybrid products. As a consequence, weeds that carry transgenic resistance to harmful organisms and having a normal high level of adaptation to specific agro. Finally, the process of expansion and spread of neo-weed in nature, together with local adaptation to different conditions, it is enough when crossing the wide area. Aspects of weed ecology and evolutionary biology are important for the interaction of the three phases described above. Real scientific data on the ecology of weeds are lacking. Scientists who study weed, focus on weed control with herbicides. In these prevailing studies the ecological research is ignored, particularly theoretical description [3, 11]. Hybridization between transgenic and conventional crops and sexually compatible relatives occurs in many crops and has produced new forms of weed populations obtained. In many papers, this hybridization is described in detail and can be expected that the transgenic cross even over large spatial and the significant barriers of genetic incompatibility [16]. In some systems the random transgene transfer by hybridization seems inevitable. However, in other cases it is unclear whether the hybridization is relatively restrictive phase in transgene transition. This leads to the assumption that hybridization may in fact be relatively restrictive in some circumstances, for example, when hybridization occurs over substantial obstacles to the incompatibility. Aspects of weed ecology which can affect the levels of hybridization in these situations include the breeding systems of weeds and the effects of spatial and temporal distribution of weeds in several stages. The system of selection between weeds in agroecosystems has been mixed system in which fertilization and self-fertilisation occur, although other reproductive systems are known. Therefore, the most widely used system of selection of weeds allows hybridization, but such a crossing must occur at a significant level of self-fertilisation. For selection systems and other aspects of genetic systems and reproductive ecology, that affect levels of hybridization is known to vary within and amongst populations of weeds. For example, populations of Datura stramonium in North Carolina have flowers that open to pollinators and show approximately 10% level of fertilisation. In contrast, certain populations are exclusively self-pollinating, with flowers that do not open to pollinators. In some cases, this variation is related to the adaptation of the system after a major enlargement of selection [14], but the behavior of pollinators can vary geographically. These aspects of reproduction, therefore, should not be considered a permanent feature in weeds. The spatial spread of weeds can strongly affect the hybridization of weed-plant species. Firstly, many weeds are very unequally distributed in the fields, and some papers describe that unequal distribution in some species has a certain degree of temporary stability [16]. The unequal distribution can occur due to edaphic factors and the effects of persistent high seed production. In the field, the unequal distribution of weeds can reduce crop-weed hybridization. If weeds appear in the appropriate density so that the proportions of individual weeds at the edges of these components is small, thatwill limit proportion of the population hybridization. Homogeneous and uneven distribution can significantly favour higher levels of foreign crossings. Isolated individuals may locally have higher amounts of pollen or crop due to changes in the movement of pollinators as a function of local density. Weed density can have an adverse effect on the levels of hybridization, when the plant is female parent. In this case, the high density may facilitate hybridization with the advantage of achieving large local density of weed pollen, and homogeneous density of weeds can reduce plant hybridization.

8. INTROGRESSION AND ADAPTATION

The evolutionary process that follows the hybridization is likely to be affected by many ecological characteristics of weeds in crop agrosystems. The nature of these systems seem to be imposed in weeds a few more prominent factors regulating the population, compared with the majority of annual plant populations, which are short-lived and inhabit other types of ecosystems. This might benefit transgene introgression, even if the initial hybrids and back cross generations have low levels of adaptive characteristics in comparison with the weeds that do not carry the transgene [17]. The emergence of resistance to herbicides, often significantly increases overall survival and the level of population growth of weeds. Herbicide-resistant mutations may have a high absolute adaptability, despite the basic functional impairments resulting from pleiotropičnih effects of resistance mutations. This example illustrates how selection can favor mutants that overcome the limiting factors. Another line of evidence for this comes from multiple instances of increased distribution and density of weeds resulting from field trials through hybridization [16]. If correct, this assumption suggests that the adaptation of weeds that carry accidentally transposed transgene after hybridization is greatly facilitated by the biological ecosystem jednolikošću current field crops. Weeds may require relatively little evolutionary shift, as is the connection between the termination of undesirable characteristics of plant species in accordance with the adaptation to a wide expanse. One criterion for assessing the transgene spread in weed populations is that the survival of weed-crop hybrids which carry the transgene should be greater than the adaptability of the non-hybrid weeds. This criterion is much easier to meet in temporary ecosystems of field crops than in most others. Transgene transfer can be a quick process. Even the hybrids with very low adaptability and early backcrossing can survive in agrosystems in corresponding densities. There is a possibility for introgression and remodeling, which facilitate their survival. However, it is possible that in the wider areas, weed populations are limited by one biotic factor to which the basic adaptation would make the increase in survival [6]. Another characteristic of weed ecology, which probably affects the adaptation of crop-weed hybrids, is an effective low-frequency level of events in population size and high level of selffertilisation especially in the process of colonization. Small population size cause random changes in genetic composition. These mechanisms can act on the genetic basis produced by hybridization, creating a series of genetically differentiated small populations, genetically different from the back cross of weed populations. Specifically, the adaptive effects of the combination of transgenic, crops of other genes and gene weeds can be a lot more adaptible in expression of the joint action of random genetic exchange in relation to selection acting alone [3]. This mechanism may be especially powerful when weed populations have high levels of attenuation and recolonization, thus forming the ecological and genetic metapopulation. Molecular and biochemical data on the levels of homology between crops and their wild relatives around the world indicate gene introgression from crops into populations of wild relatives. Introgression can occur in various plant species, including maize, melon, carrots, sugar beet and rice. Hybrids between crops and their wild relatives is likely to emerge with crops that are barely adapted and grown in the same region from which they originate.

