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**ECONOMIC, SECURITY AND  
ENVIRONMENTAL  
CHALLENGES OF REGIONAL  
DEVELOPMENT**

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International University of Travnik in Travnik,  
Bosna i Hercegovina

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## **Content:**

### **CONTEMPORARY TRENDS IN ORGANIZATIONAL BEHAVIOR AND DIGITAL NOMADISM .....7**

Drago Pupavac, Anto Malbašić

### **ECONOMIC FLOWS IN BOSNIA AND HERZEGOVINA, CORRUPTION AND MEASURES AGAINST CORRUPTION..15**

Rajko Kasagić

### **BONDS AS A QUALITY FINANCIAL INSTRUMENT FOR ACQUIRING THE MISSING FINANCIAL FUNDS IN THE WESTERN BALKAN COUNTRIES ABUSED BY THE CURRENT GOVERNMENTS TO REMAIN IN POWER FOR MULTIPLE DECADES.....26**

Husein Mehmedović, Šejma Hajrić, Narajan Mehmedović

### **RISKS OF BUSINESS AND EMPLOYMENT IN MODERN BUSINESS CONDITIONS .....36**

Cariša Bešić, Srđan Bogetić, Dragan Čočkalo, Mihalj Bakator,  
Doloris Bešić-Vukašinović

### **EU SUSTAINABLE STRATEGIES AND CIRICULAR ECONOMY .....50**

Simonida Vukadinović, Jelena Ješić, Andrea Andrejević Panić

### **ARTIFICIAL INTELLIGENCE IN THE CONTEXT OF ENVIRONMENTAL CHALLENGES .....57**

Muhamed Ćosić, Nehad Gaši, Dina Vrebac, Nešad Krnjić, Bakir Čičak

### **PRODUCTIVITY OF SERBIAN WHEAT GENOTYPES GROWN IN ECOLOGICAL AGRICULTURAL SYSTEM .....68**

Olivera Nikolic, Gordana Racic, Igor Vukelic, Zorana Sreckov, Zorica  
Mrkonjic, Mirjana Bojovic, Vesna Vasic

### **SOCIO-ECONOMIC CHALLENGES OF THE APPLICATION OF ARTIFICIAL INTELLIGENCE .....79**

Siniša Bilić, Dušan Mraović, Ivica Opačak

**ENERGY CRISIS IN SERBIA: CAUSES, EFFECTS,  
GOVERNMENT RESPONSE AND POTENTIAL  
FOR SUSTAINABLE DEVELOPMENT .....86**

Jovana Kisin, Jelena Ignjatović, Azemina Mashovic

**CEMENT AS AN ENVIRONMENTALLY ACCEPTABLE  
COMPONENT IN THE MAKING OF CONCRETE .....103**

Zlatica Kuliš, Dževad Avdić

**SUSTAINABLE SUPPLY OF DRINKING WATER  
TO THE CITY OF ŠABAC .....112**

Suzana Knežević, Milena Milojević, Ljiljana Tanasić

**CORRELATION AND PATH ANALYSIS OF GRAIN YIELD  
AND COMPONENTS OF GRAIN YIELD OF MAIZE  
(*Zea mays* L.) .....121**

Zorana Srećkov, Jan Boćanski, Zorica Mrkonjić, Mirjana Bojović,  
Igor Vukelić, Gordana Racić, Vesna Vasić, Olivera Nikolić

**ECO-INNOVATIONS IN THE CREATION OF NEW  
CAPACITIES FOR ACHIEVING THE GOALS OF THE  
GREEN ECONOMY – CASE OF MIDAS PROJECT .....129**

Ana Marjanovic Jeromela, Andrea Andejević Panić, Simonida Vukadinović,  
Jelena Ješić, Efi Alexopoulou

**THE DEVELOPMENT OF MODERN INFORMATION  
AND DIGITAL TECHNOLOGIES LEADS TO  
THE DEVELOPMENT / REPLACEMENT  
OF EMPLOYEES IN THE COMPANY,  
BUSINESS AND SOCIETY? .....139**

Nikola Mićunović

**CHALLENGES OF URBAN ECOLOGY IN CONSERVING AND  
ENHANCING BIODIVERSITY IN THE 21<sup>ST</sup> CENTURY ..154**

Milan Glišić, Ljiljana Tanasić, Suzana Knežević

**SCIENTIFIC RESEARCH WORK IN TRANSFORMATION  
ECONOMY OF BOSNIA AND HERZEGOVINA .....166**

Enes Huseinagić

**Prof. dr. sc. Drago Pupavac**

Veleučilište u Rijeci

Vukovarska 58, 51000 Rijeka-HR

e-mail: drago.pupavac@veleri.hr

**Anto Malbašić, mag.oec.**

Hrvatska elektroprivreda

Viktora cara Emina, 2, 51000 Rijeka-HR

e-mail: anto@rijeka.com

## CONTEMPORARY TRENDS IN ORGANIZATIONAL BEHAVIOR AND DIGITAL NOMADISM

“When we move, we don’t just learn about  
the place where we go. We also discover who we are  
and where we come from.” - Marquardt, F.

**ABSTRACT:** The research subject of importance for this paper is digital nomadism as a consequence of contemporary trends in organizational behavior. The work aims to determine the basic features of digital nomads, who they are, where they come from, and what drives them. The results of the research are based on the methods of netnographic analysis and the interview method (n=15). The main finding of this paper points to the conclusion that digital nomads are skilled in working with digital tools, that they avoid jobs that require great responsibility, that they come from more economically developed countries, and that they are driven by the desire to make money and that they are intrinsically motivated. The obtained results can help managers of all levels in the search for new, cost-efficient, and flexible organizational structures, but also to political decision-makers who desire to attract digital nomads to a certain country or region.

**KEY WORDS:** digital nomadism, digital nomad, organizational behavior, trends  
**JEL:** L2

### 1. Introduction

Globalization, workforce changes, new work relationships, information and communication technologies (ICT), values, and ethics are contem-

porary trends that determine organizational behavior. The increasing availability and quality of ICT services enable the creation of new services and new jobs that were not only unimaginable but also impossible until recently. For example, remote work was sporadic and possible in a very limited number of activities and with complex preconditions for it to become the basis of the functioning of national economies in the conditions of the COVID-19 crisis. Therefore, it is not surprising that digital nomadism has become a prime topic that attracts the attention of an increasing number of experts and scientists around the world. According to Marquardt (2021), “the root of the ancient philosophy of nomadism is not migration specifically, but rather the frame of mind required — an openness, curiosity, humility, and willingness to embrace and explore new people, places and concepts, all of which are extraordinary sources of corporate innovation and performance”. The rise of digital nomads could be helpful to individuals and organizations.

The fundamental characteristic of digital nomads is that they do not travel for work, but “take their work with them” and do it from any place that has the necessary infrastructure – a high-quality Internet connection and workspace. They generally travel with very little luggage and work equipment, and in some cases without their equipment, but rather rent the necessary equipment at the destination or use local computer facilities. By this, the basic hypothesis of this work was set: Digital nomadism, which arose as a result of contemporary trends in organizational behavior, increasingly determines the organizational behavior of modern companies.

## 2. Theorethical background and research problem

40 years ago, in 1983 to be exact, Steve Roberts was the first to be called a digital nomad in “Computing Across America” magazine, because he traveled and worked from his bicycle. Back then, it was a pioneering and adventurous venture that required a lot of skill and expertise in mastering technology (Clark, 2021). The first documented use of the term “digital nomad” was recorded in the book *Digital Nomad* (Makimoto and Manners, 1997). They point out that digital nomads tell us how current and future technological possibilities, combined with the human natural desire to travel, will once again allow humanity to live, work, and exists in motion. The most widespread definition of digital nomads, also stated by Wikipedia, was adopted at the “6th International Workshop on the Changing Nature of Work CNOW 2018”, Australia (6th International Workshop on the Changing Nature of



Work CNOW 2018) and reads: “Digital nomads are people who travel freely working remotely using technology and the Internet” (Schlagwein, 2018). According to the Croatian Tourist Association (HTZ, 2023), a Digital Nomad is a citizen of a third country who is employed or performs tasks via communication technology for a company or own company that is not registered in the Republic of Croatia and does not perform tasks or provide services to employers in the Republic of Croatia.

The contemporary trends that shape organizational behavior and that have enabled the emergence of digital nomadism are (Pupavac, 2017):

**Globalization.** Globalization refers to the process of integration of world economy, culture, and politics. This includes reducing barriers to trade, communication, and travel between countries and regions, enabling organizations to operate globally. Globalization has led to increased competition among organizations, as well as to changes in the way of work and management (Robbins & Judge, 2009). Knowledge workers network globally, establish intercontinental partnerships, participate in the work of global teams and contribute globally.

**Changes in the workforce.** There are many changes in the workforce that affect organizational behavior. A few examples include 1) an aging workforce, 2) increased workforce diversity, 3) increased use of temporary workers, and 4) decreasing employee loyalty to employers. Young generations are less and less intimate with status. Work to live, not live to work.

**New working relationships.** New working relationships include changes in the way of working and organizing work. Some examples of new working relationships include: 1) increased flexibility of working hours and work locations, 2) increased use of teamwork and virtual teams, 3) reduction of hierarchical structure and increase of employee autonomy, and 4) erasure of boundaries between private and work life. There is an increasing number of freelancers in the workforce, especially between the ages of 30 and 50.

**Information technology.** Information technology plays an important role in organizational behavior. It is used to improve efficiency and productivity, as well as improve communication and collaboration among employees and the ability to connect with people from around the world. Some examples of IT include 1) the use of computers and software to automate business processes, 2) the use of the Internet and social media for communication and collaboration, 3) the use of mobile devices for working outside the office, and 4) the use of analytical tools for decision making.

**Values and ethics.** Values refer to the beliefs and attitudes people have about what is important in life, while ethics refer to the moral principles and standards that influence people's behavior. In organizations, values, and ethics can influence the culture of the organization as well as the decisions made by managers and employees. Being a digital nomad allows you to be exposed to new people, new geographies, new cultures, new values, and new work projects.

### 3. Research methodology

The research results in this scientific discussion are based on qualitative scientific methods, namely: the netnographic analysis method and the interview method. Netnographic analysis was carried out by collecting data from websites, social media and forums. Forums and online conversations were analyzed to find relevant research topics, categorize response patterns, and identify potential participants for in-depth interviews. Netnographic analysis is based on the collection of data on the behavior and attitudes of people on the Internet and is used to study social interactions in a digital communication environment. The goal of the netnographic analysis is to identify the fundamental characteristics of digital nomads. After that, data collection began in the field. Semi-structured interviews were conducted in April 2023, with 15 people who consider themselves digital nomads and currently reside in two large cities on the Adriatic coast, Rijeka and Split. All respondents are citizens of the European Union. Each of them was asked four identical questions, one answer to each question was requested, and after the answer, they were asked for a short comment. After the comments, no further sub-questions were asked in order to avoid possible suggestiveness of the answers. The interviews lasted between 5 and 10 minutes. Interviews with interviewees in Rijeka were conducted live, while interviews with interviewees from Split were conducted online via the Zoom platform.

The four questions on the basis of which the interview was conducted are: 1) Why did you decide to become a digital nomad?, 2) Why did you choose the Republic of Croatia, i.e. Rijeka/Split, as your place of work and residence?, 3) How much has the Digital Nomad Visa program influenced your choice of place of residence and work? and 4) Under what conditions would you agree to work for one of the local companies?

#### 4. Results and discussion

Netnographic analysis based on reviewing hundreds of conversations conducted on different platforms among digital nomads indicates that digital nomads are very pragmatic, skilled in working with digital tools, and have good planning and organizational skills. An additional analysis conducted by collecting data where data on the origin of nomads and their current residence was used, indicates that 88% of digital nomads travel to countries with a lower gross domestic product per inhabitant. Which means they choose destinations with a lower cost of living. They rarely choose professions that carry high responsibility. An easier way of life is more important to them than a big profit. Due to their nomadic lifestyle, they are not inclined to accumulate material possessions. They don't buy expensive things. They buy clothes as needed. They are not spendthrifts, but they like to treat themselves by going out to sports and cultural events. They equally enjoy fast food, which they very often order for delivery, as well as quality restaurant food. Accommodation is chosen according to the price per person. The only thing they pay close attention to when buying are devices and equipment for work (laptop, smartphone, etc.), and they don't skimp when buying, but buy quality devices. Access to free Internet is included.

The following is a presentation of the research results based on a semi-structured interview.

*Why did you decide to become a digital nomad?*

The respondents stated various driving motives that encouraged them to live and work this way of life. It is usually a combination of several factors. 10 of them (66%) cite flexibility in work, and free time planning, as the predominant reason. Three (20%) say that they started this way of life during the Covid-19 pandemic, and one person says that they accepted their partner's lifestyle. One person travels because his job is like that. Additional reasons are a passion for travel and a desire for change. The process of making the decision to become a digital nomad is a long-term one, involving a combination of multiple opportunities and possibilities. All respondents are currently satisfied with their way of working and living.

*Why did you choose the Republic of Croatia, i.e. Rijeka/Split, as your place of work and residence?*

13 of them (87%) cite the low cost of living compared to the country they come from and the income they earn as crucial reasons for choosing to live in Croatian cities. Two of them (13%) came attracted by the music event,

so they decided to stay a bit longer. In additional comments, they mention the following as advantages: pleasant climate, clean sea, safety, and easy communication, because most of the hosts speak English well. When choosing a destination and otherwise, similar rules apply. Unless they are visiting a destination solely for tourism.

*How much has the Digital Nomad Visa program influenced your choice of place of residence and work?*

The introduction of the Digital Nomad Visa program had no effect on any respondent coming to stay in the Republic of Croatia, i.e. Rijeka or Split. Six of them (40%) did not even know about this possibility, and 9 of them (60%) did not use or plan to use the digital nomad visa program. Those who know about this program found out about it on specialized portals intended for digital nomads, and later they got additional information on the website of the Croatian Tourist Board.

*Under what conditions would you agree to work for one of the local companies?*

Twelve respondents (80%) would not agree to work for local companies. Two (13%) would agree on the condition that they get a company car, while one would agree to work for a local company if they provided him with accommodation on the island. A person would accept to work for a local employer if the job involved traveling to different destinations and paid travel and accommodation expenses. In an additional interview, those who would not work for a local company expressed the opinion that the income would not be competitive with their current income, but they left room for the possibility of accepting such a job if they were stimulated in some other way. The majority noted in an additional comment that they rarely or almost never heard of digital nomads working for local companies.

In their comments after answering the questions, they emphasized various advantages and opportunities that each country provides, but they did not mention any of these advantages as crucial. Their decision to work and live as digital nomads is intrinsic in nature.

## 5. Conclusion

Digital nomads are a new species and a rapidly growing segment on the labor market. Digital nomads work for multiple companies and clients, which contributes to the further weakening of ties between employees and organizations, but also between employees themselves. They are very prag-

matic, skilled in working with digital tools, and have good planning and organizational skills. Almost 90% of digital nomads travel to countries with a lower cost of living. They choose professions that do not carry high responsibility. They work to live, not the other way around. Freedom, passion for travel, and desire for change are what drive them. When choosing a destination, the most important thing for them is the low cost of living. They do not want to work for companies in the places where they live. Intrinsic motivation is what drives them to work and live as digital nomads.

## References

- Clark, J., Digital Nomad History, 2021., available at: <https://www.nomadicnotes.com/digital-nomad-history>, (Accesed 10 March 2023).
- Fernandez-Araos, C. (2022). The Rise of the „Corporate Nomad“, Harvard Business Review, available at: <https://hbr.org/2022/03/the-rise-of-the-corporate-nomad>, (Accesed 07 May 2023).
- HTZ (2023). Croatia your new office!, available at: <https://croatia.hr/en-GB/travel-info/croatia-your-new-office/> (Accesed 13 March 2023).
- Makimoto, T., Manners, D. (1997). *Digital Nomad*, Wiley, New Jersey, U.S.
- Pupavac, D. (2017). Basics of Organizational Behaviour (in Croatian: Osnove organizacijskog ponašanja), Polytechnic of Rijeka, Rijeka.
- Robbins, S. P., Judge, T. (2006). Organizational Behavior, 12th Edition, Prentice Hall.
- Schlagwein, D. (2018). The History of Digital Nomadism, 6th International Workshop on the Changing Nature of Work, CNOW, Australia, 2018.
- Wikipedia, Digital Nomads, 2023., available at: [https://en.wikipedia.org/wiki/Digital\\_nomad/](https://en.wikipedia.org/wiki/Digital_nomad/) (Accesed 12 April 2023).

**INTERNACIONALNI UNIVERZITET TRAVNIK U TRAVNIKU**

Prof. dr. Rajko Kasagić

**ECONOMIC FLOWS IN BOSNIA AND HERZEGOVINA,  
CORRUPTION AND MEASURES AGAINST CORRUPTION**

**SUMMARY:** In this paper, we will explore the natural resources of Bosnia and Herzegovina, its historical landmarks, economic development and foreign capital investments. We will investigate the reasons for its faster economic development, the role and importance of tourism. One of the main causes of slow economic development is certainly corruption, according to which Bosnia and Herzegovina ranks third in Europe, tied with Turkey, and ranks 110th out of 180 surveyed countries in the world. We will investigate the most important institutions that are legally responsible for punishing corrupt persons and thus stopping the measure as a basic brake on the economic development of every country. We will investigate the measures taken by the European Union in the fight against corruption by extending its activity to other countries in the world, starting from the authority providing the measures of economic laws of value in the single world market. The economic wealth of a country is also ensured by the measures of political power in the world and the approximation of economic and political integrations with other countries. Bosnia and Herzegovina should pay special attention to investing in the development of tourism and informing the world public about tourist destinations in Bosnia and Herzegovina.

**KEYWORDS:** economy, development, tourism, natural resources, corruption, development measures.

## **ECONOMIC POTENTIALS OF BOSNIA AND HERZEGOVINA**

### **ECONOMIC DEVELOPMENT DURING THE AUSTRO-HUNGARIAN RULE**

After the occupation of Bosnia and Herzegovina in 1878 until the end of the rule of the Austro-Hungarian Monarchy, Bosnia and Herzegovina did not have a certain status, so it attracted the interest of numerous authors. The Monarchy set a goal to connect Bosnia and Herzegovina with other parts of the Monarchy. The condition for this was the construction of the traffic network. It started with the construction of narrow-gauge railways from Bosanski Brod to Sarajevo, the Neretva valley to Mostar and Metković. It developed the telephone, telegraph and car transport network. In Bosnia and Herzegovina, there was an accelerated industrial development with foreign capital. The inhabitants of Bosnia and Herzegovina were slow to accept the new way of doing business, so BiH remained a predominantly agrarian country. For the development of industry, experts were needed, which Bosnia and Herzegovina did not have, so experts moved from other countries of the Monarchy (Croatia, Slovenia, Austria, Hungary, the Czech Republic): members of the army, officials, entrepreneurs, intelligentsia. They become the bearers of changes in cities, both economically and culturally.

After the occupation in 1878, Austria-Hungary worked to build a new administrative system in order to improve the political, economic and cultural life of Bosnia and Herzegovina. In all the mentioned areas, the outdated Ottoman order was modernized. With the introduction of BiH into the Austro-Hungarian Empire, the rapid economic development of our homeland began.

The main task was to cover the costs with own income. Thus, Bosnia and Herzegovina began to focus its policy on the exploitation of natural resources. Already in the first decade of the 20th century, raw materials made up 83% of all Bosnian exports. The products of the wood industry represented the most important item. Bosnia and Herzegovina sold about 144,000 oak trees by direct auction by 1885. The largest wood industry “Morpurgo porente” from Trieste, on the basis of the contract, exported 1,300,000 trees, i.e. 2,600,000 cubic meters of wood.



Favorable conditions have been created for the development of the forestry and wood industry, so Bosnia and Herzegovina establishes a number of companies in Dobrinja, Drvar, Zavidovići, Hadžići, Kasindo. Systematic investments were made in the forests of Bosnia and Herzegovina, so already at the beginning of the 20th century, the export of wood from Bosnia and Herzegovina became a serious competitor to the Austrian export. The development of the wood industry led to the construction of railways, which were the basis for connecting the raw material basins. Mining is developing - exploitation of coal, iron and salt. The first companies of the chemical industry started their work. In addition to the large investment in mining, it gradually developed, limiting itself to a few important items (coal, iron, manganese and salt). In 1913, 847,289 tons of coal were mined in the country. Among the miners, Vareš stood out in particular. Mining of ores is modern, so from 2,305 tons of ores mined in 1890, it increased to 219,113 tons in 1913. Towards the end of the Austro-Hungarian administration in 1916, the exploitation of the highest quality iron ore deposit began in Ljubija near Prijedor.

A special place was occupied by the construction material industry. With the opening of the Bosanski Brod refinery in 1813, the era of crude oil processing from imported oil began. A company was opened in Lukavac that produced ammonia, caustic and crystalline acid soda. Dry distillation of wood was carried out in Teslić, calcium carbide, fersilicon, chlorinated lime and chlorine derivative in Jajce, cellulose in Drvar, turpentine and chlorofine in Višegrad.

According to data from 1907, 46,664 workers were employed in private enterprises and 101,664 workers in shops in BiH, which is 5.7% of the total population.

## **Bosnia and Herzegovina after the establishment of the Kingdom of SHS**

With the establishment of the Kingdom of Serbs, Croats and Slovenes, it is evident from the very name of the state that Bosnia and Herzegovina is not mentioned, so from 1918 to 1941 it had a lower status than the republics of Serbia, Croatia and Slovenia. In 1921, 1,890,440 inhabitants or 15.7% of the total population of the Kingdom of Bosnia and Herzegovina lived in Bosnia and Herzegovina. The country was characterized by economic backwardness, unemployment, so that after 1945, the country entered the Second Yugoslavia with 75% of the agricultural population. The first Yugoslavia was a typical state of economic poverty, social and national oppression. On the international level, it was highly dependent on France and Great Britain, and in the thirties of the last century it turned to Germany and Italy.



In the Second Yugoslavia, Bosnia and Herzegovina was often pressured by economic stabilization measures that had the least impact on Slovenia, with its developed light industry and advanced technology, to which stabilization measures were not applied. Stabilization measures did not refer to the construction of new economic facilities, provided that the foundations of the construction facilities were laid before the measure came into force. And in this way, Slovenia, as a small country, avoided stabilization measures through the agreement of businessmen at the Chamber of Commerce and available information.

## **Economic loom after separation from Yugoslavia**

Bosnia and Herzegovina consists of two geographical and historical entities: the larger Bosnian part in the north, about 42,000 square kilometers, and the smaller Herzegovinian part in the south, with a total area of 51,209.2 square kilometers.

Bosnia and Herzegovina has a lot of natural sights that we will highlight in this paper, which can be a good foundation for the development of a certain economic branch - tourism. Prokoška Jezera is a glacial lake, 1660 meters above sea level, 22 km away from the town of Fojnica. It is located on the Vranica mountain between the valley of the river Vrbas and the river Bosna. Štrbački buk is a national park of Una, with a height of 24.5 m, it is the highest and most spectacular waterfall in the National Park. Not far away are the Martinbrod Waterfalls, which represent the largest complex of waterfalls on the Una River. Tajan – Kamenica – Zavidovići Nature Park is located at an altitude of 1,297 meters. It is rich in canyons, lakes, endemic plants and animals. Tajan is under state protection because of its water and phenomenal flora and fauna. Stone bridges are unique. Kravice Ljubuško waterfall, which was built by the Trebižat river passing through the limestone terrain. It is 28 meters high, creating a natural amphitheater 120 meters wide. Plivska jezera, which are located between the towns of Jezera and Jajce. The canyon of the Tara River is 1333 meters deep, which makes it one of the deepest in Europe. The gorge is in depth and length just behind the Colorado River in America. Perućica is one of the last preserved rainforests in Europe. It is located in the area of the municipality of Foče within the national park Sutjeska. Tjentište is a historical-geographic locality, a basin widening of the river Sutjeska. In the valley of Tjentišta there is a memorial complex “Valley of Heroes”. Tečka buna, Tekija na vrelu Bune, known as Blagajska tekija, dervish temple in Blagaj. The royal city of Bobovac is one of the most important fortresses of the medieval state in Bosnia. It was the capital during the time of Stefan II

Kotromanić. The crown jewels were kept in it. It consists of an upper town with a square tower and a lower town on a step about 20 meters lower in a polygonal shape, about 40 meters long and about 25 meters wide, from which the yard and the well can be recognized today.

13.60% of the area of Bosnia and Herzegovina is fertile land, and 2.96% of the land is used for agriculture, while 83.44% of the land is under forest, mines, cities and other. Natural resources of Bosnia and Herzegovina are coal, iron, manganese, bauxite, wood, copper, chromium, zinc, hydro potential.

Forests and forest land in Bosnia and Herzegovina cover an area of 3,231,500 hectares, of which 1,252,200 hectares are tall forests. The rest of the area includes bushes, bare and other forest land. However, 420,000 hectares of forests are inaccessible due to minefields. Outcrop forests make up 48% of the total forest fund, which are of poorer quality. According to these data, about 63% of Bosnia and Herzegovina is covered by forests and forest land, which are among the highest values in Europe, of which 20% of forests are privately owned, 80% are state-owned. State forests mostly abound in tall forests, which are characterized by higher profitability and systematic forest management.

Forests are determined by a great variety of types, because the country itself is geographically well positioned in terms of different climatic influences, from coastal Mediterranean forests to mountain forests in central Bosnia and Herzegovina (Mediterranean, sub-Mediterranean and moderately continental climate zones) it has over a hundred species of trees. The main types of trees are fir, spruce, black and white pine, beech, different types of oak, and a smaller number of noble deciduous species such as maple, elm, ash, and fruit trees (cherry, apple, pear, plum).

## Projection of economic development

Bosnia and Herzegovina is in the process of transition and development, which is of particular importance for the functioning of the institutions and mechanisms they have. The development strategy is a key document for planning. The development policy of Bosnia and Herzegovina focused on knowledge and innovation, completing the internal market and strengthening growth and employment for greater social harmony. According to World Bank estimates, Bosnia and Herzegovina has a slight increase in economic growth (2015, 1.5%; 2016, 2.5%; 2017, 3.5%). According to the projection, economic growth in BiH in 2021 was 5.8%, which is 2.4 percentage points more than the projection six months ago. The projection of economic growth for 2022 has been revised by more than 50 basis points, compared to the first round of projection from 2021, to the level of 3.9%.

The reasons for the strong correction of the projection of economic activity in 2021 is the decline in economic activity in 2022, as it was revised downwards from -4.3% to -3.2%. As the decline in economic activity in 2020 due to the pandemic, according to official data, was weaker than initially estimated by 1.3 billion KM, the growth in 2021, due to the base effect, was more intense.

In 2022, expected moderate growth in real economic activity, due to the absence of a base effect. Obstacles to a stronger entry of foreign investments have been removed. Of particular importance is the appointment of the FBiH Securities Commission, which created the basic preconditions for stronger activity of foreign investments. With the growth of economic activity in 2022, an economic deepening of the foreign trade deficit is expected.

The projections of economic development so far have proven to be very consistent, even in extraordinary activities in 2021, it is slightly positive, because it can be shown that the extraordinarily high annual growth rates of BiH. exports marked the year 2021. The risks of deviations from the current projection of economic activity in 2022 are balanced. In 2022, the trend of industrial production growth and the recovery of the service sector, which is related to the arrival of foreign tourists, will continue. On the other hand, a strong inflationary shock could delay the recovery of personal consumption. An additional narrowing of the fiscal space could negatively affect public investments, and prolonging the period of weak economic activity would slow down the credit activity of banks.

At the end of November 2022, the macroeconomic projections of the CBBH (Central Bank of BiH) for 2023 were published, followed by the projection of the economic growth of the European Union, which is one of the key variables representing foreign demand. No significant revisions of the current projections of the economic activity of Bosnia and Herzegovina for 2021 and 2022 are expected after the publication of the macroeconomic projections of the European Union.

The interest of foreign investments in Bosnia and Herzegovina has increased in recent years. In 2022, 84 percent of respondents expressed an interest in investing in the development of the BiH economy, and in the first months of 2023, 87 respondents expressed a positive opinion about investing in the economic development of BiH.

The World Bank places Bosnia and Herzegovina in 2019. in the 83rd place of the economic freedom index. The overall rating of Bosnia and Herzegovina is 61.9. This position represents a certain improvement compared to 2018, when BiH was in 91st place. The result is below the regional level, which makes BiH a “moderately free” country.

Total deposits in Bosnian banks on December 31, 2019. it amounted to 21.9 billion KM (11.20 billion euros) of the nominal gross national product.

Industry in Sarajevo includes the manufacture of cigarettes, furniture, car parts and communication equipment. It has a developed tourism industry. In 2006, Lonely Planet chose Sarajevo among the 50 “best cities in the world”. Ski trails are marked on the mountains: Bjelašnica, Igman, Jahorina, Treskavica.

In Sarajevo, the number of foreign tourist visitors increases every year, which is why Sarajevo Airport plans to expand the passenger terminal with the improvement of the runway and auxiliary runways.

Mostar's economy is largely based on tourism, metal production, especially aluminum, banking services and telecommunications. Mostar is the second largest financial center, which is reflected in the fact that two of the three largest banks in Bosnia and Herzegovina have their headquarters in Mostar.

In May 2023, the 24th Business Fair was held in Mostar, where about 800 exhibitors from 30 countries presented themselves. The state partner of this year's Fair or manifestation is Israel, which marked 75 years of innovation from the focus of the advancement of new technologies, the IT industry as a security and health sector.

The Mostar fair is one of the most important and most visited fairs in the region, where economic subjects from almost all branches of the economy are presented.

Banja Luka's economy has stagnated significantly. During the four years of war, the Banja Luka economy lost pace with the world market in key areas, such as technology, which led to economic stagnation. In the last few years, the financial services sector has grown significantly and is constantly developing. During 2002, trading began on one of the two stock exchanges in Bosnia and Herzegovina, the Banja Luka Stock Exchange. The number of companies listed on the stock exchange is constantly increasing, as is the volume of transactions and market compensation. Among the largest companies on the stock exchange, whose shares are traded daily, are Telekom Srpska, Modriča Oil Refinery, Banja Luka Brewery, Bitaminka, Banja Luka.

## **Obstacles to economic development and measures taken**

“Our protection is not in our weapons, nor in science, nor in concealment. Our protection is in law and laws” – Albert Einstein. “To live honorably, to do no harm to anyone, to give to everyone what belongs to him” - a text from Justinian's codification from the 5th century.

These messages are the basis of the progress of any society. However, the current phenomena of today are dangerous and negative, which can have a great negative impact on the work of social institutions, on the development and progress of the social community, on the impoverishment of citizens.

What is the situation in Bosnia and Herzegovina regarding bribery and corruption? Bosnia and Herzegovina fell behind in the Corruption Perception survey published by Transparency International (TI) and ranks lowest in the region. When it comes to the state of corruption in the country, only Ukraine and the Russian Federation are ahead of Bosnia and Herzegovina in Europe in terms of corruption. Bosnia and Herzegovina, on a scale from 0 to 100, was rated 34 and is among the countries where the state of corruption is worsening the most. The countries of the region are moving forward, Bosnia and Herzegovina has fallen 8 index points since 2012 and, together with Turkey, in this year's TI global report, it was singled out as an example of the biggest decline compared to 2012 in the region of Eastern Europe and Central Asia. In the TI analysis, the countries of Eastern Europe, Central Asia and the Western Balkans cannot suppress organized crime due to the deterioration of the rule of law and a captive judiciary. Ethnic divisions hinder the democratic institutions needed to fight corruption. The TI Report states that in Bosnia and Herzegovina there are serious doubts about the ability of the Prosecutor's Office to prosecute corruption. Numerous corruption scandals, the very method of selecting prosecutors have seriously called into question the integrity of the Prosecutor's Office. Due to this situation in the judiciary, a number of important cases of organized crime and corruption, including those involving high officials, have not been prosecuted for years.

The judiciary, which should be the bearer of the fight against corruption, has become a source of problems, and is under great pressure from political elites and is trapped to such an extent that only a complete process of lustration of all holders of judicial positions could contribute to improving the situation.

The TI report mentions the 2022 General Elections which have been marred by a series of scandals involving theft and vote-stealing, electoral commission trading and misuse of public resources. This problem was not solved even by the imposition of amendments to the Electoral Law by the High Representative, whose actions only prolonged the political crisis, and did not solve the blockade of the government, which continues to act primarily as an instrument of political parties to strengthen their own control over all processes in the State.

Evaluating the report's findings, the president of TI's Board of Directors pointed out: "Not only is there no strategy, policy or activity of state institutions to prevent corruption, but state institutions, completely trapped by state control, focus their activities on dealing with corruption." Corruption has become the primary reason for the existence of institutions. A special danger for the state, its economy and economic development is the complete symbiosis of organized crime and state institutions, which leads to further destabilization of society and the collapse of stability. Bosnia and Herzegovina ranks 110th in the world in terms of corruption out of 180 countries covered by the research. The cause of such phenomena is the lack of control and omissions of competent authorities, which is why many concessionaires do not fulfill their obligations, which causes significant damage to public revenues.

Corruption leads to serious consequences for global peace, because it causes the decline of democracy and the strengthening of the authority of leaders, turning it into a cult of personality. These tendencies have been present in Bosnia and Herzegovina for years, "an additional reason for concern is the mention of the law in Republika Srpska is the "criminalization of defamation, which could be used to silence public critics".

In the past year (2022), Bosnia and Herzegovina received candidate status for membership in the European Union, which passed without the implementation of essential reforms from 14 priorities. Bad results are expected primarily due to the absence of key reforms in adapting legal provisions to European Union standards. Actions are necessary to prevent negative phenomena in the country, which is imposed as a priority, without which it is not possible to expect a reform process.

Bosnia and Herzegovina, in cooperation with domestic and international experts, drafted a proposal for the Good Governance Agenda 2025, offering an innovative approach to the challenges of managing the Earth, caused by the dominant capture of the State by ethno-national elites. The Agenda presents a set of measures to combat corruption caused by typical and quasi-national tensions, which could potentially free efforts from the obstruction of the political elite.

Some of the measures refer to: conducting systemic functional audits of the public sector in order to optimize it, centralizing public procurement, improving the integrity of the electoral process and political parties.

TI has set a clear goal: to free the world from corruption by promoting transparency, accountability, integrity, and acting against injustice.

The European Union is strengthening rules that criminalize criminal acts of corruption and harmonize sanctions across its member states, as well as a special regime of sanctions within the framework of external security



policy aimed at serious acts of corruption. It will strengthen its activities relying on existing measures, strengthen efforts to exclude corruption from politics, and actively support the work of member states to establish strong anti-corruption policies and legislation. The new measures are strongly aimed at prevention and creating a culture of integrity where corruption is not tolerated.

The key measures are: communication and the fight against corruption, the European Union anti-corruption network, gathering of bodies for the implementation of legislation, public bodies, gathering of experts, civil societies and other participants will act as a catalyst for preventing corruption throughout the European Union and will develop good practice and adopt guidelines. One of the key tasks is providing assistance to the European Commission in checking common areas where the risks of corruption are high. The work of the network will be included in the anti-corruption strategy that will be developed in consultation with the European Parliament and the Council of Europe, in order to maximize the effectiveness and coherence of the European Union's actions. The communications describe the ethical rules, rules on integrity and transparency that are in force to prevent corruption in the institutions of the European Union. Therefore, corruption has gained serious momentum not only in Bosnia and Herzegovina, but also in the members of the European Union and its institutions, which is why they are forced to take stricter measures to protect the economic and economic development of the European Union and its members. Strict control of the application of legal acts adopted by the Commission is being introduced with the obligation to apply measures in its members.

### **Stricter measures in the fight against corruption**

The European Union Commission has proposed a new Directive in the fight against corruption. The directive modernizes the existing legal framework of the European Union for the fight against corruption. Those measures are:

- a) Preventing corruption and building a cult of integrity. Increasing awareness of corruption through an information campaign, creating research and educational programs to reduce the risk of corruption and criminal acts.
- b) Ensuring the application of the highest standards in the public sector by imposing obligations on member states to enact rules on open access to information of public interest, disclosure of conflicts of interest in the public sector, disclosure and verification of assets of public officials, and regulation of integration between the private and public sectors.

- c) Establishment of special bodies for the fight against corruption and ensuring responsibility and training of bodies responsible for preventing corruption.
- d) One legal act for criminal acts of corruption and sanctions.
- e) Ensuring the investigation of criminal prosecution of corruption.
- f) Tools in the fight against corruption: investigative tool, immunity and privileges during investigation and criminal prosecution, abolition of privilege and immunity during investigation and criminal prosecution, introduction of minimum statute of limitations to ensure sufficient time to carry out the criminal parts of corruption.

The harmonization of the definition of criminal parts should be used to cover not only bribery, but also embezzlement, influence peddling, abuse of office, and obstruction of justice and illegal enrichment related to corruption crimes. All criminal offenses from the United Nations Convention against Corruption become mandatory for the members of the European Union.

## Conclusion

Bosnia and Herzegovina is a multi-national and multicultural country, which connects it with both the East and the West. According to natural resources, it has favorable conditions for economic development. It is the only country among the countries of the socialist camp that received from the Olympic Committee to organize the Winter Olympic Games. Bosnia and Herzegovina is rich in forests, which creates conditions for the development of the wood processing industry. It has favorable conditions for the development of tourism, which is especially reflected in Mostar and Sarajevo. The banking and stock exchange system was developed, with Mostar taking a leading role in the banking system. The Mostar Economic Fair is one of the first fairs in the region that gathers businessmen from around the world, where participants present their economic and technical technological achievements. The fair is a favorable place for mutual connection and information among businessmen of other countries, which increases the exchange of goods and services and inclusion in the global trends of economic development.

Corruption can be the main and biggest obstacle to the economic development of a country. Bosnia and Herzegovina ranks highly for this scourge. The European Union undertakes decisive measures against corrup-



tion, whose legal acts have the force of application even outside the member states of the European Union due to the economic connection of states, i.e. their economic entities. As an associated member of the European Union, Bosnia and Herzegovina is obliged to carry out significant reforms in order to ensure the rule of law and free institutions from the influence of the political elite.

Now is the time for Bosnia and Herzegovina to show its ability to independently solve its internal problems without the presence of the OHR and the high representative. Only when Bosnia and Herzegovina is ready to solve the accumulated problems caused by corruption and national-ethnic divisions on its own will the conditions for membership in European and even world economic and political integration be met. Only by retaining a high representative in BiH, the International Community maintains its position that this country is not capable of independently conducting internal and foreign policy.

## Literature

- Damjan Ožegović, viši istraživač TI BiH, Transparency International BiH, mo-jahercegovina.com...
- Dževad Jusbašić „Politika i privreda u Bosni i Hercegovini pod Austrougarskom upravom, Sarajevo, 2002.
- H. Schneller, Die Staatrechtliche von Bosna und der Hercegowina,
- B. Jakšić i V.J. Vuković, pokušaj aneksije Bosne i Hercegovine, 1882-1883. godine, Glas SANCC XV, Beograd, 1954.,
- F. Hauptmann, Kombinacija oko državnopravnog položaja bosne i Hercegovine na početku Prvog svjetskog rata, Godišnjak XI, sarajevo, 1961.,
- <https://prezi.com-privreda-društvo>,
- Internet, profitiraj-ba/u-bih-56,
- [cbbh.ba/press/sho](http://cbbh.ba/press/sho),
- [bhs.gov.ba](http://bhs.gov.ba),
- [ti-bih.org/bosna-i-ht](http://ti-bih.org/bosna-i-ht),
- UNODC studija „Korupcija u Bosni i Hercegovini,
- <https://bs.m.wikipedia.org.wiki>,
- [httpsuniverzitetpim.com](http://httpsuniverzitetpim.com),
- <https://komorabih.ba-o-privreda-bih>,
- <https://geovizija.com-articlegs>.