9. INFLUENCE OF GM PLANTS ON BIODIVERSITY

One of the limitations for the introduction of GM plants in the environment is that they may affect and even destroy biodiversity. Scientific papers and discussions are aimed at understanding whether GM crops have impact on biodiversity and what are the qualitative and quantitative differences from commercial crops. Biodiversity is important for survival, regulation and maintenance of global planetary conditions, providing the aesthetic, scientific, cultural and other values. The general value of the world's biodiversity is estimated to amount about 33 trillion $ annually [18]. Regarding the multidimensional complexity of the concept of biodiversity and taking into account the importance of technological development of GM plants, the research that will further clarify this interdependence are needed. This will be a broad social-economic and political context of the application of genetic modification that will determine whether the current risks and potential benefits of GM plants on biodiversity can become a reality.

10. MONITORING

Within complex ecosystems, and after the commercialization of GM plants, environmental monitoring is required. The complexity varies from year to year and shows the indirect biotic effects. Since laboratory and field experiments can not be appropriately reproduce all the interactions that occur in an ecosystem, the only way to estimate the full level of environmental effects of GM plants are tracking in natural ecosystems. Some of these effects can not be predicted in advance, so that ecological monitoring will be needed to detect and differentiate existing environmental influences [1, 11]. Environmental monitoring is very expensive, so the information regarding activities should be used within a clear system of adaptive management. This management involves repeated cycles of designed programs, implementation, evaluation and assessment of the overall monitoring [6].

11. CONCLUSION

Recombination of new genes into crops is a long process for breeders, if they apply only classical breeding technique. Transgenetic technologies enable breeders use genes from a wide range of wildlife and to combine them within a single plant genotype. This overcomes problems related to breeding for the existence of sexual incompatibility between distant species and genera, and provide favorable conditions for the use of wild relatives as sources of genes for various types of resistance. It is noteworthy that the genetic modification, as any other new scientific technology, carries certain risks in the application, and especially the behavior and impact on the environment. Research in the field of genetic manipulation is considerable in terms of understanding the technology, using a foreign modified plant material and research into risk assessment related to the environment, and it needs to be intensified. The information from many scientific disciplines, such as weed science, genetics, conventional and molecular selection, molecular biology, plant pathology, entomology, population biology, ecology, and others are needed for its implementation.

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RECYCLING OF ROAD VEHICLES IN SERBIA

RECIKLAŽA DRUMSKIH VOZILA U SRBIJI

Slobodan Stefanović[1], Radoje Cvejić[2], Dragoslav Ilić[3]
[1]Visoka škola primenjenih strukovnih studija, Vranje
[2]Privredna akademija, Novi Sad
[3]JKP Vodovod, Zaječar

Abstract: *The environmental directives introduction of recycling in the production of vehicles is a very important limitation. For a number of waste materials in the production process has already found a new purpose. The most important stage of the technological processes for the manufacturing waste materials sorted. The subject of interest not only metallic waste materials but also waste paper, leather, textiles, wood, solvents, old oil and other fluids. When you eliminate cadmium, lead, chromium, mercury, and the like. from production processes, then only 3-4% of the total waste remain in the group especially problematic.*
Key words*: recycling, land vehicles, recovery, disposal.*

Apstrakt: *Ekološka direktiva uvođenje reciklaže u procesu proizvodnje vozila je veoma bitno ograničenje. Za brojne otpadne materije u proizvodnom procesu već je pronađena nova namena. Najvažnija faza svih tehnoloških postupaka je da se proizvodni otpadni materijali sortiraju. Predmet interesovanja nisu samo metalni otpadni materijali već i stari papir, koža, tekstil, drvo, rastvarači, stara ulja i drugi fluidi. Kada se eliminišu kadmijum, olovo, hrom, živa i sl. iz proizvodnih procesa onda samo 3-4% od ukupnih otpadaka ostaju u grupi posebno problematičnih.*
Ključne reči: *reciklaža, drumska vozila, obnavljanje, deponovanje.*

1. INTRODUCTION

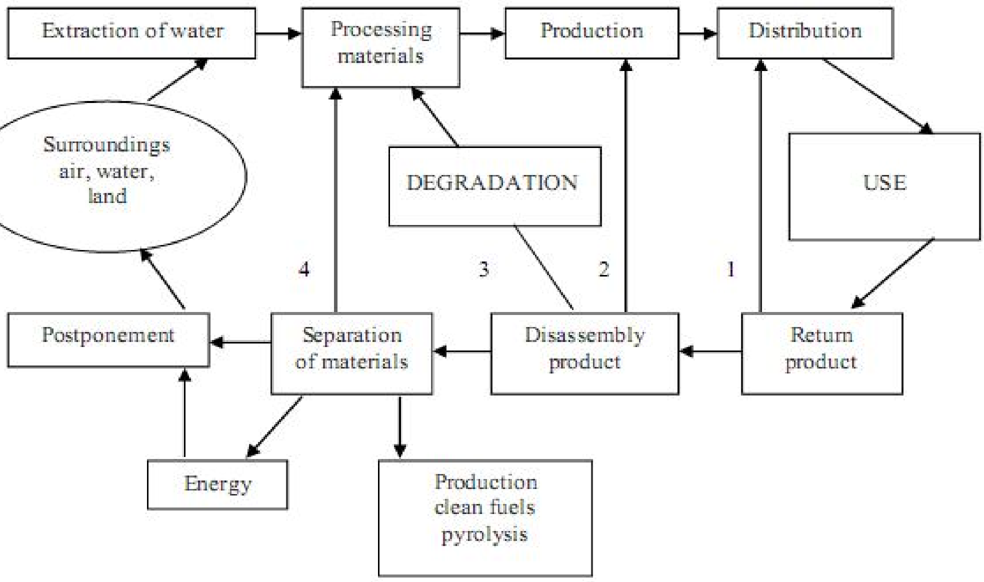
Cars are very complex constructions that contain about 15,000 parts produced using different technologies and different materials. With the process of production and induction of waste during exploatation they continually degrade the environment, which leads to wasting vehicles after their lifetime. These facts cause the recycling of used vehicles (ELV - End of LifeEend Vehicles) and forming of a system, which can be managed well and completely.