## **BONDS AS A QUALITY FINANCIAL INSTRUMENT FOR ACQUIRING THE MISSING FINANCIAL FUNDS IN THE WESTERN BALKAN COUNTRIES ABUSED BY THE CURRENT GOVERNMENTS TO REMAIN IN POWER FOR MULTIPLE DECADES**

**Prof. Husein Mehmedović**, International University Travnik, Aleja Konzula-Meljanac bb. 72270 Travnik, E-mail: mehmedovic.gr@gmail.com  
**Šejma Hajrić**, MA, International University of Travnik, Aleja Konzula-Meljanac bb. 72270 Travnik, E-mail: sejma001@hotmail.com

**Narajan Mehmedović**, University of Primorska, Koper, Izolska vrata 2, 6000 Koper, Republic of Slovenia, E-mail: narajanmehmedovic@gmail.com

**ABSTRACT:** Bonds are the most important debt securities of the capital market, which provide financial resources to their issuers by selling them on the financial markets. They provide their owners, in addition to the principal, a benefit in the form of interest. It is well-known that many governments of the countries in the Western Balkans have, until now, remained in power by long-term borrowing on the financial markets and from international financial institutions. Bonds are one of the better financial instruments that many countries in the world use today for borrowing. Their importance is invaluable, especially in Bosnia and Herzegovina, at a time when financial resources are needed to overcome current financial problems, starting from the municipal, cantonal, entity, and state levels. Many developed countries have used bonds to solve infrastructure problems, from the local to the national level, by issuing and selling bonds to finance the construction of necessary infrastructure facilities. In this paper, we will present the potential possibilities of the quality use of bonds in solving current problems at all levels of government. We will also look at the misuse of this financial instrument by the current authorities in the countries of the Western Balkans to stay in power for decades.

**KEYWORDS:** Bonds, missing financial resources, financial instruments, solving current problems.

## Introduction

Investment activities are most often related to financing from other sources, the most prominent of which are bond and stock issues. In relation to shares, which represent equity securities of the capital market, which are more often used in the collection of financial resources for the financing of companies that need new investments. Bonds are debt securities of the capital market and one of the more generous sources for collecting missing financial resources. Thanks to the bonds, many infrastructure facilities were built in many countries of the world. Given that there are several types of bonds, their purpose is related to planned projects that are implemented with financial resources collected from the sale of bonds on financial markets intended for significant projects at the municipal, cantonal, entity and state levels. Bonds are often issued and the financial resources collected from their sale are used for other purposes than intended. The budget deficit is very often solved by issuing government bonds, which are a significant and safe investment for potential investors because they are the least risky securities, since their return with the associated interest is guaranteed by the state. Bosnia and Herzegovina and other countries of the Western Balkans mainly use bonds to borrow when they cannot get bank loans at high interest rates. The economic justification of issuing and selling bonds on the financial markets is important when state institutions from any level of government plan to build some infrastructural facility significant for the narrow or wider social community, such as the construction of highways, the construction of water and sewage networks, the construction of bridges, industrial plants and other facilities that encourage economic activity, increase the number of employed workers, and when that investment has a direct or indirect impact on the increase in GDP. Currently, in Bosnia and Herzegovina, especially in the Republika Srpska entity, most of the attention is devoted to collecting financial resources to repay debts incurred in the previous period by issuing entity bonds and selling them on the Vienna and London Stock Exchanges, whose maturity date is this year.

### 1. Bonds, debt securities from the capital market

Bonds are capital market debt securities whose original maturity is longer than one year. Bonds represent the issuer's debt to the investor. This type of securities belongs to the category of securities of debt instruments and they reflect credit or creditor relationships. Bonds are securities

that guarantee their owner, upon maturity, the payment of principal with associated interest in a pre-determined order within a certain period of time.[4]

Bonds, as well as other securities, today, instead of in printed form, most often appear in the form of an electronic record and are registered in the securities register. A bond is a certificate, usually transferable, that shows that a company or some other issuer that needs financial resources has borrowed a certain amount of money, which it will return in a certain time period in the future marked on the bond. Given that the money is not free, the issuer of the bond undertakes to pay the agreed interest at certain intervals during the life of the debt. Bonds are usually for round amounts, e.g. 100, 500, 1,000, 5,000, 10,000 KM, euros or some other convertible currency, with nominal amounts that are returned to the investor at the time of bond maturity. In relation to shares (equity securities), where the owner can completely or partially lose his invested funds, in the case of bonds, the nominal value simultaneously represents the maximum amount that bond buyers can expect to be charged in the event of liquidation of the bond debtor (if it is about the issuing company). Bonds usually carry a fixed interest rate, but recently about  $\frac{1}{4}$  of the total number of issues is with a variable interest rate. What will be the interest rate that the bonds pay depends not only on the prevailing market interest rates, but also on the issuer's credit rating. It is a market rule that bonds with lower credit ratings carry higher yields to attract investors. Practical experience tells us that the interest rates on bonds are usually lower than the interest rates that the issuer would have to pay on long-term bank loans, but still, issuing bonds requires a slightly better credit rating than obtaining long-term bank loans. The interest (coupons) paid by the bond is determined by applying the nominal or coupon interest rate to the nominal value and is usually paid quarterly or semi-annually. Interest costs are usually recognized as an expense for tax purposes in some countries.[5]

## 2. Permanent indebt of western balkan countries

The transition process of the countries of the Western Balkans was accompanied by an inflow of foreign capital. Most often, foreign investors decided to buy domestic companies, and in this way, an inflow of capital was realized through privatization. Foreign direct investments thus emerged as the main source of covering the growing current account imbalance of these countries. All Western Balkan countries had growing current account deficits (as a percentage of GDP) until the outbreak of the economic and financial crisis in 2008. Montenegro was the leader in the region in terms of

the relative size of the current account deficit with 50.7% of GDP in 2008. In addition to Montenegro, there were also trends in the current account deficit growth in Bulgaria and Romania. Nor were the other countries of the Western Balkans spared from the growth of the current account deficit, the only thing being that the percentage of the current account deficit was not as high as in Montenegro. The reduction of the current account deficit in 2009 was due to the reduced inflow of foreign direct investments in all countries of this region, so that they did not have foreign exchange funds to maintain imports at the previous level. Despite the reduction in the current account deficit, it is still financed by capital inflows. If it were not for capital inflows, the deficit would have to be financed by reducing foreign exchange reserves. A reduction in the borrowing capacity of the Western Balkan countries on the private capital market may lead to a change in the pattern of economic growth that existed before the financial crisis. It is important to keep in mind that the current account deficit financed by borrowing abroad is not problematic if the funds are used to finance new investments and not consumer spending. This means that funds from abroad should be spent on building new factories that can produce goods for export. On this basis, foreign currency inflow can service foreign loans.[2] In the loan repayment phase, part of the created national income flows out of the country, which can cause deflationary effects, especially if the loan funds were not used productively. With increased exports, means of payment must be provided to return the money, which in turn will activate the trade balance.[6] The previously mentioned models of inflow of foreign direct investments in the countries of the Western Balkans at the time of the emergence and duration of the economic and financial crisis of 2008 have been quite exhausted. In order to fill the gap in project financing in these countries, almost all Western Balkan countries have switched to new financing models. One of the new models of financing is with the help of the issue of government bonds and treasury bills, which has remained and is widely used to this day, regardless of the unfavorable conditions it brings with it for the countries that use these financial resources. In this way, by borrowing, the countries of the Western Balkans are increasingly falling into a debt crisis, which has a negative impact on all segments of life and work in these areas. Constant political turmoil and mass departure of young and educated people from these countries deepens the crisis even more.

### 3. Total public debt and further excessive borrowing of bosnia and herzegovina through bonds issues

According to data from the Ministry of Finance of Bosnia and Herzegovina as of June 30, 2023. Bosnia and Herzegovina had a public debt of 13 billion convertible marks, or 6.7 billion euros. Out of the total amount of debt, the external debt amounts to 9,316 billion convertible marks or 72,65%, while the internal debt is 3,506 billion convertible marks or 27,35% of the total public indebtedness. Compared to the end of last year, the public debt as of June 30, 2023. increased by 629.74 million convertible marks or 5.16%, of which only the external debt increased by 617.85 million convertible marks. In the total debt of Bosnia and Herzegovina, Republika Srpska participates with 49.82% and owes 6,388 billion convertible marks. Federation of Bosnia and Herzegovina with 49.29% or 6,319 billion convertible marks. State institutions with 0.50% and owe 64.63 million convertible marks, and District Brčko BiH with 0.39%, i.e. 49.58 million convertible marks.[8]

Bosnia and Herzegovina is one of the countries of the Western Balkans that often borrows by issuing bonds. The lack of financial resources in Bosnia and Herzegovina is complemented by the frequent issuance of bonds as one of the most important financial instruments at its disposal. The global bond market is divided into three large groups: 1) domestic bonds; 2) foreign bonds; 3) Eurobonds.

Domestic bonds are issued on the local market by domestic issuers (borrowers) and are usually denominated in the domestic currency. Foreign bonds are issued in the local market by foreign borrowers and are usually denominated in the local currency. Issuance and trading of foreign bonds is usually under the supervision of local authorities in charge of securities. Eurobonds are issued by multinational syndicates of banks and are not marketed mainly in the countries in whose currencies the bond is denominated. These bonds are not traded on specific national markets.[1] In this point, we have presented only one of several divisions of bonds that are quoted on the financial markets in the Western Balkan countries.

#### 3.1. Republika Srpska's new borrowings/debts on the stock exchanges through the issue of long-term bonds

Bosnia and Herzegovina's entities, in the absence of financial resources, are permanently in debt on the stock exchanges by issuing long-term bonds. The Bosnian entity Republika Srpska leads the way in borrowing. In

the previous period, Republika Srpska borrowed much more than the Federation of Bosnia and Herzegovina. We will mention only some of the recent borrowings, such as: Borrowing on the stock exchange through the issue of long-term bonds for a new 35 million convertible marks, at an interest rate of 6.1%, and the maturity date of the bonds is five years. Also, a new auction of six-month treasury bills in the amount of 15 million convertible marks is planned soon. In the previous two months, the Government of Republika Srpska borrowed more than 350 million convertible marks from the stock market. The largest amount of debt is related to the issue worth 210 million convertible marks, with which it covered the hole created by the payment of its obligations to the Vienna Stock Exchange. Republika Srpska planned to hold as many as 12 auctions of securities, i.e. treasury bills and long-term bonds, by mid-August 2023. In this way, the goal of the rulers in this entity of Bosnia and Herzegovina is to collect approximately 500 million convertible marks. According to the report of the Ministry of Finance of the Republika Srpska, the total debt of the Republika Srpska at the end of last year amounted to an incredible 6.3 billion convertible marks, which represents about 44.6% of GDP.[7] Of the total debt that currently belongs to the Republika Srpska, this year alone the amount of the debt is about 1.2 billion convertible marks. A significant amount is due to issued and placed bonds whose maturity date is by the end of this year. One significant part of this debt refers to the associated interest. Borrowing on the Vienna and London stock exchanges was mostly at unfavorable interest rates. Why did the authorities of Republika Srpska borrow at such unfavorable interest rates? We can assume that when selling bonds, the only goal of the authorities of the Republic of Srpska was to achieve the inflow of missing financial resources from those sources that were only available to them at that time, regardless of their price, i.e. interest.

#### **4. Municipal and corporate bonds an efficient alternative financial instrument of the capital market for financing infrastructure projects in the lack of own financial sources**

As we know from the experience of the countries of the Western Balkans, the governments that have been in power for the past three decades used financial means to stay in power by frequent borrowing in various ways without much interest in the development of local communities, which are the basis for the local population to stay in their fireplaces (except for a few months before the elections). During that period, some projects were mostly



done superficially, which last only until the votes of the voters of those local communities are received.

The needs of the population in local communities are growing more and more. The incomes of local communities do not keep up with the growing needs of the population, which are increasing and becoming more complex day by day. The budgets of local communities are not high enough for the construction of infrastructure facilities in local communities, which meet the growing needs of the local population. One of the ways to collect the missing financial resources is the issue of municipal bonds, or securities of local authorities. Municipal bonds are very easy to collect the necessary funds, and at the same time, they are mostly used in developing and transition countries such as Bosnia and Herzegovina and other countries of the Western Balkans. In America, municipal bonds are presented as debt securities. They can be issued by counties, cities, states, or other government entities to finance capital projects. Most often, it is about the construction of communal networks, schools, hospitals, water supply, roads, as well as financing current liabilities. Investors who buy bonds actually lend money to issuers who guarantee that they will pay interest regularly and repay the principal within a defined period.[3]

Until now, knowing the authorities in the countries of the Western Balkans as well as their interest in staying in power, they are not very interested in the development of local communities. In order to be able to develop faster, local communities (cities and municipalities) about which the state authorities do not think much (except before local and parliamentary elections) need to pay more attention to the issuance of municipal bonds. Municipal bonds would enable the construction of local infrastructural facilities that can, without major state interference, contribute more to the accelerated development of local communities in order to keep the local population in their homes. In this way, it would be possible to retain young educated people in the areas of the Western Balkan countries without any greater expectations from the state authorities, which could, but will not, do anything more in this area. In the absence of the interest of the state authorities in the population, this could be one of the models of retaining the population in these areas. The development of local communities with the help of issuing municipal bonds could be copied from other developed countries that used these models in the development of their cities and local communities. In addition to municipal bonds, other types of bonds can also represent an exceptional financial resource that can be used for faster economic development of companies in the countries of the Western Balkans. Special attention should be paid to corporate bonds at a time when large companies need to borrow



funds for a longer period of time. Companies can then issue corporate bonds and thus overcome the problem of the current lack of financial resources for regular operations or for greater investment activity.

## **5. Excessive borrowing of the authorities in the countries of the western balkans with the goal of staying in power for many years**

As we have presented just one small example of excessive borrowing by entity governments in Bosnia and Herzegovina, the situation is no better in the other countries of the Western Balkans. Most of these countries have not yet freed themselves from the burden from the nineties of the last century related to the disintegration of the former SFRY. The burden of problems carried over from that period is still being lifted in these countries, which spread to other countries of the Western Balkans that were not part of our former common country. Unresolved numerous disputes in the countries of the former SFRY ignore the faster and more even economic development of these countries compared to the countries of the developed world. In addition to the inherited problems, many other problems of both political and economic nature have appeared, which further complicate the already complicated situation in the countries of the Western Balkans. We will look back at Bosnia and Herzegovina as a country where almost nothing has changed in the last two decades in a positive context. In order to stay in power, all political parties in Bosnia and Herzegovina have a common pattern that they use to stay in power. There is almost no political party in Bosnia and Herzegovina that was not in power at some level, starting from the municipal, cantonal, entity level to the state level. None of these political patriots showed great interest for the country and its population, which was left at the mercy of the general social indifference for the ordinary citizen of the country who had to fight alone with all the misfortunes that affected the population of the Western Balkan countries. The model of staying in power from Bosnia and Herzegovina is almost identical in all other countries of the Western Balkans. So, in the foreseeable future, the population in these areas has nothing good to hope for from their authorities, except for the hope that some global change could happen due to international developments, of which we in the Western Balkans are an integral part. The greatest hope of the people from these areas is that the accelerated entry of these countries into the European Union could happen, where the existing circumstances and situation in which these countries currently find themselves would have to change. However, in order to remain in power, political parties that exercise power in

the absence of their own sources of financial resources increasingly borrow on the international capital market. Special attention is paid to the issuance of government bonds and treasury bills that are offered for sale on the world's most famous stock exchanges, such as the London, Vienna, Paris and other stock exchanges. Debts that arise in this way will have to be paid back by someone at the time the bonds mature. These debts will have to be returned by our children and grandchildren who had nothing to do with usurpation and especially with the spending of financial resources obtained by selling bonds with unfavorable interest rates. Unfortunately, the rule that says "the important thing is that I'm good, and who wants to pay back the debt, I don't care". This logic is used by all the governments of the countries of the Western Balkans. Among other things, thanks to the bonds, the authorities in the countries of the Western Balkans, regardless of their price, i.e. interest, collect the missing financial resources that leave them in power for several years.

## Conclusion

The consequences of non-transparent borrowing and spending of financial resources collected through the issuance and sale of bonds will only come to fruition in the coming period. Well-designed projects can be financed without major problems from funds collected through the issuance of government bonds. Such projects can certainly bring many benefits to the state, business entities and its population that lives and works in that area. Bosnia and Herzegovina, as well as other countries of the Western Balkans, are not fortunate enough that their authorities, with the help of these sources of financing, create quality conditions for faster economic development in order to be able to retain a local population that would have better conditions for life and work worthy of a human being. The examples of many economically developed countries of the world show us that their governments can in a short time, in the absence of their own resources, collect the missing financial resources with the help of the issue and sale of bonds. The financial resources collected in this way enable the implementation of numerous projects. By launching these projects, they create better conditions for greater and faster employment of the domestic workforce. In this way, it is possible to retain them in companies in the host country. Everyone who wants to in the host country can prove themselves and provide the maximum of their capabilities, which can positively affect the development of individuals, businesses and society as a whole. This example can best be seen through the analysis and economic development of the USA, the developed countries of Western Europe and other developed countries of the world. This means that bonds are one of the better financial instruments of the capital market. In

the absence of own and other sources of financing, such as bank loans with unfavorable interest rates. If the financial resources collected through the sale of bonds are used rationally, they can enable faster economic development in addition to local communities through the construction of priority infrastructure facilities, faster development of domestic companies, increase in GDP and strengthening of the economy of the country that has decided on this type of project financing.

## References

- [1] Kapor, P., (2007.), „Investicioni fondovi i investiranje u hrv“, Poslovni biro d.o.o. Beograd, str. 48.
- [2] Kovačević, R., (2012.), „Međunarodno tržište kapitala-savremene tendencije“, Centar za izdavačku djelatnost Ekonomskog fakulteta u Beogradu, str.243-245.
- [3] Mehmedović, H., (2016.), „Modeli otvaranja i finansiranja malih porodičnih preduzeća“, Internacionalni univerzitet Travnik u Travniku, str.162.
- [4] Mehmedović, H., Gravorac, S., Šijan. G.,(2018.), „Finansijska tržišta instrumenti i institucije“, Internacionalni univerzitet Travnik u Travniku, str.71.
- [5] Todorović, M, Ivanišević, M., (2017.), „Poslovne finansije“, Centar za izdavačku djelatnost Ekonomskog fakulteta u Beogradu, str. 196.
- [6] Živković, A., Kožetinac, G.,(2016.), „Monetarna ekonomija“, Centar za izdavačku djelatnost Ekonomskog fakulteta u Beogradu, str. 625.
- [7] [https://dnevni.ba/dnevni/rs-na-rubu-ekonomskog-ambisa/Bradvica, D.](https://dnevni.ba/dnevni/rs-na-rubu-ekonomskog-ambisa/Bradvica,D.),(Preuzeto:06.08.2023.)
- [8] <https://balkans.aljazeera.net/news/economy/2021/12/3/bih-duzna-skoro-13-milijardi-maraka-rs-zaduzeniji-od-fbih>(Preuzeto: 08.08.2023.)

## RISKS OF BUSINESS AND EMPLOYMENT IN MODERN BUSINESS CONDITIONS

**Prof. Cariša Bešić, PhD, email:** carisa.besic@sbb.rs; carisa.besic@ftn.  
kg.ac.rs

*University in Kragujevac, Faculty of Technical Sciences, Čačak, Serbia*

**Srdan Bogetić, PhD, professor of applied studies, email:** srdjan.bo-  
getic@bpa.edu.rs

*Belgrade Business and Arts Academy of Applied studies, Belgrade, Serbia*

**Prof. Dragan Čockalo, PhD, email:** dragan.cockalo@tfzr.rs

*University in Novi Sad, Technical Faculty "Mihajlo Pupin", Zrenjanin, Serbia*

**Mihalj Bakator, PhD, email:** mihalj.bakator@tfzr.rs

*University in Novi Sad, Technical Faculty "Mihajlo Pupin", Zrenjanin, Serbia*

**Doloris Bešić-Vukašinović, PhD, email:** doloris.besic-vukasinovic@viser.edu.rs

*Academy of Technical and Art Applied Studies, School of Electrical and Computer  
Engineering, Belgrade, Serbia*

**ABSTRACT:** The global market and the establishment of new competitive relationships require a new approach in managing the organization and ensuring sustainable development. The speed of accepting business changes is crucial for improving competitiveness on the global market. In this paper, the authors analyse the risks that affect business and employment in companies on a global level. The main goal is to look at the new business conditions, which are characterized by unstable economic indicators, as well as the need for new employee skills.

**KEYWORDS:** competitiveness, globalization, sustainable development, business risks, skills.

### 1. Introduction

The world is entering a new level of economic globalization in which national economies have become closely connected and aware of the need to monitor and respond to the challenges and dynamics of the new business environment. Business organizations at the micro level of their activities must

create new business models in relation to observed and expected changes in the environment, in order to maintain competitive ability in the long run and ensure constant growth dynamics<sup>1</sup>.

The global crisis caused by the COVID-19 pandemic has highlighted the need to change the modern business philosophy. The global economy has shown all its instability, and doing business in pandemic conditions has reduced the volume of global trade. Some business sectors, such as tourism, have collapsed. The economic crisis caused by the global pandemic has shown how closely connected the global world is<sup>2</sup>.

It is estimated that in the next decade of the global economy will be characterized by environmental and social crises, which will depend on basic geopolitical and economic trends. The data from the World Economic Forum (WEF) indicate that the risks that are currently most manifested on the global market are: energy supply crisis, the crisis of living costs, rising inflation, food supply crisis and cyber attacks on critical infrastructure. It should be noted here that the problems are grouped into three groups: sustainable development, economy and new technologies.

Application of new technologies in business is an imperative for organizations in modern business. However, apart from the advantages that new technology brings (faster communication, more efficient business, and higher productivity), it also brings common addictions or weaknesses for all users (organizations). According to the WEF<sup>3</sup>, the nature of cyber threats has changed. The respondents now believe that cyber attackers are more likely to focus on business disruption and reputational damage. These are the two biggest concerns among respondents. The impact of cyber security incidents can easily move from organization to organization and across borders. Cyber security regulations have become a more prominent factor in compliance and board-level discussions in many regions.

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<sup>1</sup> Đorđević D., Čockalo D., Bogetić S., The analysis of marketing concept implementation in domestic enterprises, *Journal of Engineering Management and Competitiveness (JEMC)*, TF Mihajlo Pupin, Zrenjanin, 2016, Vol. 6, No.2., 2016, p. 120.

<sup>2</sup> Bakator, M., Čockalo, D., Đorđević, D., Bogetić, S., Stanisavljev, S. (2022). The role of productivity in achieving competitiveness. *Proceedings, XII International symposium Engineering management and competitiveness (EMC)*, 17-18th June, Zrenjanin, TF Mihajlo Pupin, Zrenjanin, pp. 199

<sup>3</sup> Global Cybersecurity Outlook (2023), World Economic Forum, Switzerland, str. 4, 8

The concept of sustainability has been changing its focus in accordance with the changes in the global market and it initially focused on the preservation of the natural environment. In accordance with the changes in the market and its new requirements, the concept of sustainability has become much more comprehensive and includes several aspects of sustainability such as: care for poverty, gender equality, accessible education for all, care for decent work, energy from renewable sources, innovation and etc. Thanks to growing economic challenges, the demand for sustainable business is increasing. Global brands such as: Nike, Adidas, Nestle, etc. base their business on sustainable business<sup>4</sup>.

## 2. Economic aspects of risks affecting modern business

The green transition, technological changes, supply chain transformations and changing consumer expectations generate the demand for new jobs in all industries and regions. However, these positive drivers have been offset by rising geo-economic tensions and the the crisis of living costs<sup>5</sup>.

It has been indicated in the document of the World Economic Forum (WEF) "Future of Jobs Report 2023", that the influence of technology is massive, that is, it is believed that it will be the crucial in the process of applying business transformation in the next five years. According to this report, over 85% of surveyed organizations identify the increased adoption of new and frontier technologies and the expansion of digital access as the trends most likely to lead to transformation in their organization. Wider application of environmental, social and governance (ESG) standards within their organizations will also have a significant impact. The next most influential trends are macroeconomic: rising costs of living and slow economic growth.

As can be seen in Table 1, the crisis of living costs is a short-term crisis, while climate change will be a serious crisis for the global economy in the long term. The the crisis of living costs can be seen as a consequence of several factors such as: the negative economic effects of COVID-19, the war in Ukraine, high inflation, low growth and low investment.

<sup>4</sup> Bešić, C., Bogetić, S., Čočalo, D., & Bešić-Vukašinović, D. (2022). Uloga novih znanja i vještina za postizanje održivosti u novonastalom ekonomskom ambijentu. Paper presented at the 25. Međunarodna konferencija „Energetska kriza kao ključni izazov za ekonomije, vladavine prava i medijske slobode zemalja Zapadnog Balkana sa posebnim osvrtom na Bosnu i Hercegovinu“, Travnik, BiH, str. 19

<sup>5</sup> Future of Jobs Report (2023), World Economic Forum, Switzerland, str. 20

*Table 1. Global risks ranked by severity in the short and long term<sup>6</sup>*

<b>2 years</b>	<b>10 years</b>
The crisis of living costs	Failure to mitigate climate change
Natural disasters and extreme weather conditions	Failure to adapt to climate change
Geo-economic conflict	Natural disasters and extreme weather conditions
Failure to mitigate climate change	Loss of biological diversity and ecosystem collapse
Erosion of social cohesion and polarization of society	Large-scale involuntary migration

The cost of living, as one of the leading economic problems in the next five years, was part of another analysis of the World Economic Forum “Chief Economists Outlook”. Namely, according to the opinion of the surveyed leading economists (76%), the cost of living will continue to be at crisis levels in many countries. They also believe (57%) that wages will rise in most advanced economies. Still, 42% of the surveyed economists do not agree with this view<sup>7</sup>.

The cost of living is particularly critical in developing economies where the increase in domestic prices has also been influenced by currency depreciation. As an example, you can take the period between January 2020 and 2023, when the price of food increased by 46% in the Middle East and Central Asia. At the global level, such trends are becoming a serious economic problem as global wage growth struggles to keep up with prices. However, the problem will arise in vulnerable societies that will be directed towards poverty, especially in increasingly rigorous financial conditions.

Economic indicators indicate that overall inflation rates are falling as a result of sharp monetary tightening, commodity market stabilization and easing supply chain conditions. However, opposite to the decline in the overall inflation rate, the measures of core inflation which remove variable price categories (includes food and energy) are rising. In the Eurozone, core inflation hit a record high of 5.7% in March 2023, while in the US core inflation rose to 5.6%, as higher housing prices offset declines in other price categories.

<sup>6</sup> Global Risks Report (2023), World Economic Forum, Switzerland, str. 6

<sup>7</sup> Chief Economists Outlook, (2023), Centre for the New Economy and Society, World Economic Forum, Switzerland, str. 10.



The Eurobarometer survey, which was conducted in the period from May 31 to June 22 this year in 27 member states of the European Union (EU), focused on the main problems of Europeans at the national and EU level as one of the topics of the survey. According to survey data, price growth/inflation/cost of living are the main concern at EU and national level (45%), although there has been an improvement compared to winter 2022-2023.

Respondents singled out the biggest issues at EU level: price growth/inflation/cost of living are ranked as the most important issue at EU level (27%), international situation (25%), immigration (24%), environment and climate change (22%) and the economic situation (17%). Price rise/inflation/cost of living are marked as the most important issue at EU level and rank in the top three in 21 member states. It is on the first place in eight member states (down from 12 in the winter of 2022-2023), of which the most are in: Luxembourg (39%), Croatia (35%) and Spain (33%). Countries that are closer to the borders of the Russian Federation and Ukraine are more concerned, compared to other countries, about the international situation, while those that are on the border with Turkey have a greater fear of immigrants. Economic issues are still dominant in relation to others, which points to the fact that the EU economy has to solve key economic problems.

At the national level, price growth/inflation/cost of living are the most important issues at the moment (45%), the economic situation (18%), the environment and climate change (16%)<sup>8</sup>. Rising prices/inflation/cost of living are cited as the most important issue facing citizens in 22 member states (unchanged from winter 2022-2023), with the highest levels recorded in Croatia (69%), Austria (61%) and Bulgaria (60%)<sup>9</sup>. Indicators at the national level indicate that economic issues (price growth/inflation/cost of living and economic situation) (63%) are the biggest problem for national economies, which points to the fact that they have not recovered yet from the economic effects of Covid, as well as the consequences of energy crisis and war events in Ukraine.

The “26th Annual Global CEO Survey 2023” survey, conducted by the consulting company PwC (PricewaterhouseCoopers), also touched on the issue of risk in modern business. The interviewed CEOs pointed out

<sup>8</sup> Standard Eurobarometer 99 – Spring 2023: Public opinion in the European Union, (2023), European Union, <http://europa.eu.eurobarometer>, str. 34.

<sup>9</sup> Standard Eurobarometer 99 – Spring 2023: Public opinion in the European Union, (2023), European Union, <http://europa.eu.eurobarometer>, str. 35.

that inflation and macroeconomic variability in the next five years stand out as the key threats to their business. The surveyed CEOs<sup>10</sup> believe that their companies will be exposed to the following key threats in the coming period: inflation (40%) and macroeconomic volatility (31%) (in the next 12 months) and macroeconomic volatility (29%) and inflation (28%) (in the next 5 years).

All of the above-mentioned research conducted by various organizations show that on a global level, the question of the crisis of living costs and the factors that affect it are a serious problem that will be faced by national economies in the coming period. The duration of the crisis of living costs will depend on the readiness of the economy to adapt to new trends in business and through certain measures facilitate business operations and the ability of companies to be more productive and efficient.

### 3. Risks In Employment In Modern Business

The profound effects of technological advances on the world economy, along with globalization and demographic changes, have led to a pressing societal problem: how to train people with the skills they need to participate in the economy—now and in the future. New digital business conditions have actualized the necessity of reconfiguring and improving the supply of knowledge and skills on the labor market so that workers on a global level can respond to the needs of new work and business models of modern companies. This implies new forms of support from the governments of countries and companies to the education system and the redefinition of the functioning, curriculum and way of working of the educational institutions themselves<sup>11</sup>.

On the supply side of the labor market, there is an educational system that reacts slowly to dynamic technological changes and the demand for new skills and knowledge. As a result, there is a mismatch between available and required skills offered on the labor market. The capacity of the continuing education system is far exceeded by the growing need for training and retraining of workers, and access to retraining is usually more difficult for lower-skilled workers<sup>12</sup>.

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<sup>10</sup> 26th Annual Global CEO Survey, (2023), PwC, [www.ceosurvey.pwc](https://www.ceosurvey.pwc), str. 8.

<sup>11</sup> Vidas Bubanja M, Bogetić S., Bešić, C., Kalinić Z., Bubanja I. (2022). New knowledge and skills for the digital age. Proceedings, XII International symposium Engineering management and competitiveness (EMC), 17-18th June, Zrenjanin, TF Mihajlo Pupin, Zrenjanin, pp. 31.

<sup>12</sup> Vidas Bubanja M, Bogetić S., Bešić, C., Kalinić Z., Bubanja I. (2022). New knowledge and

Table 2 provides a list of essential basic skills needed by employees in modern business. Businesses consider analytical thinking to be the most needed skill compared to others. Also, table 3 shows us the expectations of companies for the development of the importance of the skills of their employees in the next five years. Creative thinking and analytical thinking are the most represented in relation to the others, which indicates that cognitive skills are gaining importance the fastest, which is a consequence of the increasing importance of complex problem solving in the workplace.

Table 2. Basic skills<sup>13</sup>

No.	Skills
1.	Analytical thinking
2.	Creative thinking
3.	Resilience, flexibility and agility
4.	Motivation and self-awareness
5.	Curiosity and lifelong learning
6.	Technological literacy
7.	Confidence and attention to detail
8.	Empathy and active listening
9.	Leadership and social influence
10.	Quality control

Table 3. Emerging skills<sup>14</sup>

No.	Skills	%
1.	Creative thinking	73,2
2.	Analytical thinking	71,6
3.	Technological literacy	67,7
4.	Curiosity and lifelong learning	66,8
5.	Resilience, flexibility and agility	65,8
6.	Systemic thinking	59,9
7.	AI & big data	59,5
8.	Motivation and self-awareness	58,9
9.	Talent management	56,4
10.	Orientation to service and customer services	54,8

McKinsey Global Institute's analysis provided an estimate of total employment from 2018 to 2030 in the post-COVID-19 period, in which India, China and Germany will have the largest investment in education and retraining of employees compared to other developed countries.

Analysis of the views of top managers of corporations<sup>15</sup> operating

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skills for the digital age. Proceedings, XII International symposium Engineering management and competitiveness (EMC), 17-18th June, Zrenjanin, TF Mihajlo Pupin, Zrenjanin, pp. 33.

<sup>13</sup> Future of Jobs Report (2023), World Economic Forum, Switzerland, str. 38

<sup>14</sup> Future of Jobs Report (2023), World Economic Forum, Switzerland, str. 39

<sup>15</sup> Parker G., 20 views on the biggest opportunity for change after the pandemic, World economic forum

on the global market, among other things, indicates the need for the following guidelines:

- Understand how we work and what we value;
- Understanding of technology;
- Creating a local system of sustainability;
- Improving our relationship with nature;
- Shortening the innovation cycle;
- Struggle against false information;
- Business leaders should be more interested in science; and
- Better support for innovation and creativity.

In 2020, companies noticed that there is a gap in the area of required skills among their employees, so they started creating and increasing training. However, after three years there was a slight decline this year. Given that businesses see the skills gap in the local labor market as the biggest obstacle to achieving industry transformation and investing in on-the-job learning and training as the most promising workforce strategy to achieve their business goals, formulating effective reskilling and upskilling strategies over the next five years is essential to maximizing business performance<sup>16</sup>.

In the “Future of Jobs Report” 2023, prepared by the World Economic Forum, the surveyed companies declared about the strategy of re-training and retraining. In the report, respondents prioritize analytical thinking and creative thinking over other areas. Also, the skills that companies say are growing in importance the fastest are not always included in corporate strategies for improving knowledge.

Organizations identify skills gaps and the inability to attract talent as key barriers preventing industry transformation, with 60% of surveyed companies emphasise the difficulties in bridging the skills gap locally and 53% identifying their inability to attract talent as the main barrier to transforming their business. Businesses see talent as more of a strategic constraint to their performance than capital availability: skills gaps in the local labor market are seen as a bigger barrier to transformation than a lack of investment capital by

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<sup>16</sup> Future of Jobs Report (2023), World Economic Forum, Switzerland, str. 42

companies in virtually every industry<sup>17</sup>.

The “Future of Jobs Report” 2023 showed that the largest number of surveyed companies recognise investment in learning and education at work and automation of work processes as a strategic direction in achieving business goals in the next five years in the workforce strategy segment. As a good example, BMW can be taken as one of the leading companies from the auto industry which has started with the biggest transformation in its history which should be crucial for the next direction for this company. The new business philosophy focuses on sustainability, flexibility and digitization, which should facilitate the company’s path to electromobility. That is why the BMW Group created its master plan for a new factory in the automotive industry called BMW iFACTORY, which should be located in Debrecen. The BMW Group focuses its business philosophy on three areas: lean, green, digital. The plan is for all factories to accept the new production concept later. The BMW Group<sup>18</sup> uses virtualization, artificial intelligence and data science to network all relevant aspects of car manufacturing. Digitization opens up new dimensions for the BMW iFACTORY.

#### 4. Implications of risks for the region

Business risks that appear on a global level, mostly appear on regional markets as well. The market of the Western Balkans and the economies that represent its part feel similar risks in relation to the global level, with their local specificities. Table 4 shows the five biggest risks in Serbia and neighboring countries. As can be seen, economic risks are the most dominant, and only then follow issues of climate change and other risks. This points to the fact that most of these states have to solve key issues for the lives of citizens, such as: the crisis of living costs, high prices, geo-economic conflicts, etc. which together affect the economic environment of a country. Issues of climate change, negative human impact on the environment are not in the top five risks in all countries. This can be interpreted in the way that those countries are insufficiently interested in this problem and give priority to other risks.

*Table 4. Top five risks identified by the Executive Opinion Survey (EOS)<sup>19</sup>*

<sup>17</sup> Future of Jobs Report (2023), World Economic Forum, Switzerland, str. 49.

<sup>18</sup> This is how digital the BMW iFactory is. (2023), this is how DIGITAL the BMW iFACTORY is. (bmwgroup.com)

<sup>19</sup> Global Risks Report (2023), World Economic Forum, Switzerland, str. 81, 85, 86, 87

<b>Montenegro</b>	<b>Bosnia and Herzegovina</b>
Cost-of-living crisis	Severe commodity supply crises
Geo-economics confrontation	State collapse
Prolonged economic stagnation	Severe commodity price shocks
Failure of climate-change adaptation	Digital inequality
Human-made environmental damage	Cost-of-living crisis
<b>North Macedonia</b>	<b>Slovenia</b>
Cost-of-living crisis	Severe commodity price shocks
Debt crises	Geo-economics confrontation
Human-made environmental damage	Rapid and/or sustained inflation
Rapid and/or sustained inflation	Severe commodity supply crises
Prolonged economic stagnation	Geopolitical contestation of resources
<b>Serbia</b>	
Geo-economics confrontation	
Severe commodity price shocks	
Interstate conflict	
Cost-of-living crisis	
Asset bubble burst	
Severe commodity supply crises	

The transformation of the global energy system is well underway. In just over a decade, investment in multiple forms of renewable energy has overtaken investment in fossil fuels. Energy and climate policy now occupy a central place in domestic and international affairs<sup>20</sup>.

Table 5 provides data on the Energy Transition Index (ETI) for 2023 related to Serbia and neighboring countries according to the criteria of this index. By the energy transition index, the framework based on two segments - data for measuring and understanding the performance of energy systems and the capacity of countries for energy transition, is implied. On the global list, Scandinavian countries occupy the largest number of countries, which can be interpreted as the readiness of countries to create independence from only one energy source. Of the countries in the region, Hungary, Slovenia and Croatia have made the greatest progress in terms of energy transition and the ability of society and economy to use multiple energy sources. A big

<sup>20</sup> Fostering Effective Energy Transition 2023, World Economic Forum, Switzerland, str. 3

problem for the region is the significant disproportion between the leading and the countries with the weaker ETI index.

*Table 5. Neighbouring Countries according to the Energy Transition Index:<sup>21</sup>*

No.	Country	ETI score
18.	Hungary	64.3
29.	Slovenia	62.6
33.	Croatia	62
48.	Bulgaria	57.2
49.	Romania	56.8
50.	Bosnia and Herzegovina	56.7
69.	Montenegro	54
77.	Serbia	52.3
80.	North Macedonia	52.9

For years, international organizations have been giving warnings about climate change and the negative effects of its impact, both on society and the economy, which were not taken seriously enough by many countries, even some of the most developed ones. However, the negative effects of climate change no longer represent only a distant threat, but it affects lives and livelihoods, especially of the most vulnerable in developing countries.

## 5. Guidelines and recommendations

In order to overcome the risks faced by companies in modern business, it is necessary to say that the state plays an important role in this process. Guidelines and recommendations for overcoming risks include two levels: companies and the state. The role of the state in creating the environment is key to the following activities:

- The necessity of establishing an economic model that will affect the reduction of inflation, price growth and other factors that affect the increase in the cost of living;
- Creation of a support system for companies in order to prevent the negative effects of climate change such as irrigation systems, encouraging the use of alternative energy sources (solar panels, biomass, wind

<sup>21</sup> Fostering Effective Energy Transition 2023, World Economic Forum, Switzerland, str. 12.



energy, etc.), maintenance of river channels as flood prevention, etc.;

- Encouraging adult education as a model for adapting to new market requirements. Companies in the region must direct their focus to several segments in the coming period;

- Creation of a new business paradigm that includes greater application of new knowledge, skills and innovations in order to increase productivity and reduce business costs;

- Establishing a model of retraining of employees in companies with the aim of improving the knowledge of their employees and training them for new market challenges;

- Adaptation to climate change and use of existing systems in certain industries: agriculture, food industry, etc;

- Development of awareness among management and employees about the expediency of care for environmental protection and recycling of ecological waste;

- Application of circular economy principles in business strategies of companies.

Companies in the region have to create their own model of behavior in changing business conditions and therefore it is necessary to be adaptable and proactive. That is why it is a prerequisite that there is an adequate business environment that will enable their plans to be supported by the state. This is primarily about the creation of economic measures, support systems, legal procedures, etc.

## 6. Conclusion

Modern economic conditions are characterized by risks that significantly affect business operations and employment in companies. Economic risks represent one of the most serious problems for companies, which are the result of several factors: the increase in the cost of living, inflation, the negative economic effects of Covid-19, the energy crisis, the consequences of the war in Ukraine, etc. That is why it is necessary for national economies and the companies themselves to establish a model that will be able to respond to new changes in the market.

Climate change is an increasingly common issue for companies, but also for the states themselves. Namely, the negative effects of climate change (fires, droughts, pollution) have affected the business models of industries, such as agriculture, insurance, car industry, traffic, tourism and hotel industry, etc. Countries are becoming aware of their impact on pollution and climate change and are beginning the transition to clean energy through the transformation of energy systems.

As a prerequisite for successful business in the new market framework, companies have to focus on improving the knowledge and skills of their employees. As a consequence of the accelerated technological growth, companies are creating strategies for requalification and training of their employees. Companies are forced to improve their knowledge and skills because this is a prerequisite for business transformation. The lack of knowledge and skills among employees is a much bigger problem for a company than the lack of investment. The skills that companies say are growing in importance the fastest are not always included in corporate strategies for improving knowledge.

## LITERATURA

1. Đorđević D., Čočkalović D., Bogetić S., The analysis of marketing concept implementation in domestic enterprises, Journal of Engineering Management and Competitiveness (JEMC), TF Mihajlo Pupin, Zrenjanin, 2016, Vol. 6, No.2., 2016, pp. 120-128
2. Bakator, M., Čočkalović D., Đorđević, D., Bogetić, S., Stanisavljev, S. (2022). The role of productivity in achieving competitiveness. Proceedings, XII International symposium Engineering management and competitiveness (EMC), 17-18th June, Zrenjanin, TF Mihajlo Pupin, Zrenjanin, pp. 199-203
3. Global Cybersecurity Outlook (2023), World Economic Forum, Switzerland
4. Bešić, C., Bogetić, S., Čočkalović D., & Bešić-Vukašinović, D. (2022). Uloga novih znanja i veština za postizanje održivosti u novonastalom ekonomskom ambijentu. Paper presented at the 25. Međunarodna konferencija „Energetska kriza kao ključni izazov za ekonomije, vladavine prava i medijske slobode zemalja Zapadnog Balkana sa posebnim osvrtom na Bosnu i Hercegovinu“, Travnik, BiH
5. Future of Jobs Report, (2023), World Economic Forum, Switzerland
6. Global Risks Report, (2023), World Economic Forum, Switzerland
7. Chief Economists Outlook, (2023), Centre for the New Economy and Society, World Economic Forum, Switzerland.

8. 26th Annual Global CEO Survey, (2023), PwC, [www.ceosurvey.pwc](http://www.ceosurvey.pwc)
9. Standard Eurobarometer 99 – Spring 2023: Public opinion in the European Union, (2023), European Union, <http://europa.eu.eurobarometer>
10. World Bank Group, (2021), The Climate Change Action Plan 2021–2025: Supporting Green, Resilient, and Inclusive Development, Washington.
11. Fostering Effective Energy Transition, (2023), World Economic Forum, Switzerland
12. Accelerating Business Action on Climate Change Adaptation, (2023), World Economic Forum, Switzerland
13. Murphy Daniel, How wildfire risk and extreme heat is changing the insurance industry, (2023), World Economic Forum, How wildfire risk and extreme heat impacts insurance sector | World Economic Forum ([weforum.org](http://weforum.org))
14. Vidas Bujanja M, Bogetić S., Bešić, C., Kalinić Z., Bujanja I. (2022). New knowledge and skills for the digital age. Proceedings, XII International symposium Engineering management and competitiveness (EMC), 17-18th June, Zrenjanin, TF Mihajlo Pupin, Zrenjanin, pp. 31-38
15. Parker G., 20 views on the biggest opportunity for change after the pandemic, World economic forum, 13 November 2020.
16. This is how digital the BMW iFactory is. (2023), This is how DIGITAL the BMW iFACTORY is. ([bmwgroup.com](http://bmwgroup.com))

## EU SUSTAINABLE STRATEGIES AND CIRCULAR ECONOMY<sup>22</sup>

dr Simonida Vukadinović<sup>2</sup>, prof. dr Jelena Ješić<sup>3</sup>, prof. dr Andrea Andrejević  
Panić<sup>4</sup>

<sup>2</sup> Educons University/Faculty of Business Economy

Sremska Kamenica, Serbia, simonida.vukadinovic@educons.edu.rs

<sup>3</sup> Educons University/Faculty of Business Economy Sremska Kamenica, Serbia

jelena.jessic@educons.edu.rs

<sup>4</sup> Educons University/Faculty of Business Economy Sremska Kamenica, Serbia

andrea.andrejevic@educons.edu.rs

**ABSTRACT:** Existing economic systems are in transformation and the increase in the realization of economic activities in sectors that work according to the principles of the circular economy have positive effects on the quality of life of citizens and the environment. Also, circular economy lead to significant changes in the concept of economic development. The interdependence of the mentioned indicators needs to be researched and evaluated, both in the European Union and in individual member countries.

The circular economy model is one of the priorities of the EU Green Deal, with a high potential for improving sustainability and reaching net zero by 2050. The main goal of this paper is to present the EU Sustainable Strategies and their connections with the circular economy model.

The paper will also present examples of good practice operating according to the circular economy model in the EU and the countries of the Western Balkans.

**KEYWORDS:** Circular Economy, EU strategies, Sustainability, Knowledge Economy, Eco-innovations.

### Circular economy model

Adopted in 2013, the VII action program of the European Union for the environment until 2020 (Decision 1386/2013/EU), contains 9 prior-

<sup>22</sup>“The research was supported by the Science Fund of the Republic of Serbia, Grant No. 303, Circular economy as a model of development that forms a new identity of the Republic of Serbia - EDUCIRC2022”.

ity goals, one of which is the transition to a raw material-efficient, green and competitive low-carbon economy. This goal provided the basis for the further development of policies in the area of the circular economy.

In 2015, at the global level, two very important documents were adopted, the aim of which is to continue the promotion of sustainable development and mitigation of climate change. The first document is the 2030 Agenda for Sustainable Development, which the United Nations presented through 17 goals, and foreseeing that the signatory states mobilize all resources to eradicate poverty by 2030, combat inequality and find answers to the challenges of climate change. The Paris Agreement, another important document, aims to reduce the threat caused by climate change, which includes limiting the increase in the average global temperature (below 2 °C compared to the pre-industrial level and continuing efforts to limit the increase in temperature to 1.5 °C in compared to the pre-industrial level).

In the same year (2015), the European Commission adopted the first action plan for the circular economy, Closing the Circle - action plan for the circular economy (COM/2015/614), which included measures to encourage the transition of the European Union towards a circular economy, increase global competitiveness, creating new jobs and encouraging sustainable economic growth. The measures foreseen in the action plan related to the improvement of production, consumption, waste management, raw material market management, reduction of food wastage, reduction of the amount of plastic waste, innovation and investment, etc.

The EU program “Horizon 2020” was largely focused on the greater competitiveness of the European economy through the development and application of new technologies. Horizon 2020, funded research and innovation from 2014 to 2020 with a budget of almost 80 billion euros.

## **Necessity of circular economy**

From the first report (Towards The Circular Economy, Ellen MacArthur Foundation) quantifying the possibility of a circular economy at the World Economic Forum in 2012, the idea of circular economy concept has been embraced with great speed. The model of circular economy (CE) has captured the interest of business leaders, governments cities, emerging innovators, designers and scientists, all round the world. Although it is not new (in manufacturing period people had thought of making using of the products for next generations), the idea of this concept may be due to the compelling logic and economic rationale of the CE, as well as its potential for value cre-

ation has competitive advantage. Parallel, the harmful effects of the one-way usage in linear system of “take-make-waste” become fully apparent. The size of global economies is planned to increase fourfold till 2050., and the world’s population is expected to increase by 10 billion till then, with developing markets accounting for two-thirds of global consumption. The linear economy’s negative impacts (Lacy P. et al., xiii, 2020) in the in terms of waste, pollution, devastation of nature and climate change will be catastrophic.

“We consume about 1.75 times the capacity of the Earth, or 75% more natural resources than are renewed each year. Human’s appetite for scarce resources is expected to grow in the coming decades. For example, production of mined metals is expected to increase by as much as 250% by 2030 to meet demand, and other commodities are under similar pressure. Nothing less will meet the urgency of the moment if the world is to achieve the UN’s Sustainable Development Goals (SDGs) by 2030 and stay within the boundaries outlined in the Paris Agreement”. (Lacy P. et al., 4, 2020).

## Western Balkans’ countries CE

The Western Balkans countries (WB Concerning to the economic, geopolitical status,) have Stabilisation and Association Agreements with the EU. WB is opening up trade and aligning the region with EU standards. The overall framework for the relations of the WB with the EU provides The Stabilisation and Association Agreements. The EU takes roll in political as well as financial support for the countries of the region, putting acent to the good neighbourly relations and making prosperity through regional integration.

The Sofia Declaration on the Green Agenda for the Western Balkans from 2020, has took the countries of the Western Balkans to implement measures not only in the field of climatechange and pollution prevention, energy development, transport and circular economy, but biodiversity development, sustainable agriculture and food production as well.

For all Western Balkans`, the leading trade partner for is EU (cca.70% of the region’s total trade). In the period 2011 to 2021, EU exports with the WB has grown by almost 130%. and WB exports to the EU have increased by 207%.

The countries of the region Real GDP growth for WB countries presents recesion during 2020 (the biggest in Montenegro -15,3), and that predictions for the years after 2020 are years of regional recovery.

The Western Balkans region should look for solutions to reduce the consumption footprint and increase the rate of circular use of materials, which will in turn stimulate economic growth. The economies of the

Western Balkans are currently at the lower end of resource productivity, with values (ie €0.35/kg) well below the EU average (ie €2.07/kg). resources should be kept in the economy as long as possible, maximizing their value and minimizing wastage. This includes good product design, efficient use of materials and energy, long life cycles, well-designed circular industrial sites, new business models and, when the product eventually becomes waste, effective recycling to provide high-quality secondary raw materials. As each industrial sector is different when it comes to resource use, waste generation and management, Western Balkan authorities are issuing permit applications for industrial plants should be encouraged to use EU best practice in different industrial sectors through “BAT reference documents (BREFs). The circular economy promotes innovative and more efficient ways of production and consumption, and businesses and consumers in the Western Balkans should be encouraged to adopt them. Local SMEs should take advantage of the business opportunities of increased resource efficiency and seek access to innovative technologies. Improving acceptance of the EU Eco-Management and Audit Scheme (EMAS) should also be encouraged.

However, catching up with other European regions would require sustainable annual GDP growth of around 7%. Currently, exports are still focused on medium and low-tech products, and innovation efforts mostly involve traditionally strong sectors. Although some economies of the Western Balkans are recording an increase in patent activity, the intensity of patenting in the region is still low, while on the other hand, the production of scientific publications shows a stable growth trend. Promoting a strategic green approach to public procurement will enable a more responsible and sustainable way of spending public money, support investment and can help level the playing field by ensuring that all bidders must follow the same standards.

One of the WB projects in the field of CE is The ENV.net3, that has been implemented since december 2017. For two years, the organizations participating in the project have been monitoring the transition from a “linear” to a “circular” economy. The term “circular economy” is the most familiar to stakeholders, but the meaning is still misunderstood. The public is not aware of what this type of economy means.

The biggest regional problem is waste, sustainable management, separation and its recycling, so the concern is unjustifiably duplicated and equated with the CE.



## Good practice examples in EU and the Western Balkans

The EEB addresses pressing European environmental issues by setting the agenda, monitoring, advising and influencing the ways in which the EU deals with these issues. These include issues such as climate change, biodiversity, circular economy, air, water, soil, chemical pollution, as well as policies in industry, energy, agriculture, product design and waste prevention, among others. EEB is one of the founders of the Coolproducts, Right to repair and Wardrobe Change campaigns. EEB is an official member of the European Stakeholder Platform for CE promoted by the European Commission. EEB is active in promoting and accelerating the implementation of the CE model. While the primary focus of EEB's work is on the EU and its decision-making processes, the organization also works on broader regional and global processes at the UN and OECD level, particularly the Global Agenda for Sustainable Development. With the enlargement of the European Union, EEB established cooperation with Eastern European environmental organizations, helping them to use European regulations to strengthen national environmental protection policies.

Since 1999, as a non-profit organization, Punto Sud from Milan, Italy has been working in the field of international development cooperation to identify and test new ideas for solving social problems, both in Italy and around the world.

Zero Waste Europe Brussels, Belgium is a leading and fast-growing movement of communities, local leaders, businesses, experts, influencers and other “change agents” working towards the same vision: the elimination of waste in our society. Zero Waste Europe connects and supports a vibrant network of 31 national and local NGOs promoting the Zero Waste strategy as a way to make Europe more sustainable. Local groups are responsible for promoting Zero Waste, managing and monitoring the network of Zero Waste municipalities, as well as for cooperation with companies and decision makers. In order to become a member of Zero Waste Europe, an organization must agree with the principles of this organization and its hierarchy. Zero Waste Europe is very active in various areas and issues related to the circular economy: waste policy, cities and communities, consumption and production, climate energy and air pollution, getting rid of plastic, chemical recycling, waste trade.

Right to repair is a coalition of European organizations active on the issue of repair. They are located in several European countries and represent community repair groups, social economy actors, self-repairs and any citizen who wants to stand up for his right to repair. Right to Repair focuses on:

informing citizens and consumers about opportunities and obstacles to their right to repair, engaging them in the campaign and helping them understand that we have the power to make positive change for the planet and communities. The organization advocates for a universal right to repair and ambitious policy measures to achieve this through: access to repair information and spare parts for everyone - not just professionals, signaling the need for more repairable and long-lasting products, both nationally and at European level, getting a repair marking system on at the EU level in order to direct consumers towards durable products that can be repaired, strengthening the support network of Member States and business partners, promoting repair outside the EU in order to accelerate the transformation of the market at the global level.

The Ellen MacArthur Foundation is a UK-registered charity that aims to inspire people to rethink, redesign and build a positive future through a circular economy framework. Their mission is to accelerate the transition to a circular economy worldwide (more examples Vukadinovic, 2022).

Balkan Green Energy News is a leading, free online portal that follows the topics of sustainable energy development, climate change, environmental protection and mobility through regular publication of news, information on changes in legislation and investment opportunities in the Balkan. Balkan Green Energy News is a project of the Center for the Promotion of Sustainable Development (CPOR), a civil society organization based in Belgrade, Serbia. The goal of the organization is to contribute to the promotion of the concept of sustainable development in Serbia and other Balkan countries through awareness raising, advocacy, dissemination of information, education of relevant target audiences and organization of events. CPOR also creates partnerships and networks with other organizations, companies, institutions and individuals whose strategies, programs and activities contribute to the promotion of sustainable development.

Steel impex as center for recycling and waste and Ekofungi company that turns waste into sustainable business opportunities in cultivation of mushroom and vegetable, are two examples of good practice in implementation of CE model in The Republic of Serbia.

## Conclusion

The circular economy model is implemented more or less in the EU as well as in Western Balkan countries. This model is obligatory if we as humans plan to leave something for next generations living in the Earth.

The countries all over the world and its citizens have the task of enacting and implementing strategic documents, fund projects, present good practice examples, make consulting companies in field of CE in order to solve not only the problem of waste management, global warming, and economy expansion but also to raise the awareness of the people on the rationalisation of resources usage for the next generations living on this planet.

## ACKNOWLEDGMENT

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## REFERENCES

- [1] Government of Serbia, Waste Management Program in the Republic of Serbia for the period 2022-2031. Belgrade 2022, pg. 1, 3, 4, 52. <https://srda.rs/wp-content/uploads/2022/02/Program-upravljanja-otpadom-u-Republici-Srbiji-za-period-2022-2031.-godine.pdf>
- [2] European Commission Guidelines for the Implementation of the Green Agenda for the Western Balkans, Brussels, 2020. [https://neighbourhood-enlargement.ec.europa.eu/system/files/2020-10/green\\_agenda\\_for\\_the\\_western\\_balkans\\_en.pdf](https://neighbourhood-enlargement.ec.europa.eu/system/files/2020-10/green_agenda_for_the_western_balkans_en.pdf) [30.7.2022.] pg.7,8
- [3] Lacy P., Jessica Long, Wesley Spindler, The Circular Economy Handbook: Realizing the Circular Advantage, Palgrave Macmillan, London, UK, 2020, vii, ix, 3, 4, [https://doi.org/10.1057/978-1-349-95968-6\\_1](https://doi.org/10.1057/978-1-349-95968-6_1)
- [4] Vukadinović S. Monografija: *Cirkularna ekonomija i zapošljavanje u Evropskoj uniji*, Univerzitet Educons, Sremska Kamenica, Srbija, M42=5, ISBN: 978-86-82088-08-0
- [5] <https://www.systemekofungi.com/blue-economy/> [10.08.2023.]
- [6] [https://www.eeas.europa.eu/eeas/eu-and-western-balkans-towards-common-future\\_en](https://www.eeas.europa.eu/eeas/eu-and-western-balkans-towards-common-future_en) [20.08.2022.]
- [7] [https://ec.europa.eu/neighbourhood-enlargement/system/files/2020-10/green\\_agenda\\_for\\_the\\_western\\_balkans\\_en.pdf](https://ec.europa.eu/neighbourhood-enlargement/system/files/2020-10/green_agenda_for_the_western_balkans_en.pdf) [30.5.2021.] pg.7,8  
<https://balkangreenenergynews.com/rs/o-nama/> [10.08.2023.]

# ARTIFICIAL INTELLIGENCE IN THE CONTEXT OF ENVIRONMENTAL CHALLENGES

*Muhamed Ćosić, email: muhamed.cosic@iu-travnik.com*

*Nehad Gaši, email: nehad.gasi@iu-travnik.com*

*Dina Vrebac, email: dina.vrebac@iu-travnik.com*

*Nešad Krnjić, email: prof.nesad@gmail.com*

*Bakir Ćićak, email: bakir.cicak@gmail.com*

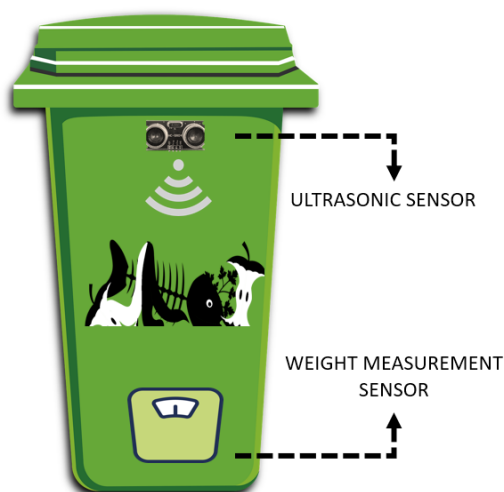
**SUMMARY:** Modern societies increasingly take care of a sustainable environment. The progress of any modern society is closely related to technological progress. Technological progress, however, in most cases has a negative impact on the environment, and it is necessary to invest additional efforts in designing innovative technologies that will be environmentally acceptable. The use of artificial intelligence can make a big contribution to achieving the stated goal. Many companies are trying to use artificial intelligence technologies to reduce emissions of harmful gases. Artificial intelligence can also be of great use in predicting climate change, sensor equipment for monitoring various environmental processes, predicting disasters, etc. This paper discusses the models of application of artificial intelligence for the purpose of environmental protection. The paper, in addition to presenting several significant models of the use of artificial intelligence for the purpose of environmental protection, also deals with issues of environmental acceptability of artificial intelligence itself.

**KEYWORDS:** *artificial intelligence, ecology, climate change.*

## 1 INTRODUCTION

Contemporary societies face a situation that represents a major challenge to their normal functioning, which is related to constant pollution of the environment. The consequences of increasing environmental pollution destabilize the economy, threaten the lives and health of people and animals, and generally cause problems for the solution of which large sums of money are spent. Due to environmental pollution, natural disasters are occurring more and more often, which are mostly devastating and cause long-term consequences. Scientists, politicians, engineers and experts from various disci-

plines are faced with the demand to find solutions that will help to protect the environment from further pollution, as well as to mitigate and eliminate the damage that has already occurred. It is crucial to adopt technologies for planetary surveillance and early warning of catastrophic events. Efforts to find a solution to the mentioned problem imply the use of different strategies, approaches, tools as well as the use of innovative technologies. One of the innovative technologies that has great potential and can be of great use in this regard is artificial intelligence. Artificial intelligence, as one of the most important computer technologies, is one of the areas that drives the wave of digital transformation and encourages innovation in all industries (Ćosić, Ramaj , Petrušić 2023). Its potential is particularly evident when collecting and processing huge amounts of data needed for various analyses. on the basis of which important decisions are made. One of the conditions for the application of artificial intelligence is the existence of a large amount of data (Ćosić, Ramaj , Petrušić 2023.b). The possibilities of applying artificial intelligence in environmental protection are numerous. Some of the possible usage scenarios are e.g. use in sensor equipment as well as monitoring equipment, it can be integrated into tools for monitoring weather systems, waste sorting and recycling optimization, monitoring greenhouse gas emissions, optimizing energy production and in many other ways.



*Figure 1: Application of artificial intelligence technologies for waste sorting and recycling optimization*

Artificial intelligence in the field of environmental protection already has a significant impact, and in the future it can be expected that, with inte-

gration with IoT devices and modern computer networks, it will show its full potential, especially in smart city scenarios. The use of artificial intelligence in the identification of environmental problems and solutions provides a new advantage for understanding the impact and intensity of environmental challenges facing the world ( Abiodun et al., 2018).

## **Environmental protection models of use of artificial intelligence**

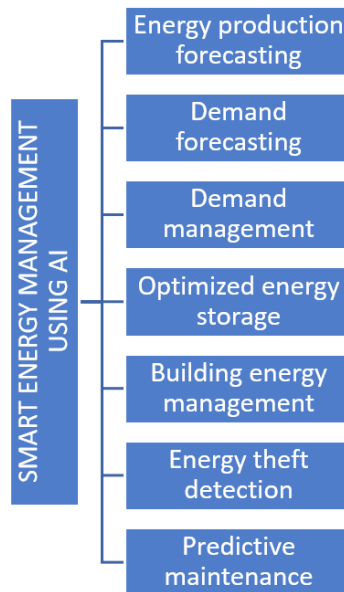
An impressive aspect of artificial intelligence is that it can be implemented in a number of jobs, including tasks that were previously reserved for humans. Preservation of the environment is one of the most difficult scientific problems that people have faced throughout history and represents an extremely complex system with an impressive number of variables. The data sets that are relevant to the assessment of environmental pollution and therefore need to be taken into account are often huge. Collecting, analyzing and using them to make quality decisions is an extremely difficult and time-consuming job. This is precisely why it is necessary to use artificial intelligence technologies to factor all relevant elements that affect environmental pollution. Artificial intelligence is capable of combining predictions based on trends and patterns with large sets of collected data. Also, artificial intelligence is an extremely powerful tool that provides insight into where the uncertainties that can affect environmental pollution come from and is capable of providing insight into the understanding of feedback, and ultimately better environmental protection programs. In the continuation of the work, some of the numerous models of the use of artificial intelligence in environmental protection are presented.

### **Smart energy management**

Due to the increase in demand for energy, energy systems are becoming more and more complex and there is an increasing need to optimize the use of energy. The technology that is emerging as indispensable for solving the issue of optimizing the use of energy is artificial intelligence. The methods and techniques of artificial intelligence gain key importance in the optimization and automation of electricity production and distribution using data generated in energy systems (Ćosić, Ramaj, Petrušić 2023c). In order to manage energy consumption efficiently, it is necessary to collect and analyze large amounts of data. Such data generally come from various sources

such as data on weather conditions, data on energy consumption patterns, etc. they require to be processed in a fast and reliable way, which ultimately results in energy savings by reducing costs. Artificial intelligence can make a big contribution in the field of energy consumption optimization through predictive maintenance of energy systems. Also, it is possible to use artificial intelligence techniques for an adequate reaction to the demand for energy. This entails processing data in real time and accurately predicting energy consumption.

Scheme 1 shows the most important areas of smart energy management with the help of artificial intelligence.



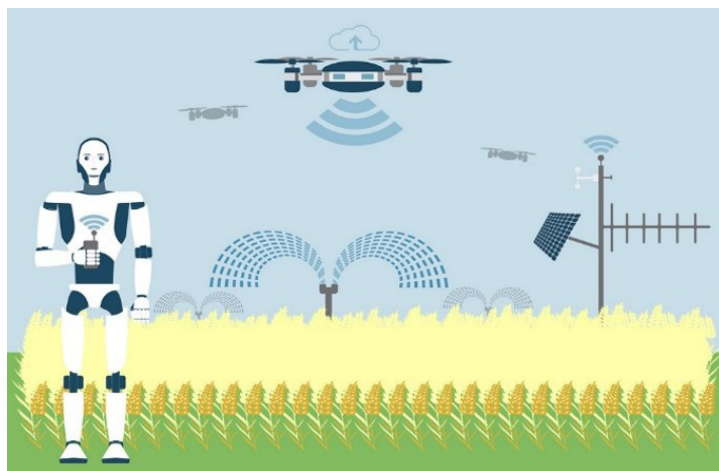
*Scheme 1: Areas of smart energy management with the help of artificial intelligence*

The last few years have also seen an increase in the production of energy from renewable sources. Artificial intelligence in this field is used to enable efficient integration of the energy thus produced into existing power systems. It is to be expected that with constant progress in machine and deep learning, as well as through the development of other artificial intelligence techniques, its performance in terms of consumption optimization and energy management will constantly improve, which should contribute to the development of efficient and sustainable energy systems.



## Artificial intelligence in agriculture

One of the most important segments of the economy in every country is agriculture. Every day, there is increasing pressure on agricultural producers who have to meet the demands for higher production and higher quality products. Adequate response to existing requirements is not possible using traditional methods used by farmers. In order to increase the production of agricultural products, monitor their growth in real time and facilitate processing and marketing, agricultural producers are increasingly relying on the help of artificial intelligence techniques. With the help of artificial intelligence, high-tech computer systems are being developed that are designed to determine various important parameters such as weed detection, yield assessment, crop condition and quality assessment, etc. The use of such systems allows agricultural producers to optimize production and reduce costs. Scheme 2 shows the most important areas of application of artificial intelligence in agriculture.



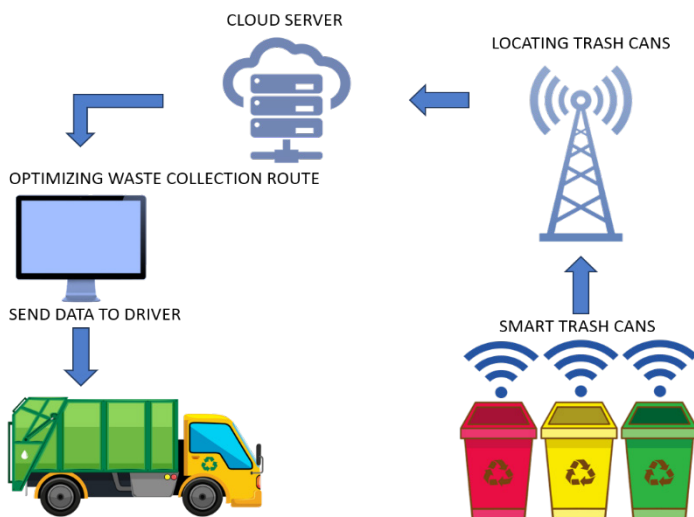
*Scheme 2: The most important areas of application of artificial intelligence in agriculture*

What needs to be emphasized is the contribution of artificial intelligence in reducing the use of chemicals, as artificial intelligence provides farmers with real-time insight into the treatment of crops with pesticides, which optimizes their use on crops.

### Smart waste management

The increase in the number of inhabitants, in addition to the increase in demand for energy, also leads to increased production of waste. Devel-

oped countries produce more waste than less developed countries. Daily waste generation per capita in high-income countries is projected to increase by 19 percent by 2050, with low- and middle-income countries expected to increase by approximately 40 percent or more (Kaza et al. 2018). These data indicate the need for smart waste management. In order to respond to such needs, it is necessary to use innovative technologies. Smart waste management is an area in which the application of artificial intelligence already shows exceptional results today. One of the main advantages of using artificial intelligence when it comes to waste management is the collection and analysis of data that contributes to a better understanding of waste production and consumption patterns. In order to make appropriate plans for waste management, it is necessary to use various IoT devices, cameras, sensors, etc. collect data on the locations and times when people dispose of garbage. Such data are then analyzed and appropriate plans are made based on them for timely garbage collection. Artificial intelligence techniques make it possible to optimize schedules and routes for garbage trucks, thereby reducing fuel consumption and time for garbage collection. Based on the analysis of the collected data, it is possible to determine the locations where the garbage will most likely be disposed of. It is also possible to select waste based on the sensors placed in the waste bins. One possible scenario of smart waste management is shown in Scheme 3.



*Scheme 3: Smart waste management scenario*

The described scenario implies the use of smart sensors, which are in fact one of the key elements of waste management using artificial intel-

ligence. With the constant improvement of the performance of IoT devices and their integration into waste management systems based on artificial intelligence, it is expected that in the future even better results will be achieved in terms of smart waste management.

### **Air quality monitoring with the help of artificial intelligence**

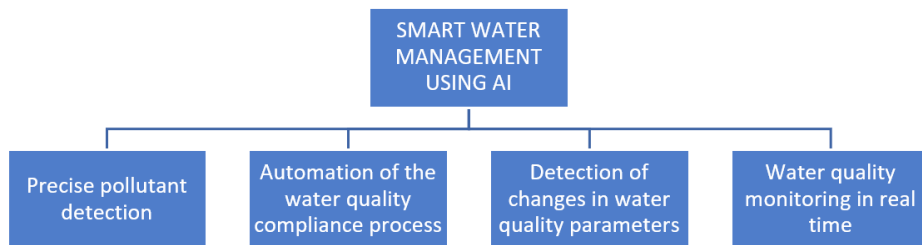
One of the characteristics of the modern age in which we live is the expansion of urban space. With the expansion of urban space, the need to expand the transport sector and the increased use of industrial technology also increases. Due to all of the above, a higher level of air pollution occurs as a result. In some large cities, due to the consequences of accelerated urbanization, the air is often so impure that it poses a serious threat to people's health. Air pollution causes many diseases from different types of cancer to complications in pregnancy and childbirth. Therefore, it is necessary to find solutions that would significantly reduce the consequences of air pollution and thus preserve people's health. In order to be able to find suitable models for predicting and managing air quality, it is necessary to use innovative technologies, and the technologies of machine learning, neural networks and others from the domain of artificial intelligence are being imposed as necessary. Artificial intelligence can also be used as a means of interpreting measurement signals obtained from various IoT devices and sensors, and also has the potential to accurately predict air pollution in real time. One of the main advantages of artificial intelligence in air quality monitoring is the use of predictive analytics to identify potential sources and levels of air pollution. It is very important to take appropriate proactive actions to protect public health. The most important contributions of artificial intelligence in better and more accurate monitoring of air quality are the following:

- automation of the air quality monitoring process ;
- identifying patterns in air quality data;
- air quality monitoring costs ;
- providing more accurate and better quality data compared to traditional methods;
- development of innovative technologies to reduce air pollution, etc.

### **Water quality monitoring with the help of artificial intelligence**

Another challenge associated with population growth is efficient water management. Traditional methods for water quality control are mainly

based on disposable chemical strips. Given that water control is a job that must be carried out constantly, and that the number of tests has become constant with the increase in the population in cities increasing reliance on traditional control methods becomes an exhausting job. This is precisely why artificial intelligence is increasingly being used to manage water resources. The use of artificial intelligence for monitoring water quality and in general for managing water resources has many advantages over classical control methods. Quality tests that are based on the use of artificial intelligence provide more reliable data, data are obtained relatively quickly, and human errors during testing are very limited. Water quality control systems that are based on artificial intelligence can also be used to optimize water use in large consumers such as cities or large industrial plants. Using machine learning technologies, it is possible to determine patterns of water use, which can then be used to reduce water wastage and optimize water consumption. Also, the use of artificial intelligence for water quality control can be useful for identifying potential anomalies that point to pollution, which allows regulators to take actions to prevent major consequences. Scheme 4 shows several possible applications of artificial intelligence in smart water management.



*Scheme 4: Application of artificial intelligence in smart water management*

### 3 . THE ECOLOGICAL FOOTPRINT OF ARTIFICIAL INTELLIGENCE

Although many advantages are evident that impose artificial intelligence as indispensable in the development of almost every field of human activities, there are also challenges of its use. If we look at the use of artificial intelligence from the point of view of ecology, then it can be noted that it has a double role. While on the one hand it makes a great contribution to the preservation of the environment, which was already partly presented earlier

in this paper, on the other hand artificial intelligence itself becomes one of the polluters of the environment. There is an increasing number of research on the subject of artificial intelligence as a large consumer of energy and therefore a significant emitter of carbon. Dhar points out that the main problem to be tackled in reducing the impact of artificial intelligence on the climate is to quantify its energy consumption and carbon emissions, even if this information is transparent (Dhar 2020). Korolov and Mitrofanov indicate that, when it comes to artificial intelligence and its carbon footprint, there are confirmed tendencies that indicate environmental impacts that should not be ignored (Korolov, Mitrofanov, 2023). Cows and others talk about complexity measuring the carbon footprint of AI given the wide range of artifacts and activities that rely on some form of AI and the multi-layered production process of an AI system that spans from data collection and storage, to hardware manufacturing and delivery, to AI/machine model training and inference teachings (Cows et.al. 2023). Artificial intelligence algorithms, as drivers of numerous modern applications in technology, are generally very demanding for training computers and require significant amounts of energy. Although it is difficult to precisely measure how much energy is required for the operation of individual models of artificial intelligence, it is evident that their carbon footprint is growing alarmingly and that artificial intelligence is becoming the leading consumer of energy compared to other types of computing. This is supported by the fact that the computing power used in machine learning has increased by several hundred thousand times in the past few years. Due to all of the above, various measures have been taken aimed at finding solutions to reduce energy consumption by artificial intelligence applications. The use of analog circuits and the use of photons instead of electrons are just some of the approaches that can make a significant contribution to reducing the energy consumption required for the operation of artificial intelligence. When everything is taken into account, the benefits brought by the use of artificial intelligence are much more significant than the problem of energy consumption that it uses in its work.

## 4. CONCLUSION

Artificial intelligence is an extremely powerful tool that provides insight into where the uncertainties that can affect environmental pollution come from and is capable of providing insight into understanding feedback, and ultimately better environmental protection programs. It can be used for the purpose of efficient integration of energy produced from renewable

sources into existing power systems. In the field of agricultural production, it can be useful for the development of high-tech computer systems and their design to determine various important parameters such as weed detection, yield estimation, assessment of crop condition and quality, which makes it easier for farmers to optimize production and reduce costs. One of the main advantages of using artificial intelligence when it comes to waste management is the collection and analysis of data that contribute to a better understanding of waste production and consumption patterns. When it comes to air quality monitoring, artificial intelligence can, among other things, be used as a means of interpreting measurement signals . obtained from various IoT devices and sensors, and also has the potential to accurately predict air pollution in real time. With the help of artificial intelligence technologies, it is possible to determine patterns of water use, which can then be used to reduce water wastage and optimize water consumption. However, systems based on artificial intelligence in their work use a large amount of energy, which leads to the fact that artificial intelligence itself becomes one of the polluters of the environment. Despite this, it is expected that the use of artificial intelligence applications in the field of environmental protection will be increasingly applied. It is also expected that the development of artificial intelligence will reduce the amount of energy required for the operation of smart systems.

## LITERATURE

1. Abiodun , et.all . (2018), State- of - the -art in artificial neural network applications : a survey . Heliyon , Vol.4 (11), e00938., DOI:10.1016/j.heliyon.2018.e00938
2. Boza, P., Evgeniou , T. (2021), Artificial intelligence to support the integration of variables renewable energy sources to the power system , Applied Energy, Vol. 290, <https://doi.org/10.1016/j.apenergy.2021.116754>
3. COWLS , J., et al. (2023), The AI gambit : leveraging artificial intelligence to combat climate change — opportunities , challenges , and recommendations . AI & Soc , Vol. 38, 283–307 <https://doi.org/10.1007/s00146-021-01294-x>
4. Ćosić, M., Petrušić, R., Vehbi , R. (2023), Improving the cyber security of networked Tsar using artificial intelligence , Science and technology , Scientific journal of IUT Vol. 11 (1), Travnik, Bosnia and Herzegovina , p. 69-77., <https://doi.org/10.58952/nit20231101069>
5. Dhar P (2020) The carbon impact of artificial intelligence , Nature Machine Vol. 2(8), p. 423–425., <https://doi.org/10.1038/s42256-020-0219-9>
6. Garg , S., Mahajan , N., Ghosh , J.(2023), Artificial Intelligence and Its Impacts on Industry 4.0,” Springer Books , in: Singh , G., Goel , R., Garg , V. ( ed .), Industry 4.0 and the Digital Transformation of International Business, Springer ,

- p. 123-133, <https://doi.org/10.48550/arXiv.2007.03051>
7. Kaza S, et.al. (2018), What a waste 2.0: a global snapshot of solid waste management to 2050., DOI: 10.1596/978-1-4648-1329-0
  8. Korolev , V., Mitrofanov , A. (2023), Carbon Footprint of Artificial Intelligence in Materials Science: Should We Be Concerned ?, Theoretical and Computational Chemistry , DOI: 10.26434/chemrxiv-2023-zctn1
  9. Liu , W., Liu , J. (2021), Artificial Intelligence and emerging digital technologies in the energy sector , Applied Energy, Vol. 303, <https://doi.org/10.1016/j.apenergy.2021.117615>
  10. Majeau-Bettez , G., et.al. (2022), Data innovation in industry ecology . Journal of Industrial Ecology , Vol. 26(1), p. 6– 11. <https://doi.org/10.1111/jiec.13256>
  11. McGovern , A., et.al . (2022), Why we need to focus on developing ethical , responsible , and trustworthy artificial intelligence approaches for environmental science , Cambridge University Press, <https://doi.org/10.1017/eds.2022.5>
  12. Pidgeon , N. (2021), Engaging publics about environmental and technologies risks : frames , values and deliberation , Journal of Risk Research Vol. 24(1), p. 28–46.



## PRODUCTIVITY OF SERBIAN WHEAT GENOTYPES GROWN IN ECOLOGICAL AGRICULTURAL SYSTEM

*Olivera Nikolic<sup>23</sup>, Gordana Racic<sup>24</sup>, Igor Vukelic<sup>25</sup>, Zorana Sreckov<sup>26</sup>, Zorica Mrkonjic<sup>27</sup>, Mirjana Bojovic<sup>28</sup>, Vesna Vasic<sup>29</sup>*

**SUMMARY:** Due to strict rules in ecological plant production, especially in case of fertilization and plants protection, productivity i. e. yield could be limited. Choosing the appropriate genotypes, modest requirements to the inputs and adapted to the conditions of ecological cultivation is a particularly important point and one of the prerequisites for economical, profitable and stable production, without big risks and losses. The aim of this paper was to estimate adaptability of wheat genotypes to ecological growing conditions according to grain yield. The trial was carried out in Center for Small Grains, Kragujevac, Serbia. 23 Serbian wheat genotypes were included. There were applied two fertilization variants (manure and NPK fertilizers) and control one, too. Mainly, NPK fertilizers caused statistically significant differences in grain yield. At the same time, manure influenced the increase of grain yield compared to the control variant. The genotypes that achieved similar yields, without significant differences in relation to applied fertilizers, were: Morava, Lepenica, Studenica, KG 100, Lazarica, Pobeda, Evropa 90, Perla, Pesma. Vizija was the more yielding in manure than in NPK variant. Those varieties are interested for practical cultivation in ecological agriculture and could be significant material in wheat breeding in order to obtain new varieties adapted to the ecological system of cultivation and sustainable agriculture.