The current number of passenger cars in the world is 500 million and forecasts for the next century to the present expansion of the market stand at 1.2 billion. The vehicles, therefore, have to be created, used and updated within full compatibility with the laws of nature. The automotive industry with the increasing attention defines the environmental quality of products in the initial stage of research relying on new materials. The decisive criteria are longevity and re-entering into the circulation of raw material (Figure 1). In the process of constructing each part and each circuit have to be clearly marked in order to be easily identified and after using the separate for ease of introduction of reuse. Appreciation of global goals R + 3E (Raw materials + Energy + Ecology + Economy) was first inspired by the new technologies in oil processing and production of additives and also introduced a continuous optimization of technical, transport, logistics and environmental quality of vehicles and engines.

Production of a large number of vehicles each year requires significant amounts of steel, glass, aluminum and other minerals. There is a question of how many reserve materials are there left to use. It is believed that if their supply become scarce, we can use some cheaper substitutes – such as the transition fromsteel to plastic, and copper to fiber glass (SiO2), which is, by the way, the most abundant mineral on Earth. On the other hand each year worldwide, about 18 million vehicles end their lifetime cycle. If all these vehicles can be disposed as a waste, that would mean 20 million tons (or 70 million of m3 by volume) of a new solid waste each year, which is a huge burden on the ecosystem as a whole.

A large amount of metal, plastic and glass, which contains every single vehicle can be recycled. The average life of cars in the world is from 10 to 15 years. After that, the question is what to do with the old vehicle, given the fact that total amount of scrap old cars paticipate with 0.2%.

From the ingredients point of view old cars are very important sources of secondary raw materials. This applies to most metals, because with good organization most of them can re – enter the circle of raw materials. Other parts that can again be used as engine, transmission and other aggregates.



(1st: direct reusing, 2nd: subsequent production of components that can be reused, 3rd: re-manufacturing recycled materials and 4th: regeneration)
Figure 1: Circulation of materials

2. ASPECTS OF RECYCLING

Positive aspects of recycling are also present with reflected energy from the point of engaging in the production of certain materials. To obtain 1 kg of steel from ore you have to spend 40.000 kJ of energy and of you recycle the figure stands at 18.100 kJ (twice the less). Approximately 20-25% of old cars is deposited (half of which are made from plastic). Difficulties that follow old materials are that after 10 to 15 years it is hard to recognize them. New criteria for construction firms in the automotive industry is named DFE – Design for Environment (ecological design); ZWC - Zero Waste Concept (production that includes no waste) has visible effects of the increased level of recycling. Recycling includes recycling of ELV in the narrow sense, recovery and reuseing.

Concept 3R (Reduce – Reuse – Recycle) defines a modern management approach towards recycling. The first R means to reduce, especially when it comes to design a vehicle which lasts longer and uses less resources. The second R means reusing – some parts of a vehicle can be used more than once. At the very end, they are being recycled into same materials from which they have been made (recycling – the third R).

The concept of 3R Toyota (Toyota) has improved into 5R, which adds the purification process of materials that allows easy recycling and process of energy recovery (from waste back into system), where everything is done to continue reducing the remaining of 25% which is being deposited.

Following explains the structure of material content of an average European car (see Figure 2) that is direced towards recycling. Resolving problem that provokes the fact that total share of plastics in the average vehicle are at about 9,3%, and therefore resolving inevitabely leads to analysing the type of plastic that is being used in production (polyvinyl chloride, polypropylene,polyurethane rubber, etc..), then determinate its application. These are the primary processes.

Old vehicles are being purchased by companies that are involved in dismantling vehicles for the purpose of re-utilization of certain components or materials.The rest of the vehicles are still selling companies which are getting involved in its processing at large capacity mills, where it is being chopped into pieces – into the size of a human fist. With series of mechanical and physical processes which allow separation of black and non-ferrous metals for further recycling. The rest of the process is about 20 - 25% of the total weight of the old vehicle and its average composition is approximately given in Figure 2. This remaining is the weakest link of recycling vehicles, because it is toxic enough so that in many countries it is considered hazardous waste and can be characterized as an energy source due to it is containing more than 7% of usable enegry.

There are two ways of processing the rest: ***recycling / recovery and disposal***/. Many alternatives have been developed for processing this type of residue (physicalseparation, incineration, pyrolysis), but it seems that the land disposal is the best current solution. In the process of recycling of road vehicles it is required:

1. Elimination of toxic elements: chromium, mercury, lead, halogenated polymers, etc. After previously dismantled vehicles are being processed in mills, heavy / toxic metals are distributed as the remainings, because during combustion, chlorinated and fluorinated polymers can lead to emissions of some of the most toxic pollutants that are the most destructive when it comes to pollution of nature (and ozone).

2. The design of key structural components of the basic alloy, where it is important to pursue the reduction of weight and number of parts. Selecting a standard family of alloys accordng to usually used alloying elements: Al, AlCu, AlMn, AlSi, AlMg, AlMgSi, i AlZn.

3. Avoid unusual alloying elements that have desirable characteristics. Addition of lithium increases the specific stiffness, and tin to plastic molding. However, limit of concentration of these elements in common alloys is less than 0,05%, while a small number of components with unusual alloying additives can make aluminum recycling system harmful.

4. Providing a market for any recycled material.

5. Promoting market development of recycled materials from old vehicles in eachindustry.

6. Construction of components so that after processing in mills you can get a piece of material obtained. This can be achieved by harmonizing the material components and reducing to a minimum of permanent joining of different materials.

7. Rational use of composite materials. Reinforced plastics, ceramic matrix composites with metal and some other rare combinations can have functional and physical characteristics so that they provide significant usability (formats that can not be obtained from the use of steel is very easily achieved using composites taht are lighter than steel). A major problem in the recycling of composite materials is that the fibers which give them strength at the same time hinder their separation into components.

8. Encourage the separation of different materials after grinding to the greatest extent.Construction of new processing plant where aluminum and steel will be separately treated, and if possible, the individual alloys.