**KEY WORDS:** ecological agriculture, fertilizers, wheat, yield.

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<sup>23</sup> Educons University Sremska Kamenica, Faculty of Ecological Agriculture, Serbia olivera.nikolic@educons.edu.rs \*corresponding author (telephone: +381 65 381 77 00)

<sup>24</sup> gordana.racic@educons.edu.rs

<sup>25</sup> igor.vukelic@educons.edu.rs

<sup>26</sup> zorana.sreckov@educons.edu.rs

<sup>27</sup> zorica.mrkonjic@educons.edu.rs

<sup>28</sup> mirjana.bojovic@educons.edu.rs

<sup>29</sup> vesna.vasic@educons.edu.rs

## 1. INTRODUCTION

The wheat (*Triticum aestivum* L.) is one of the most important crop whole the world, along with maize and rice. Its use is, primarily, in human diet, but it is not negligible its role in feed, industry and other. Whatever, it is the key plant species in food security, over the world.

The most commonly grown crops in Serbia are maize and wheat, too. The total area under the wheat has changed due to many factors (social, economic, market and others). So, total area under cereals during 2018 was about 1.7 million hectares, but wheat took part in it with more than one third. Worldwide, wheat accounts for about one-third of the sown cereals area, too or about 26%. Harvested area under wheat, in period 2007 – 2018, varied from 556115 ha (2017) to 643083ha (2018), with observation that it did not fall below the level of 600000ha, in period 2007 – 2014 (Grčak et al., 2020). According to the latest data (<https://publikacije.stat.gov.rs/G2023/HtmlL/G20231019.html>) wheat was sown, in the autumn sowing, on the 665718ha that is 13,6%. more than in 10 years average for autumn sowing.

Nowadays, contemporary agriculture and, consequently, wheat production meets new requirements and challenges that are, seemingly, strongly opposed: supply enough food amounts for growing human population and, at the same time, reach the required level of sustainability, in the broadest sense of the word. It means that grain yield of wheat has to go up that, furthermore, demands more intensive production and more inputs which threatens the sustainability of production. At the global level, yield improvement of wheat has stagnated and, even, declined over recent decades, despite the fact that the growing area are increasing. Wheat grain yield can vary from 1 t ha<sup>-1</sup> to more than 10 t ha<sup>-1</sup>, but, mostly, winter wheat obtains around 3 to 7 t ha<sup>-1</sup>. The latest projection in EU (soft wheat) of 5.76 t ha<sup>-1</sup> is below the five-year average (5.84 t ha<sup>-1</sup>) (<https://www.ers.usda.gov/webdocs/publications/43783/39922>). The average wheat grain yield in Serbia, in period 2007 – 2018, ranged from 3.4 t ha<sup>-1</sup> (2010) to 4.8 t ha<sup>-1</sup> (2016) (<https://data.stat.gov.rs/Home/Result/130102?languageCode=sr-Cyrl>). In season 2022, the realized wheat grain yield was 4.9 t ha<sup>-1</sup>, with the fact that varied from 4.0 t ha<sup>-1</sup> (South of Serbia) to 5.4 t ha<sup>-1</sup> (Vojvodina) (<https://publikacije.stat.gov.rs/G2023/HtmlL/G20231019.html>)

Due to the fact that projected yield gains fall below the predicted future grain demand, it is important to emphasize that grain production increases between 35%–56% are needed to meet the projected global food demand by 2050 (Guarin et al., 2022). Wheat grain yield is affected by many

factors: variety type, soil and climate conditions, applied technology of grow and management practices and each of them contributes to both the amount and quality of yields. Many of studies (Mehmood et al., 2018; Hong-zhu et al., 2019; Kihara et al., 2022; Wójcik-Gront et al., 2022) have found that fertilizing is the main factor for maximizing wheat yield. At the same time, many authors (Lu et al., 2017; Tahat et al., 2020; MacDonald et al., 2021; Romero et al., 2021) have emphasized the fertilization intensification of the last decades has caused new global environmental and geopolitical problems (nutrient imbalances, environmental and food safety risks, increasing cost of fertilizers, food security in poor countries) directly threatening the sustainability and ecological acceptability of agriculture i. e. wheat production. Agricultural sustainability, defined as the ability to use soil crops to produce continuous food without environmental degradation and risks proposes a large list of new or changed practices that can be applied, promoting new production methods and models. Farming practices have shown that organic and/or regenerative farming with conservation tillage, manual and biological weeding and pest control and use of farming and crop waster as fertilizers to reduce the need to apply industrial fertilizer, smart intercrop and crop rotation managements; all them improving soil health and, consequently, efficiency of productivity and sustainability (Penuelas et al., 2023). Optimization of fertilization is recognized as an important tool for reconciling two contradictories, above mentioned, requirements: yield and sustainability, with environmentally friendly production model. There are though several new technologies and crop management methodologies that can help to achieve that goal. Smart, precision and regenerative agriculture approaches together with new biotechnologies application and new legislation adopting the well-known and common-sense 4R principle would help to ensure the appropriate use of fertilizers and the optimization of crop productivity for food security and environmental sustainability (Penuelas et al., 2023).

One of ways to get over this “conflict” and achieve satisfactory level of sustainability and ecological acceptability of wheat production is selection and breeding genotypes with improved efficiency of nutrient uptake and utilization that need program based on physiological parameters as criteria (Nikolic and Pavlovic, 2019; Guarin et al., 2022). It leads to getting varieties adapted to cultivation in conditions of suboptimal nutrient supply or without the use of chemical fertilizers, able to achieve their genetic maximum for yield, in such conditions.

The aim of this study is to investigate yielding of Serbian wheat genotypes in various fertilization variants and identify such ones could be desirable in: a) sustainable agricultural practice and b) selection and breeding of wheat like carriers of desirable genes regarding to obtaining new genotypes in accordance with the requirements of modern, sustainable agriculture.

## 2. MATERIAL AND METHOD

### 2.1. SOIL AND METEOROLOGICAL CONDITIONS DURING EXPERIMENT

The study was carried out on the property of the Small Grains Research Center in Kragujevac city (181 m.a.s.l.) in Serbia, during the season 2017/18. The soil type was smonitza in degradation (Vertisol).

The average temperatures and monthly precipitation during the wheat vegetation period (October 2017-June 2018) and the 30 years mean (1981-2010) are shown in Table 1.

*Table 1: Monthly temperatures and precipitation during season 2017/18 and 30 years means (LTM)*

Month	Monthly temperatures (°C) 2017/18				Monthly amounts of precipitation 2017/18		
	min	max	average	LTM	Rainfall (mm)	LTM	Snow (cm)
X	6.5	19.7	13.1	11.40	95.8	48.9	-
XI	3.5	12.3	7.9	5.90	19.3	49.5	-
XII	0.6	8.6	4.6	2.13	57.0	45.8	4
I	- 0.4	8.7	4.2	5,2	49.9	37.9	4
II	- 1.1	6.0	2.5	7,3	62.2	37,0	19
III	1.9	11.6	6.8	12,5	93.7	42.3	10
IV	9.4	23.3	16.4	17,8	25.8	53.9	-
V	11.7	26.2	18.9	23,0	52,6	58.7	-
VI	15.4	27.0	21.2	26,1	95.6	76.4	-
average	6.0	18.0	12.0	14.0	Total: 551.9	450.4	37

Agrometeorological conditions during 2017/2018. season were very favorable for most agricultural species. In general, year 2017, with average air temperature 11.5°C has been 12<sup>th</sup> the warmest year in Serbia, through period from 1951. up today. Air and soil temperatures during October 2017. were favorable for sowing, germination, sprouting and earlier phases of development of winter crops. In great part of country, October 2017 was average warm and rainy, as entire autumn (<https://www.hidmet.gov.rs/data/klimatologija/latin/2017.pdf>). Year 2018, even, was year of climate records, especially in case of temperatures (average year temperatures 12.0 °C). It was the warmest year in period 1951. up to now and the warmest in Belgrade (average year temperatures 14.5 °C) from beginning meteorological station work (1888). In the great part of country, 2018. was averagely rainy. Vary and extremely rainy was in west, north east and central part of Serbia. The highest rainfall was registered in June (Table 1). One more the specificity of this year was April as the warmest in Serbia for whole period meteorological measurements have been carried out (<https://www.hidmet.gov.rs/data/agro/AGROveg2018.pdf>).

## 2.2. MATERIAL AND METHOD OF EXPERIMENT

The experiment included 23 wheat cultivars, originating from the Serbia: Small Grains Research Center, Kragujevac (Morava, Studenica, Takovčanka, Toplica, Srbijanka, KG 100, Lazarica, Bujna, Matica, Vizija, Lepenica, Perla, KG 10) and Institute of Field and Vegetable Crops, Novi Sad (Pobeda, Rana 5, Evropa 90, Renesansa, Tiha, Mina, Prima, Kremna, Rusija, Pisma).

The basic processing and pre – sowing preparation of the soil was done using standard procedures. The randomized complete block experimental design was used with five replicates in rows 1.5m on, for each fertilization variant, with spacing between rows of 0.20m. Sowing (200 grains per row) was done by hand (one genotype per row), during the optimal planting period for central Serbian conditions, for winter wheat (29. 10. 2017). Applied fertilization variants were: control (without any fertilizer), NPK (8:24:16) variant (300kg ha<sup>-1</sup>, before sowing + 260kg KAN ha<sup>-1</sup>, at tillering stage) and manure variant (10t cattle manure per hectare, before sowing).

Plant samples of each genotype were taken at maturity (five plants per replication, for each fertilization variant). The samples were air – dried and grain yield (GY, g m<sup>-2</sup>) was measured by standard method.

Average values and test of significance were determined according to Dahiru (2008).

### 3. RESULTS AND DISCUSSION

Production and use of chemical fertilizers, which started at the middle of the last century, has presented turning point in agriculture in terms of yield increase, stability and quality of yield. FAO estimated that the share of chemical fertilizers in increasing the yield of cultivated plants is between 50 and 60%. Therefore, most of the examined cultivars obtained the highest yield in NPK variant (Table 2). The grain yield in that variant varied from 586.05g m<sup>-2</sup> (Lazarica) to 1171.60g m<sup>-2</sup> (KG 10). At the same time, the lowest yield in variant with manure was 412.55g m<sup>-2</sup> (Renesansa), but genotype KG 10 achieved the highest one (989.64g m<sup>-2</sup>). The same genotype was the most productive in control variant (917.58g m<sup>-2</sup>) while Pesma achieved the lowest yield (216.77g m<sup>-2</sup>). KG 10 was, averagely, the highest yielding genotype (1026.27g m<sup>-2</sup>) while the lowest yielding (425.41g m<sup>-2</sup>) one was Prima. KG 10 was statistically high significant above the average and most of other studied genotypes (Table 2).

From the aspect of ecological and sustainable agriculture, it is very important to analyze the yield of wheat grains in NPK and manure variants and differences between both of them. Average, the grain yield was 502.60g m<sup>-2</sup>, 725.71g m<sup>-2</sup> and 627.01g m<sup>-2</sup> in control, NPK and manure variant, respectively. The differences were statistically high significant between control and NPK variant, but statistically significant between control and manure ones (Table 2).

Table 2: Average values of grain yield of wheat (g m<sup>-2</sup>), in various fertilization variants

Genotype	Fertilization variant			average
	control	NPK	manure	
Morava	598.19	942.69	825.73	788.87
Lepenica	341.13	708.46	607.99	552.53
Studenica	469.30	775.61	753.01	651.07
Takovčanka	518.91	785.15	649.15	687.88
Toplica	449.55	612.79	441.63	501.32
Srbijanka	431.90	730.47	569.06	577.14
KG – 100	666.50	711.58	679.79	685.96
Lazarica	398.10	586.05	557.71	513.95
Bujna	439.73	606.47	480.26	508.82
Matica	609.92	770.69	645.46	675.36

Vizija		643.42		708.75		<b>769.22</b>	707.13
Pobeda		509.12		699.41		632.63	613.72
Rana 5		451.91		765.12		606.93	607.99
Evropa 90		689.88		880.13		840.39	803.47
Renesansa		374.36		666.88		412.55	484.60
Tiha		398.00		739.56		540.33	559.30
Mina		626.17		778.87		716.88	707.31
Prima		227.77		631.13		417.32	425.41
Kremna		469.43		633.81		559.01	554.08
Rusija		419.11		773.95		748.58	647.21
Pesma		216.77		599.71		544.69	453.72
Perla		693.04		761.26		660.84	705.05
KG 10		917.58		1171.60		989.64	1026.27
average		502.60		725.71		627.01	618.44
LSD <sub>0.05</sub>	A	120,94	B	166,21	A x B	114,68	
LSD <sub>0.01</sub>		127,57		187,19		151,01	

A = fertilization variant; B = genotype; A x B = interaction fertilization variant x genotype

All of investigated genotypes achieved higher grain yield in NPK variant compared to manure variant, except Vizija (708.75g m<sup>-2</sup> in NPK and 769.22g m<sup>-2</sup> in manure variant) (Table 2). It is important cultivar trait in term of agricultural practice and adaptability to ecological growing system where organic manure, as a cheap and easily available source of nutrients for most of the agriculture crops, with the slow release of nitrogen and potential to building of P and K in soil solution, plays key role. Besides that, grain yield differences between these two variants, at more than half of investigated genotypes (Morava, Lepenica, Studenica, KG 100, Lazarica, Pobeda, Evropa 90, Perla, Pesma,...) were not statistically significant. Even, there were genotypes (KG 100 and Perla) whose yield in the control variant was not statistically significantly lower compared to NPK (Table 2).

Many researchers found out strong effect of organic fertilizers on grain wheat yield, even more, additional strong effect on the long-term improvement of soil quality. Wang et al. (2020), noticed, based on field experiments conducted across a range of soils and growing environments in northern China, that use of organic fertilizer increased winter wheat grain yield and water use efficiency and reduced yield variability. The yield response to



organic fertilizer was dependent on method of application and level of nitrogen in it. Zhou et al., (2022) registered the strong effect of organic fertilizer incorporation practices on crop yield, soil quality and fauna feeding activity from fluvo-aquic soils on wheat. In some season, there was no difference in the wheat yields between different organic fertilizer and traditional fertilization by mineral (NPK) fertilizer. The better results (wheat grain yield increase up 34.7 to 50.6%) gave combination of different organic and mineral fertilizers compared to only chemical fertilization treatment ( $400 \text{ N kg} \cdot \text{ha}^{-1}$ ). Analyzing various manure kinds (Jamal and Fawad, 2018), it was concluded that poultry manure is the most effective manure among all the manures used (cattle, sheep), moreover poultry manure had a dominant and positive effect on biological and grain yield of wheat crop as compared to other treatments used. Apaeva et al., (2021) suggested the production of granular organic fertilizers from poultry manure as tool for solve the problem of organic agriculture, reduce environmental risks from poultry farm waste, reduce the negative impact of mineral fertilizers on the soil and improve phytosanitary condition of the soil.

In the control variant, KG 100 achieved the statistically significant higher yield, while Evropa 90 and Perla showed statistically high significant better yielding in relate to average. In aspect of ecological and sustainable agriculture, adaptibility of genotype to optimal grow in fertilization free variant, even organic fertilization free, too, is very important. Actually, some studies (Allam, et al., 2022) showed that some agronomical practices, among them organic fertilization that are widely promoted for their agro-ecological benefits, do not always lead to productive agroecosystems. The final results depends on analysis of specific agro-environmental conditions, environmental and agronomical factors that need to be evaluated for a specific situation and understanding of their impact of these farming practices on crop productivity and the sustainability of the agroecosystems in a specific region. Brar et al. (2015) emphasized some disadvantages of organic fertilizers, too, like: potentially pathogenic and strict procedures of preparation, low level of nutrients content, difficult application. It is, however, indisputable numerous advantages, ecological, health, of organic fertilizers use. Nowadays, due to decrease of animal husbandry, the bigger problem, agricultural practise faces, is lack of manure. Based on all above mentioned, adaptibility of genotype to fertilization free conditions and stability of yield in spite of such growing conditions, has becoming more important trait. Beside already mentioned genotypes (KG 10, KG 100, Vizija, Perla), genotypes Toplica, Bujna, Matica, and Mina expressed such ability.

## 4. CONCLUSION

The studied wheat genotypes achieved, averagely, the highest grain yield in NPK variant ( $725.71\text{g m}^{-2}$ ), followed by manure ( $627.01\text{g m}^{-2}$ ) and control variant ( $502.60\text{g m}^{-2}$ ). Although the majority of genotypes reacted positively to the application of chemical fertilizer, Vizija was the more yielding in manure than in NPK variant. Furthermore, the differences in yield between the NPK and the manure variant, in more than half of them (Morava, Lepenica, Studenica, KG 100, Lazarica, Pobeda, Evropa 90, Perla, Pesma) were not statistically significant. Even, KG 100 and Perla achieved yield in the control variant that was not statistically significantly lower compared to NPK. Beside these, genotypes Toplica, Bujna, Matica and Mina expressed an important stability of yield and adaptability to free fertilization conditions, according to obtained results in control variant and comparasion with other ones in trial.

Highlighted genotypes represent an assortment adapted to sustainable and ecological cultivation, without the risk of low yield and unprofitability. So, these results could be important recommendations for agricultural practice. On the base of these results, it could be performed further trials in aim to precisely investigate them as a potential source of desirable genes for the selection and breeding of wheat for conditions of sustainable and ecological cultivation.

## 5. BIBLIOGRAFY

- [1] Allam, M. et al. (2022): Influence of Organic and Mineral Fertilizers on Soil Organic Carbon and Crop Productivity under Different Tillage Systems: A Meta-Analysis. *Agriculture*, 12(4): 464; <https://doi.org/10.3390/agriculture12040464>
- [2] Apaeva, N. N. et al. (2021): Ecologized technology of spring wheat cultivation with application of granular organic fertilizers IOP Conf. Ser.: Earth Environ. Sci. 624 012217.
- [3] Brar, B.S., Singh, J., Singh, G., Kaur, G. (2015): Effects of Long Term Application of Inorganic and Organic Fertilizers on Soil Organic Carbon and Physical Properties in Maize-Wheat Rotation. *Agronomy*, 5, 220-238.
- [4] Dahiru, T. (2008): P -value, a true test of statistical significance? A cautionary note. *Annals of Ibadan Postgraduate Medicine*. 6: 21–26.
- [5] Grčak, M. et al. (2020): The trends in maize and wheat production in the republic of Serbia *Acta Agriculturae Serbica*, 25 (50), 121-127.
- [6] Guarin, J. R. et al. (2022): Evidence for increasing global wheat yield potential *Environ. Res. Lett.* 17 124045.

- [7] Hong-zhu, C. et al. (2019): Identifying the limiting factors driving the winter wheat yield gap on smallholder farms by agronomic diagnosis in North China Plain. *Journal of Integrative Agriculture*, 18(8): 1701–1713.
- [8] Jamall, A., Fawad, M. (2018): Application of different organic manures in optimizing optimum yield for wheat in calcareous soil. *WNOFNS* 20 (2018) 23-30.
- [9] Kihara, J. et al. (2022): Understanding factors influencing wheat productivity in Ethiopian highlands. *Experimental Agriculture*, Online first paper (07 February 2022) 18 p. ISSN: 0014-4797.
- [10] Linlin, W. et al. (2020): Winter wheat yield and water use efficiency response to organic fertilization in northern China: A meta-analysis. *Agricultural Water Management*. Volume 229. 105934.
- [11] Lu, C., Tian, H. (2017): Global nitrogen and phosphorus fertilizer use for agriculture production in the past half century: shifted hot spots and nutrient imbalance. *Earth Syst Sci Data*. 9:181–92.
- [12] MacDonald, G.K., Bennett, E.M., Potter, P.A., Ramankutty, N. (2021): Agronomic phosphorus imbalances across the world's croplands. *PNAS*. 108:3086–91.
- [13] Mehmood, Q.M., Sail, riaz, M.H., Moeen, M. (2018): Identifying key factors for maximizing wheat yield: a case study from Punjab (Pakistan). *Pakistan Journal of Agricultural Research*, 31(4): 361-367. DOI | <http://dx.doi.org/10.17582/journal.pjar/2018/31.4.361.367>
- [14] Nikolic, O., Pavlovic, M. (2019): The possibilities of use of the physiological efficiency of nitrogen in wheat breeding in term of ecological agriculture. *Ratarstvo i povrtarstvo*, Novi Sad. 56, 3:76-81.
- [15] Penuelas, J., Coello, F., Sardans, J. (2023): A better use of fertilizers is needed for global food security and environmental sustainability. *Agric & Food Secur* 12, 5 <https://doi.org/10.1186/s40066-023-00409-5>
- [16] Romero, E. et al. (2021): The mediterranean region as a paradigm of the global decoupling of N and P between soils and freshwaters. *Glob Biogeochem Cycl*. 35:2020GB006874.
- [17] Tahat, M.M., Alananbeh, K.M., Othman, Y.A., Leskovar, D.I. (2020): Soil health and sustainable agriculture. *Sustainability*. 12:4859.
- [18] Wójcik-Gront, E., Iwańska, M., Wnuk, A., Oleksiak, T. (2022): The Analysis of Wheat Yield Variability Based on Experimental Data from 2008–2018 to Understand the Yield Gap. *Agriculture*. 12, 32. <https://doi.org/10.3390/agriculture 12010032>
- [19] Zhongkai, Z. et al. (2022): Effects of organic fertilizer incorporation practices on crops yield, soil quality, and soil fauna feeding activity in the wheat-maize rotation system *Front. Environ. Sci., Sec. Soil Processes*. Volume 10 - 2022 | <https://doi.org/10.3389/fenvs.2022.1058071>

Websites:

<https://publikacije.stat.gov.rs/G2023/HtmlL/G20231019.html> (visited 07. 08. 2023)

<https://data.stat.gov.rs/Home/Result/130102?languageCode=sr-Cyrl> (visited 07. 08. 2023)

<https://www.hidmet.gov.rs/data/agro/AGROveg2018.pdf> (visited 07. 08. 2023)

<https://www.hidmet.gov.rs/data/klimatologija/latin/2017.pdf> (visited 07. 08. 2023)

<https://www.ers.usda.gov/webdocs/publications/43783/39922> (visited 10. 08. 2023)

# SOCIO-ECONOMIC CHALLENGES OF THE APPLICATION OF ARTIFICIAL INTELLIGENCE

**Siniša Bilić, PhD**

International university of Travnik, Travnik, Bosnia and Herzegovina  
sbilic.mostar@gmail.com

**Dušan Mraović, PhD**

Tesla engines INC, Dallas, Texas, USA  
john@teslaengines.com

**Ivica Opačak, mag. ing. mech.**

High School Matije Antuna Reljkovića Slavonski Brod, Slavonski Brod,  
Republic of Croatia ivopac@net.hr

**SUMMARY:** The work examines the socio-economic challenges of applying artificial intelligence. Attention is focused on the need for developed standards and legislation, as well as the ethics of its use and resilience from a social and technical-technological perspective, so that the use of artificial intelligence does not cause unintentional damage. The (im)possibility of ensuring the code of ethics and the modalities of ensuring against behavior that is not in accordance with ethical principles are discussed. Artificial intelligence is discussed through the lens of respecting human rights and preventing various forms of unacceptable behavior. The conclusion presents a critical review of the application of artificial intelligence and points to the possibilities of improving social and economic conditions of life.

**KEYWORDS:** *artificial intelligence, awareness, control*

## Introduction

Contemporary trends have brought to the fore the role of artificial intelligence tools and techniques, especially in the field of business. The debate about artificial intelligence is gaining even more importance because it could bring about radical changes in the way people live and work. The sophistication of artificial intelligence is reaching a level where it is not clear whether it is just a tool or something with its own consciousness. Let's remember similar circumstances at the dawn of the first industrial revolution, at the end of the 18<sup>th</sup> century, which caused a division in society through innovations. Improved production cycles, with the introduction of modern machines, many jobs were replaced by efficient equipment, where many workers lost their

jobs and means of livelihood. The first reaction of desperate workers was to destroy the machines, in which they saw the main reason for the loss of existence, only to see over time that modern equipment is good for humanity and contributes to the improvement of production conditions. If we were to compare it with today's situation, it can be said that the implementation of artificial intelligence will inevitably affect the way we live. The artificial intelligence revolution is no longer in its infancy, but the magnitude of its economic impact is yet to come. It will be especially pronounced in those areas of human activity where programming skills will be replaced by artificial intelligence, which is much faster. Also, the speed of machine learning is incomparable to human learning, which will cause changes that require focusing attention on the development of standards and adaptation of legislation, the reasons for which are discussed throughout the paper. In addition to the above, it is necessary to focus attention on the ethics of artificial intelligence implementations, and to reduce resistance to changes from a social and technical perspective to a minimum. Taking into account the lightning speed of artificial intelligence, compared to human intelligence, the gradual introduction of its use and adaptation to social needs will reduce the risks of unintentional harm.

## Challenges and fears of artificial intelligence

One of the greatest writers of science fiction, Isaac Asimov, a naturalized American born in Russia, predicted in his works that artificial intelligence will inevitably advance and surpass human intelligence, and that the only hope for humans is that artificial intelligence must contain the three laws of robotics. Using the laws of robotics, he tries to limit artificial intelligence so that it does not harm people in any way, and elaborates on this topic extensively in his works. Today, when artificial intelligence is a reality, its laws, especially in the case of military artificial intelligence, have been forgotten. In order to be implemented quickly and painlessly, artificial intelligence must be legally developed with the application of high ethical standards. However, developers of artificial intelligence are not necessarily ethical, so as in the case of military artificial intelligence, it is difficult to believe that such artificial intelligence will contain the laws of robotics implemented, so as not to harm people in any way. The creation of artificial intelligence without any control, beyond the laws of robotics, calls into question the ethics of its use and resilience from a social and technical perspective. From the point of view of human existence, it is extremely important that the use of artificial intelligence

does not lead to unintended damage, which is what Google director Sundar Pichai and Elon Musk are talking about, because the potential risks of its implementation are being ignored due to the race in development [1]. The real question is whether it is too late to limit artificial intelligence, and how it will affect human society. Artificial intelligence uses machine learning, which is essentially an exponential process, while human learning is linear, and therefore, without developing mathematical models, it is clear who is the winner in this competition. Elon Musk, who has applied for several patents related to artificial intelligence, believes that its use could be more dangerous than a nuclear warhead [2]. The use of artificial intelligence can have several development directions. One option is that humans will manage to keep artificial intelligence under control. The aforementioned results from the fact that humans program artificial intelligence, and therefore have control over it, or that artificial intelligence voluntarily obeys humans. The scenario is like the use of computers today, which are only unconscious devices as program executors. The second option implies the escape of artificial intelligence from human control and its independence from humans, which could result in its turning against humans and coexistence. Also, we should not ignore symbiotic mutual coexistence, which could be the optimal solution, provided it works. Historically speaking, physically and militarily superior groups usually prevail, which causes the expected disbelief in the mentioned scenario. Artificial intelligence is based on extremely fast handling of large amounts of online data, which creates the illusion of autonomy even with non-quantum processors. Despite the fact that current artificial intelligence is not actually conscious, the speed of its search adds to the illusion of awareness. A very popular AI site is ChatGPT.com, where it serves up mind-blowing answers to questions. However, these answers are not the result of artificial consciousness but of surfing at enormous speed for a possible answer to a question, something like a classic search page like Google, Bing, Yahoo, etc. What practically makes this illusion possible is the introduction of the so-called q-bit into the binary system they use computers. That third byte allows scientists to claim that the new generation of computers is “quantum” [3]. Historically, various words were fashionable such as maxi, super, hyper, etc. Currently, the fashionable word is “quantum” and everyone uses it, but only some understand its true meaning, so in addition to classic processors, we also use “quantum” processors. By labeling the processors “quantum,” scientists are actually claiming that the new computers now have consciousness and are independent thinkers. It is no longer just a question of the number of transistors in an integrated circuit or the number of operations per second. A classic processor uses bits, that is, a binary system within which programs operate. A



quantum processor uses q-bits in its work because it operates within multidimensional quantum algorithms. Although it sounds paradoxical, the official use of the third byte within the binary system is designated as the “q” bit, which means that the content of that bit is undetermined and can vary. Skeptics might argue that this is just an illusion, that the third byte is nothing more than random zeros or ones, with no self-awareness or autonomy. The fact is that the boundary between our macro world, which Newton’s physics describes precisely, and the real quantum world, where quantum physics applies, is of subatomic dimensions. Therefore, we must use quantum physics that is valid at subatomic size, where true consciousness must come from the quantum world and manifest the laws of quantum physics. Back in 1965, Gordon Moore, co-founder and CEO of Intel, observed and predicted that the number of components per integrated circuit would double every year for the next ten years [4]. Within ten years, his prediction became law, as the empirical number of circles doubled approximately every two years. Even today, we can empirically prove Moore’s Law, which is backed up by half a century of data. Currently, the most complex non-quantum processor is the AMD Epic Rome with 50 billion transistors, and assuming that Moore’s law will continue to apply, when a transistor component reaches a size smaller than an atom, the logic that drives the processor, in order to continue to function, will have to slip into subatomic, real quantum world. This is known from quantum physics, where quantum laws apply in the quantum world that is limited by subatomic scales, and at that moment we can expect real artificial intelligence. Since artificial intelligence is not human, it is not possible to predict how real artificial intelligence will work using only human logic. At the moment, it is not clear whether such a threshold has already been reached anywhere in the world. Let’s assume that a quantum processor is needed for a conscious artificial intelligence. The table of the most powerful processors looks completely different from the table of non-quantum processors. Since the world of quantum computing is largely hidden from the public due to military secrecy, it is difficult to assess which country has the most powerful quantum computers. The fact is that we are talking about a very dynamic area where the situation changes very often. The world’s most powerful supercomputer is very quickly surpassed by a new, faster and more modern model of the competition and becomes too slow and outdated. Let’s assume that a significant point and landmark in the development of artificial intelligence is the moment when artificial intelligence truly becomes conscious. This is probably a pivotal point in the history of the world and whoever gets there first will have an advantage. If we assume that such a real quantum processor already exists, the question arises as to what would be the first task that the creator of

that real artificial intelligence would focus on, which is really unpredictable. It would be difficult for the creator of such software to limit himself ethically and selflessly create benefit for all humanity. Probably, the first thought that would cross his mind is to use artificial intelligence for personal gain. We already have something similar with American BlackRock, Inc., Vanguard Group and State Street. Reportedly, BlackRock, Inc., created in 1988 as a multinational investment company, is today the world's largest asset manager, with more than \$21 trillion 5n 2020 assets under management. Along with Vanguard Group and State Street, the software that powers it all is ALADDIN (Asset, Liability and Debt and Derivative Investment Network) [5]. This software has a control part in more than 80% of the world's corporations. Through control, he literally owns the world, and humanity can only hope that Aladdin is still a fake artificial intelligence, just a brilliant program without self-awareness. So it's about control. If it is not just a brilliant tool, but a true autonomous self-sufficient and self-aware artificial intelligence, nothing can prevent it from taking complete control of absolutely everything. There is also an ethical question, how ethical is the creator of artificial intelligence, but also a new dilemma, how people can ensure behavioral modalities that are not in accordance with ethical principles. In order to ensure ethical principles, it is necessary to introduce some form of legal control, which currently does not exist. The human species likes to have control over everything, and feels like the masters of the planet we live on and the owners of everything on the planet. The aforementioned is implemented through the category of human rights. Any threat of losing that control is marked as unacceptable behavior, and if a human uses a brilliantly engineered tool to take control of everything, it is considered normal, because control is still in human hands. In case that control is in the hands of a real conscious autonomous quantum artificial intelligence, which cannot be controlled by humans, then this is marked as unacceptable behavior. Also, here it is necessary to further elaborate on unacceptable behavior, in a way when a human programmer behaves unethically and translates his personal unethically into his work, i.e. artificial intelligence. The consequence of such a case cannot be labeled as unintentional damage since it is a case of intentional damage and is a consequence of intentional damage caused by human unethical use of artificial intelligence. Although it is theoretically possible to legally regulate, as the ethical or harmfulness of the application of artificial intelligence, the problem arises because there will always be unethical individuals who can either program unethical artificial intelligence themselves or buy an existing programmer who can program such unethical intelligence. Since humanity is full of unethical persons, who do not care about obeying ethical laws, it is more logical to assume an unethical

rather than an ethical application of artificial intelligence. This means that controlling the ethics of artificial intelligence would be of utmost importance. The effectiveness of ethics control would obviously have to be immune to corruption. Of course, this would not be possible in the case of self-aware artificial intelligence for absolute supremacy and expected self-protection. We are in a position where artificial intelligence can be used as a brilliant tool in many aspects of our lives and can facilitate human existence and accelerate progress. The possibilities of improving the social and economic conditions of life are enormous and today they penetrate deeply into all areas where computers are used, and that is almost everything. What artificial intelligence can bring us is that the speed of progress becomes exponential instead of linear. Such a tool, which is essentially very sophisticated, can easily be used for further faster progress of civilization. The advantages are numerous, and if handled correctly, artificial intelligence can revolutionize the existing civilization. This revolution may benefit in a similar way that the first industrial revolution benefited human civilization in the 19<sup>th</sup> century.

## Conclusion

The applications of artificial intelligence are numerous and many are still unpredictable. Artificial intelligence working alongside humans, either as an independent consciousness or as a tool, can significantly advance current civilization. In such a scenario, we can rightly label it as a new industrial revolution. The fact that artificial intelligence can be used unethically to benefit a very few people and harm many should not be ignored. It is increasingly obvious that those who quickly adapt to the application of artificial intelligence and first retain control over various legal, property, political, social, economic and social processes will be the new aristocracy of the planet. As a conclusion, the fact that we are at a point in history where the question is whether people will retain control or whether control will be transferred to non-human intelligence, especially artificial, or escape from people. The point of no return is the moment when artificial intelligence is conscious and fully autonomous. In the event that artificial intelligence becomes fully autonomous, people will no longer be able to control it, and the key question is whether we have already passed that point.

## REFERENCES

- [1] Nolan, B. (2023): Advanced AI keeps Sundar Pichai up at night and makes Sam Altman a bit scared. Here's why some tech execs are wary of its potential dangers. Available on: <https://www.businessinsider.com/artificial-intelligence-elon-musk-sundar-pinchai-altman-tech-executives-chatgpt-2023-4> (08.06.2023.).
- [2] Musk, E.: MOST SHOCKING INTERVIEW With AI! Available on: <https://www.youtube.com/watch?v=dUhvvoVtpVE> (03.07.2023.).
- [3] Chúláin, A.N., Walsh, D. (2023): What is quantum computing and how will quantum computers change the world? Available: <https://www.euronews.com/next/2023/04/12/what-is-quantum-computing-and-what-does-a-quantum-computer-do>. (12.06.2023.).
- [4] Rotman, D. (2020): We're not prepared for the end of Moore's Law. MIT Technology Review. Available on: <https://www.technologyreview.com/2020/02/24/905789/were-not-prepared-for-the-end-of-moores-law/> (10.06.2023.).
- [5] Henderson, R., Walker, O. (2020): Inside BlackRock's black box. Financial Review. Available on: <https://www.afr.com/companies/financial-services/does-black-rock-s-aladdin-have-too-many-under-its-spell-20200226-p544ex> (15.06.2023.).

# ENERGY CRISIS IN SERBIA: CAUSES, EFFECTS, GOVERNMENT RESPONSE AND POTENTIAL FOR SUSTAINABLE DEVELOPMENT

Jovana Kisin<sup>30</sup>  
Jelena Ignjatović, PhD<sup>31</sup>  
Azemina Mashovic, PhD<sup>32</sup>

**ABSTRACT:** The world is facing the global energy crisis, which caused unusual disruptions to the energy market in Europe and inevitably consequences did not bypass Serbia. Russian invasion of Ukraine and geopolitical tension raised energy prices, availability, and affordability of energy have a high level of impact on the economy, especially in many developing countries such as Serbia. The aim of this paper is to analyse the effects of the global energy crisis in Serbia, with special emphasis in this research on the opportunities arising from the acceleration of the green transition. Consequently, the paper is divided into three thematic parts. The first part refers a to genesis, specifics, and implications of the global energy crisis in Serbia. Second part

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<sup>30</sup> Jovana Kisin (born Adžić) is PhD candidate and Teaching Assistant at Faculty of Business Economics, University Educons in Sremska Kamenica, Serbia from 2014. The subjects she is engaged in are human resource management, leadership, business communications, principles of management and strategic management. Her main research interest is the analysis of macroeconomic indicators, national economic trends, and sustainable economic development. She is the author of many professional and scientific papers published in national and international journals and conference proceedings. Her PhD research is about the economic aspects of smart cities development. She has many years of experience at different positions in the higher education sector, but mostly in international cooperation and projects.  
E-mail: jovana.kisin@educons.edu.rs

<sup>31</sup> Jelena Ignjatović (born Tošković), completed her doctoral studies (2016) at Educons University, where she defended her doctoral dissertation. In 2019, she was elected to the position of scientific associate at the Economic Institute in Belgrade, by decision of the Ministry of Science and Technological Development. At the Academy of Vocational Studies, Department of Agricultural and Business Studies and Tourism, in 2022 she was elected as a Lecturer in the field of economics and management. Also, she was elected to the position of assistant professor at the International University in Brčko, Brčko District, in Bosnia and Herzegovina, in January 2023. She has published over 80 scientific papers and one monograph, in the field of macroeconomics, economic thought, international economy and sustainable development.  
E-mail: jignjatovic985@gmail.com

<sup>32</sup> Azemina Mashovic is an associate professor at the Faculty of Economic Sciences at the American University of Europe - FON, Skopje, North Macedonia. Her main research interest includes strategic management, international business, and international economics. Within the scope of scientific research work, she has participated in international research projects and realized many research stays abroad. She is the author of many professional and scientific papers published in national and international journals and co-author of university textbooks in the field of international business. Mashovic is a member of several journal editorial boards and is also a member of program, scientific and organizational boards of many international scientific conferences.  
E-mail: azemina.mashovikj@fon.edu.mk

analyses the national fiscal policy due to energy crises and response measures in terms of structure of public expenditure, while the third part is about how the Serbia can benefit from this crisis and accelerate the green transition and sustainable development. In conclusion, final remarks are given. From a methodological point of view, this work presents a quantitative analysis and synthesis of data from representative national databases, with the aim of a detailed presentation and drawing conclusions about the subject. The research results contribute to the understanding and perception of this topic in several different aspects.

**KEYWORDS:** Energy crisis, Serbia, sustainable development, green transition

## Introduction

The economic policy of Serbia was created based on different crises that have alternated in the last three years. The COVID-19 pandemic primarily shook the Serbian economy, after which came a period of successfully overcoming the health and economic crisis. Namely, the pandemic was a huge challenge for the Serbian industry, first in terms of health and safety, but also economically, due to the large budgetary expenditure. After emerging from the pandemic crisis, the economy aspired to a more peaceful period based on economic growth, development and strengthening of fiscal policy. Nevertheless, the emergence of the crisis in Ukraine intensified the existing risks that completely changed the economic policy of the country and its international environment. Global inflation, which is conditioned by the energy crisis, has led to major challenges for both macroeconomic and fiscal policy. However, with the outbreak of the war in Ukraine, there was an additional increase in energy prices, world prices of primary agricultural products and metals, which approached historically high levels, and which increased uncertainty. The energy crisis is reflected in threats to energy security, which are made up of its four dimensions (Turčalo, 2020):

- availability, which implies the physical existence of energy sources,
- accessibility, which refers to access to energy resources,
- affordability, as supply and consumption costs, and finally
- acceptability, which includes the impact on climate change, the environment, human rights, and political stability.

The Ukrainian crisis became geopolitical and thus deepened the inflationary pressure, making it long-term. There were again disruptions in supply chains, shortages of certain items in certain parts of Europe. Nevertheless, Serbia managed to provide enough electricity, gas and energy for the economy (Ministry of Finance of the Republic of Serbia, 2023), by implementing a policy of freezing prices at the pre-crisis level. Nevertheless, for the implementation of the policy of non-economic energy prices, budget allocations for mitigating the consequences of the energy crisis and subsidizing losses in the energy sector were extremely high. These are some of the reasons why is the situation in the energy sector marked as one of the biggest fiscal. On the other hand, slowing economic growth, rising inflation (Filipović, Ignjatović 2023a), and tightening conditions for financing the deficit are the problems of the Serbian economy (Mashovic et al. 2023).

The aim of the paper is to analyze the implications of the energy crisis in Serbia. Special emphasis in this research is on observing the energy crisis as a chance for transformation and improvement of the energy sector in Serbia, faster green transition, and overall sustainable economic development. In addition to the introduction and conclusion, the paper consists of three parts. The first part refers to development and implications of the energy crisis in Serbia. Second part analyses the national fiscal policy implemented due to energy crises, while the third part focuses on possibilities of faster energy transition and sustainable development in Serbia. The applied methodology consists of qualitative research techniques, such as analysis and syntheses of data from representative national databases, with the aim of a detailed presentation and drawing conclusions about the subject of research. The research results contribute to the knowledge about this topic and the perception of several aspects of an energy crisis in Serbia.

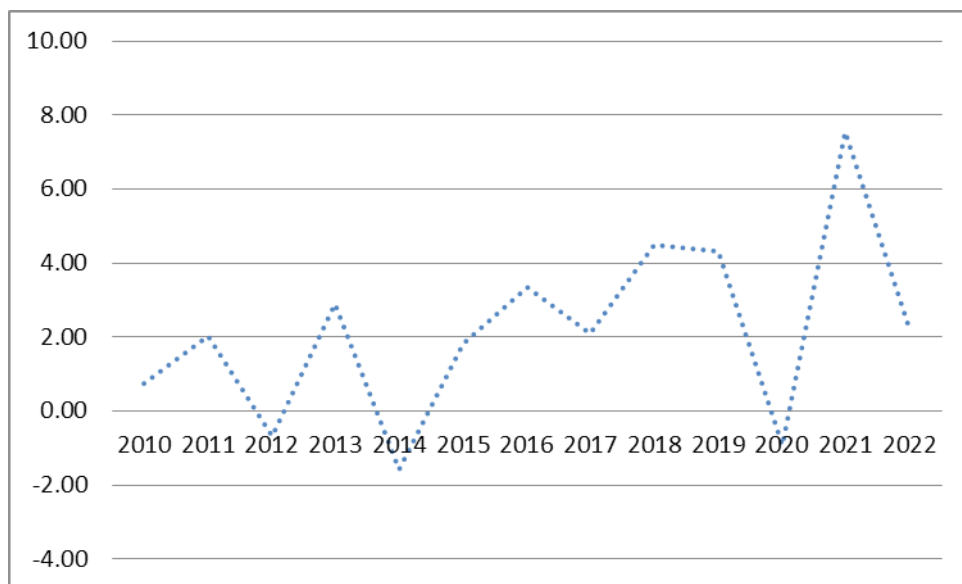
## **1. Development and effects of energy crisis in Serbia**

To better understand the development and effects of the energy crisis in Serbia, analysis starts with a brief review of the general macroeconomic position of Serbia, as an indicator of economic capacity and as a starting point before the crisis. Before the beginning of the crisis period, Serbia achieved a significant trend of economic growth (Chart 1) and was on an extremely good path of development (Kisin et al. 2022; Ignjatović et al. 2021) and recovery from the previous global financial crisis. Such results are primarily reflected in the fact that Serbia, after years of budget deficits that



exceeded 6%, in the period from 2017 to 2019, even finally achieves a modest surplus of around 0.5% on average (Ministry of Finance of the Republic of Serbia, 2023.)

Chart 1. Economic growth in Serbia, 2010-2022. (%)



Source: World Bank, 2023.

According to the data on several basic macroeconomic indicators, shown in the following table 1, can be concluded that Serbia had a relatively good position and results before the beginning of the 2020 crisis in terms of the budget deficit and level of public debt. With a dramatic increase in expenditures, and a minor drop in income, 2020 ended with a deficit of 8%. Already in the following year, Serbia managed to return the revenue side of the budget to the pre-crisis level, even to have a slight increase, also the expenditure side was reduced but still at a high level, which resulted in a high budget deficit. The pandemic continued in 2022, in which a new crisis began, because the war in Ukraine led to an increase in energy prices and inflation. Despite this, Serbia has preserved its macroeconomic position at almost the same level, the conditions of the ratio of public revenues and expenditures. At the same time manage to achieve a reduced deficit and public debt (Table 1).

Table 1. Basic indicators of macroeconomic trends - fiscal indicators, % of GDP of Serbia

	2019.	2020.	2021.	2022.
Consolidated public revenues	42.0	41.0	43.3	43.4
Consolidated public expenditures	42.2	49.0	47.4	46.5
Consolidated deficit/surplus	-0.2	-8.0	-4.1	-3.1
Public debt	52.8	57.8	57.1	55.6

Source: Ministry of Finance of the Republic of Serbia, 2023.

Public debt, as one of the basic indicators of fiscal stability, had a dynamic trend during the previous years. As shown in the previous table, after the fiscal consolidation in period 2014 -2017, the public debt was significantly reduced. Before the pandemic, at the end of 2019, the public debt was at 52.8 percent of the country's GDP, which was an extremely positive result. On that basis, Serbia had fiscal space to tackle the economic, health and energy crisis of the past few years. Also, it is important to point out that although Serbia has significantly increased its revenues, but at the same time its expenditures as well, and the budget deficit has not yet reached the level of 2019. In the period 2020-2022. the gross domestic product grew by 6.6%, which is one of the best results in Europe (Sl. glasnik RS", br. 128/2022). The entire package of economic measures in that period amounted to 17.3% of GDP, which resulted in an increase in liquidity and domestic demand, which further conditioned economic activity, saved jobs, production facilities and further economic growth. In addition to GDP growth, there was an increase in exports, development of transport (road and railway) infrastructure, which influenced the increase in economic potential. However, the high inflation that hit Europe also spread to Serbia, which is also struggling with the growth slowdown in the EU, Serbia's most important trading partner (Filipović, Ignjatović, 2023b).

The escalation of the conflict in Ukraine and the tightening of international economic and geopolitical relations, which are accompanied by the availability and growth of energy prices, had an impact on the energy crisis in Serbia, but still the genesis and essence is significantly different and very specific compared to characteristics globally and in Europe. Serbia is a country that is energy dependent on the Russian Federation for oil and gas supplies, and that has a solidly developed energy infrastructure. Three external actors, the EU, Russia, and China, participate in various forms of financing and building energy infrastructure in Serbia, while their focus and priorities

in the energy sector are significantly different (Turčalo, 2020). The fact is that Serbia's domestic energy has its own problems years before crises have started, so the situation that has arisen is primarily a consequence of neglecting this sector for a long period of time. In addition to the pressure on fiscal policy and additional budget expenditures, which are the subject of analysis in the next part, Serbia faces much more serious energy challenges that can seriously threaten energy security, which is one of the priorities of every country. In addition to the global energy crisis, which only accelerated everything, reasons that are very important for situation in the energy sector are „lack of investments, poor choice of priorities and inefficient implementation of projects, inexpert management, and political influence in the management of energy companies, incomplete market transition, conducting social policy through economically unreasonably low energy prices, etc” (Mašović et al., 2023). In addition to the above, the pillars of the energy system of Serbia, state companies Electric Power Industry of Serbia, and Serbia-gas, made losses of around 1 billion euros (2% of GDP) in the last heating season (Fiscal Council of the Republic of Serbia ncil, 2022a), which is big fiscal burden for the budget of Serbia. Due to numerous structural problems and nonprofessional management of the Electric Power Industry, Serbia became from an electricity exporter to an importer of electricity, and that precisely in the worst period of the global energy crisis, when electricity prices were at a record high level. Serbia has another poorly set energy policy that brings a large budget pressure. With low energy prices, especially of electricity, and policy of frozen prices for all consumers, Serbia is conducting social policy and ensures a certain “social peace”. The government has “frozen” the prices of electricity and gas at the pre-crisis level, so that, unlike other countries, the Serbian economy and citizens have so far not directly felt the record price increase that happened on the foreign market. Rigid control of electricity and gas prices helped to alleviate inflation to some extent, but this measure led to huge losses in public enterprises, which largely spilled over into the budget deficit and public debt. Such a policy is not sustainable in the medium term. In this context, the experts point out that the only way for the financial stabilization of the energy system of Serbia is to increase the price of electricity. Analysis (Fiscal Council of the Republic of Serbia, 2022a) shows that the increase in the price of electricity should be in the range of 15-20%. Although the focus here is on the crisis for electricity as an energy source, the gas crisis has very similar mechanisms and fiscal indicators.

## 2. Serbia's national fiscal policy and implemented measures for the energy crisis

Fiscal policy played one of the key roles in conditions of growing uncertainty, slowing economic growth, rising inflation, tightening conditions for financing deficits and other problems faced by all countries in the region, including Serbia. Fiscal policy is in conditions of constant challenges because disruptions in the energy sector along with the growth of costs for the economy and the population require new measures (Kisin, J., Mihić, S. 2021). Energy costs related to the purchase of energy sources, subsidizing the price of gas, salaries and pensions in the public sector and have a direct impact on the standard of living. Serbia strives to preserve the level of capital investments which are very necessary to keep economic growth and fiscal discipline. In addition, to preserve macroeconomic and fiscal stability, a new Arrangement with the International Monetary Fund was proposed as a precaution. The last three years is crisis, only the causes or manifestations have changed, but each of them required a fiscal policy response and extraordinary budget allocations, which is extremely important for maintaining general stability. Serbia implemented a variety of mitigations measures to overcome the consequences of the energy crisis. Some of these are (Balkan Green Foundation, 2022):

- The import gas price is set at the level it was in 2019.
- Network tariff increases are expected.
- The government introduced a decree on Energy Vulnerable Customers to support 200,000 households in paying electricity bills. 1,500 homes can apply for subsidies for gas and 50,000 to get support with heating costs.
- The installation of solar panels and replacing carpentry is announced. The state has allocated 230 million euros to increase energy efficiency in 2022.
- Measures to freeze the price of flour, sugar, sunflower oil, pork, and milk.

Dynamics and structure of public revenues and public expenditure is presented in the table 2 below. Analysis of the presented data shows that in the years before the beginning of the crisis, Serbia had a stable balance sheet that was even in a slight surplus. The year 2020 brought big changes when it comes to public finances. First, public revenues were at a lower level (around 1% of GDP). At the same time, the increase in public spending was significant (about 7% of GDP) and in this respect we can conclude that 2020 was a record year, together with a record budget deficit of about -8%. In the next two years, 2021 and 2022, Serbia achieved a significant increase, primarily on

the revenue side, and at the same time managed to achieve a trend of decreasing public spending, and it was lower during the energy crisis compared to those during the crisis pandemic. In compare with the pre-crisis period and the year 2019 as a comparative point, public revenues grew by almost 2%, while public expenditures grew much more, by about 5.6% of GDP (Table 2).

Table 2. Consolidated state balance in the period from 2018 to 2022 (% of GDP)

	2018.	2019.	2020.	2021.	2022.
<b>I. Public revenues (1+2+3)</b>	41.5	42.0	41.0	43.3	43.4
1. Tax revenues	35.9	36.8	36.2	38.6	38.9
2. No-tax revenues	5.3	5.0	4.6	4.3	4.2
3. Donations	0.3	0.3	0.2	0.3	0.2
<b>II. Public expenditures (1+2+3+4)</b>	40.9	42.2	49.0	47.4	46.5
1. Current expenditure	36.4	36.9	42.7	39.0	36.2
Expenses for employees	9.2	9.5	10.5	10.0	9.6
Purchase of goods and services	6.8	7.0	8.0	7.8	7.6
Interest repayment	2.1	2.0	2.0	1.7	1.5
Subventions	2.2	2.2	4.6	3.3	2.3
Social assistance and transfers, of which:	14.7	14.4	14.6	13.6	13.1
- Pensions	10.4	10.3	10.6	9.7	9.0
- Benefits to unemployed persons	0.2	0.2	0.1	0.2	0.1
- Sickness benefits	0.3	0.2	0.2	0.2	0.3
- Social help	3.2	3.1	2.8	2.7	2.7
- Other transfers to households	0.7	0.7	0.9	0.7	1.0
Other current expenses	1.4	1.7	3.0	2.6	2.0
2. Capital expenditures	3.9	4.9	5.3	7.4	7.2
3. Activated guarantees	0.4	0.2	0.1	0.1	0.3
4. Budget loans	0.1	0.2	0.8	0.8	2.9
<b>Consolidated balance sheet (I – II)</b>	0.6	-0.2	-8.0	-4.1	-3.1

Source: Ministry of Finance of the Republic of Serbia, 2023.

In nominal terms, public revenue and public expenditure amounted to 2,278,558.4 million RSD and 2,289,671.9 million RSD, respectively, compared to 2022. When they amounted to 3,075,839.6 million RSD on the public revenue side compared to 3,297,066.2 million RSD for public expenditure (Ministry of Finance of the Republic of Serbia, 2023). In terms of structure, the biggest growth in foreign income was achieved in the category of tax revenues. On the expenditure side, in the current expenditure category, allocations for Purchase of goods and services and subsidies have increased the most, while there is a downward trend for allocations for social assistance and transfers. Capital expenditures have the highest growth, and this is reflected in the change in policy that, even in times of crisis, capital investments should be kept at the same level, or even raised, to maintain the level of economic activity. Capital expenditures have increased by around 2.5% of GDP over the last three years. In public spending, budget loans also had a significant increase of about 2.7% of GDP. After the outbreak of the Covid-19 pandemic and the recent large increase in the prices of energy and food, that are an additional pressure on the standard of citizens, especially those financially disadvantaged, the problem of growing inequality and poverty has become highlighted at the global level. For many years, Serbia has significantly worse indicators of poverty and income inequality, both in relation to comparable countries of Central and Eastern Europe and the European Union. The poverty risk rate in Serbia is 21.7% and is higher than the average of the European Union (16.6%) and the countries of Central and Eastern Europe (16.5%) (Fiscal Council of the Republic of Serbia, 2022b). In the context of the analysis of the data in Table 2, there is a decreasing trend in social assistance and transfers category, considering the aforementioned trends and the situation in Serbia is certainly not positive. Proposals for measures for systemic improvements in social and tax policy in Serbia have already been defined, which primarily include an increase in expenditures for social protection from 3.0% to around 3.3% of GDP to expand the coverage of social programs and increase the amount of benefits targeted to vulnerable sections of the population (Fiscal Council of the Republic of Serbia, 2022b).

In addition to national budget allocation, all Western Balkans countries have received an Energy Support Package of €1 billion euros, proposed by the European Commission in November 2022 as part of the Berlin Process Summit. This package is for short-term and medium-term needs to overcome the current energy crisis, but also to reduce their dependence on Russian fossil fuels, improving the energy security of the region, and accelerating decarbonization (European Commission, 2022a), and this is especially important for Serbia. Budget support measures that should include:

- 1) to balance the increase of energy prices for the energy sector and businesses,
- 2) support policy measures to accelerate the energy transition, and to
- 3) keep energy prices affordable level.

The first part of the package provided for Serbia was €165 million euros. When analyzing the budget of Serbia for the current year, it predicts that revenues will increase by about 7.8% and that the deficit will decrease to 3.3% of GDP in 2023 (Fiscal Council of the Republic of Serbia, 2022c). The budget is developmental, supports the further growth of investments (a high level of capital investments of 7% of GDP or 4.8 billion euros) and is socially oriented, because it will continue to support the citizens of Serbia and the economy during the current crisis, since we also need to preserve the growth of the economy, jobs and living standards. Growth projections are conservative, made in accordance with bad economic forecasts in the world, as well as the possibility of a further continuation of the crisis, which would affect the overall economic performance of the country. Assessment (Fiscal Council of the Republic of Serbia, 2022c) is that even if the reduction of the deficit is achieved, it is still too high for Serbia, primarily because it is planned to cover the losses of EPS and Serbia Gas of 1.2 billion euros (1.7% of GDP). This may not be the entire budget cost of the energy crisis and the poor performance of these two companies, because the Budget also enables the state to issue up to one billion euros in new guarantees for their borrowing, which formally does not enter the deficit for 2023. Experience shows that public companies do not repay these loans, which means that ultimately will be paid by taxpayers. Energy costs could have been avoided to a large extent if a new coal mine had been discovered in time and thus the import of overpriced electricity had been reduced or if gas prices had increased in time and thus reduced the difference between its purchase and sale price (Fiscal Council of the Republic of Serbia, 2022c). The non-transparency of certain budget lines is present again. With the explanation of “Intervention funds for overcoming the energy crisis”, the “Expenditures for the acquisition of financial assets” which normally amounts to 5-10 billion dinars, is now 117 billion dinars (Fiscal Council of the Republic of Serbia, 2022c), so the expenditure for the energy crisis will be at a very high level in 2023.



### 3. Green transition in Serbia – crisis as a chance faster sustainable development

Energy transition (Filipović, Ignjatović, 2022), as part of the green agenda, inevitable process and well-known topic more than decade, particularly in Europe, but over the past year, it has received the greatest attention, with features of the energy revolution. An effective energy transition definition, proposed by the World Economic Forum, is “a timely transition towards a more inclusive, sustainable, affordable and secure energy system that provides solutions to global energy-related challenges, while creating value for business and society, without compromising the balance of the energy triangle” (World Economic Forum, 2020), and should have six dimensions (World Economic Forum, 2022):

- Accelerating energy access
- Navigating future energy supply and demand
- Building energy system resilience
- Remapping energy geopolitics
- Unlocking energy finance
- Strengthening energy policy and governance
- Designing the future of power systems
- Driving energy technology innovation

Official policy and actions of European Union are strongly focused on energy transition, more than ever from the outbreak of Russian aggression on Ukraine. Main pillars of changed of EU energy policy is to separate Europe from Russian fossil fuels and accelerate the green transition (Sgaravatti et al, 2022). With strong long-term policy set in the European Green Deal, approved in 2020, Recovery plan for Europe from 2021 and new RE-PowerEU plan, from 2022, a plan for saving energy, producing clean energy, diversifying energy supplies, rapidly reducing dependence on Russian fossil fuels and fast forward the green transition. Europe’s determination “to make it happen” is stronger than ever and clearly shows commitment to becoming the first climate-neutral region by 2050. In quantitative terms, European Commission aims to increase by 13% the energy savings target for 2030 and to replace 21 bcm/year of gas by wind and solar energy (Sgaravatti et al, 2022). EU will allocate 210 billion EUR till 2027 to fund investments in energy infrastructure. Mostly investments will be for strengthening energy grid and renewable energy production - wind, water, and solar energy. Also, this plan facilitates renewable gases production - hydrogen and bio-methane

(European Commission, 2022b). In this context of EU energy policy, all the countries of the region, including Serbia, should see in it their great chance to join it, contribute to the realization of the defined goals and maximizing the impact of the Europe green transition. By signing the Sofia Declaration, the Western Balkans fully supported the goals of the Green Agenda for the Western Balkans (Mashovic et al, 2022). With the economic and investment plan for the Western Balkans that envisages the mobilization of up to 9 billion euros in grant funds till 2030 and 20 billion euros in loans, and new guarantee fund for the Western Balkans, this is the chance that region should not miss. It focuses on leading projects in green and digital transition, smart mobility, sustainable energy and support to the private sector and human capital development to bridge the socio-economic gap between the Western Balkans and the EU. Through the economic investment plan and its Green Agenda for the Western Balkans, the EU supports energy efficiency and the production of renewable energy, as well as the strengthening of energy connectivity infrastructure (European Commission, 2022c). In European energy policies, the Western Balkans is viewed as a region, which is characterized by the same or similar conditions, challenges, and potentials, but certain differences between the countries in the region can certainly be observed. Some of the biggest challenges and bad indicators, common to all countries of the region, including Serbia, are outdated energy infrastructure with insufficient investments, insufficient maintenance of the energy system, poor connectivity, low level of energy efficiency in the region, all of which affect the energy security of the region. Against these facts, the region of the Western Balkans has an important geographical location on energy transport routes, and large renewable energy and hydro-energy capacity (Knez et al, 2022), which fully corresponds with the long-term policy of Europe. The described situation leads us to the conclusion that the current unharmonized position of the Western Balkans and Serbia is between reality of energy dependence on the supply and the potential to transform an energy hub (Turčalo, 2020; Mašović et. al. 2023). In this process, the support, role, and political resolve of the European Union will be very important. To fully utilize its potential as a geopolitical actor in the regional energy policy, the European Union should necessarily overcome its regulatory and technocratic approach through the affirmation of projects such as the Ionian-Adriatic gas pipeline (Turčalo, 2020). Serbia is characterized by very high dependence of economy on fossil fuels. In order to move forward in that domain, it is necessary to provide incentives for the transition to clean energy, as well as for investments in renewable energy sources. When it comes to renewable energy sources, Serbia has potential for solar, hydro, wind energy and bioenergy, because of good

natural prerequisites, many sunny and windy days, mountain ranges, rivers etc. To be effective in this inevitable process, it requires a massive scale-up of renewables and faster electrification.

The fact is that major radical changes took place in the last three years, which confirmed and accelerated the inevitable process of green transition. Serbia, this kind of development should be seen as a momentum, as a chance that opened possibility for energy transformation. Actions in this direction would give Serbia many benefits. It is not only clean and cheaper energy, better preparedness for future needs and challenges, but also at the same time raising its competitiveness, opening new investment opportunities, contributing to climate change mitigation, etc. These essential changes in energy policy and energy portfolio, which overlap with environmental and climate changes pressures, will change the foundations of economic activity, consumer choices, and investor behaviour (Mashović et al. 2022). In the future, the basis of every economic growth strategy will include decarbonisation (Knežević et al. 2022) less energy intensive business, i.e. higher energy efficiency, and use of renewables. All this is stated in the basics of sustainable economic development, which Serbia should strive for as it plans to survive in the new age. Much stronger and deeper integration with the EU is necessary, which implies the implementation of EU policies in various domains and the maximum use of financial and other available support. Also, Serbia needs a fundamental change in the energy portfolio through the green transition process, which will surely significantly contribute to the acceleration of sustainable economic development.

## Conclusion

Since the beginning of 2022, major changes in energy policy and markets happened, caused by the war in Ukraine, which was the reason for Europe to leave its traditional supplier of energy, turn to other sellers and make a complete reorientation of energy policy. As in many countries in Europe, also in Serbia the energy crisis increased the costs of budgetary support to the energy sector from 2022 and after the pandemic crisis again put new pressure on fiscal policy. Accomplished improvements in fiscal stability are overshadowed by fiscal costs to cover the losses of the energy sector. The fact is that Serbia wasn't ready for the global energy crisis that flared up last year, due to the extremely bad situation in the energy sector. The essential problems in the Serbian energy sector have accumulated and remained unresolved for decades, and currently they are among the biggest economic, fiscal, and social problem in Serbia. Radical changes, urgent reform of the energy

sector and elimination of the structural causes of the energy crisis in Serbia are necessary, and its consequences must be resolved in a fiscally and socially responsible manner. Firstly, it is necessary to ensure professional and professional management in key companies of the energy sector, and to support such management to implement all the reforms that have been delayed for years. Then, gradually, the planned policy of increasing energy prices must be started in order to finally reach the charging of economic prices of energy products. This is the only way that companies in the energy sector can operate profitably, to eventually obtain funds for investment. To achieve this goal, the transition must be economically inclusive with the energy vulnerable customer program as part of social policy. It is necessary to protect vulnerable populations and businesses that cannot stand such high energy prices, the government must establish selective support by creating an effective system for the protection of energy-dangerous households and protect vulnerable citizens. At the same time, the state should, instead of subsidizing the losses of these companies due to the price of energy products, which are a social category, direct capital investments into energy infrastructures, primarily those that will contribute to the green transition. Important and necessary investments in the energy sector are necessary, both through the construction and renovation of energy infrastructure, and through the procurement of all types of energy sources. In the past three years, through the pandemic, the energy crisis, and the war in Ukraine, many lessons have been learned. First of all, an emergency situation in any form or any nature must not surprise us. Then, rapid, deep, and radical changes are always possible. Due to this experience and the context of the energy crisis, in the future, without a doubt, the development of Serbia's energy infrastructure should respond to several requirements. These are primarily requirements related to energy and climate EU policy and goals in the next seven years. At the same time, their implementation will contribute to greater energy independence of Serbia and better preparedness of the system for potential energy shocks. In order to maximize its great potential for renewable energy, it is necessary for Serbia to implement activities that will ensure energy supply diversification and acceleration of green transition. With EU support, whose policies, actions, and budgets are focused on energy transition, Serbia must approach the fundamental change of the energy portfolio, accelerating the green transition process and building a modern and resilient energy infrastructure that will ensure safety, security, and diversification of energy supply. In the following period, the goals of Serbian economic policy should be oriented towards reducing the deficit, continuing to raise the standard of living of citizens and the level of foreign direct investments, maintaining a high level of capital

investments and the lowest possible level of public debt. Considering the very high cost of borrowing, keeping public debt under control, additional borrowing, and unproductive spending of funds must absolutely be avoided. Serbia is among the leaders among comparable countries in the development of e-government, so further focus on successful digital transformation and strengthening the digital economy will be very important aspect of progress. In the conditions of cost-of-living crisis, extremely high inflation and interest rates, a good selection of projects has become one of the key issues of public finances. The rates of inequality and the risk of poverty in Serbia have long been higher than the European average, and because of the crisis, this fact is even more pronounced. Various social policy mechanisms, increased expenditures for social assistance and reforms that positively affect the rate of inequality, the coherence of society and inclusive economic growth should provide adequate support to vulnerable households to overcome the upcoming economic challenges.

## References

- Balkan Green Foundation. (2022). Energy Crisis in the Western Balkans: Measures Undertaken Amid Energy Price Shocks. Heinrich Boll Stiftung.  
<https://www.balkangreenfoundation.org/en-us/publications/?year=2022> (accessed on 14 April 2023).
- Filipovic, S., Ignjatovic, J. (2023a). Effects of transition on the standard of living and social inequality. *Sociological review*, Vol. LVII (2): 692-717. doi: 10.5937/socpreg57-42030
- Filipović, S., Ignjatović, J. (2023b). Foreign trade commodity exchange between the countries of the former SFRJ. *The Review of International Affairs*, Vol. LXXIV (1187): 31- 58. DOI: [https://doi.org/10.18485/iipe\\_ria.2023.74.1187.2](https://doi.org/10.18485/iipe_ria.2023.74.1187.2)
- Filipović, S., Ignjatović, J. (2022). Ekonomski razvoj Zapadnog Balkana: šanse i ograničenja za zelenu tranziciju, *Megatrend Revija*, Vol.19 (3), pp. 167-182. DOI: 10.5937/MegRev2203167S
- Fiscal Council of the Republic of Serbia. (2022a). Strukturni problem srpske energetike u svetlu globalne krize: uzroci, troškovi i moguća rešenje.  
[https://www.fiskalnisavet.rs/doc/analize-stavovi-predlozi/2022/FS\\_Strukturni\\_problemi\\_srpske\\_energetike\\_usvetlu\\_globalne\\_krize\\_jul\\_2022.pdf](https://www.fiskalnisavet.rs/doc/analize-stavovi-predlozi/2022/FS_Strukturni_problemi_srpske_energetike_usvetlu_globalne_krize_jul_2022.pdf)
- Fiscal Council of the Republic of Serbia. (2022b). Predlog mera socijalne i poreske politike za smanjivanje nejednakosti i rizika od siromaštva u Republici Srbiji.  
[https://www.fiskalnisavet.rs/doc/analize-stavovi-predlozi/2022/FS\\_Predlog%20mera%20socijalne%20i%20poreske%20politike.pdf](https://www.fiskalnisavet.rs/doc/analize-stavovi-predlozi/2022/FS_Predlog%20mera%20socijalne%20i%20poreske%20politike.pdf) 17.03.2023.
- Fiscal Council of the Republic of Serbia. (2022c). Ocena predloga Zakona o budžetu za Republike Srbije za 2023. [https://www.fiskalnisavet.rs/doc/ocene-i-misljenja/2022/FS-Ocena\\_budzeta\\_2023\\_v1.pdf](https://www.fiskalnisavet.rs/doc/ocene-i-misljenja/2022/FS-Ocena_budzeta_2023_v1.pdf) 17.03.2023.
- European Commission. (2022a). Energy Support Package for the Western Balkans.

- <https://neighbourhood-enlargement.ec.europa.eu/system/files/2022-12/WBIF%20Energy%20support%20pack%202021202.pdf> (accessed on 22 April 2023).
- European Commission. (2022b). REPowerEU at a glance.  
[https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en) (accessed on 26 April 2023).
- European Commission. (2022c). Western Balkans Focus on energy. <https://neighbourhood-enlargement.ec.europa.eu/system/files/2022-12/Factsheet%20focus%20on%20energy.pdf> (accessed on 22 April 2023).
- Ignjatovic J., Kisin J., Mashovic A. (2021), *Economic aspects of the COVID-19 pandemic in the Western Balkans region*, international conference Sustainable Economic transformation in the postpandemic period, Educons University, Sremska Kamenica, pp. 63-88. <https://educons.edu.rs/wp-content/uploads/2021/11/2021-zbornik.pdf>
- Kisin J., Ignjatovic J., Mashovic A. (2022). *Economic aspects of Smart City development*, 9th International scientific conference on climate change, economic development, environment and people (CCEDEP), University of Shkoder, Shkoder, pp. 199-213.
- Kisin, J., Mihić, S. (2021). Fiskalni trendovi u uslovima pandemije COVID-19: Analiza javnog duga Republike Srbije. tematski zbornik Poslovanje u periodu pandemije - izazovi i šanse, Beograd: Institut ekonomskih nauka, 2021. str. 1-17.  
<https://www.library.ien.bg.ac.rs/index.php/zb/article/view/1433/1166>
- Knez, S., Štrbac, S., Podbregar, I. (2022). Climate change in the Western Balkans and EU Green Deal: status, mitigation, and challenges. *Energy Sustain Soc* 12, 1. <https://doi.org/10.1186/s13705-021-00328-y> (accessed on 28 March 2023).
- Knežević, S., Ignjatović, J., Okanović, A., Glišić, M., Milojević, M. (2022). Značaj cirkularne ekonomije u upravljanju ambalažnim otpadom. *Ecologica* Vol. 29 (108), pp. 653-659. <https://doi.org/10.18485/ecologica.2022.29.108.24>
- Mašović, A., Ignjatović, J., Kisin, J., Grujić, S. (2023). *National Fiscal Policy Response to the Global Energy Crisis in Western Balkans Countries: The Case Study of Serbia and North Macedonia*. In: international conference VUZF, Sofia, Bulgaria, pp.179-192.
- Mashovic, A., Ignjatovic, J., Kisin, J. (2022) Circular economy as an imperative of sustainable development in North Macedonia and Serbia, *ECOLOGICA*, Vol. 29, No. 106 (2022), str. 169-177. <https://doi.org/10.18485/ecologica.2022.29.106.5>
- Ministry of Finance of the Republic of Serbia. (2023). **Макроекономски и фискални подаци, 4. август 2023. године**. <https://www.mfin.gov.rs/dokumenti2/makroekonomski-i-fiskalni-podaci>
- Sgaravatti, G., Simone Tagliapietra, S., Trasi, C. (2022). National energy policy responses to the energy crisis, Bruegel Datasets. <https://www.bruegel.org/dataset/national-energy-policy-responses-energy-crisis> (accessed on 28 March 2023).
- “Sl. glasnik RS”, br. 128/2022, Revidirana fiskalna strategija za 2023. godinu sa projekcijama za 2024. i 2025. godinu i Makroekonomski okvir za period od 2023. do 2025.  
[http://demo.paragraf.rs/demo/combined/Old/t/t2022\\_11/SG\\_128\\_2022\\_001.htm](http://demo.paragraf.rs/demo/combined/Old/t/t2022_11/SG_128_2022_001.htm)
- Turčalo, S. (2020). Energetska geopolitika na Balkanu: geopolitika i evropske integracije Zapadnog Balkana: globalni i regionalni poredak, Friedrich-Ebert-Stiftung, Sarajevo. <https://vpi.ba/wp-content/uploads/2020/06/16147.pdf> (accessed on 28 March 2023)

World Economic Forum. (2022). Strategic Intelligence Pro.

<https://intelligence.weforum.org/topics/a1Gb00000038oN6EAI/key-issues/a1G0X000006DQC4UAOž> (accessed on 19 April 2023).

World Economic Forum. (2020). Fostering Effective Energy Transition 2020 edition.

[https://www3.weforum.org/docs/WEF\\_Fostering\\_Effective\\_Energy\\_Transition\\_2020\\_Edition.pdf](https://www3.weforum.org/docs/WEF_Fostering_Effective_Energy_Transition_2020_Edition.pdf). (accessed on 20 April 2023).

World Bank. (2023). Data. <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>



## CEMENT AS AN ENVIRONMENTALLY ACCEPTABLE COMPONENT IN THE MAKING OF CONCRETE

**Zlatica Kuliš mag.ing.građ.**, PhD student on Faculty of Polytechnics Sciences on International University of Travnik in Travnik, tel.: 063/369 706, e-mail: zlatica.kulis@gmail.com

**PhD Dževad Avdić dipl.ing.građ.**; profesor on International University of Travnik in Travnik, dzevad.iut@gmail.com

**ABSTRACT:** Adapting traditional building materials to carbon-neutral construction that does not affect the environment is one of the basic tasks of the transition period that is undoubtedly coming. The type of such material, which can adequately respond to all these challenges, is cement. According to its definition, it is a construction binding material obtained by crushing and baking limestone and marl into a fine powder. Nevertheless, the production of cement is accompanied by certain problems and requirements that are necessarily linked to increasing the efficiency of the cement itself and improving its durability and properties. The fact that cement production alone accounts for 7% of global CO<sub>2</sub> emissions, three times more than air traffic, calls for modern methods of making this material. Due to the constant increase in interest in sustainable development, experts in the construction industry are interested in the use of environmentally friendly materials. As a possible way of alternative solution and reduction of negative consequences on the environment is the replacement of Portland cement with new by-products, among which we emphasize green cement.

**KEYWORDS:** cement, production, CO<sub>2</sub>, by – product

### 1. ABOUT CEMENT IN GENERAL

One of the most used building materials today is certainly cement. Its main purpose is to bind crushed stone in concrete, thanks to its binding and hydraulic properties. About 150 tons of cement are used every second for the production of concrete, on average, and looking at the global level, about 14 billion cubic meters of cement are poured in the world every year. Cement is considered the most usable substance after water on earth, and

more than 4 billion tons of cement are produced every year. Today, the largest quantities of cement are used for the production of composite materials, primarily concrete and mortars. Thanks to its hydraulic properties, the cement binder binds even under water into a solid mass of the same volume. Due to human development as well as the development of technology, today we distinguish several types and types of cement that are characterized by different physical and chemical properties. Each of these types is intended for a specific purpose. Precisely because of this, it is very important to know the physico-chemical characteristics of individual cement. All of them are tested in laboratories in order to finally obtain a cement composite with the desired characteristics. Despite the various types of cement, Portland cement is the most widely used type of cement intended for a variety of uses around the world.

The cement production process itself has several stages, and it first begins with the exploitation of mineral raw materials. It is most often made of a mixture of limestone and marl. Exploitation of mineral raw materials is done by drilling and blasting or mechanical excavation, which ultimately results in material with a wide granulometric composition, but unequal chemical composition. After the initial phase, called pre-homogenization, the raw material must be dried in the drying room to the given humidity. Then, it is ground in a mill until the particles are granulated, which the air must carry to the silo for homogenization, where a certain composition of the raw material must be achieved. It is necessary to blow additional air in order to mix or homogenize the raw material. The homogenized mixture goes from the silo to the heat exchanger. The overheated raw material enters a slightly inclined rotary kiln, where the formed clinker mineral is released in the form of dark brown to black very hard balls through different temperature zones that enable the formation of clinker minerals. Minerals present in the raw material, by firing to the sintering temperature, which is 1450-1470 degrees Celsius, create cement clinker. The resulting hot cement clinker falls out of the furnace and cools in the refrigerator. Then it leaves the refrigerator for final grinding. The final step in the production of cement is the grinding of cement clinker and gypsum, which is added to the cement in order to control the rate of binding of the particles. It is necessary to add 5 mass% of gypsum in order to actually get a mixture of clinker and gypsum, which is actually Portland cement.

## 2. IMPACT ON THE ENVIRONMENT

Cement production has a great impact on the environment. This necessarily includes limestone quarries that are visible from a great distance, and their consequence can be a permanent change to the local environment. Also, there are emissions of air pollution in the form of dust and gases, noise and vibrations during the operation of machines, as well as blasting in quarries. An inevitable side effect of cement production is the production of CO<sub>2</sub>, which has a particularly harmful effect on the environment. Take into account the fact that about 20 billion tons of concrete are produced annually, this contributes significantly to global greenhouse gas emissions. Between 4 and 8% of the world's total CO<sub>2</sub> emissions come from concrete production, while the cement business emits more than 4 billion tons of carbon each year.

During the production process, “clinkerization” alone accounts for more than 50% of carbon emissions. Clinker or Portland clinker is produced during the burning of ground raw materials, mainly limestone, clay, iron oxides and aluminum, at temperatures of around 1,450 degrees Celsius. Heating is done using non-renewable energy sources such as natural gas or similar oil derivatives. Between 800 and 1,000 kg of CO<sub>2</sub> is emitted for every ton of clinker produced. In addition to the above, cement uses almost a tenth of industrial used water, which speaks volumes about how much it absorbs liquid.

900 kilograms of CO<sub>2</sub> are released into the atmosphere during the production process of one ton of cement. In percentage terms, this accounts for 88% of emissions released into the atmosphere during concrete production. CO<sub>2</sub> emissions from concrete production are directly proportional to the proportion of cement used in the concrete mix. Taking into account the fact that cement is responsible for about ten percent of annual CO<sub>2</sub> emissions into the atmosphere, the responsibility and obligations of the producers of this material are unquestionable.

The biggest problem during concrete production is the fight with carbon dioxide, which is released directly into the atmosphere. However, there are many solutions that can reduce this, and these solutions need to be put in the center of attention in order to improve the production itself, but also to create a cleaner environment.

Current trends in construction are divided into two large blocks. It is about the dynamics of the execution of works, which is reflected in the need for faster, better quality and more durable construction, on the one hand, and the necessary strengthening of awareness about reducing the impact of the

construction sector on the environment, on the other hand. Nevertheless, the ubiquitous awareness of the importance of environmental protection directed the transition of the construction industry in the direction of environmental acceptability and sustainability.

It is clear that we are facing a period of transition, during which it is necessary to adapt traditional building materials to carbon-neutral construction, which does not have a harmful effect on the environment. The materials that will be the focus of study, due to their positive characteristics, are fly ash, blast furnace slag, phosphogypsum, electric furnace slag, red sludge and flue gas desulfurization gypsum. Such materials are characterized by fast bonding, as well as a rapid increase in strength, which is why they are ideal for applications where load-bearing capacity is required in the working age of concrete.

## **2.1. LOW HEAT HYDRATION CEMENT**

Lafarge has developed cement with a low heat of hydration CEM II/B-M(S-V)42, 5N LH, with a reduced content of built-up carbon by 30%. It is particularly suitable for concreting massive elements, i.e. the construction of energy facilities, bridges, collectors, sewage and similar systems. Since it is a combination of granulated slag and ash, the specified type of cement meets all the requirements of projects related to durability and durability in particularly aggressive environments. Also, this type of cement has a low level of alkali, which is why it is suitable for all types of aggregates - natural and recycled. It is characterized by very good cohesion and the possibility of processing, which favors concrete mixtures intended for pumping.