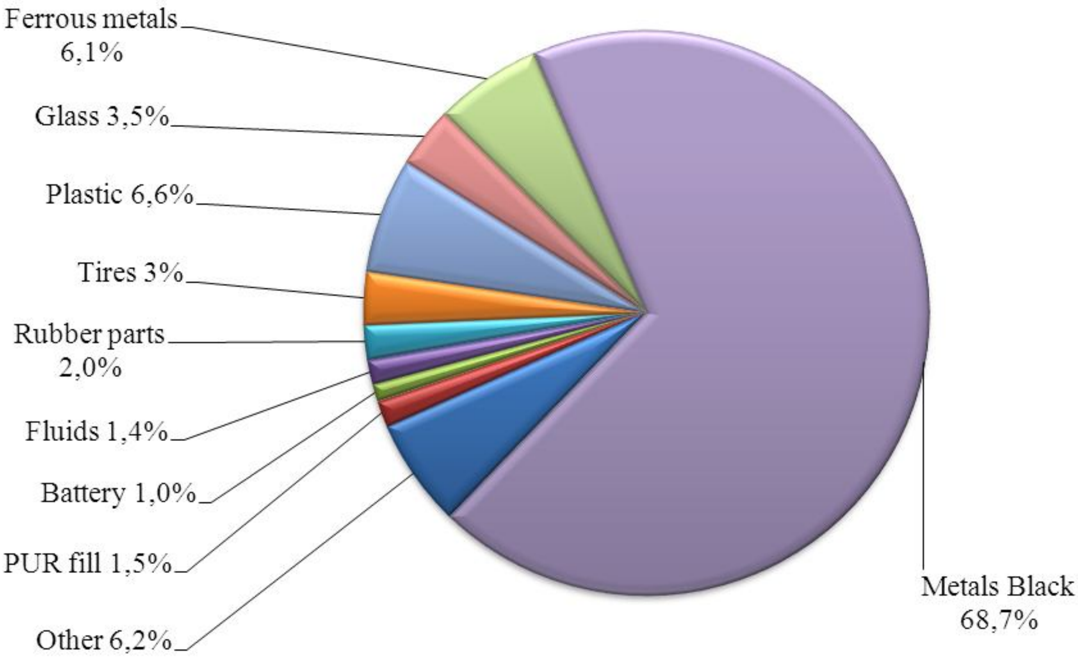


Figure 2. The percentage share of certain materials in the vehicle

Table 1. The percentage share of the degree of recyclability of materials by road vehicle

Name	Weight per vehicle		Recyclability	
	%	kg	%	kg
Ferometali	68	680	90	612
Sheel car	25	250	90	225
Other steel parts	28	280	90	252
Cast iron	15	150	90	135
Ferrous metals	6	60	90	54
AlSi alloys	4,4	44	90	39,6
Copper	1	10	80	9
Lead	0,6	6	90	5,4
Plastuka and composites	8	80		
ABC	1	10	80	8
Prolipropilen	1	10	80	8
PVC	0,8	8		
Polyester	1,2	12		
Polyurethane	1,5	15		
Lead	2,5	25		

3. RECYCLING CAR IN SERBIA

Considering the current general situation of the ELV recycling in the country andexamining the legislation, it can be concluded that:

- the effective use of the car usually does not act in a manner that ensures protection of the environment;
- ELV recycling system is not established, which means that there is no globally organized management of this type of waste. There are car – dumps where customers can take what they need from a vehicle with appropriate paymen. When there is only a shell remaining, it is usually set on fire to burn anticorrosive paint and other materials, which is not legally permitted;
- preparation of materials for recycling is a priviledge made for a small number of companies, which are mostly specialized for metal. Reparation of parts (mainly bonds, oscillating shoulders, brake panels, antiroll bar – which means all parts of particular importance to safety is being done without any quality control and often without appropriate materials and technologies.
- There is a tradition mainly in steel recycling of waste that is being generated primarily in the production of parts;
- establish a system of waste materials is a complex process that involves the minimization of waste at source, collection of secondary raw materials, processing, and finally disposal of waste which does not have use in landfills or in some centers for the incineration or thermal treatment. This area in Serbia is regulated by the Waste Management Law and the Regulation on the collection, storage and transportation of recyclable materials. In 2003. Serbia adopted the National Waste Strategy, which highlighted the regional approach to solving waste management. This means that the program can not be solved separately because it involves expensive investments;

- Regional management system involves the collection of waste materials in certain municipalities and transportation of only those which has no practical value. It is necessary for municipalities to organize the collection of secondary raw materials, as well as an specific amount of land or transfer station where the waste in the municipality will be temporarily postponed until the moment of transportation to a regional center.

The system of waste materials in the world was organized at the regional level (region does not need to be an administrative center, only connected by infrastructure) because if you make a municipal landfill for 8-9 municipalities then it is financially better for the individual municipality.

3.1. TECHNOLOGY IMPLEMENTATION PROCESS OF RECYCLING

As the backbone for the recycling of irradiated road vehicles we can use company "InosProgress" from Sabac (manufacturing, storage and baling of scrap metal and paper) that has a press for metal scrap. Founded in 1948. by Serbian country as a commercial enterprise that is mainly used for Pocerski district, based in Sabac, called "Basic service for storage andvtransport of waste, with 69 employees, it purchased the material from enterprizes and persons (power plant" Nikola Tesla "A and B, Electro Sabac, Bor, Zaječar, "Serbian Railways", "Thermo-mont", "Thermo-electric", "Minel", "Ingo" Sabac "Viskoza", "electro"-Loznica, "Brotherhood" Subotica "Šinovoz" - Zrenjanin "Lifon "- Stara Pazova, etc..) and many other factories.

Paper

Paper is being collected by two vehicles that perform on a daily - based collection of paper that enterprizes and persons deposited in special containers, which have 40 and are properly labeled. Paper, collected by trucks is unloaded directly into the hall where the plant is located for the separation and baling waste. It is desirable that the paper is with the least % of moisture. Upon arrival at the warehouse is the selection by type, ie. classification of the board and "noodles".