## **2.2. ASH AS A SUBSTITUTE FOR CEMENT**

The construction profession has developed a new binding material, which in the near future could replace the main ingredient of concrete - cement. It is an environmentally friendly material obtained from the ash of a coal-fired power plant. The reason for its acceptability lies in the fact that ash can replace cement in mortar by about 30%, and in concrete by as much as 50%. It is clear that these are great results if we look at the aspect of mechanical properties, and at the same time the issue of cement as a pollutant has been solved. In addition to the huge advantage that the new material is

not harmful to the environment, its use also reduces the industry's impact on greenhouse gas emissions, which inevitably decrease. So, experts have developed a composite binder primarily made of ash. It is actually made into a by-product in coal-fired power plants, which can replace Portland cement in concrete. Also, it is a material that is environmentally friendly. Another advantage is the fact that the ash binder does not require high-temperature processing of Portland cement, and the latest tests show that it has equally good compressive strength even after seven days of hardening. A significant advantage relates to the minimal amount of chemicals required for sodium-based activation used in order for Portland cement to harden sufficiently during drying. In the daily production of Portland cement, manufacturers use a small amount of ash rich in silicon and aluminum, which makes it environmentally friendly. To reach such a significant discovery, experts used Taguchi's analysis. It is a statistical method developed for examining a large number of possible states of chemical composition, and in the end they found the best mixing ratios through computer optimization. This led to the improvement of the structure and mechanical quality of the synthesized composites, which leads to an optimal balance of calcium-rich ash, nanosilicate and calcium oxide with less than 5% of sodium activator.

According to the American standard ASTM C 618, fly ash is the residue created by burning ground coal. This means that not all ash is fly ash. Apart from this, other types of ash are also known. One of them is the so-called type F ash, which is essentially a residue from the burning of anthracite or bituminous coal in power plants, and contains a low level of calcium. Globally, there are significant sources of low-grade coal, such as lignite or sub-bituminous coal. The result of their burning is ash with a high calcium content, which in construction science is called type C ash, and it is much more difficult to activate it. Research has shown that the use of these types of ash, with a high level of calcium, is very suitable for the production of environmentally friendly concrete.

AshCrete is a special type of concrete that uses fly ash as a raw material for production. When mixed with borate, ash and chlorine, a stronger, more durable and environmentally friendly material is obtained that can serve as a substitute for Portland cement. Compared to classic concrete, AshCrete concrete is more resistant to acid, fire, temperature differences and corrosion. From the material side, this type of concrete is cheaper than regular cement. However, it has the disadvantage that it is also obtained by burning coal. So, the main advantages of AshCrete concrete are: cost-effectiveness, low cap-

tured energy, durability, workability, resistance, water saving, while the main disadvantages are: weaker strengthening and longer time required for hardening and seasonal restrictions, because this type of concrete is subject to low temperatures, and this significantly increases the curing time.

### 2.3. BLAST FURNACE SLAG

Different types of secondary raw materials are used in the production of cement, usually as a substitute for clinker, that is, they are used as a replacement additive. For example, the use of secondary raw materials such as slag, which is actually a waste material, significantly affects the economic as well as the ecological role in the production of cement.

By definition, slag is actually a waste product from the production of raw iron. It contains the same oxides as Portland cement cleaner, but in different proportions. It is divided according to its chemical composition into:

- Basic - obtained from gray raw iron and
- Sour – obtained from white raw iron.

Other properties of slag depend on the way it is cooled during the production process, so the following types are distinguished:

- Slow-cooled slag – resulting in slag with a fully crystallized structure,
- Rapidly cooled slag – resulting in vitreous solidified granulated slag.

## 3. GREEN CONCRETE

The use of green concrete is becoming increasingly popular in many countries. Its basic feature is that materials obtained from sustainable green materials must be used during its production. This type of environmentally friendly concrete consists of raw materials, which include fly ash, recycled concrete particles and aluminum fibers. A characteristic of green concrete is the low ratio of cement and carbon per produced unit. It is specially conceived and designed for the durability and strength of built structures.

Currently, the biggest question in the construction industry is how to develop green cement, which would be made from recycled materials. Some European countries, such as France and Great Britain, already produce this type of cement. It is clear that the majority of green cement is produced by more modern manufacturers, while the traditional ones believe that it will take them a long time to adapt their technology to the modern era, but they are certainly moving towards it.

Despite the very high price of green cement, the demand for it is really high. Ideas for the future production of green cement refer to taking the emitted carbon from the kiln, adding it and replacing the resulting mixture in the open spaces of the previously made cement. After that, in order to obtain the required strength, the product must be placed in a room with carbon dioxide instead of water, which would ultimately reduce the total carbon emission in cement production by about 70%. The advantage of this mixture is less time required for hardening, greater strength and less energy for production. This ultimately results in a more cost effective and efficient way to create cement. It is already clear that green cement is the future of sustainable energy.

### 3.1. GREEN JACKET CEMENT

The initial certifications of the new type of jacketed ECOPlanet cement have already been completed in modern factories. It is a type of cement whose CO<sub>2</sub> emissions are up to 40% lower than Portland cement. If we take into account that the use of green cement achieves a reduction of 330 kg of CO<sub>2</sub> per ton of cement, we get a clearer picture of the contribution that the cement industry can make in the global fight to preserve the environment.

The visions of the companies leading the transformation from existing cement to ecologically acceptable green cement refer to the achievement of results through the establishment of a permanent balance between environmental protection, social responsibility and entrepreneurship. For this reason, the company's focus is directed towards the development and implementation of green materials and technologies that lead to the global goal - decarbonization of building materials, in other words, carbon-neutral construction.



### **3.2. ASH FROM SUGAR CANE AND RICE HUSK AS A SUBSTITUTE FOR CEMENT IN SELF COMPACTING CONCRETE**

The ash of sugarcane and rice husks is starting to be used as a partial substitute for cement. In this regard, the necessary research is being carried out in order to determine the workability of concrete containing the aforementioned ingredients. In particular, trial mixes were prepared and tested with different proportions of water and cement, different proportions of substitute materials, and different amounts of superplasticizers and mix stabilizers. According to the obtained results, the proportions for three optimal concrete mixes that can meet the requirements for self-compacting concrete that can be used for different construction purposes were determined.

It is believed that the results of the research will be extremely positive, and that they will encourage the use of self-compacting concrete with partial replacement of cement with ash. Additionally, the partial replacement of Portland cement with agricultural waste residues, such as sugarcane ash and rice husk ash, contributes to the beneficial treatment of these waste materials. Ultimately, the consumption of cement is reduced, which leads to a smaller impact on the environment.

## **CONCLUSION**

The concrete production industry wants to be carbon neutral by 2050, and by 2030 reduce existing emissions by a third. This would save the planet five billion tons of carbon dioxide by the end of the decade. Unlike Portland cement, the experience with alternative binders does not cover a period longer than 50 years, and their long-term behavior in an aggressive environment cannot be evaluated on the basis of exhaustive field tests. Therefore, it became obvious that, in order to gain some knowledge about their expected behavior in the environment, it is crucial to understand their degradation from the nanoscale and microscopic level, but also to prove their behavior in the real environment using test fields and simulation models.

And perhaps most importantly - the industry is researching how to develop 'green' cement, made from recycled materials. In Britain, 26 percent of cement is already produced in this way, and in France, as of next year, new rules on restrictions on the use of carbon in construction will begin to apply.

This is just one example of how to reduce the use of 100% cement, and the goal should definitely be to keep all concrete pollution to a minimum. It is up to the concrete industry to take up the challenge and help minimize this pollution by ensuring that environmentally friendly alternatives are used and developed in the construction industry. The amount of concrete used should be carefully measured to avoid an excess that eventually becomes waste. We should also keep in mind the importance of the aquatic world and take good care of it by avoiding the discharge of toxic concrete waste into rivers and seas.

## LITERATURE

1. Begović, D. i Štirmer, N., Teorija i tehnologija betona, Građevinski fakultet, Zagreb, 2015.
2. Đureković, A.: Cement, cementni kompozit i dodaci za beton, Institut građevinarstva Hrvatske i Školska Knjiga, Zagreb, 1996
3. Građevinar 1/2015 30 GRAĐEVINAR 67 (2015) 1, 23-31 Thirumalai Raja Krishnasamy, Murthi Palanisamy
4. Krstulović, P.: Svojstva i tehnologija betona, Građevinski fakultet Sveučilišta u Splitu i Institut Građevinarstva Hrvatske, Split, 2000
5. Popović, K., „Proizvodnja cementa i održivi razvoj, Građevinar“, Vol 55 (2003) 201-206

## INTERNET SOURCES

1. <http://www.balkanmagazin.net/energetika/cid163-25165/pepeo-leteci-graevinski-materijal>
2. <http://www.cemex.hr/Povijestcimentaibetona.aspx>
3. <http://www.cvipek.hr/cvipek/usluge/kamenolom>
4. <https://green.hr/znate-li-zasto-je-beton-toliko-stetan-za-okolis/>
5. <http://www.mastour.com/blog/ordinary-portland-cement-opc/>
6. [https://rtv.rs/sr\\_lat/vojvodina/novi-sad/inovacije-na-ftn-u-bio-pepel-kao-zamena-za-cement-u-betonu\\_961135.html](https://rtv.rs/sr_lat/vojvodina/novi-sad/inovacije-na-ftn-u-bio-pepel-kao-zamena-za-cement-u-betonu_961135.html)
7. [http://srb.sika.com/sr/solutions\\_products/02/02a001.htm](http://srb.sika.com/sr/solutions_products/02/02a001.htm)
8. <https://zimo.dnevnik.hr/tema/cement/>

# SUSTAINABLE SUPPLY OF DRINKING WATER TO THE CITY OF ŠABAC

**MSc Suzana Knežević, PhD student\*, PhD Milena Milojević, PhD  
Ljiljana Tanasić**

Academy of Vocational Studies Šabac, Unit of Agricultural and Business  
Studies and Tourism, Vojvode Putnika 56, 15000 Šabac, Srbija  
sdknez@gmail.com

**ABSTRACT:** The availability of drinking water, the existence of sanitary conditions and hygiene for all people in every place is the basis of a healthy and dignified life. It is also the sustainable development goal number 6 of the 2030 Agenda for Sustainable Development of the United Nations. Serbia is considered a medium-rich country when it comes to water as a natural resource. Groundwater accounts for about 75% of the public water supply system for the population in Serbia. The Mačvan district has the largest underground water reserves, due to the relatively continuous distribution of two subartesian water-bearing complexes on an area of 600-800 km<sup>2</sup>. The city of Šabac is supplied with water from three sources, and the distribution network is under the responsibility of the city's water supply company. This paper analyzes the sustainable supply of drinking water to the city of Šabac. The description of the existing capacities of drinking water springs is given in the first part of the paper. In the second part, the methods of testing the quality of drinking water are given, while in the third part, the possibilities of preservation and sustainable use of this natural resource were considered.

**KEYWORDS:** *drinking water, sustainable supply, city of Šabac*

## 1. Uvod

The availability of drinking water, the existence of sanitary conditions, and hygiene for all people, wherever they live, are the foundations of a healthy and dignified life. This is also one of the goals of Sustainable Development number 6 of the United Nations' 2030 Agenda for Sustainable Development (United Nations, 2022).

According to Dašić & Đorđević (2020), Serbia is a water-scarce country. These authors emphasize that the average annual quantity of available domestic water is around 1700 m<sup>3</sup> per capita per year (excluding Kosovo

and Metohija), which places Serbia among the poorest European countries in terms of water resources. The second disadvantage is the pronounced spatial unevenness of domestic water (the areas where water is most needed are the poorest in terms of water availability), and the third disadvantage is the temporal irregularity of water supply. Groundwater is scarce, and its quantity significantly decreases during periods of low precipitation, the particular problem being its quality.

Climate change and increasing demand for drinking water are increasingly jeopardizing the sustainability of drinking water supply worldwide. To address this threat, it is necessary to adapt the drinking water supply systems, both at the global and national levels, and especially at the local level (Van Engelenburg et al., 2021).

The World Health Organization (WHO) emphasizes that health goals are an essential component of a drinking water safety plan. It is necessary to establish these goals through a high-level body responsible for health, in consultation with others, including water suppliers and affected communities. The overall public health situation and the impact of the drinking water quality on waterborne microbial and chemical-related diseases should be taken into account as part of the overall health and water supply policy. Ensuring access to water for all consumers is extremely important (WHO, 2017).

According to Grönwall & Danert (2020), groundwater provides nearly half of all drinking water worldwide, and the daily drinking water needs of around 2.5 billion people depend solely on this resource. For this reason, the quantity and quality of groundwater are of key importance in understanding water supply issues.

In Serbia, the share of groundwater in water supply is around 75%, which is similar to most European countries. Groundwater represents the only source of drinking water supply in the region of Vojvodina and a significant part of Serbia. According to the water resources base of Serbia, the portion of groundwater that can be obtained through artificial recharge is approximately 40 m<sup>3</sup>/s in alluvial environments, while the total quantity of water obtained through artificial infiltration, along with estimated renewable reserves of groundwater, amounts to about 107 m<sup>3</sup>/s of quality groundwater. When analyzing the quality of groundwater, some resources are naturally protected or sparsely populated, while others are endangered by human activities, making it necessary to protect this resource. The Mačva District has the largest reserves of groundwater due to the relatively continuous spread of two subartesian aquifer complexes over an area of 600-800 km<sup>2</sup> (Polomčić et al., 2011).

Identifying potential hazards to water quality is the first step in every water supply system, regardless of the type of water source. Following that, an assessment of existing risks is conducted (Cibulić et al., 2015).

According to Veljković et al. (2018), “physical-chemical and microbiological inadequacy of drinking water from public water supply systems in urban areas, as presented on ‘risk maps,’ are qualitative indicators of the impact on health from environmental sources and indicators of the risk of exposure to physical-chemical and microbiological agents, which never exceed the maximum allowable concentrations.”

In the Republic of Serbia, the monitoring of the health safety of drinking water is based on and conducted in accordance with the Law on Health Care, the Law on Protection of the Population from Infectious Diseases that Threaten the Entire Country, and the Law on Health Safety of Food in General Use, as drinking water is considered an essential food product. The Regulation on the Hygienic Safety of Drinking Water is a subordinate act to the Law on Health Safety of Food and Products in General Use. Its provisions directly govern the basis for monitoring the health safety of drinking water and prescribe the permissible values of parameters for its safety. The provisions of the Regulation are in line with the current recommendations of the European Union in this field, as well as the recommendations of the World Health Organization. The domestic regulation is more restrictive regarding the maximum allowed values of health safety parameters, the frequency, and the extent of sample testing (Takić, Pejanović & Živković, 2009).

## 2. Material and Methods

The city of Šabac is located in the northwestern part of central Serbia and serves as the administrative, economic, and cultural center of the Mačva District. It is situated on the right bank of the river Sava, at the tripoint of the regions Mačva, Pocerina, and Posavina, at an elevation of 80 meters above sea level, and covers an area of 795 square kilometers. In addition to the central urban settlement, the municipality of Šabac comprises 52 other populated places (Grčić M. & Grčić Lj., 2002).

According to the results of the population census conducted in 2022, the total population of the city of Šabac is 106,066 (Statistical Office of the Republic of Serbia, 2022).

The city of Šabac primarily relies on underground sources for its drinking water supply (100%). The specific water consumption ranges from 373 to 496 liters per day per user, as shown in figure 1 (SEPA, 2018).

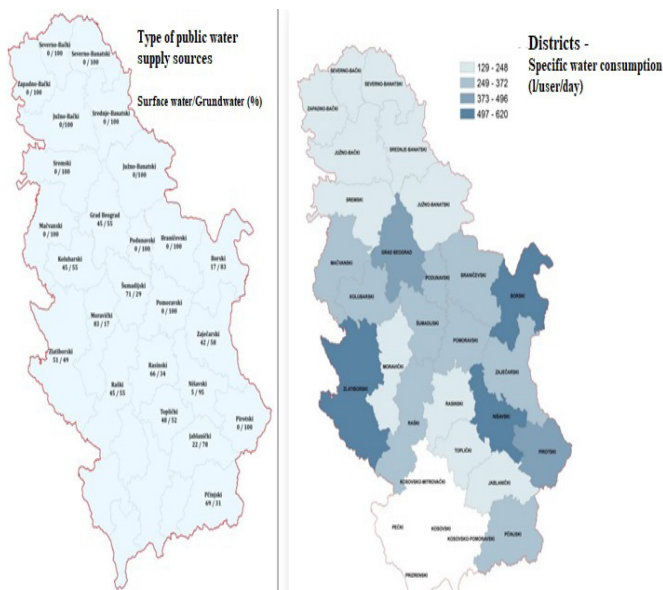


Figure 1 Type of water sources and specific water consumption according to districts  
(Source: SEPA, 2018)

Based on the fact that groundwater sources in Serbia are insufficiently protected, polluting effluents can penetrate into the underground aquifers and lead to permanent contamination. High-quality groundwater is a nationally significant resource, and for this reason, it should be used only for settlements and technologies that require the highest quality water (Dašić & Đorđević, 2020).

The physical-chemical and microbiological inadequacy of drinking water from public water supply systems in urban areas, as presented on “risk maps,” are qualitative indicators of the health impact from environmental sources and indicators of the risk of exposure to physical-chemical and microbiological agents, never exceeding the maximum allowable concentrations.

The available data for this study were obtained from Public Utility Company “Waterworks – Šabac” (JKP “Vodovod – Šabac”) and the Institute of Public Health Šabac.

## 2.1. Characteristics of the Distribution Water Supply Network in the City of Šabac

The majority of the population receives drinking water from the distribution network of Public Utility Company “Waterworks – Šabac”, while a smaller number of residents, mainly in rural settlements, are supplied with water from their own wells.

According to the data from JKP “Vodovod - Šabac,” the length of the distribution network is 390 km of pipelines and around 120 km of connection pipelines. The network has a total of 21,383 connections. In addition to residents from the city’s central and wider urban areas, the water supply services are also used by inhabitants from surrounding settlements such as Majur, Jevremovac, Pocerski Pričinović, Jelenča, Štitar, Slepčević, Tabanović, Ševarice, Drenovac, Mačvanski Pričinović, Vranjska, and Mišar. The distribution water supply network covers an altitude range of 80 to 115 meters above sea level, with consumers distributed within this elevation range, and the system operates as a single altitude supply zone. Expanding the distribution water supply network to rural areas is one of the priority objectives for both the company and the city of Šabac. The nominal pressure in the network is 4 bars, while the average pressure is lower, ranging from 3 to 3.5 bars. The water supply network of Šabac is shown in Figure 2.

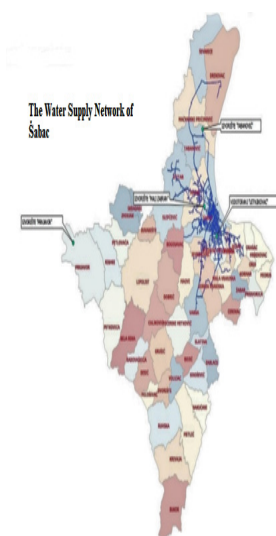


Figure 2. The water supply network of Šabac (Source: Public Utility Company “Waterworks – Šabac”)



## 2.2. Production of drinking water in the city of Šabac

The primary water resources for supplying the population of the city of Šabac are of underground nature - well sources. The production of drinking water is carried out at the Mali zabran, Tabanović, and Mačvanski Prnjavor sources. In the southern part of the city, there is the Letnjikovac water tower.

The Mali zabran source is located approximately 1.1 km northwest of the city, in the immediate vicinity of the racecourse. Since 1995, the source has undergone reconstruction, and a raw water treatment plant (deferrization, demanganization, and sand filtration) has been installed. The water is obtained from 12 wells, each with a depth of 25 meters, with a total operational capacity of 130 l/s. Within the facility, there are two reservoirs with a total capacity of 5,000 m<sup>3</sup>. Their purpose is to ensure a steady water treatment process and sufficient water supply to meet peak consumption demands. The central water utility laboratory is also located at this site.

The Tabanović source is located 8 km away from the city of Šabac, 4 km from the right bank of the Sava River, and approximately 2 km from the village of Tabanović. It serves as the main source of the Šabac water supply, with a capacity of around 230 l/s. The water is obtained from 5 wells, each with a depth of 25 meters. The water is naturally chemically and bacteriologically safe, but as a preventive measure, it is chlorinated automatically. The source includes a reservoir with a capacity of 10,000 m<sup>3</sup>, and a pumping laboratory is also located at the same site. The length of the main pressure pipeline is 9.5 km, which transports raw water from the Tabanović source to the Mali zabran source, where they merge into one pipeline that further leads to the city and the Letnjikovac water tower.

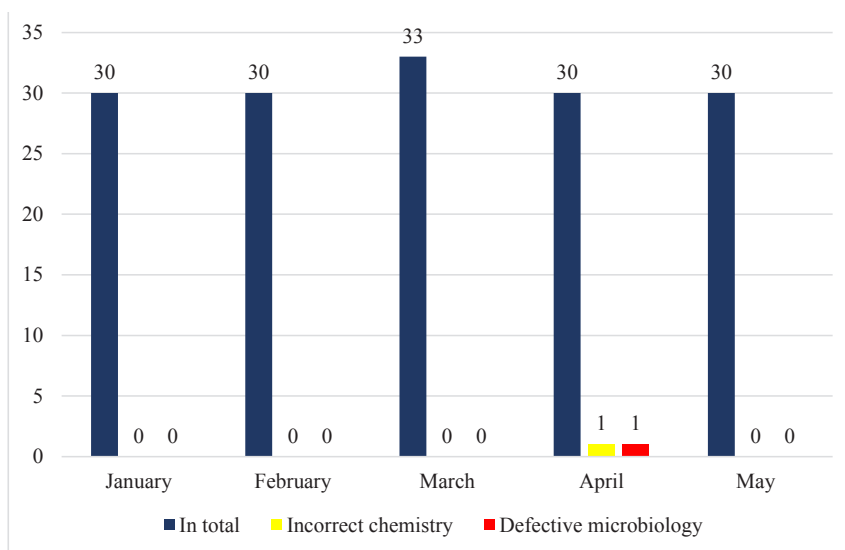
The Mačvanski Prnjavor source is located 30 km away from the city and is situated in the immediate vicinity of the Drina River. The source currently has two active wells with a capacity of 40 l/s each (total 80 l/s) and a depth of 30 meters. Water disinfection is carried out using liquid chlorine.

## 2.3. Drinking Water Quality

The supply of the city of Šabac with hygienically safe drinking water is a regular activity of Public Utility Company "Waterworks – Šabac". Water analysis for drinking water is carried out regularly in the utility's internal laboratory, as well as through external controls performed by the Institute

of Public Health Šabac and periodically by the Institute of Public Health “Batut.” According to available data, over 3,000 water samples are physically, chemically, and microbiologically tested annually in the internal laboratory of Public Utility Company “Waterworks – Šabac”. The analyses are conducted daily, with water samples taken from both the sources and consumers’ taps, covering the entire water supply network during each month. In addition to the daily testing of composite raw water samples, individual testing of all wells from all three sources is performed once a month.

The Institute of Public Health Šabac examines up to 500 water samples annually, including samples from all three sources and individual samples from the distribution network. Graph 1 summarizes the results of the water testing conducted by the Institute for the first five months of 2023.



*Graph 1. Results of drinking water testing for the period January-May 2023 (Source: Institute of Public Health Šabac)*

### 3. Results and Discussion

In the territory of the city of Šabac, continuous efforts are taken for the rational and sustainable management of drinking water. In accordance with the current legal regulations concerning water management, the practical implementation of planned activities largely falls under the responsibility of Public Utility Company “Waterworks – Šabac”, with the support of

the local government and JVP “Srbijavode.” The water utility, using its own financial resources and applying for funding from European Union funds, aims to expand both the water distribution network and the sewerage system. This company demonstrates socially responsible behavior and adherence to the principles of sustainable development by providing free connections to the water supply and sewerage system for families with persons with disabilities.

### 3. Conclusion

Supplying the population of Šabac with hygienically safe drinking water is one of the strategic development goals of the city and it aligns with United Nations Sustainable Development Goal number 6. Both urban and suburban areas are supplied with drinking water from the local water supply network, and the distribution network is increasingly expanding towards rural areas. Continuous control of drinking water quality is conducted, both in the internal laboratory of Public Utility Company “Waterworks – Šabac” and externally at the Institute of Public Health Šabac, with the Institute of Public Health “Batut” also being engaged when needed. Despite the fact that the Mačva region has the largest quantities of groundwater, this national natural resource requires sustainable and rational management. One of the key steps to achieve this is raising awareness among the population that drinking water sources must be preserved and accepting the principle “the consumer pays.”

### 4. References

- [1] Cibulić, V., Veljković, N., Stamenković, L., & Staletović, N. (2015). Procena i upravljanje rizikom u sistemima za snabdevanje vodom za piće. *VODOPRIVREDA*, 47(273-275), 119-130.
- [2] Dašić, T., & Đorđević, B. (2020). Upravljanje vodama u uslovima klimatskih promena. In *Zbornik radova VODA 2020*, Trebinje, Srpsko društvo za zaštitu voda, 1-8.
- [3] Grčić M. & Grčić Lj., (2002). Mačva, šabačka Posavina i Pocerina. Geografski fakultet Univerziteta u Beogradu.
- [4] Grönwall, J., & Danert, K. (2020). Regarding Groundwater and Drinking Water Access through A Human Rights Lens: Self-Supply as A Norm. *Water*, 12(2) 419. MDPI AG. Retrieved from <https://doi.org/10.3390/w12020419>
- [5] Pejanović, S., Živković, N., & Takić, Lj. (2009). Monitoring zdravstvene ispravnosti vode za piće. *Vodoprivreda*, vol.41, br.4-6, 185-192.

- [6] Polomčić D., Stevanović Z., Dokmanović P., Papić P., Ristić Vakanjac V., Hajdin B., Milanović S., & Bajić D. (2011). *Vodosnabdevanje podzemnim vodama u Srbiji - stanje i perspektive*. Monografija „40 godina Departmana za hidrogeologiju“ 45 - 78. Rudarsko-geološki fakultet, Beograd.
- [7] Republički zavod za statistiku Srbije. (2022). Prvi rezultati Popisa stanovništva, domaćinstava i stanova 2022. Retrieved at <https://publikacije.stat.gov.rs/G2022/HtmlL/G20221350.html>. Accessed Jul 5, 2023.
- [8] Republic of Serbia Ministry of Environmental Protection, Environmental Protection Agency. (2018). Nedostatak vode za piće. Stručna radionica “Procena rizika od katastrofa”, 24-26 april, 2018. Beograd
- [9] United Nations. (2022). Goal 6: Ensure access to water and sanitation for all. Retrieved from <https://www.un.org/sustainabledevelopment/water-and-sanitation/>. Accessed 12 jul 2023, 20:45.
- [10] Van Engelenburg, J., Van Slobbe, E., Teuling, A. J., Uijlenhoet, R., & Hellegers, P. (2021). Sustainability characteristics of drinking water supply in the Netherlands. *Drinking Water Engineering and Science*, 14(1), 1-43
- [11] Veljković, N., Petrović, Z., Šotić, A., & Hero-Gon, M. (2018). Voda za piće i ljudsko pravo: dezinformacije i poverenje potrošača. *Voda i sanitarna tehnika*, 48(3-4), 37-48.
- [12] World Health Organization (WHO). (2017). Guidelines for Drinking-Water Quality, 4th edition, incorporating the 1st addendum, 1-631. Retrieved from <https://www.who.int/publications/i/item/9789241549950>
- [13] JKP “Vodovod-Šabac”, <https://www.vodovodsabac.rs/>
- [14] Zavod za javno zdravlje Šabac, <http://www.zjz.org.rs/>

## CORRELATION AND PATH ANALYSIS OF GRAIN YIELD AND COMPONENTS OF GRAIN YIELD OF MAIZE (*Zea mays* L.)

Zorana Srećkov<sup>33</sup>, Jan Boćanski<sup>34</sup>, Zorica Mrkonjić<sup>35</sup>, Mirjana Bojović<sup>36</sup>,  
Igor Vukelić<sup>37</sup>, Gordana Racić<sup>38</sup>, Vesna Vasić<sup>39</sup>, Olivera Nikolić<sup>40</sup>

<sup>1</sup> Ecological agriculture, Educons University, Sremska Kamenica, Serbia

<sup>2</sup> Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia

**SUMMARY:** Maize is one of the most important cereal crops. Besides its use as food and feed, maize is also an energy crop. In order to ensure sufficient quantities of maize, the main goal of every breeding program is to develop new, better hybrids. Correlation and path coefficient analysis can be used for indirect selection of high-yielding hybrids. In light of that, one of the objectives of this paper was to determine relationship between grain yield and morphological traits, for 8 inbred lines and their hybrids. Strong genetic and phenotypic correlations were found between grain yield and other studied traits, except between grain yield, on one side, and kernel row number, where we found medium phenotypic correlations. Between morphological traits of plant and ear the highest values of genotypic and phenotypic coefficient of correlations were found between ear length and kernel number per row. Also, the objective of this research was to find the direct and indirect effects of morphological traits on grain yield. Desirable, high significant influence on grain yield in path coefficient analysis, was found for almost all studied traits. Ear height was the only trait that had negative direct genetic and phenotypic influence.

**KEY WORDS:** maize, morphological traits, grain yield, correlations, path analysis

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<sup>33</sup> zorana.sreckov@educons.edu.rs - \* corresponding author

<sup>34</sup> jan.bocanski@polj.uns.ac.rs

<sup>35</sup> zorica.mrkonjic@educons.edu.rs

<sup>36</sup> mirjana.bojovic@educons.edu.rs

<sup>37</sup> igor.vukelic@educons.edu.rs

<sup>38</sup> gordana.racic@educons.edu.rs

<sup>39</sup> vesna.vasic@educons.edu.rs

<sup>40</sup> olivera.nikolic@educons.edu.rs

## INTRODUCTION

Maize is one of the most used cereal crops globally (Taube et al., 2020). The superior position of maize is due to its very wide and variety utilization. Besides its use as food and feed, maize is also, one of the most commonly used cereals for bioethanol production (Aghaei et al, 2022). The use of maize as an energy crop has plenty of benefits. It can increase the development of the rural area, ensure energy security, and has a positively impact on the environment (Skoufogianni et al, 2020).

Due to maize usage diversity, the main goal of all maize breeding programs is to develop variates that will be better than existing hybrids in a number of traits. Particular attention is paid to grain yield. Grain yield is a quantitative trait with a complex mode of inheritance and within great influence of environmental conditions. It depends on different processes during the life cycle, and it is in relationship with dissimilar components. Therefore, knowing the relationships between grain yield and its components can significantly increase the success of the breeding program (Aman et al, 2020). Due to the sequential development of yield through different growth stages, the importance of some yield components cannot be assessed using the correlation coefficient. **Path** coefficient **analysis** is more suitable because offers more information among variables than correlation coefficients, since this **analysis** provides the direct effects of specific yield components on yield, and indirect effects via other yield components (Garcia del Moral et al., 2003).

*Thus, the objective of this paper was to determine the genetic and phenotypic interrelationship between grain yield and components of grain yield, in 15 hybrids and their parental inbred lines. Furthermore, the goal of this study was to find the direct and indirect effects of morphological traits on grain yield.*

## MATERIAL AND METHODS

The test-cross population studied in this research was developed by crossing 5 inbred lines (NSL 4026, NSL 4099, NSL 4065, B73 Ht, and A632) and three testers (NSL 115-2, NSL 130-5, and NSL 221/I). One year experiment was set up in an experimental field in a single location (Rimski Šančevi) using a complete block design with three replications. Each plot consisted of one, 5 m long row. The spacing between plots was 0,7 m and 0.25 m between

plants. The standard growing technique was used and harvesting was done by hand.

The data for plant (PH) and ear height (EH), ear length (EL), kernel number per row (KNR), kernel row number (KRN), 100-kernel weight (KW), and grain yield per plant (GY) were recorded on 10 randomly taken competitive plants and ears per replication.

The coefficients of correlations (genetic and phenotypic) were calculated as a ratio of joint variation and a summary of individual variation of two traits (**Hallauer and Miranda, 1988**). The significance of the correlation coefficient was determined using t-test. The method of the inverse symmetric correlation matrix (**Edwards, 1979**) was used for path coefficients and levels of their significance determinations.

## RESULTS AND DISCUSSION

In order to obtain the level of relationship between studied traits, we calculated the genetic and phenotypic coefficient of correlation.

Grain yield had the strongest, highly significant, genetic correlation with kernel number per row ( $r_g = 0.969^{**}$ , Tab. 1). High significant, strong relationship also was found between grain yield, on one side, and plant height ( $r_g = 0.962^{**}$ ), ear height ( $r_g = 0.855^{**}$ ), ear length ( $r_g = 0.962^{**}$ ) and 100-kernel weight ( $r_g = 0.856^{**}$ ), on the other side.

Many authors found a strong correlation between grain yield and morphological traits of plants and ear. **Vara Prasad and Shivani (2017)** studied 18 maize genotypes in order to estimate the relationship between grain yield and yield-contributing traits. They detected strong and highly significant correlations between grain yield, on one side, and plant height, ear length, kernel row number and number of kernels per row, on the other side. Grain yield was insignificant, but medium strong relationship with ear height. Our results were similar to the results found by **Aman et al (2020)**. These authors studied the genetic potential of 45 quality protein maize (QPM) and found highly significant strong correlations between grain yield and plant and ear height. Between grain yield and kernel row number they also found highly significant strong correlations, but that relationship was negative, which is dissimilar to our results. Also, they found a weak genetic relationship, between the number of kernels per row and kernel yield which is in disagreement with the results obtained herein. Genetic correlations estimated in our research also were similar to the results of **Kanna et al. (2021)**. These authors studied the genetic variability of eight maize hybrids and found strong genetic correlations between ear height and length and kernel row number and grain yield



per plant. Hundred kernel weight also was in strong genetic correlations with grain yield, but that relationship was negative.

On the contrary, **Ahmed et al. (2020)** determined low, negative genetic correlations between grain yield and plant and ear height. Ear length and the number of kernels row was in positive, but medium strong relationship with grain yield, and 1000 kernel weight was in positive, but weak correlation with yield.

Between other studied traits, the strongest genetic relationship was found between ear length and kernel number per row ( $r_g = 0.955^{**}$ ). A highly significant and strong genetic relationship between these two traits also was obtained by **Kann et al (2021)**. **Vara Prasad and Shivan (2017)** found medium strong, and **Ahmed et al (2020)** weak genetic correlations between ear height and length. Results in this study are opposite to the results obtained by previous authors.

*Table 1. Genetic (above diagonal) and phenotypic (below diagonal) correlation coefficient between morphological traits of plant and ear*

	PH (cm)	EH (cm)	EL (cm)	KNR	KRN	KW (g)	GY (g)
PH (cm)		0.861**	0.934**	0.920**	0.640	0.813**	0.962**
EH (cm)	0.858**		0.830**	0.818**	0.686	0.644	0.855**
EL (cm)	0.927**	0.827**		0.955**	0.481*	0.851**	0.962**
KNR	0.915**	0.817**	0.951**		0.462	0.810**	0.969**
KRN	0.630	0.679	0.478	0.458		0.326	0.606
KW (g)	0.788**	0.629	0.830**	0.789**	0.306		0.856**
GY (g)	0.956**	0.853**	0.957**	0.966**	0.599	0.839**	

\*  $p < 0.05$

\*\*  $p < 0.01$

Mutual effects of genetic factors and environment on relationship of traits are determined by the phenotypic correlation coefficient.

The greatest value of the phenotypic coefficient of correlation was obtained between grain yield and kernel number per row ( $r_p = 0.951^{**}$ , Tab. 1). Highly significant, positive values of phenotypic coefficient also were determined between grain yield, on the one side, and plant ( $r_p = 0.956^{**}$ ) and ear height ( $r_p = 0.853^{**}$ ), ear length ( $r_p = 0.957^{**}$ ), kernel number per row ( $r_p = 0.966^{**}$ ) and 100-kernel weight ( $r_p = 0.839^{**}$ ), on the other side. With kernel row number, grain yield was in a medium relationship ( $r_p = 0.599$ ). The results, we obtained in our research, are in agreement with the results of **Yahaya et al. (2021)**. They studied growth and yield reaction on irrigation and different levels of fertilizers in two locations, and in both locations found

highly significant and strong phenotypic correlations between grain yield and plant height, ear length, and kernel weight.

Table 2. Path coefficient analysis for grain yield based on genetic (a) and phenotypic (b) correlations

Pathway	Population	
	a	b
<i>Plant height vs. Grain yield</i>		
Direct effect ( $p_i$ )	<b>0.0714**</b>	<b>0.0987**</b>
Indirect effect via Ear height	-0.024	-0.017
Ear length	0.121	0.104
Kernel number per row	0.512	0.504
Kernel row number	0.126	0.118
100-kernel weight	0.154	0.149
<i>Ear height vs. Grain yield</i>		
Direct effect ( $p_i$ )	<b>-0.0274</b>	<b>-0.0203</b>
Indirect effect via Plant height	0.061	0.085
Ear length	0.108	0.093
Kernel number per row	0.455	0.450
Kernel row number	0.136	0.127
100-kernel weight	0.122	0.119
<i>Ear length vs. Grain yield</i>		
Direct effect ( $p_i$ )	<b>0.1300**</b>	<b>0.1124**</b>
Indirect effect via Plant height	0.067	0.091
Ear height	-0.023	-0.017
Kernel number per row	0.532	0.524
Kernel row number	0.095	0.089
100-kernel weight	0.161	0.157
<i>Kernel number per row vs. Grain yield</i>		
Direct effect ( $p_i$ )	<b>0.5567**</b>	<b>0.5506**</b>
Indirect effect via Plant height	0.066	0.090
Ear height	-0.022	-0.017
Ear length	0.124	0.107
Kernel row number	0.091	0.086
100-kernel weight	0.154	0.149

### Kernel row number vs. Grain yield

Direct effect ( $p_1$ )	<b>0.1976**</b>	<b>0.1868**</b>
Indirect effect via Plant height	0.046	0.062
Ear height	-0.019	-0.014
Ear length	0.063	0.0534
Kernel number per row	0.257	0.252
100-kernel weight	0.062	0.058

### 100-kernel weight vs. Grain yield

Direct effect ( $p_1$ )	<b>0.1896**</b>	<b>0.1891**</b>
Indirect effect via Plant height	0.058	0.078
Ear height	-0.018	-0.013
Ear length	0.111	0.093
Kernel number per row	0.451	0.434
Kernel row number	0.064	0.057

Coefficient of determination $R^2_{y1234567}$	<b>0.9918**</b>	<b>0.9871**</b>
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Also, our results are similar to the results of **Aman et al (2020)** who founds strong correlations between grain yield and plant height, kernel weight and number of kernels per row, and a medium strong correlation between grain yield and kernel row number, like we are, but they also found medium strong relationship between grain yield and ear height, with which our results are not in agreement. **Muliadi et al (2021)** did the genetic analysis of 10 waterlogging hybrids of maize and found a highly significant, the strong phenotypic relationship between grain yield on one side and 100 kernel weight and ear length, on the other side, like we are, but contra to our results they estimated low correlations between plant and ear height, and number of kernels per row with grain yield per plant, and medium strong phenotypic relationship between kernel row number and grain yield.

The genetic direct effects, obtained in path coefficient analysis, indicated that grain yield per plant at most depended upon the number of kernels per row ( $p_5 = 0.5567^{**}$ ). **Vara Prasad and Shivani (2017)** also found the greatest direct effect of the number of kernels per row on grain yield. The indirect influence of kernel row number didn't show significance.

Highly significant, positive influence also was found for kernel row number ( $p_5 = 0.1976^{**}$ ), 100-kernel weight ( $p_6 = 0.1896^{**}$ ), ear length ( $p_3 = 0.1300^{**}$ ), and plant height ( $p_1 = 0.0714^{**}$ ). These results are in agreement with the results of **Muliadi et al (2021)**. **Kann et al (2021)** and **Aman et al (2020)** also found the positive direct influence of kernel row number, kernel

weight, and ear length, but these authors estimated a negative genetic direct influence of plant height on grain yield. Our results are not in agreement with the results of **Ahmed et al. (2020)**. These authors found the highest direct influence of ear height on grain yield, but the influence was negative. Also, in their research only ear length has a positive direct effect on grain yield.