The selection is made by workers, who then insert the paper on a conveyor belt from it goes to a special press for baling paper. The result of the recycling materials are baled with dimensions of 1200 x 800 x 1000 mm. Formated paper is called a "bundle". Bundles are tied to prevent spillage and then leave the plant in part of the warehouse where the customer is waiting for him to continue processing (processing factory of paper "Umka").

Aluminum

Aluminum can be purchased from enterprizes and persons. The special trucks with a metal frame and a system for unloading the aluminum waste are delivered directly to the warehouse. After unloading the waste starts first phase of cuting that is taking place in factory. With specialized machines waste is being pushed on the conveyor belt, which he carried to the sorting. The sorting process starts the second phase where the manual-separated useful materials from the waste through special openings that are inserted in boxes. Boxes of materials are extracted under sorting. Two workers throw in scrap of aluminum handpress in which the worker is trained to handle that type of activity. As a product of the process of baling presses comes the finished product, ie. Bundle with size of 400 x 300 x 100 mm and weight to 10 kg, which is stored in a roofed hall, a product used by the company, "Val-metal" from Croatia. It is planned to expand the business by building a foundry for processing scrap aluminum (dimensions 33.3 x 17,4 m).

Figure 3. Selection of paper-conveyor belt

Figure 4 The end-product bundle of paper

Secondary aluminum is mainly used in Japan (96% of total raw materials), the U.S. and Western Europe, and there is a prediction for further increasing in shares of secondary aluminum in the production of this metal.

The scope of works in process of recycling waste

1. Waste paper 60-100 t,
2. Steel Scrap - compressed (scrap iron (2000 tons per year, car scrap sheets year 3000 t, alloy steel scrap (5 t per year), cast iron (annual production of 500 t),
   - 10,000 pieces of waste batteries,
   - Waste lead 200 t,
   - Copper Scrap (800 t),
   - Waste zinc (about 20 t).

It is of great importance for the waste products to remain in storage for the shortest period possible. There are conditions that have to meet the standards for recycling, in accordance with ISO standards. Problems in applying the standards are product of inadequate technology and lack of knowledge innovation.

Plates and recycling of road vehicles

"Inos Progress" has a press for metal scrap, which is irradiated recycling of road vehicles. Owner useless road vehicle is a legal or natural person to whom this car belongs. The owner of unusable vehicles shall give the vehicle to provide a person who is licensed to handle. If the owner of the unusable vehicle is unknown, the competent authority of local government provides collection and delivery vehicles to a person who is licensed to handle. The responsible local authority shall prescribe the procedure for collection and sale of vehicles and reimbursement of expenses for these activities.

Perform the dismantling of vehicles and the separation of the parts that can be recycled: plastic, metal, rubber, textiles, oil. A separate sheet is compressed in a special presses for this purpose. The finished product has dimension of 1200x800x1000 mm and is weighting 400 to 600 kg. Bundles go into the car to the customer in Bulgaria.

This press is mobile, easy to handle, move and transport to the required location upon which is being bundling.

Batteries

The company "Inos Progress" is in the bussines of collection and storage of batteries. Batteries are made by individual collectors, as well as organizations that collect recyclable materials. Treatment batteries are made in factories mines and smelters in Zajača with whom Inos Progress has successful and long-term cooperation. The current storage is collected annually about 10.000 pieces of batteries.

The most favorable and the most expensive are truck and air transport, as opposed to rail and ship transport, which are the cheapest and slowest. The choice of transportation is of great importance, considering long transportation of the goods, it may even change prices for perishable goods and goods that ferments must be taken under special treatment for transportation.

Recording of processing unusable vehicles is the obligation of person who processes data:

- all stages of processing and providing treatment for unusable vehicle,
- disposal of parts that can not be processed;
- ensure separation of hazardous materials and components from unusable vehicles for further processing prior to disposal.

The risks of technological processes

The greatest risk (in modern terms) is a collection of payment for every individual job, considering not knowing the customs regulations in the countries that are exported or from which goods are imported and the imprecision of the contract, which is very far from the technological realization.

4. CONCLUSION

The general conclusion is that about 70% of our vehicles are recyclable, however, our country has not developed a system of companies that participate in recycling process. Processing of return materials that allows the melting of pure metal of same kind, leads to possibility of getting a quality selection that can be used as a replacement for the original raw material, with the same or similar quality.

Serbian terms of recycling of waste materials, not just motor vehicles, must be picked up at a much higher level than the level of economic activity. This means that in addition to education at all levels, especially for new investments, it requires greater inter – agency relationship. Here we have seen examples of neighboring countries, where much larger recycling means producing quality design solutions in this area which allows to compete with financial institutions or donors from abroad. Especially interesting is the example of Poland, which received large funds from the European institutions. But financial resources alone are not guarantee of success. The requirements for adequate recycling with implementing the overall project implementation and including planning that anticipates ecosystem can lead to far greater effect, not only financially.

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CLEANER PRODUCTION AND CSR IN PRESERVING NATURAL RESOURCES AND ENVIRONMENT

ČISTIJA PROIZVODNJA I DOP U FUNKCIJI OČUVANJA PRIRODNIH RESURSA I ŽIVOTNE SREDINE

Rodoljub Jovanović, Violeta Jovanović, Miroslava Marić
Faculty of Management in Zajecar

***Abstract**: Companies are part of the society they operate in, and that is why in addition to achieving economic goals, they must take into account the impact they have on the society and the environment, i.e. they need to organize their business in a socially acceptable way. One way to reduce the negative environmental impact when it comes to manufacturing companies, is the introduction of the concept of cleaner production and cleaner technologies in production processes. These processes influence the reduction of the resource use level at the source as well as waste reduction. The paper stresses the importance of the concept of social responsibility and cleaner production, and their introduction into enterprises in Serbia.*
***Keywords**: Corporate social responsibility (CSR), cleaner production, natural resources, environment.*

***Apstrakt:** Preduzeća su deo društva u kome funkcionišu zato, pored ostvarenja ekonomskih ciljeva, moraju voditi računa o uticaju koji vrše na društvo i prirodnu sredinu, tj. potrebno je da organizuju svoje poslovanje na društveno prihvatljiv način. Jedan od načina za smanjenje negativnog uticaja na životnu sredinu, kada su proizvodna prduzeća u pitanju, jeste uvođenje koncepta čistije proizvodnje i čistijih tehnologija u proizvodne procese koji utiču na smanjenje nivoa korišćenja resursa na izvoru kao i smanjenje otpada, inače velikog zagađivača životne sredine. U radu je ukazano na značaj koncepta društvene odgovornosti i čistije proizvodnje i njihovo uvođenje u preduzeća u Srbiji.*
***Ključne reči**: Društvena odgovornost preduzeća (DOP), čistija proizvodnja, prirodni resursi, životna sredina.*

1. INTRODUCTION

Currently there are many social problems in the world which have arisen as a result of irresponsible behavior of individuals, companies and countries. Compared to individual irresponsibility, much larger problems can be created by a socially irresponsible company. Many firms dispose of waste products into rivers and seas, which destroy different ecosystems and pollute the environment; a great many companies do not pay health insurance to employees, etc. The primary responsibility for solving social and environmental problems at the society belongs to the state (government administration). Government administration is responsible for the characteristics of the legal-political system of each country, so with different rules and regulations it can compel companies to do business in a socially acceptable manner, and the population to act responsibly towards the society and the natural environment and prevent the emergence and spread of social and environmental problems.

Human activities have significantly contributed to environmental degradation and reduction of available natural resources. Pollution caused by production processes in relation to the environment can be lessened by using one of two basic approaches: a) the application of technical solutions based on the control of pollution - pollution treatment technologies at the end of the production process ("*end-of-pipe*" *technologies*, *EOP*) and b) prevention of pollution - cleaner production. In the last two decades approaches based on pollution control have been replaced with strategies based on preventing the creation of pollution. Preventing pollution is the general approach that can be applied in all spheres of social life. Cleaner production is a modern approach to preventing the emergence of pollution that has provided the largest contribution in the manufacturing sector, particularly in industry. Cleaner production is part of the concept of sustainable development that takes into account the fact that the environment has a limited capacity to accept a certain amount of pollutants so that no irreparable damage is done.

2. DEVELOPMENT OF CORPORATE SOCIAL RESPONSIBILITY CONCEPT AND CLEANER PRODUCTION

Corporate Social Responsibility (CSR) is one of the latest management concepts. Since 1950, a modern concept of CSR has been developed which includes key issues related to moral principles and ethical behavior, such as product safety, honesty in marketing, employees' rights, opportunities for advancement at work, environmental and natural resources protection and the like. The development of this concept was further enhanced by human rights movements and activities of organizations for protection of consumer rights, environmental protection and the like (since the 1960s). These organizations have presented new demands to enterprises. Many companies have begun to consider the safety of their products, environment protection and to behave morally towards their stakeholders. [1]

The concept of corporate social responsibility is being accepted by more and more companies, especially successful ones, because the management of the companies realize that CSR provides a sustainable competitive advantage. It can be concluded that socially responsible business that takes into account the interests of a large number of social groups and the society brings benefits to the society (smaller number of different problems) and businesses (creating a sustainable competitive advantage). As a result, and due to the presence of a large number of social and environmental problems at the global level, the concept of corporate social responsibility is becoming more accepted. But since this is a relatively new concept, there are very different approaches in its conceptual designation, definition and method of application. The key dilemma in these approaches is related to voluntariness. The question is whether the management of a company should be left to decide whether to organize its company in a socially acceptable way (according to its feeling) or whether some obligations towards the community should be imposed by the law and formal rules. Most scholars agree that responsible operation is the obligation of a company, so that in theory and in practice the term "Corporate Social Responsibility" is widely accepted. [2]Together with the development of CSR concept, the concept of cleaner production in the manufacturing process has evolved. Cleaner production is globally recognized in the world today. The term "cleaner production" is explained by the definition of the UN Environment Programme (UNEP): The continuous application of an integrated environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment. [3] Cleaner Production can be applied to any process in the industry, the products themselves and the various services provided in a society. In the production processes, cleaner production is related to the conservation of raw materials, water and energy, reducing the use of toxic and hazardous raw materials and reducing the quantity and toxicity of all emissions and wastes at the source of the production process. For products, Cleaner Production aims to reduce the impacts, throughout the life cycle of a product, on the environment, health and safety, imposed by the exploitation of raw materials, their processing and use, to the final disposal. For services, cleaner production involves the concern for environmental protection in the design and services.The development of cleaner production approaches and the introduction of cleaner technologies in production processes are often limited by internal organizational weaknesses of the company. New, cleaner technologies generally require significant investment, which is also a limiting factor. Regulations restricting the level of emissions which are subject to control and supervision in practice often set requirements that can be fulfilled only by measures based on the EOP technologies.

Cleaner production requires changes in behavior, responsible environmental management, design and implementation of appropriate policies and constant evaluation of different technological options. It focuses on the causes of the problems related to environment, not on the consequences and deals not only with the processes of production, but can also be applied to the entire product life cycle, from the beginning of its development, through consumption to the disposal phase.

The task of cleaner production is to ensure preservation of resources, elimination of hazardous materials and waste reduction. The five basic techniques of application of cleaner production are economical business, process optimization, substitution of raw materials, new technology and new product development.Cleaner production preserves the environment through prevention of inefficient resource use and the prevention of waste that can be avoided. Companies that implement cleaner production should gain economic advantage by reduced labor costs, reduced volume of the waste, reduced disposal costs, reduced environmental pollution and so on. Investing in cleaner production in the long run has an impact on better economic performance of companies and reduces costs in relation to the implementation of solutions for waste treatment.

3. CHARACTERISTICS OF CLEANER PRODUCTION

There is not a manufacturing process that in addition to the main product does not produce by-products in gaseous, liquid or solid form. These remains can be used as additional material or as raw material for another form of production, and if there is not a technical and economic justification for such utilization, we talk about the waste that pollutes the environment. The so-called "*end-of-pipe*" technologies, or technologies for environmental protection that appeared in the 70s, then the technologies involved in recycling of waste that appeared in the 80s, are only partially successful methods for preventing pollution. These are technologies that have high operating costs, high capital investment costs and demand lots of energy. The 90s carry activities aimed at implementation of pollution prevention at source and application of cleaner production concept.