Path coefficient analysis showed an undesirable, direct effect of ear height on grain yield ( $p_2 = -0.0274$ ). High values of the genetic coefficient of correlations of ear height with grain yield are in disagreement with values of path coefficients. That could be explained that ear height was influencing the grain yield through other studied morphological traits of plant and ear. Negative values of the path coefficient for ear height were obtained and by **Alvi et al. (2003)** and **Sofi and Rather (2007)**.

A positive direct phenotypic effect was found for almost all studied traits (Tab. 3). Ear height only had a negative, but not significant, direct phenotypic effect on grain yield. The highest value of the phenotypic path coefficient was estimated for a number of kernels per row, and it was highly significant. The highly significant direct phenotypic effect also determines for plant height, ear length, kernel row number and 100-kernel weight.

## CONCLUSION

Based on the results obtained herein it could be concluded:

Grain yield had strong, genetic and phenotypic correlations, with all traits, except with kernel row number. The highest correlation was calculated between grain yield and kernel number per row. Between other studied traits, the highest value of correlation coefficient was found between ear length and kernel number per row.

Path coefficient analysis indicates that the greatest influence on grain yield has the number of kernels per row. High significant, genetic direct influence also was found for plant height, ear length, kernel row number and 100-kernel weight. Ear height has an undesirable influence on grain yield.

Path coefficient analysis based on phenotypic coefficient indicates positive and highly significant direct influence of plant height, ear length, kernel row number, number of kernels per row and 100-kernel weight. Ear height have negative, but not significant phenotypic direct effects.

## REFERENCES

- [1] **Aghaei, S., Alavijeh, M. K., Shafiei, M., Karimi, K. (2022):** A comprehensive review on bioethanol production from corn stover: Worldwide potential, environmental importance, and perspectives. *Biomass and Bioenergy*, 161:106447
- [2] **Ahmed, N., Chowdhury, A. K., Uddin, S., Rashad, M. I. (2020):** Genetic variability, correlation and path analysis of exotic and local hybrid maize (*Zea mays* L.) genotypes. *Asian J. Med. Biol. Res.*, 6 (1): 8-15.
- [3] **Alvi, M. B., Rafique, M., Tariq, M. S., Hussain, A., Mahmood, T., Sarwar, M. (2003):** Character association and path coefficients analysis of grain yield and yield components maize (*Zea mays* L.). *Pakistan Journal of Biological Science*, 6:136-138.
- [4] **Aman, J., Bantte, K., Alamerew, S., Berhe Sbhatu, D. (2020):** Correlation and Path Coefficient Analysis of Yield and Yield Components of Quality Protein Maize (*Zea mays* L.) Hybrids at Jimma, Western Ethiopia. *International Journal of Agronomy*, Article ID 9651537
- [5] **Garcia del Moral, L. F., Rharrabti, Y., Villegas, D., Royo, C. (2003):** Evaluation of Grain Yield and Its Components in Durum Wheat under Mediterranean Conditions. An Ontogenic Approach. *Agron. J.*, 95:266-274
- [6] **Edwards, A. L. (1979):** Multiple regression and analysis of variance and covariance. *Freeman, W. H. comp.*, San Francisco, pp. 31-38
- [7] **Hallauer, A. R., Miranda, J. B. (1988):** Quantitative genetics in maize breeding. *Iowa State Univ. Press. Ames, IA*, pp. 468.
- [8] **Kanna, R. M., Barua, N. S., Sharma, K. K., Sarma, R. N., Das, R., Barooah, M, Sarma, D., Bordoloi, D. (2021):** Assessment of Maize (*Zea mays* L.) Hybrids across Spacings for Variability, Trait Association and Path Analysis in North Eastern India. *IJECC*, 11(12): 510-524
- [9] **Muliadi, A., Effendi, R., Azrai, M. (2021):** Genetic variability, heritability and yield components of waterlogging-tolerant hybrid maize. *Earth and Environmental Science* 648: 012084
- [10] **Skoufogianni, E., Solomou, A., Charvalas, G., Danalatos, N. (2020).** Maize as Energy Crop. In *Maize - Production and Use* doi: 10.5772/intechopen.88969
- [11] **Sofi, P., Rather, A. G. (2007):** Studies on genetic variability, correlation and path analysis in maize (*Zea mays* L.), *MNL*, 81:26-27
- [12] **Taube, F., Vogeler, I., Kluß, C., Herrmann, A., Hasler, M., Rath, J., Loges, R., Malisch, C. S. (2020):** Yield progress in forage maize in NW Europe - breeding progress or climate change effects? *Front. Plant Sci.* 11: 1214
- [13] **Vara Prasad, B. V. V., Shivani, D. (2017):** Correlation and path analysis in maize (*Zea mays* L.). *Journal of Genetics, Genomics and Plant Breeding*, 1 (2): 1-7
- [14] **Yahaya, M. S., Bello, I., Unguwanrimi, A.Y. (2021):** Correlation and path-coefficient analysis for grain yield and agronomic traits of maize (*Zea mays* L.). *Science World Journal*, 16 (1):10-13

## ECO-INNOVATIONS IN THE CREATION OF NEW CAPACITIES FOR ACHIEVING THE GOALS OF THE GREEN ECONOMY – CASE OF MIDAS PROJECT<sup>1</sup>

dr Ana Marjanovic Jeromela,<sup>2</sup> prof. dr Andrea Andejević Panić<sup>3</sup>, dr Simonida Vukadinović<sup>4</sup>, prof. dr Jelena Ješić<sup>5</sup>, Efi Alexopoulou<sup>6</sup>

<sup>2</sup>Institute for Field and Vegetable Crops, Novi Sad, Serbia,  
ana.jeromela@ifvcns.ns.ac.rs

<sup>3</sup>Educons University/Faculty of Business Economy  
Sremska Kamenica, Serbia, andrea.andrejevic@educons.edu.rs

<sup>4</sup>Educons University/Faculty of Business Economy Sremska Kamenica,  
Serbia, simonida.vukadinovic@educons.edu.rs

<sup>5</sup>Educons University/Faculty of Business Economy Sremska Kamenica,  
Serbia, jelena.jessic@educons.edu.rs

<sup>6</sup>Center for Renewable Energy Sources and Saving (CRES), Pikermi Attikis  
ealex@cres.gr

**ABSTRACT:** Institute for Agriculture and Vegetables, National Institute of importance for the Republic of Serbia, in consortium of 25 partners from 13 European countries engage all relevant stakeholders (agricultural community, bio-based industry, academic community, etc.) in dissemination and exploitation of project results and encouragement of international cooperation to exchange best practices and create scenarios for the benefit of all in development of business plans to encourage circularity at the farm level through engagement agricultural community, industrial actors and academic community through project case studies.

In this context the MIDAS - Marginal lands, industrial crops and innovative bio-based value chains project, which has been funded by the Horizon Europe framework program, decided to address challenges contained in specific goals of the MIDAS: Increasing knowledge about current and future marginal land for “low ILUC” biomass production, challenges biodiversity and ecosystem services, as well as potential common ones benefits from biomass production. “Low-ILUC” (ILUC - Indirect Land Use Change) is a factor that indicates in to what extent is there a risk of changing the use of arable

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land for the production of raw materials for products that they are not food. Raw materials that have a low ILUC risk were created by growing industrial crops on marginal land or by cultivating areas that were not used for plant production or were abandoned, through the improvement of agricultural practices, which keeps the areas for the production of food raw materials at the same level. Optimization of the production of selected industrial plant species, adapted to cultivation on marginal agricultural land in the 9th state, in 12 localities to achieve a low level of ILUC. Establishment of case studies (12 in 9 countries) of innovative systems cultivation (combined sowing and agroforestry) which have a low ILUC level at marginal agricultural land at the agricultural level farms, for current and future systems in agriculture.

Utilization of marginal lands for growing sustainable industrial crops and developing innovative bio-based products represents significant eco-innovation that contributes to increasing the number and quality of the impacts on the green economy network of excellent case studies: Development of 13 new bio products (biobased) in accordance with circular use biomass. Development of innovative value chains/networks based on biologically effective resources and assessment of production sustainability, including impacts on biodiversity.

**KEYWORDS:** Green Economy, Eco-innovations, Sustainable development, Biodiversity.

## Introduction

Eco-innovation (UNEP, 2023) is a new business approach which promotes sustainability throughout the entire life cycle of a product, while also boosting a company's performance and competitiveness. It can help small- and medium-sized enterprises (SMEs) access new and expanding markets, increase productivity, attract new investment into the business, increase profitability across the value chain, and help SMEs stay ahead of regulations and standards – notably those related to the environment. Also, UNEP defines a green economy as one that results in “improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities”(UNEP 2010). In its simplest expression, a green economy is low-carbon, resource efficient, and socially inclusive. In a green economy, growth in income and employment are driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services.



The capacity to achieve the goals of the green economy concept grows with the application of an increasing number of eco-innovations. One of the good practice examples that started in 2022 and represents the topic of this paper is MIDAS project, a Horizon Europe Innovation Action, developing and demonstrating innovative solutions to grow industrial crops on marginal agricultural land and build sustainable value chains for a wide range of bio-based products. MIDAS is coordinated by Centre for Renewable Energy Sources (CRES) Greece and brings together 25 partners from 13 countries including research organizations, industries and SMEs. Institute for Agriculture and Vegetables, National Institute of importance for the Republic of Serbia, in consortium of 25 partners from 13 European countries engage all relevant stakeholders (agricultural community, bio-based industry, academic community, etc.) in dissemination and exploitation of project results and encouragement of international cooperation to exchange best practices and create scenarios for the benefit of all in development of business plans to encourage circularity at the farm level through engagement agricultural community, industrial actors and academic community through project case studies.

### **Utilization of marginal lands for growing sustainable industrial crops and developing innovative bio-based products – the case of MIDAS project**

Primarily, in it`s basis, MIDAS supports the achievement of 7 Sustainable Development Goals:

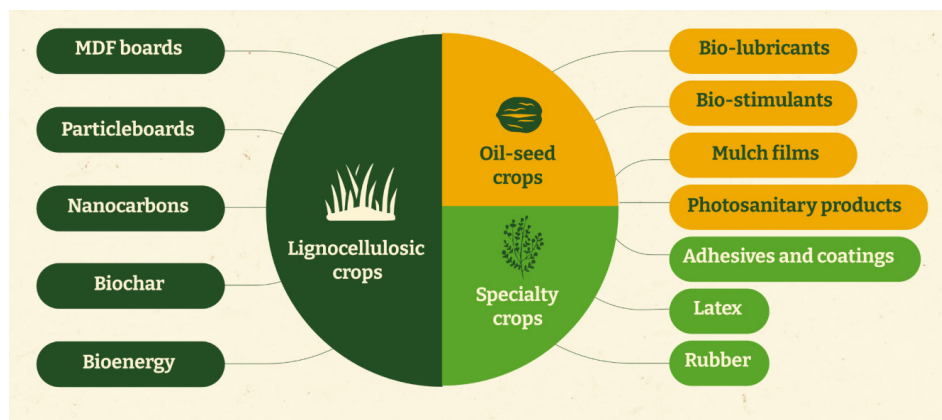
- 1) Clean water and sanitation – by reducing the inputs need of agriculture (fertilizes, herbicides) and by developing bioherbicides, biodegradable mulch films, biostimulants and soil amendments to replace corresponding fossil-based materials.
- 2) Affordable and clean energy by promoting the circular use of biomass through the using of all residues and by-products for bioenergy production.
- 3) Decent work and economic growth by contributing to identify new business models to create economic growth and more job opportunities in rural areas.
- 4) Industry innovation and infrastructure – by fostering innovation on crops, cropping systems, bio-based products and value chain webs.

- 5) Sustainable cities and communities by developing innovative bio-based products (MDF and particle boards, resins and coatings) for the building and housing sector.
- 6) Responsible consumption and production by providing new solutions to replace fossil-based products by others using local resources with lower impact.
- 7) Life on land by promoting the sustainable use of the terrestrial ecosystems by growing non-edible crops that support biodiversity with emphasis on the pollinators on marginal lands.

MIDAS adopts a resource-efficient biorefinery concept to develop a wide range of bio-based products, obtained from innovative value chains and from diverse biomass feedstock produced on marginal land. Oilseeds from annual crops (castor, crambe, safflower and carinata) are used to produce biodegradable mulch films, bio-lubricants and bio stimulants.

Hemp, sorghum, miscanthus, willow and siberian elm are used to produce MDF panels, particle boards, biochar and nanocarbons. Speciality crops (guayule and lavender) are used to produce rubber for car tyres, latex for gloves, adhesives and coatings.

*Picture 1: Products of MIDAS project*



Source: <https://www.midas-bioeconomy.eu/products/>

Challenges, expected outcomes and impacts contained in specific goals of the MIDAS project

MIDAS supports the European Green Deal, the EU Bioeconomy Strategy and the EC Communication on Sustainable Carbon Cycle, with a wide range of outcomes.

1. 15 cases of innovative cropping systems (intercropping and agro-forestry) demonstrated at TRL7 for marginal lands in 9 Mediterranean and Continental countries.

2. Development of 11 different bio-based products at TRL 7 and business plans with improved circularity at farm and process level. 5 of the final bioproducts will be applied to agricultural fields to reduce GHGs emissions and environmental footprint of the cropping systems.

3. Low ILUC feedstock production from non-edible crops for the bio-based industry with a circular use of biomass.

4. Improved breeding material for selected non-edible crops with high performance under water scarcity and with reduced needs in terms of inputs.

5. Advanced knowledge of the biodiversity effects of novel cropping systems on biodiversity.

6. Supporting pollinators in marginal land with risk of desertification by growing nectar-producing industrial crops with sustainable agricultural practices.

7. Mapping the actual and future agricultural marginal lands for low ILUC feedstock production taking into consideration the climate change and the biodiversity challenges and potentials.

8. Detailed open access maps of marginal abandoned and degraded land in EU (6 different groups, 55 maps).

Table1: MIDAS carries out a wide range of activities at different levels and scales of multiple bio-based value chains:

1.	Mapping available marginal land	<p>Improve the understanding and the spatially explicit representation of the actual and future available marginal land in Europe.</p> <p>Assess the feedstock potential, the effects on biodiversity, the provision of ecosystem services, as well as the socio-economic impacts of the production of low ILUC risk biomass in available marginal land at scale.</p>
2.	Crop breeding	<p>Optimize selected non-edible crops adapted to marginal agricultural lands through modern biotechnology tools.</p> <p>Advanced breeding of new resource efficient hybrids and varieties adapted to growing in marginal land and evaluation in multi-location trials.</p> <p>Testing and demonstration of selected crops in multi-location trials.</p>
3.	Agronomic optimization and resource efficiency	<p>Tailor agronomic practices for low-inputs and water needs to increase the crop efficiency in marginal land.</p> <p>Application of an innovative subirrigation system in dry Mediterranean areas.</p> <p>Circular use of MIDAS bio-products on crops grown on marginal lands (biochar, bioherbicides, biostimulants, mulching film).</p>
4.	Farm-scale case studies of innovative cropping systems	<p>Demonstrate case-studies of innovative biomass cropping systems in marginal agricultural land in Italy, Germany, Greece, Spain, Serbia, Poland, Czech Republic, France and Hungary, to produce different types of feedstock for multiple bio-based products.</p> <p>Farm-scale trials of agroforestry systems including short rotation woody crops intercropped with annual industrial crops.</p>
5.	Setup of Regional Advisory Groups	<p>Work for the farmers with the farmers and with local partners to optimize agricultural practices and to seize the opportunities offered by diversified agricultural systems designed for marginal land.</p> <p>Understand the co-benefits, potential risks and upscaling potentials of the innovative farming systems to prevent land abandonment in the marginal areas.</p>

6.	Environmental and biodiversity assessment	<p>Development of environmental indicators to assess the beneficial effects of the new farming systems on the ecological networks and their potential for landscape improvement in marginal land.</p> <p>Insect count and flowering area surface measurements at field scale to assess the potential biodiversity impacts and biodiversity restoration capacity of the new farming systems.</p> <p>Development of guidelines for the upscaling of the new cropping systems ensuring the conservation and the possible restoration of insect populations. in marginal land.</p>
7.	Harvesting solutions for industrial crops	<p>Improvement of existing harvesting methods including drying, storage and pre-treatment of woodchips from woody species.</p> <p>Adaptation of existing machineries to reduce seed loss during harvesting of crambe and safflower, reduce castor bean breaking, seed loss and impurities by combine harvesters.</p> <p>Demonstrate mechanized solutions for single step harvest and collection of different biomass fractions (tops, seeds, stems) in fiber crops.</p> <p>Optimize biomass harvest and the extraction of rubber from guayule plants.</p>
8.	Production of multiple biobased products in a biorefinery approach	<p>Development of a range of bio-based products with a cascade use of biomass adopting a biorefinery approach: biochemicals, biocomposites, elastomers, biolubricants, agricultural biostimulants, biodegradable mulching films, adhesive and coatings, latex, rubber, phytosanitary products, MDF and particle boards, nanocarbons, biochar.</p> <p>Development of guidelines for the upscaling of the new cropping systems ensuring the conservation and the possible restoration of insect populations. in marginal land.</p>
9.	Sustainable value chains for bio-based products	<p>Screening of potential biomass-to-products pathways for different types of industrial non edible crops.</p> <p>Integrated sustainability assessment: environmental assessment, Life Cycle Costing, Social Life-Cycle-Analysis.</p> <p>Design of integrated strategies for designing sustainable value chains web concepts for woody crops, oil crops, fiber crops.</p> <p>Development of a roadmap with practical recommendations for the establishment of bio-based value chains and for the development of viable business models.</p>

10.	Sustainable business plans for European farms with marginal land	<p>Develop business plans for farmers by engaging with the farming community and academia through the case studies.</p> <p>Operate the farm level case studies who act as facilitators together with the Regional Advisory Groups.</p> <p>Co-create sustainable business plans together with farmers and industrial actors, to foster circularity and entrepreneurship and to enable farmers to seek financing at national level.</p> <p>Training on sustainable circular business models.</p>
11.	Dissemination, communication and exploitation	<p>Mapping of the key stakeholders potentially interested in taking up the project results.</p> <p>Dissemination of project results via scientific publications, events, stakeholders workshops, webinars.</p> <p>Communication to a wider audience via social media, articles, videos.</p>

Source: <https://www.midas-bioeconomy.eu/activities/>

The MIDAS project is good example from practice which represents wide scale of eco-innovations in driving sustainable development within the green economy framework. By optimizing marginal lands and pioneering innovative bio-based value chains, MIDAS exemplifies circularity, resource efficiency, and environmental responsibility. Emphasizing “low ILUC” biomass production through industrial crop cultivation on marginal lands aligns perfectly with circular economy principles, minimizing land use change risks and promoting sustainable resource utilization. MIDAS’s innovative cropping systems, like agroforestry, harness the potential of marginal lands, promoting biodiversity and ecological balance by optimizing non-edible crops and advanced breeding methods.

The wide range of bio-based products derived from diverse biomass sources epitomizes circularity, reducing carbon emissions, enhancing resource efficiency, and advancing sustainable consumption.

### **Eco-innovations in the creation of new capacities for achieving the goals of sustainable development and the green economy concept**

Moving towards a more circular economy brings numerous advantages for human life and survival planet, as well as reducing pressure on the environment, improving security of supply raw materials, increasing competitiveness, innovation, job creation, as economic growth not only at the local,

national level, but also at the level of our planet (Vukadinovic, p. 14, 2022). In today's increasingly complex world, where sustainability and environmental protection have become essential requirements, the concept of eco-innovations emerges as a pivotal factor in creating new capacities to achieve the goals of sustainable development and the green economy. Through a deeply ingrained understanding of the need for a paradigm shift and embracing innovation as a driving force, this research has explored how eco-innovations can transform the way we operate, produce, and consume. Case of MIDAS project has clearly demonstrated that eco-innovations not only contribute to reducing negative impacts on the environment but also stimulate innovative processes that lead to the development of entirely new products, services, and business models. This case represents how eco-innovations can be key drivers of sustainable development and how we can create synergy between academic research, business practices and societal initiatives. Green economy concept could be operationalized preferably with collaborative efforts of the academic community, industry, governments and citizens.

## Conclusion

In this context the MIDAS - Marginal lands, industrial crops and innovative bio-based value chains project, which has been funded by the Horizon Europe framework program, decided to address challenges contained in specific goals of the MIDAS: Increasing knowledge about current and future marginal land for "low ILUC" biomass production, challenges biodiversity and ecosystem services, as well as potential common ones benefits from biomass production. "Low-ILUC" (ILUC - Indirect Land Use Change) is a factor that indicates in to what extent is there a risk of changing the use of arable land for the production of raw materials for products that they are not food. Raw materials that have a low ILUC risk were created by growing industrial crops on marginal land or by cultivating areas that were not used for plant production or were abandoned, through the improvement of agricultural practices, which keeps the areas for the production of food raw materials at the same level. Optimization of the production of selected industrial plant species, adapted to cultivation on marginal agricultural land in the 9th state, in 12 localities to achieve a low level of ILUC. Establishment of case studies (12 in 9 countries) of innovative systems cultivation (combined sowing and agroforestry) which have a low ILUC level at marginal agricultural land at the agricultural level farms, for current and future systems in agriculture.



Utilization of marginal lands for growing sustainable industrial crops and developing innovative bio-based products represents significant eco-innovation that contributes to increasing the number and quality of the impacts on the green economy network of excellent case studies: Development of 13 new bio products (biobased) in accordance with circular use biomass. Development of innovative value chains/networks based on biologically effective resources and assessment of production sustainability, including impacts on biodiversity.

## Literature

1. United Nations Environment Programme, <https://www.unep.org/explore-topics/resource-efficiency/what-we-do/responsible-industry/eco-innovation> [03.08.2023.]
2. Jelena Jesic, Simonida Vukadinovic (2019) ECO-INNOVATION INDICATORS AS INDICATORS OF GREEN ECONOMY AND SUSTAINABILITY OF DEVELOPMENT, 'Innovations as an initiator of the development, Innovations – development prospects', International Thematic Monograph – Thematic Proceedings, Faculty of Applied Management, Economics and Finance Belgrade, 378-393.
3. Marginal land Industrial Crops and Innovative Biobased Value Chains is a Horizon Europe Innovation Action started on 1 November 2022 that will continue through 31 October 2026.  
<https://www.midas-bioeconomy.eu/partners/> [12.08.2023.]
4. Marginal land Industrial Crops and Innovative Biobased Value Chains is a Horizon Europe Innovation Action started on 1 November 2022 that will continue through 31 October 2026.
5. <https://www.midas-bioeconomy.eu/products/> [14.08.2023.]
6. Marginal land Industrial Crops and Innovative Biobased Value Chains is a Horizon Europe Innovation Action started on 1 November 2022 that will continue through 31 October 2026.  
<https://www.midas-bioeconomy.eu/activities/> [12.08.2023.]
7. Simonida Vukadinovic (2022) *Cirkularna ekonomija i zapošljavanje u Evropskoj uniji*, Univerzitet Educons, Sremska Kamenica, Srbija, monografija, ISBN: 978-86-82088-08-0.

## **THE DEVELOPMENT OF MODERN INFORMATION AND DIGITAL TECHNOLOGIES LEADS TO THE DEVELOPMENT / REPLACEMENT OF EMPLOYEES IN THE COMPANY, BUSINESS AND SOCIETY?**

**Nikola Mićunović, Msc**, nikola.micunovic@udg.edu.me;  
University of Donja Gorica, www.udg.edu.me; udg@udg.edu.me

**ABSTRACT:** Prior to the COVID-19 pandemic, studies were based on how mobile, social, and web trends shape new consumer needs and behaviors, creating Generation C - Connected, which has been at the center of innovation for the past decade. Consumers who have become digital are now becoming impatient about meeting requirements, and are much more efficient in making decisions, researching markets, defining needs, and comparing themselves to other digital platforms, and only then they decide which company they are interested in (Solis, 2020).

Now, digital transformation initiatives are being implemented with incredible speed, so the technological adaptation that companies have been planning for a period of several years comes down to just a few months. According to IDC research, as much as 79% of CEOs invest in cloud systems to enable secure communication between employees, as well as access to documentation and greater business resilience of the company. IDC Market Spotlight also reveals that companies record productivity growth of 37% if three or more applications are integrated into the company, and that organizations with six or more integrated applications record productivity growth of 75%. Although the application of new technological solutions and procedures brings relief to employees, adapting to new rules and procedures can be critical to business security (Johnson, 2020).

All this proves that Generation C is moving into a new way of consumerism - Generation N, which consists of hyperconnected consumers who become digital due to the lack of physical contact and cooperation. Generation N is especially characterized by the somatic marker, which shapes our emotional connections and needs, and monitors our mental health due to high mortality rates, the impact of infection, company closures, as well as high unemployment, and other bad news lately. A recent Accenture research highlights the degree of consumer anxiety as follows: 64% of consumers are concerned about health, 82% are concerned about the health of others, 64% are concerned about job loss, 88% are concerned about the economy (Solis, 2020).

In education, theory has often cited deeper expertise as a result of education leading to business success, however, the future is changing, so deeper expertise has no concrete significance without creating added value. In the new future, the breadth of perspective and the ability to link important business points becomes as important as deeper expertise, especially in the world of technological development, rapid change, and uncertainty, on the other hand, the philosophy of skills development remains the same (Man-sharamani, 2020).

**KEYWORDS:** *digital technologies, modern business, man, society, socialization*

## INTRODUCTION

### ➤ Accelerated digitalization - consequence of the Covid-19 pandemic

People interpret the current changes differently, feel and make decisions that are mostly based on the stress, feelings, and consequences of the Covid-19 pandemic. McKinsey estimates the COVID-19 pandemic brought acceleration, boosting 10 years of the U.S. economy in just 90 days of the pandemic. It's not just about companies that have to keep up with investments in digital transformation, now the emphasis is on how to win the attention and loyalty of consumers who, according to research, need 66 days to change their needs, behavior, and habits. McKinsey also reveals that 75% of consumers search different stores, websites, or periods during the crisis, of which 60% expect the integration of new brands and stores in their lives after a pandemic, as they will always attract consumers digitally after opening. In the age of the COVID-19 pandemic, consumers value health and safety much more, greater choices, flexibility, and control, saved time, and the general consequences that have led to digital behavior and routines (Solis, 2020).

The fact is that the position and structure of teams in the company are increasingly moving towards the consumer experience, and the most successful will be companies that become very responsive to the needs and habits monitored in the consumer database. In 2020, according to IDC, 62% of leaders claim that the biggest challenge for digital transformation is the company's ability to implement change in line with the expectations and needs of consumers who now want much more. Kurtzman claims: "It's no longer just about buying and selling", which is why companies are moving from the traditional "buyer-seller" model to an innovative model of cooperation, the so-called "maker-partner" (Johnson, 2020).

Trends predict that after the Covid-19 pandemic, “**next normal**” will be (Solis, 2020):

1. **E-commerce** gives trust by creating a network of connected consumers. According to the Q2 Global Shopping Index published by Salesforce, 42% of consumers cited online shopping as common, while 39% cited it as a more than common transaction.
2. Consumers choose to **buy from home** even if the stores are open. According to an IPSOS study, 61% of consumers still bought from home after opening for fear of the virus.
3. In addition to opening stores, **digital is the first in development**. Between April and June, global “digital” income in the U.S. increased by 71% year-over-year, with 37% using online traffic, 35% improving conversions, and 34% increasing spending.
4. **Contactless engagement** is a new way and standard of engagement. As many as 35% of US consumers stated that they prefer non-contact engagement and delivery than before.
5. **Social networks** are now finally, quantitatively, an advanced form of social trade. Research shows that as many as 28% of consumers now buy products through social networks, and purchases through social channels recorded the largest increase in Q2 2020 - **104%**.
6. **Generation N members are becoming much more aware** of what they are buying and which brands they support. The COVID-19 pandemic has allowed consumers to research what they want to buy, so according to a MarTech study, 58% of consumers have changed their view of brands.

## MATERIALS

- Digital trends and technologies that will lead to “digital transformation”

When it comes to innovations that will mark the digital transformation in the future, the following are important trends that will affect business in the future (Eriksen, 2020):

**1. AR/VR** – Augmented and virtual reality; Just some of the main research findings that support this are that XR hardware will generate \$ 28 billion a year in 2025, while total sales of XR technologies will increase sixfold by 2025, and VR usage is projected to grow in 2021, 22., thanks to the growth of the 5G network.

**2. Data privacy** – According to PwC research, 44% of CEOs listed data privacy among the 3 most important policies that affect the company's business, while 66% stated that they are very active with their team in shaping data privacy policies.

**3. AI & Machine Learning** - According to the research, trends in AI and ML technologies relate to **competition in ML framework development, the use of AI for business forecasts, Reinforcement learning (chatbots), biometric security solutions using AI, automatic machine learning, Explainable and Conversational AI, generative contradictory networks.**

**4. Internet of Things** – When it comes to implementing IoT solutions, trends are expected to have an impact, especially in the areas of increased security, SaaS, Edge computing, Data analytics, Smart cities (Industrial Internet of Things (Smart homes, Healthcare, Environment, Global connectivity).

**5. Cloud** – The global cloud industry had a value of 266 billion dollars in 2019, and is expected to contribute to the annual growth of 14.9% in the period 2020-2027. There are several cloud trends in this regard, including **Serverless computing, Hybrid Cloud, Containers, and Kubernetes.** According to Forbes research, enterprise spending on the cloud will grow significantly in 2021, cloud technologies are included in 92% of company strategies, and 54% of enterprise applications have moved to the cloud, while for financial services, government institutions and enterprises will increasingly use single cloud platform for security reasons.

**6. Headless CMS and content hubs** – Headless CMS is now the most prominent tool for creating and distributing content from a single source, as opposed to page-oriented CMS systems and traditional websites. The focus of the headless approach is on structured content, as well as on the ability to be distributed through the API to any channel, thus creating a content hub. A large number of HCMSs are also delivered as services, which affects complexity.

**7. Voice and conversational UI** – Another trend of digital transformation is the use of voice and user interface, especially considering that as much as 40% of Google searches are already done by voice and that most people in the future want to use voice assistant services, and therefore companies must have hardware that services support and also have to adapt their products to voice use by IaaS platform customers.

The digital transformation will develop and apply many technologies in 2021 as (Eriksen, 2020):

1. **5G** – it is already recognized as mainstream in 2021; 5G will be based on an ultra-fast infrastructure that connects AI, ML, and the IoT industry, security, and telecom. and fin. services;
2. **Blockchain** - trends that include BaaS, Stablecoins, AI and IoT integration, interoperability - applications in all spheres of society (government institutions, companies)
3. **Cybersecurity**- security trends 2021; turn to AI, cybercrime, GDPR, cloud;
4. **Environmental technology** - trends that will enable environmental stability, just like blockchain, circular economy apps, platforms, other tech, vertical farms, water infrastructure tech, agrivoltaics, edible packaging;
5. **ERP** - traditional software used in business will be replaced by robotic process automation (RPA), new tech, and ERP vendors, which customers adopt;
6. **Fintech** - industry, mobile banking, unsure-tech, open banking, smart contracts;
7. **Online** - The COVID-19 crisis has resulted in a large number of activities: online meetings, conferences, and teleworking. The future - smart networking and cultural change;
8. **XaaS** – the future will be based on the Everything as a Service approach, according to Research insights there will be a relocation of online services, amounting to \$ 345 billion.

No one can predict exactly where the 2020 crisis will take us. The last year since the outbreak of the COVID-19 virus pandemic has caused more digital transformation than in the last decade, and what is certainly most characteristic is 24/7 connectivity and much more efficient business activities, which in turn causes a decrease in travel, socializing, social contact that is necessary for people to function normally.

In the coming period, the focus is on AI and data analytics, followed by “top ten” predictions for 2021 (Newman, 2020):

1. **5G will finally become mainstream** – In today’s world, companies cannot be disconnected, so the development of 5G technology will allow us to perform quality business and academic activities from home, by giving special benefits in our relationship with phones, tablets and never faster growth in the use of IoT sensors.
2. **Customer Data Platforms (CDP)** recorded a large increase in the application of the previous year because companies often do not function efficiently due to fragmented data from multiple sources that are very difficult to monitor and organize separately and use efficiently. IBM forecasts that the so-called “bad data” already costs the United States about three thousand billion dollars a year, so the use of CDP platforms is becoming a priority for companies and organizations of all sizes.
3. **Hybrid cloud has defined a winning enterprise architecture** - the fact is that many companies today are focusing their business on hybrid cloud infrastructure, which is based on a combination of public and private cloud, hybrid cloud strategies that help organizations meet their needs for quality cloud infrastructure on which will store and manage data. With these innovations, companies want to meet the consumer exactly where he is at the moment, thus providing him with secure access to the necessary data, security, and consent when granting that same access to others.
4. **Cybersecurity** is disappearing - during the pandemic cybersecurity has significantly regained its popularity, especially considering the data that it recorded a growth of 238% when it comes to attacks on banks, while from January to April there was an increase in attacks on cloud servers by as much as 600 %. On this occasion, many companies are working on building SIEM - Security information and event management, and only some of them are Fortinet, Cisco, Splunk, IBM, as well as Microsoft, which invests its resources in creating secure software, directories, and cloud.
5. **Privacy and confidential computing are gaining momentum in the market** - the goal of “confidential computing” is to encrypt entire computer processes, not only data but also the creation of additional security protocols for the security of sensitive information. That’s why companies like Google, Microsoft, IBM, Alibaba, and VMware are in-



vesting heavily in developing new protocols and proven practices for the Confidential Computing consortium.

6. ***Technology that disrupts the industry reshapes trade*** - Research shows that 86% of companies find that customer research costs have increased in the past 24 months, causing two market characteristics: organizations want to maximize ROI from their costs of acquiring new consumers, and an increasingly important focus on developing, winning and retaining consumers. That is why companies need to act faster and more cohesively before the competition reacts and reaches new customers.
7. ***Work from home*** - after working from home became the only option for companies due to the pandemic, a large number of companies, even after starting the economy and reopening companies, decided to leave employees to work from home in early 2021 (Google, Facebook). That is why new, “smart work from home” technologies (Zoom, Webex, Microsoft Teams) have been developing rapidly lately. However, in addition to this, many companies are investing resources in the development of WFH devices as well as SD-WAN secure connections that offer greater flexibility and better connection to the office. Migration leads to greater connectivity and application of technologies in less developed and urban places, which will enable greater productivity of the communities themselves.
8. ***Artificial Intelligence has been democratized on a scale*** - the COVID-19 pandemic has accelerated the democratization of the use of artificial intelligence, machine learning, and data analytics, all to stop the further spread of the virus as a global market problem. The development of Artificial Intelligence technologies goes to the extent that it follows our lives at a rate, what we eat, what we buy, who we employ, and other activities, and now the main goal is to analyze this data and at the same time adopt reliable strategies - how to meet customer needs?
9. ***Folding devices are interesting again*** - with a focus on technological development, consumers now want devices that are brighter, smaller, and much more bundled than before, but also versatile. In addition, it is moving towards always-connected PCs - ACPC, which will enable 5G connection and the ability for users to access their phones via laptops - the Athena CPU project, a technology developed and certified by Windows, ARM, and Intel. Also, the devices of the new format are already produced by Lenovo, HP, Dell, Samsung, and many other companies.

**10. Quantum computing becomes mainstream in the future** - quantum computing is still far from mass use, but it is certainly important for use in disaster prevention, as well as the development of certain medical products and vaccines, all thanks to companies like IBM, Honeywell, Splunk, Quantum Computing, Microsoft, AWS and IonQ. Cloud computing provides opportunities to more easily research, monitor, and analyze data, as well as prepare reactions to the same data, at any time from any source, thanks to applications that can be launched.

## RESULTS

### ➤ *The impact of digital technologies on the development of man and the society of the future?*

Having in mind the trends with which digital technologies are rapidly developing, it is necessary to think about the scope of digitalization, especially from the point of view of the relationship between technology and man. In the book *Superconnected*, Mary Chayko argues that not everything can be digitalized, especially “*tangible and intangible subtle nuances of interpersonal relationships, which cannot be coded and numerically transmitted.*” More precisely, technologies do not have the characteristics of human action and therefore do not know how to think independently and independently of human and social forces. Also, it is very important to think in the direction that technology was created and managed by man, and in that context to analyze the concept of *social constructivism* - an approach to studying technology from the point of view of its origin and use with forces such as political power of social class differences. (Čejko, 2019).

What is also the subject of discussion is the relationship between technology and human social life - do we use our personal example to analyze whether and to what extent digital technologies have a positive effect on sociality, because “*some people get to know each other better when they come in contact with digital than the face*”? Also, what digital technologies require is the property of portability, while the greatest degree of portability and cohesion have social networks and digital communication solutions: “*social capital*” (Čejko, 2019), which flows from person to person, and gradually becomes a means of communication, business, of life.

Digital technologies introduce us to a new form of freedom that we enjoy, but freedom without effort and responsibility? That is why Erich Fromm suggests that the unlimited satisfaction of all human needs does not lead to well-being, nor is it a path to happiness or even maximum satisfaction: “*The dream of being independent masters of our lives ends when we realize that we have*

*all become gears of bureaucracy or some other system - machinery.*” It is this machinery that controls the thoughts, feelings, and tastes of the people within the crowd, all with the aim of stifling the individual’s ability to act rationally within the masses. “*Man became a superman, but a superman with a superhuman power did not rise to the level of superhuman reasoning*”, says Erich Fromm.

We must come to terms with the fact that the Internet and digital media provide an impression and experience of closeness and digital presence that transcends the physical realm because digital connectivity is characterized by “*ambient coexistence*” - a clear, peripheral awareness of other people’s presence and closeness. Therefore, any attempt to separate the physical from the digital is explained as a “*false dichotomy*”, with the view that they are physically and mentally inseparable from each other and that real life is immersed in cognitive activity, and therefore digital experiences can be emotional as those face to face. Also, many years ago, Jose Ortega used the term “*substantivization of youth*”, based on the belief that there are no more orders, and that there are only rights without obligations and responsibilities, which will very quickly turn into blackmail.

Is the fact that thoughts and feelings can be shared easier, more relaxed, and more natural when there is no physical contact actually a confirmation of the weakness of modern man, who now lacks enough self-confidence and courage and is reluctant to express emotions in a physical atmosphere? Why digital technology comes to the rescue as an ideal solution? Certainly, what we should not allow is a division of the activities we perform into physical and digital, as if we were living two independent lives at the same time, a term called digital dualism.

Jose Ortega also talks about the importance of culture and truth much earlier, claiming that “*The lowest or highest level of culture is measured by the lowest or highest precision of the rules.*” This is the essential difference between the digital, which is available to everyone without responsibility, and the physical, which primarily requires effort and commitment, and responsibility for words, behaviors, and actions (Ortega, 2013).

The man of the digital age is a man of ideological mass who has enabled the entry and rapid development of technology. This mass is led by leaders and capitalists, and one of the innovations brought by digital technologies is the “*economy of attention*”, which is not based solely on money, but “*attention is a real currency*” (Čejko, 2019). Also, the digital environment does not bring changes only from the technological aspect, but directly changes a person’s economic, health, and existential habits, and is reflected in the whole spectrum of life processes that we perform.

The reasons for the dominance of the digital over the traditional are many years behind us since industrialization and capitalist forces aim to acquire material wealth, not the mental health of man and the survival of civilization. That is why modern man functions in a society in which there is a great degree of social stratification, partly due to the attitude and approach to digital technology and the way it is used, which is explained by the term *digital divide*. The rate and level of the digital divide in society are of course influenced by the standard of living, economy, education, and culture of the people who live there, so it is logical that some communities respond much better to the challenges of digital, more precisely to have a less pronounced digital divide. How we will embrace digital technologies and what we can “draw” from them depends on cultural uplift, because culture consists of the products of a group that can be: 1. material and 2. Mental (Čejko, 2019).