The application of the "*end-of-pipe*" technology principle offers a partial solution of environmental problems at the end of the production process. Costs increase, and waste is only transferred from one medium to another.

The main feature of cleaner production is that the application of this principle is based on the question where waste is produced, preventing the generation of waste at source, using an action rather than reaction in response to the situation, avoiding dangerous practices and preventing the use of hazardous substances, reducing consumption of materials and energy and environment protection is a continuing challenge. These and some other features of cleaner production are given in the table and compared to the characteristics of "end-of-pipe" technologies.

Table 1. Characteristics of cleaner production [4]

„End of pipe“ principle	**„Cleaner production“**
What is the current method of processing waste	Where waste is produced
The reaction in response to the situation	Action in response to the situation
It usually leads to the development of new cost	Helps reduce costs
Waste and emissions are limited through the filters and purification systems Solving at the completion of process Repair Retention of waste and emissions	Prevention at source Avoiding the use of hazardous processes and preventing the use of hazardous substances
Environmental protection performance after the product development process	Protecting the environment acts as an integral part of development and process engineering
Environmental problems are solved with the technological aspects	Environmental problems are solved in all areas and at all levels
Environmental protection is a responsible experts domain	Environmental protection is the domain of all employees
The purchased equipment	Innovation within the company
Increasing consumption of materials and energy	Reduced consumption of materials and energy
Increases the complexity of the problem	Reduces risk and increases transparency
Environmental protection is performed in order to meet legal obligations	Environmental protection is a constant challenge

Cleaner production has an impact on decreasing levels of resource use at source (to prevent inefficient use of resources) by the development of new, cleaner products and production methods. EOP technologies place the pollution emissions under control by applying additional measures in relation to production processes. It can be regarded as a superior approach in relation to EOP technologies, due to the application of the principle of environmental pollution prevention and economic reasons.

4. BENEFITS OF INTRODUCING CLEANER PRODUCTION AND SOCIAL RESPONSIBILITY

Cleaner production is a method of problem prevention in relation to the environment. Systems of environmental management and verification (EMAS and ISO 14001) require the use of prevention in the formulation of environmental policy in a company. Cleaner production fully supports this request because it focuses on the prevention of problems, as opposed to the application of EOP technology which solves problems that have already been incurred. Cleaner production techniques and mentioned systems of environmental management in companies agree very well in achieving common goals for implementation of permanent improvements.

Contributions of the application of cleaner production are far greater and can be directly linked to the economic interests of companies, for example:

1) Cleaner production reduces damage to the natural environment caused by mining and ore refining processes and decreases the risk of emissions discharge from the production processes and during the waste treatment or disposal;

2) Cleaner production reduces the cost of plants and enterprises. Costs related to waste treatment, storage and disposal are reduced by applying the activities and programs of cleaner production. Saved funds can be used for investments in cleaner production. Cleaner production also saves raw materials, additional materials and energy;

3) Participation in the activities of cleaner production can reduce the risk and cost of waste treatment. This contribution is extremely important for companies if the waste materials have the characteristics of hazardous waste. Cleaner production facilitates bringing activities of a company into compliance with environmental regulations;

4) The application of cleaner production enhances the image of the company. Inspection, employees, neighboring companies, local governments, other partner companies, will develop a positive approach towards the company whose leaders have committed themselves to the modern approach of cleaner production to provide safe working conditions and minimize pollution. [4]

Analyses made by the Organization for Economic Cooperation and Development (OECD) and conducted in Canada, France, Germany, Hungary, Japan, Norway and the United States, indicate that firms in 76.8% of the cases choose investing in cleaner production technologies and dominantly in new production processes, and relatively less in new products. The business environment of companies, savings, support of the management, systems and schemes of environmental management, help the development of cleaner production. [5]

The practice of corporate social responsibility refers to the whole operation of a company: what it produces, what products to buy and sell, whether it respects the laws, how it treats its employees, whether it invests in the local community and how it contributes to environmental protection. [2] Corporate social responsibility can make the following business advantages [3]:

• Protection and enhancement of existing resources (human capital or the environment) that influence the company's operations;

• predicting, avoiding and minimizing business risk and associated costs;
• increase of the companies' financial effectiveness by reducing operating costs;
• Creating new business opportunities and new markets;
• protection, building and improving the company's reputation, particularly in relation to consumers;
• the company becomes attractive to investors with its educated and motivated employees.

The link between social responsibility and cleaner production is given in Figure 1. The Figure shows that the ultimate aim of introducing these concepts in companies is to protect natural resources and environment.

Figure 1. The link between social responsibility and cleaner production

There are many arguments that suggest that there is a real interest of companies to act socially responsible, and behind each of their activities, including those associated with incorporating social responsibility into their business, there is more or less direct interest.

5. INTRODUCING THE CONCEPT OF SOCIAL RESPONSIBILITY AND CLEANER PRODUCTION IN SERBIAN COMPANIES

Serbia is a country in transition with a large number of economic and social problems, which are further deepened by irresponsible business activities. In addition, the competitive position of Serbian companies and Serbia's reputation in the global market is very unfavorable due to the presence of high level of corruption, disrespect for legal and ethical principles, economic and political instability, etc. [6] In order for the Serbian companies' competitive position in the global market to recover and to stop the spread of social and environmental problems, it is necessary to promote CSR. CSR is a new concept for Serbia, which has began to be promoted over the last decade. The studies that were conducted in Serbia in 2005, 2006, and until 2011 show that in the period from 2001 to 2011 the awareness of the need for CSR, as well as the knowledge of this concept have gradually increased. However, the majority of Serbian citizens do not still understand the essence and importance of this concept so that they do not attach to it great importance [7].

Managers of Serbian companies exhibit the unsatisfactory level of awareness of the need for CSR (according to a large number of managers in Serbian companies, it is the state that should take care of social issues), so that they do not attach great significance to the organization of operation in a socially acceptable way. Even the managers who consider CSR relevant to their business, mostly associate it with different forms of one-off financial assistance (sponsorship of cultural, sporting and other non-profit events, donating money or equipment to hospitals and charities that help disadvantaged groups in a society, etc.) because according to the managers of most companies, sponsorships and donations are the most visible form of CSR from which the company has benefits [8]. In addition, most managers of Serbian companies are not sufficiently familiar with this concept. The situation in practice is even worse. CSR is generally understood as a marketing tool that could be a form of propaganda, and possibly a way to build a good reputation without real strategic importance. That the meaning of the term corporate responsibility is at a very low level is also shown by the fact that, when asked: "What is the main role of a company in a society?", 96% of respondents think that it is the protection of the environment and natural resources. Thus, a significant proportion of respondents do not see environmental protection as part of the concept of social responsibility, but most of them later agree that the primary role of a company in a society is the protection of the environment and natural resources.

According to the data base of good practice[9], an extremely small number of companies in Serbia (only 5) has a manager for CSR, in some of them the CSR is left to the directors of foundations, while in all other companies this job is done by the public relations. In addition, the results achieved by CSR, companies generally do not put in their reports, but they are conveyed to the public using web sites or through the media [10]. Only 23% of the surveyed companies (5 companies with foreign ownership) publish annual reports (give data on the impact of their operations on the environment) with the results of protecting the environment; a little more than 40% are those who plan to write the reports in the next five years. As for the financial statements, they are written by almost all the companies (97%). [9] It can be concluded that the environmental dimension of CSR in Serbia is given some importance, but it is on a lower level compared to the EU countries [10]. In Serbia, the practice of CSR is underdeveloped, except in a small number of companies that take care of the impact of its operations on the society and the environment and report on the effects of these activities.
One reason for extremely low level of CSR in Serbian companies is insufficient involvement of the state [11]. The research shows that the managers in more than 61% of companies said they do not feel any incentives or initiatives to work in a more transparent way, and more than 47% are not motivated by the state or other stakeholders to implement environmental projects of any type.

In the past three years, 67 percent of the surveyed companies in Serbia have engaged in environmental projects, while 33 percent have not. Companies engaged in production are more present in environmental projects than companies that provide services. More than half of respondents in Serbia have no environmental certificate. Twenty-six percent of companies have received ISO 14000, while nine percent have received some other certificates. For the respondents, the greatest internal benefits to their companies deriving from CSR practices are the following: increases in productivity, quality and sales, company longevity, easier compliance with legislation, greater employee loyalty, the advantage over the competition, attracting and retaining qualified employees; cost reduction, and financial improvement and access to capital. Only four percent of respondents believe that there are not internal benefits to be derived from the adoption of CSR practices. [9] The greatest external benefits from the adoption of CSR practices in companies are perceived as follows: a better image and reputation, contribution to sustainable development in Serbia, customer loyalty, environmental protection, political impact (government support and the relationship with the government), intangible benefits, and increased visibility. Only three percent of the respondents believe that there are no external benefits from the adoption of CSR practices. [9]

The first and biggest obstacle to wider adoption of CSR practices is related to the institutions and the government – the lack of adequate legal framework and insufficient involvement of public authorities, then comes a set of financial barriers and barriers related to government institutions: the absence of visible results and lack of appropriate institutions, total costs, lack of connection with financial success, and others. Barriers related to human resources, such as the lack of incentives for employees (middle management level), followed by current government policies, cultural differences, employees resistance and management resistance are at the bottom of the list. [10]

It is considered that the main risk in adopting CSR practices is mainly the increase in operating expenses, after that, according to the size of the perceived risk, come: the increased demands of stakeholders, the increased mixing of the regulatory authorities, lagging behind the competition, decreased productivity, negative impact on profitability, and a negative impact on the quality of goods / services. Only two percent of the respondents believe that there is no risk if corporate social responsibility practices are adopted. According to the data from surveys in 2010, 188 companies in Serbia had ISO 14001 certificates. The project of cleaner production in Serbia began its implementation in 2004, three years later the Center for Cleaner Production was founded and in 2009, the strategy for the introduction of cleaner production was set. By 2010, only 35 companies in Serbia have introduced cleaner production in their business. The regulation on eco - mark was passed in 2010, but only three Serbian products have eco - mark license. As to the environment funding, it had significantly increased, from 7.08 billion dinars in the year 2006 to 19.54 billion dinars in 2010.

6. CONSLUSION

Companies are set up in order to manufacture products or provide services that enable the fulfillment of certain needs of the society. By performing operations, investing capital, supplying of products and performing various daily activities, companies make a positive impact on the society, which is the purpose of their foundation. The most important thing a company can do for the society and the economy is to enhance economic prosperity. However, the successful achievement of economic objectives of companies may not be an excuse to ignore the negative effects that their operations have on the society and the environment. Among other things, companies are elements of the society so that they are expected to be aware of the impact of their actions and voluntarily engage in solving social and environmental problems. It is characteristic for companies in Serbia to have a very low level of implementation of certain elements of social responsibility and social responsibility is not given a strategic importance.

Cleaner production is a preventive approach to environmental protection, primarily aimed at increasing the efficiency of resource use and reducing pollution and waste at the source. The focus of cleaner production is to reduce the occurrence of environmental pollution, ie, the complete elimination of pollution sources where possible, rather than the treatment of waste streams. With the introduction of cleaner production, energy and available materials are used rationally and reduce the creation of waste. The application of CP saves raw materials, additional materials and energy, reduces the cost of the plant and the company. In Serbia, there are very few companies that apply the concept of cleaner production within its operations, despite the existence of the strategy. There is a huge number of social problems in Serbia, so the state and the companies themselves should be much more involved. The management in companies should give a strategic importance to social responsibility, clean production and technologies, in order to bring to life the practical application of these concepts.

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