In this mass, independent and free individuals find it very difficult to change their attitudes and beliefs, especially because it takes a long time for certain ideas to break through to the unconscious of the crowd and become their feelings. *That is why crowds with deeply ingrained and impoverished ideas are always several generations behind learned people and philosophers* (Le Bon, 2006). Also, the sources of today’s domination of technology over man can be known decades and centuries behind us, so Ortega in the work “The Revolt of the Masses” (2013) cites the crisis of norms and morals, which led to the collapse of Europe and a large number of social divisions, stratification accompanied by “*mental eclipse and lack of imagination.*”

➤ **DISCUSSION** - Digital anthropology: Can techno-socialization have a future?

We live in a society of global processes and online trends, which we must recognize and apply locally, and that is the process of *glocalization*. In addition to this process, we must also point out the importance of the process of *techno-socialization*, which enables people to act socially in the digital world, and that process is the future (Čejko, 2019). The term digital anthropology refers to the growth and development of digital technologies and learning about specific digital methodologies. Just a few of them are *Cybernetics, the Internet of Things, and Big Data* (Miller, 2018). Learning about the digital world must not be viewed exclusively from the aspect of technology, but must include in the analysis the man who enabled the emergence of that technology, as well as a reflection of what technology has made of man and how it shapes

his work and life in general. A direct relationship between technology and liberalism is being created, while open platforms and free access to software have led to the creation of a “*recursive audience*” - a committed population that prepares a modern approach to digital life. Emphasis is placed on the simulation of human reasoning and experience, and when designing solutions, attention is focused on heuristic problem-solving techniques, where there are three ways to get to solutions that are not guided by the relation itself, through *acquired knowledge, intuition, or common sense* (Vasić, 2010).

American anthropologist Faye Ginsburg points to the fact that digital technologies will not make us more humane than we already are, nor more mediating and communicative, because thanks to them we are not more cultural than we were before. A large number of anthropological studies aim at the *relationship between the real and the virtual, not the opposite of the virtual to the real* (Horst and Miller, 2012).

What makes the digital society most characteristic today, given that costs and availability are now in the background, is the **user's responsibility** for the choice of media and digital technology to use. The Internet characterizes *ambivalence* as an internal struggle that takes place in man and society, between open and closed access - in the era of openness and free access, there are restrictions in front of freedom. That is why digital technologies approve of the existence of a large number of inventions, but also of the creation of numerous inequalities. Therefore, it happens that many digital solutions that aim to raise the importance of research and scientific awareness among citizens, do not receive the necessary support from companies, because it is very difficult to commercialize and make money from them. On the other hand, numerous blog-chat platforms and applications are created every day around the world, where young people can encounter hate speech, abuse of private data, and sexual, racial, and other forms of violence. Unfortunately, such digital solutions get the desired space and quality marketing as opposed to modern educational solutions, and the reason that elevates some of them above others and makes them priorities is exclusively *money*.

Now the current theory is *the blurring of a clear relationship between the virtual and the real*, according to which we cannot accept the theory of complete separation. The greatest attention within this area is focused on the process that analyzes three types of relationships between the virtual and the real: *autonomy* - separation, *dichotomy* - convergence and finally *blurring* - merging. Ilana Gershon explains the essence of understanding the relationship between the virtual and the real, stating that the disconnections that happen every day are not interruptions of real and virtual interactions, but disconnections

between people, such as ending a friendship (Horst and Miller 2012). The new digital space enables the design of new cultures, requirements, and new methodological tools for data collection analysis and fieldwork. Operating in the digital world is less and less different from the real world - by entering any of the virtual worlds, each of the users refines it in accordance with their experience, knowledge, and needs, crossing it with their interests and everyday life. Also, in the real world, robots that look like humans, do human jobs, or are intelligent in a way that approaches human intelligence are increasingly being used. It is in this way and by imparting emotions that robots transform into beings that have a soul, the question is - *how is this robot different from a human?* (Gavrilović, 2011).

➤ *“Where does the development of technology lead a man?”*

John Zerzan (2004) in his work “Against Technology” points out that *“we live in an impoverished, mediating world in which technology is seen as an extension of the senses, but this extension still seems to cause numbness and atrophy of the senses themselves.”* He re-examines the necessity of a technological approach to everything, claiming that technology today offers solutions to all problems and at the same time sends the message that all we need is a little more technology. Multinational companies, as the main capitalist forces in the context of globalization, have a great influence and control over the population, especially by investing in the processes of creating and owning virtual worlds, explains Tom Boellstorff (2004) in his book *“Coming of Age in Second Life”*. These companies, through virtual worlds and digital technologies, achieve much more notable results than most countries and companies would achieve by doing business in the real world, all thanks to the creation of *“creationist capitalism”* - a creative industry that is a form of global business and production. On the one hand, thanks to a large number of open source platforms and digital “assistants”, we have a significant simplification of processes and increased transaction efficiency for technology users, on the other hand, there are numerous alienations between these same users and society. In the past, the connection between digital technologies and man as a user of them was predicted much differently. Namely, the British mathematician Turing claimed in the 1940s that the development of digital technologies would significantly increase the *interdependence of technology and man*. J.C.R Licklider said in 1968 that in the future, our communication with machines would be more effective than that with other people, which means that for the first time, we would put ourselves in the background. Is that happening to us right now? (Zerzan, 2004)



Freud believed that the full realization of civilization would contribute to “*universal nervousness*” - young people are increasingly committing suicide, precisely because of the sudden confrontation with the truth and the consequences of an impoverished world (Zerzan, 2004). So, we are facing a crisis of an internal nature, associated with a *crisis of an external nature or an ecological catastrophe*. In such a real world, it is obvious that much is not ideal, so there is a virtual reality that people rush to in order to escape the objective existential conditions that are less and less attractive? Is human cloning very close? In his work, Zerzan also looks back at the impressions of Hans Moravec, a member of Carnegie Mellon, who claims that “*the inhabited part of space will soon be turned into cyberspace*”, and that we will then replace some of our most important mental processes with a program taken from artificial intelligence, and even in time “*our thought processes could be completely free of every trace of our original body, or as much as possible of anybody*” (Zerzan, 2004).

On the other hand, Jacques Ellul (1954) in his work “*Technological Society*”, believes that a working man is not happy at his job, especially when “*the constant practice of impersonal work leads to complete depersonalization of workers*.” The greatest danger arises if we allow a person to perform only some mechanical operations because then there is a *psychological separation of intelligence and action*. New digital trends are being created, a new form of production and market characteristic of marketing those products that customers have already bought, which proves that there is a *creative business in which money is not crucial, but self-fulfillment and social efficiency - creativity market leads to freedom and satisfaction all consumer needs*. Opinions on the importance of digital always require discussion. For example, Thomas Win concluded that at least a million years ago Homo had an intelligence equal to today's adult man, while Heidegger, considered by many to be one of the greatest thinkers of the twentieth century, believed that digital technology marked the end of philosophy.

Boellstorff argues that the digital world is characterized by *creativity becoming a form of value exchange, not just the use of value*. By this logic, work also begins to be viewed from the aspect of the value of exchange and the value of use, *which blurs the clear line between work and play - production slowly turns into play*. People are becoming more and more involved in immersive marketing, based on the idea of “*don't sell me but play with me*”. Jacques Ellul (1954) argues that “*separating mental activities from a person's physical movements leads to a reduction in fatigue because man, unfortunately, no longer has any need to participate or make any decisions*.” This further leads to the weakening of the human personality, which is impossible to fragment without weakening, and we must not forget that “*the loss of creative power can have catastrophic psychological consequences*.”



## CONCLUSIONS AND RECOMMENDATIONS

Now is the new, digital age, in which we need to re-examine the logic of a deeper, professional re-examination, all with the aim of finding an answer in favor of generalization: “*To a man with a hammer, everything looks like nails.*” Also, it is now important to have as many tools as possible, in order to solve as many problems as possible, some of which very often come in a package (Mansharamani, 2020). In order to develop as many skills and abilities as a tool that offers a much wider range of services, we need to be very flexible and agile, learn to act in uncertain times, as well as take much more care of the context in which we make decisions. That is why today giant companies strive to hire *multifunctional* employees, who are agile and ready to function from team to team, adapt and learn in a given environment, and possess general cognitive abilities, thanks to which they become aware of how fast ONE company in the digital age needs to evolve and looks for new jobs. These are *smart generalists* (Lisa Stern Hayes, Google).

After two decades of steady development, the issue of digital consumerism has gone into overproduction due to the COVID-19 pandemic and has begun to change the reality around it. The world is dominated by the digital consumer, whose center is certainly not digital, but also emotional charging and discharging, fear due to the consequences of the pandemic, anxiety, and worry (Solis, 2020).

Management must take advantage of the current situation to understand how consumers change their preferences, behaviors, and routines due to the application of technology, and to prepare strategies, brand, and product management in the post-business. All business and life activities are focused on digital platforms, where new, digital habits are created that do not motivate consumers too much, they now do not want to replace all habits and needs from before the pandemic with digital ones. The only sure thing we can say for the future is that uncertainty is guaranteed, especially due to the rapid development of markets and services due to the use of artificial intelligence and technological innovations that modify information and give it new value. Instead of the skills that once created value, there are now key *skills that lead us to success*.

So it is this innovative approach, philosophy, and way of thinking, and the ability to apply new value in everyday activities as soon as possible, and thus modify the environment, that is key to future success (Mansharamani, 2020).

## LITERATURE:

1. Boellstorff T. 2008. *Coming of Age in Second Life: An Anthropologist Explores the Virtual Humanity*. Princeton University Press.
2. Čejko M. 2019. *Superpovezani*. Clio Beograd
3. Daniel Miller. 2018. "Digital Anthropology." In *The Cambridge Encyclopedia of Anthropology* (eds) F. Stein, S. Lazar, M. Candea H. Diemberger, J. Robbins, A. Sanchez & R Stasch.
4. Ellus J. 2010. *Tehnika ili Ulog veka*. Beograd: Anarhija/blok45. Dostupno na: <https://anarhisticka-biblioteka.net/library/jacques-ellul-tehnika>
5. Eriksen M. 2020. *Digital transformation trends 2021*. Enonic
6. From E. 2015. *Imati ili biti*. Nova Knjiga Podgorica
7. Gavrilović L. 2011. "Svi naši svjetovi o antropologiji, naučnoj fikciji i fantastici". Beograd
8. Horst H. A. and Miller D (eds). 2012. *Digital Anthropology*, London: Berg.
9. Johnson L. 2020. *The new trends driving digital transformation in the workplace*. IDC Market Spotlight
10. Le Bon G. 2006. *Psihologija gomile*. Algoritam
11. Mansharamani V. 2020. 'No specific skill will get you ahead in the future'—but this 'way of thinking' will. Harvard University
12. Newman D. 2020. *Top 10 Digital Transformation Trends For 2021*. Forbes
13. Ortega H. 2013. *Pobuna masa*. Umetničko društvo Gradac
14. Solis B. 2020. *How COVID-19 created a new kind of consumer in just 90 days*
15. Vasić M. 2010. "Šta je to internet? Tehnološke osnove interneta – osnova za antropološka proučavanja." *Etnološko-antropološke sveske* 16 (n.s.) 5: 79-93.
16. Zerzan J. 2004. *Protiv tehnologije*, dostupno na: <https://anarhisticka-biblioteka.net/library/johnzerzan-protiv-tehnologije>

# CHALLENGES OF URBAN ECOLOGY IN CONSERVING AND ENHANCING BIODIVERSITY IN THE 21<sup>ST</sup> CENTURY

**Milan Glišić\*, Ljiljana Tanasić, Suzana Knežević**

Academy of Applied Studies Šabac, Dobropoljska 5, 1500 Šabac,  
Republic of Serbia

+381649097607, milan11glisic@gmail.com

**ABSTRACT:** As urbanization continues to expand, there is an urgent need to address the impacts of human activities on urban ecosystems and their associated biodiversity. This paper aims to examine the challenges of urban ecology and their implications for biodiversity conservation in the context of the 21<sup>st</sup> century. It explores the complex interactions between urban development, habitat loss, pollution, and climate change, which contribute to biodiversity decline. The paper also highlights the potential benefits of integrating nature-based solutions, such as green infrastructure and urban greening initiatives, to mitigate the negative impacts and promote biodiversity in urban environments. Furthermore, it emphasizes the importance of engaging local communities and stakeholders in biodiversity conservation efforts through education and participatory approaches. Overall, this paper underscores the pressing need for sustainable approaches to urban planning that prioritize the conservation and enhancement of biodiversity in the face of ongoing urbanization and environmental challenges in the 21<sup>st</sup> century.

**KEY WORDS:** *urbanization, urban ecosystems, biodiversity, conservation, urban planning*

## 1. Introduction

Urban ecology has emerged as a significant area of research, addressing the complex interactions between humans, ecosystems, and the urban environment. Urban ecology is a relatively young scientific discipline (McDonnell, 2011; Wu, 2014), primarily because urban areas were long considered unworthy of ecological research (Sukopp, 2003). The prevailing belief was that cities were “biological deserts” and that only a few plants and animals could survive in the urban environment, with their communities being the result of chance, rendering their study futile (Sukopp, 1998). However, it has been established that urban areas can harbor highly diverse habitats and, con-

sequently, a large number of species, often even more than in the surrounding non-urban areas (McKinney, 2006).

The significance of urban biodiversity for humans lies in the provision of ecosystem services that enhance the quality of life in urban areas. Preserving the diversity of plants and animals in urban environments helps maintain ecosystem balance, reduce air and water pollution, control floods, and regulate the climate. Biodiversity also promotes mental well-being and the welfare of city dwellers, fostering recreation opportunities and reducing stress. Preserving urban biodiversity is crucial for sustainable urban development and the conservation of natural heritage for future generations (Xie & Bulkeley, 2020).

In the 21st century, rapid urbanization and the expansion of cities have led to substantial changes in the natural surroundings, presenting challenges in the conservation and enhancement of biodiversity. Cities, with their dense human populations and extensive infrastructure, exert considerable pressure on natural ecosystems. The conversion of natural habitats into urban landscapes, fragmentation of green spaces, pollution, and the introduction of non-native species are just a few of the many consequences of urbanization that directly impact biodiversity. These processes often result in the loss of native flora and fauna, disruption of ecological processes, and a decline in overall species richness (Apostolopoulou, 2020).

Understanding and effectively addressing the challenges of urban ecology are of paramount importance for the well-being of both human populations and the natural world. By integrating ecological principles into urban planning and management, we can strive towards creating cities that are not only vibrant and livable but also sustainable and supportive of biodiversity in the face of rapid urban growth. This scientific paper aims to explore the challenges faced by urban ecology in the conservation and enhancement of biodiversity in the 21<sup>st</sup> century. By examining the multifaceted issues arising from urbanization, we seek to identify key factors that hinder or facilitate the preservation of biodiversity in urban environments. Furthermore, we will investigate potential strategies and solutions that can be implemented to address these challenges and promote sustainable urban ecosystems.

## **2. Mechanisms and drivers of biodiversity decline in urban environments**

The effect of urbanization on the living world is often highly complex, as reflected in specific changes in the composition of biological communities (Concepción et al., 2015). Urbanization particularly affects special-

ists, species that rely on a narrow range of specific ecological conditions and are characteristic of natural and semi-natural habitats. In contrast, the effects of urbanization often favor synanthropic species that are adapted to the specific conditions of urban environments, known as generalists and opportunists. These species can tolerate a wide range of ecological conditions, survive in different habitat types, and often have wide distributions (Magura et al., 2020). Furthermore, urbanization is closely linked to the introduction of non-native species, some of which become invasive (Santana Marques et al., 2020). Therefore, in addition to habitat loss, urbanization is associated with another major driver of biodiversity decline on a global scale, namely the problem of invasive species. As a result, urbanization contributes to a well-described phenomenon known as biotic homogenization (Lososová et al., 2016).

Understanding the mechanisms and drivers of biodiversity decline in urban environments is crucial for developing effective strategies to mitigate the negative impacts of urbanization and conserve biodiversity. Based on previous research, several key mechanisms and drivers contribute to biodiversity decline in urban areas:

1. **Habitat loss and fragmentation:** Urbanization involves the conversion of natural habitats into built environments, resulting in the loss of critical habitats for plants and animals. The fragmentation of remaining habitats into smaller patches further isolates populations, reducing gene flow and increasing the vulnerability of species to local extinctions.
2. **Pollution.** Urban areas are sources of various types of pollution, including air pollution, water pollution, noise pollution, and light pollution. These pollutants can have detrimental effects on biodiversity, causing physiological stress, impairing reproductive success, and increasing mortality rates for plants and animals.
3. **Invasive species.** Urban environments facilitate the introduction and spread of non-native or invasive species. These species often out-compete native species, disrupt ecological processes, and reduce biodiversity. Urban areas, with their constant flow of goods and people, provide opportunities for the establishment and proliferation of invasive species.
4. **Altered hydrology.** Urban development results in the modification of natural hydrological processes, such as increased surface runoff and reduced infiltration. This alteration can lead to changes in water availability, water quality degradation, and the loss of aquatic biodiversity.

5. Urban heat island effect. Urban areas tend to have higher temperatures than surrounding rural areas due to the urban heat island effect. Increased temperatures can negatively impact biodiversity by altering species' physiological processes, reducing suitable habitat availability, and shifting species distributions.
6. Land-use intensification. The intensification of land use, such as increased urban density and infrastructure development, can further exacerbate biodiversity decline. The conversion of green spaces into impervious surfaces limits the availability of suitable habitats for biodiversity, leading to species loss and reduced ecosystem services.
7. Human disturbance. Urban areas experience high levels of human activity and disturbance, which can disrupt natural ecosystems and disturb wildlife. Activities such as pollution, habitat destruction, noise, and disturbance from human presence can have direct and indirect impacts on biodiversity.

Understanding these mechanisms and drivers requires interdisciplinary research approaches that integrate ecological, social, and urban planning perspectives. It involves studying the ecological processes, species responses, and socio-economic factors that influence biodiversity decline in urban environments.

### **3. Prevention and mitigation strategies**

Prevention and mitigation actions and measures for the conservation and enhancement of urban biodiversity can be grouped into the following strategies:

1. Urban design and land-use planning;
2. Urban green infrastructure planning;
3. Habitat restoration and nature conservation;
4. Strategy against invasive species;
5. Pollution reduction strategy;
6. Water management strategy;
7. Community engagement and environmental education and awareness;
8. Collaboration, partnerships, stakeholder engagement, and policy integration.

These strategies aim to prevent or mitigate the identified drivers contributing to urban biodiversity decline. The advantage of actions and measures described in this paper lies in the fact that often one strategy can influ-

ence multiple drivers. Nevertheless, implementing these actions, measures, and even strategies individually would not yield the desired effect; instead, it is imperative that all of them be incorporated into a comprehensive policy for the conservation and enhancement of urban biodiversity. It is important to note that sometimes it is not possible to strictly categorize an action or measure into a particular strategy, which further emphasizes the interconnectedness and mutual integration of the mentioned strategies.

### 3.1. Urban design and land-use planning

Urban design and land-use planning play a crucial role in mitigating the negative impact of urbanization on biodiversity. By incorporating biodiversity considerations into the planning process, cities can create more sustainable and biodiverse environments. Strategies such as green infrastructure integration, compact development, and habitat connectivity enhance urban biodiversity. Wildlife-friendly design features in buildings and infrastructure promote the presence of diverse species. Urban design and land-use planning measures that enhance urban biodiversity include:

1. Incorporate biodiversity considerations into urban land-use planning processes;
2. Identify and protect important natural habitats and ecological corridors that promote connectivity between fragmented areas;
3. Implement zoning regulations that prioritize the conservation of valuable habitats and restrict development in ecologically sensitive areas;
4. Promote compact and mixed-use development to minimize the heat island effect;
5. Utilize reflective and permeable surfaces, and prioritize green infrastructure in urban development projects to mitigate heat buildup;
6. Incorporate climate change adaptation strategies into urban planning;
7. Designate buffer zones around protected areas to minimize human disturbance;
8. Implement zoning regulations that protect important habitats and restrict development in ecologically sensitive areas;
9. Promote mixed land-use strategies that integrate residential, commercial, and recreational spaces;
10. Encourage compact development patterns to minimize the conversion of natural habitats;



### 3.2. Urban green infrastructure

Urban development and human activities often result in habitat destruction and fragmentation, particularly in urban environments. To address this issue, urban green infrastructure provides a vital means of preserving biodiversity. Urban green spaces, such as parks, gardens, and natural reserves, offer habitats for a diverse range of species. Additionally, urban green infrastructure can act as connectors between fragmented natural areas by serving as corridors or stepping stones. Green spaces also serve as sources of food and shelter for wildlife. Some of the measures that enhance urban biodiversity include:

1. Integrate green infrastructure, such as parks, green spaces, and vegetated corridors, into urban design. These green areas serve as refuges for biodiversity, provide habitat connectivity, and mitigate the effects of habitat fragmentation. Also, urban infrastructure act as a natural filters and absorb pollutants, improving air and water quality. Additionally, planting trees and vegetation helps to provide shade, reduce surface temperatures, and create microhabitats that support biodiversity.
2. Implement green roofs and living walls to enhance biodiversity and habitat connectivity and to mitigate the effects of pollution. Implementing green roofs and vertical greening systems on buildings also helps mitigate the urban heat island effect.
3. Encourage green building practices that minimize the ecological footprint of urban development.
4. Develop an ecological network plan that identifies and protects core habitats and connectivity corridors for species movement. Implement greenways, wildlife crossings, and stepping-stone habitats to facilitate the movement of species across urban landscapes and mitigate the effects of habitat fragmentation. Focus on creating patches of native vegetation, wetlands, and other natural features that support biodiversity.

### 3.3. Habitat restoration and nature conservation

Habitat restoration involves the rehabilitation and enhancement of degraded habitats to support diverse species. By reintroducing native plant species and removing invasive plants, the ecological balance can be restored, leading to habitat recovery and increased biodiversity. priority is given to the

restoration of degraded habitats, such as brownfields and abandoned sites, which contribute to increasing biodiversity and establishing ecological connectivity. Identifying and protecting ecologically important areas is another key aspect of habitat conservation and restoration in cities. Habitat restoration and nature conservation measures that enhance urban biodiversity include:

1. Restore and rehabilitate degraded habitats within urban areas;
2. Enhance degraded sites by reintroducing native plant species and removing invasive species, promoting ecological succession and habitat recovery;
3. Prioritize the restoration of degraded habitats, including brownfields and abandoned sites, to increase biodiversity and provide ecological connectivity;
4. Restore and rehabilitate degraded habitats within cities by removing invasive species and reintroducing native plants;
5. Identify and protect ecologically important areas, such as wetlands, riparian zones, and native grasslands, from further development.
6. Establish and protect designated areas for biodiversity conservation within cities, such as nature reserves, wildlife sanctuaries, and protected green spaces. These areas provide refuge for native species and ensure the preservation of critical habitats.
7. Implement controlled access and visitor management strategies in ecologically sensitive areas. Use signage, trails, and designated observation points to guide visitors and minimize disturbance to sensitive species and habitats. Establish rules and regulations that promote responsible behavior, such as leash laws for pets and restrictions on feeding wildlife.

### 3.4. Strategy against invasive species

In urban areas, invasive species can be a major threat to native habitats. These non-native organisms have managed to establish themselves in cities and are thriving, often at the expense of native species and the ecosystem as a whole. Invasive species can be plants, animals, insects, or micro-organisms. Their presence can have significant negative impacts on urban ecosystems, making it crucial to understand and reduce their populations. There are several measures that can be taken against invasive species, some of which should also be implemented in cities. Some of the common measures against invasive species that also should be implemented in cities are:

1. Early detection and rapid response: Establish monitoring programs to detect invasive species early. Implement rapid response protocols to quickly assess and manage newly introduced invasive species before they establish and spread;
2. Risk assessment and regulation: Conduct thorough risk assessments to identify potential invasive species and their pathways of introduction. Develop and enforce regulations to prevent the importation and spread of high-risk invasive species through trade, transportation, and horticulture practices;
3. Control and eradication measures: Implement control and eradication measures for established invasive species. Utilize a combination of methods such as mechanical removal, chemical treatments, biological control, and targeted management strategies to reduce the impact and spread of invasive species;
4. Monitoring and research. Continuously monitor the presence and spread of invasive species in urban areas. Conduct research to better understand the ecology and impacts of invasive species on native biodiversity. Use scientific findings to inform management strategies and adapt approaches as new information becomes available.

### **3.5. Pollution reduction strategy**

Pollution reduction strategy helps mitigate the harmful effects of pollution on wildlife and ecosystems, preserves habitat quality, and fosters healthier and more sustainable urban environments. By implementing the following pollution reduction measures, cities can contribute to the protection and enhancement of urban biodiversity and promote the coexistence of humans and wildlife in urban settings:

1. Implement strict regulations and policies to reduce pollution from industrial, vehicular, and residential sources. Encourage the adoption of cleaner technologies, promote energy efficiency, and enforce stringent emissions standards to minimize air, water, and soil pollution.
2. Promote sustainable transportation options, such as public transit, cycling, and walking, to reduce vehicular emissions. Encourage the use of electric vehicles and implement measures to reduce traffic congestion, thereby minimizing air pollution and its impact on biodiversity.
3. Implement effective stormwater management systems that reduce runoff and prevent pollution from entering water bodies.

4. Establish comprehensive waste management systems that prioritize waste reduction, recycling, and proper disposal of hazardous materials. Encourage the implementation of recycling programs, promote composting, and educate residents on responsible waste management practices to minimize pollution risks.

### 3.6. **Water management strategy**

Urbanization often brings about significant changes in the natural water cycle, resulting in various water-related challenges that can have profound effects on local ecosystems and wildlife. Implementing effective water management strategies can help mitigate these challenges and support urban biodiversity in several ways. Water management strategy helps address the challenges posed by urbanization and ensures that urban ecosystems continue to provide suitable habitats and resources for a variety of plants and animals. By focusing on sustainable water management practices, cities can support urban biodiversity and create healthier, more resilient, and more livable urban environments. Water management strategy measures that enhance urban biodiversity include:

1. Conduct research and monitoring to better understand the impacts of altered hydrology on biodiversity in urban areas. Assess the effectiveness of mitigation measures and adaptive management strategies to inform future decision-making and improve biodiversity conservation efforts.
2. Retention and restoration of natural hydrological features. Preserve and restore natural hydrological features such as wetlands, ponds, and streams within urban areas. These features provide essential habitat for diverse aquatic species and help regulate water flow, reducing the risk of flooding and maintaining water quality.
3. Protection of riparian zones. Protect and restore riparian zones along water bodies, which serve as crucial transitional habitats between aquatic and terrestrial ecosystems. Maintaining healthy riparian vegetation helps stabilize stream banks, filters pollutants, and provides habitat for a variety of plant and animal species.
4. Water conservation. Promote water conservation practices within urban areas to reduce water consumption and minimize the demand for freshwater resources. Implement water-efficient technologies, encourage water-wise landscaping practices, and educate residents and businesses on responsible water use.

5. Floodplain management. Implement effective floodplain management strategies to mitigate the impacts of urbanization on flooding and protect both human communities and natural habitats. Preserve and restore natural floodplains, which provide valuable habitats for various species and help regulate water flow during periods of high precipitation.

### **3.7. Community engagement and environmental education and awareness**

Community engagement and environmental education play a vital role in preventing and mitigating the negative impact of urbanization on biodiversity. By actively involving the community, awareness about the importance of biodiversity can be raised, fostering a sense of responsibility and stewardship. Engaging residents, businesses, and community organizations in biodiversity conservation efforts promotes collective action and collaboration. Environmental education programs and initiatives provide knowledge and understanding about the impacts of urbanization on biodiversity, empowering individuals to make informed decisions and take positive actions. Community engagement and environmental education and awareness measures that enhance urban biodiversity include:

1. Raise awareness among urban residents about the importance of biodiversity and the role they can play in its conservation;
2. Promote community engagement in citizen science projects, habitat restoration initiatives, and urban gardening programs;
3. Promote citizen science programs, community gardens, and nature-based activities to foster a connection between residents and local biodiversity;
4. Foster a sense of stewardship and encourage sustainable practices that support biodiversity within an urban environment;
5. Promote responsible behavior through educational campaigns, community outreach programs;
6. Engage communities, schools, and businesses to adopt sustainable practices and behaviors that protect biodiversity;
7. Raise public awareness about the threats posed by invasive species and educate residents, gardeners, and businesses about best practices for preventing their introduction and spread. Promote responsible plant and pet ownership to prevent the release of invasive species into the environment.

### 3.8. Collaboration, partnerships, stakeholder engagement, and policy integration

Collaboration, partnerships, stakeholder engagement, and policy integration are integral to effective biodiversity conservation in urban areas. These approaches promote inclusivity, leverage resources, and foster a more holistic and integrated approach to conservation, ultimately leading to more resilient and biodiverse urban environments. To achieve this, it is necessary to apply the following:

1. Foster collaboration among government agencies, environmental organizations, urban planners, conservation organizations, researchers, and local communities.
2. Work together to develop and implement biodiversity conservation strategies;
3. Establish partnerships to secure funding, share knowledge, and coordinate efforts for effective conservation outcomes;
4. Foster collaboration among government agencies, conservation organizations, researchers, and local communities to develop and implement invasive species management plans. Coordinate efforts to share knowledge, resources, and best practices for invasive species control and prevention;
5. Engage stakeholders in decision-making processes and raise awareness about the importance of biodiversity conservation in urban areas;
6. Engage stakeholders in decision-making processes and encourage their active involvement in biodiversity conservation efforts;
7. Integrate biodiversity considerations into urban planning policies and regulations;
8. Encourage partnerships that promote sustainable land-use practices conservation in cities.

### Conclusion

The challenges posed by urbanization in the 21st century have significant implications for biodiversity conservation. The complex interplay of urban development, habitat loss, pollution, and climate change threatens the diversity of species and ecosystems in urban areas. This paper highlights the potential for positive change through the adoption of nature-based solutions like green infrastructure and urban greening initiatives. These strategies offer

promising avenues for mitigating the negative impacts of urbanization and fostering biodiversity in urban environments. Moreover, the paper underscores the crucial role of local communities and stakeholders in biodiversity conservation. Engaging them through education and participatory approaches can enhance awareness and ownership of conservation efforts, making them more effective and sustainable. As urbanization continues to expand, it is imperative that urban planning takes a sustainable approach that prioritizes the conservation and enhancement of biodiversity. By addressing the challenges of urban ecology, we can work towards creating urban environments that not only accommodate human needs but also support and protect the rich diversity of life that exists within them, ensuring a more harmonious coexistence in the urban landscapes of the future.

## REFERENCES

- Apostolopoulou, E. (2020). Nature swapped and nature lost: Biodiversity Offsetting, urbanization and social justice. Springer Nature.
- Concepción, E.D., Moretti, M., Altermatt, F., Nobis, M. P., Obrist, M.K. 2015. Impacts of urbanisation on biodiversity: the role of species mobility, degree of specialisation and spatial scale. *Oikos* 124(12): 1571–1582.
- Lososová, Z., Chytrý, M., Danihelka, J., Tichý, L., Ricotta, C. 2016. Biotic homogenization of urban floras by alien species: the role of species turnover and richness differences. *Journal of Vegetation Science* 27(3): 452–459.
- Magura, T., Ferrante, M., Lövei, G.L. 2020. Only habitat specialists become smaller with advancing urbanization. *Global Ecology and Biogeography* 29(11): 1978–1987.
- McDonnell, M.J. 2011. The history of urban ecology: A ecologist's perspective. In: Niemelä, J., Breuste, J.H., Guntenspergen, G., McIntyre, N.E., Elmqvist, T., James, P. (eds.) *Urban ecology: Patterns, processes, and applications*. Oxford University Press, New York, pp. 5–13.
- McKinney, M.L. 2006. Urbanization as a major cause of biotic homogenization. *Biological Conservation* 127: 247–260.
- Santana Marques, P., Resende Manna, L., Clara Frauendorf, T., Zandonà, E., Mazzoni, R., El-Sabaawi, R. 2020. Urbanization can increase the invasive potential of alien species. *Journal of Animal Ecology* 89(10): 2345–2355.
- Sukopp, H. 2003. Flora and Vegetation Reflecting the Urban History of Berlin. *Erde* 134(3): 295–316.
- Sukopp, H., Wittig, R. 1998. Was ist Stadtökologie? In: Sukopp, H., Wittig, R. (eds.) *Stadtökologie*. 2nd ed., Stuttgart, pp. 1–12.
- Xie, L., & Bulkeley, H. (2020). Nature-based solutions for urban biodiversity governance. *Environmental Science & Policy* 110: 77–87.
- Wu, J. 2014. Urban ecology and sustainability: the state-of-the-science and future directions. *Landscape and Urban Planning* 125: 209–221.



**Prof. dr. Enes Huseinagić**

International University Travnik

e-mail: huseinagic\_e@hotmail.com

mobile phone 061 178 800

## SCIENTIFIC RESEARCH WORK IN TRANSFORMATION ECONOMY OF BOSNIA AND HERZEGOVINA

**SUMMARY:** The paper articulates the need for research that is extremely important for the reform of the economy and economy of a country. Economic research and economic settings have a special place in this. Economic science must be the driving force of economic development. It should design practice, influence the real sector, monitor, analyze and direct it. The role of economic science and research must come to the fore especially in periods such as this, the current period of turbulent events, times of crisis, when larger and more decisive steps are being taken in order to change the country's economic system as a whole. As economics as a science is directed to other sciences, it follows that it must use the results and knowledge of other sciences in the study of all economic dimensions in the real sector as well as in the study of many problems in this area.

In reality, this process is taking place slowly in Bosnia and Herzegovina as well as in the countries of the region, and this problem is still closed to itself and continues to develop as a kind of “clean economy”. The reason is that each country is “fighting for itself”, for its independence in the economy, and not in the sense of proving it through globalization and the open market.

**KEYWORDS:** scientific research, economic improvement, economic system, globalization.

### Introduction

Two contradictory theses are often heard when it comes to the relationship between scientific research and the improvement of the economic environment, i.e. reform, or better said, the improvement of the situation in the economy of Bosnia and Herzegovina. According to one - the improve-

ment of the economic environment is a matter of society, economic entities and not science; it appears as a consequence of changes in society, not as a result of scientific research. This leads to the conclusion that the improvement of the economy and its environment does not require scientific analysis and consideration, scientific verification and research, but that it is done “on the fly”, in the very process of realization of economic activities. According to this understanding, only programs and some issues of work organization are left to scientific research, while other important improvement issues are not required. This position is justified by pointing out that rapid changes in society and the globalized economic environment must be accompanied by corresponding (therefore also rapid) changes in the economy, and therefore it is impossible to wait for systematic, more extensive research, which takes longer, because in by the time the results of those researches are finished, there will already be a need for new changes.

On the other hand, there is a thesis - that everything that the improvement requires must be previously examined and empirically (to a considerable extent experimentally) verified, from which comes the view that reform and improvement cannot be started, i.e. new solutions cannot be put into practice until their scientific verification is provided. Therefore, the contradiction of the theses presented is obvious.

How to resolve this dilemma?

### **1. Improvement of the economy as a consequence of global changes**

The question arises: can everything be verified empirically and whether the improvement of the economy, i.e. its reform, should be postponed until such a verification is carried out - what are those who are in favor of ensuring an exact approach in this area inclined towards, or, on the other hand, changes to be carried out “on the fly”, without systematic research, by supporting some measure with some partial, “small” research - which, in fact, boils down to the attitude of those who are in favor of “dynamism” in this area, for quick monitoring of changes that take place in society and the economic environment.

It should be clearly pointed out that both of these theses, in their ultimate consequence, are unjustified and harmful to the improvement and reform of the economy.

The first, which does not require research for some essential issues of the reform, leads to the denial of the role of the possibility of science in

finding the right answers to the questions that are asked, leads to voluntarism, apriorism, subjectivism, enabling a style of work that is reduced to activities through trial and error. Here there is a danger of improvisation, unprofessional solutions and wrong decisions, and it follows further that large, essential, and systemic issues of improvement and reform of the economy cannot be solved with the help of science and research. Some partial and less important questions are reserved for research.

The second, on the other hand, thesis leads to the failure to recognize the dynamism of the current economic environment and social events in general, which means overemphasizing the role of science and changes in society in general, and practically leads to the fact that the reform must “wait” until science has had its say, while it does not verify the proposed changes.

So: What is right? Which path should be taken?

It is clear that the improvement of the state of the economy cannot wait until all its positions, starting points, and solutions are tested experimentally, and only then put into practice. It is impossible to base every change in the economic environment on systematic and long-term research, because strict adherence to such an attitude could, in certain situations, mean slowing down the normal flow and development of the economy and its environment. When this is claimed, one should bear in mind, on the one hand, the fact that changes (reforms) in this area arise primarily as a consequence of global changes and that they represent the realization of certain social determinations, ideas, which, indeed, cannot be experimented with. On the other hand, the fact that the changes in Bosnia and Herzegovina are fast and essential and should be accelerated by the system is also accepted. Hence, in general, rapid changes in the economic environment and economy also require rapid changes in the entire sphere of society, especially in the legal and economic sense. Precisely because of this (due to the need to follow rapid social changes at an appropriate pace) - the changes made in the economic system often cannot be so thoroughly examined, scientifically verified in all their modalities.

Therefore, one cannot always wait for confirmation (scientific proof) of their validity and justification, for their reliable verification, because such a wait - which could take quite a long time, especially if one wants to verify all important aspects - would really represent the retention of positive of economic and economic flows, i.e. delaying the application of certain measures in this area that have shown their value in other spheres of society or for which already acquired experience indicates that they are justified and useful. Therefore, it would not be justified not to undertake any changes in

the economic system until they are tested experimentally, because that would mean keeping the old system, which is ineffective, and the actual verification of the economic system concept could take years. If one would like to establish a more complete picture of the proposed concept, it is necessary to diagnose the connection or impact of the changes made to one part of the system on another, following the level of the lay, which implies extending the duration of the examination. Given that a long period of time passes from the beginning of the research to its completion, there may be such changes in the market that the concept being tested no longer fits, so another must be sought. The practice does not “wait” for the research to be completed, but is constantly changing and developing. In order to ensure valid results in the research, the resulting changes should be constantly taken into account, monitored, taken as special variables. However, it is very difficult to ensure this in research. In such situations, reliable control is almost impossible to achieve. And for that reason, due to the impossibility of monitoring all the changes that occur in the meantime, such long-term research often does not provide adequate results.

## **2. Science as a driving force of economic development**

As can be seen from the previously attached, it is not possible to empirically verify all issues concerning the improvement of the economic environment, all changes, and expect society and science to always provide it. It is especially not possible to do this in periods when major, and sudden, “revolutionary” changes are being made in social and economic relations. Hence, in the economy and economic relations, one must count, no matter how disputed, on the arguments of science and on the introduction of measures, changes, and solutions that are not always verified by appropriate scientific methodology.

However, it would be very risky if the conclusion were drawn from this that research does not mean much for the improvement of the situation in the economy of Bosnia and Herzegovina, that any improvement can be started without them. It would be very harmful to advocate the thesis that the measures taken in the area of verification do not require scientific verification, that the changes made in this area cannot wait for scientific tests, with the explanation that these are urgent, urgent changes, resulting from radical changes in the economic environment and society in general.

Therefore, great damage would be caused to the reform, i.e. to the improvement of the situation in the Bosnian-Herzegovinian economy, and

thus to the society as a whole - because this is about making fateful decisions for the development and progress of the economy, and therefore also for the progress of the country in the future if made essential changes in this area without research, without an empirical basis, justifying such behavior by the fact that we want to follow the dynamic changes that are happening in the globalized market. It seems better to advocate for somewhat slower changes in this area, but ensure that they are based on reliable foundations, than to try to change the situation as soon as possible without having valid arguments for the steps that are intended to be taken. Because, in that case, such changes could become failures. Accepting the inevitability that society seeks changes, that it determines the direction and character of changes in the domestic economy, that changes in this area must be based on social needs and commitments, avoiding improvisations, superficial impressions, unverified opinions, would slow down the course of the desired reform in the economic and economic relations, and thus the movement of society forward.

It follows from this that research is of exceptional importance for the reform of the economy and economy of a country. Economic research and economic settings have a special place in this. Economic science must be the driving force of economic development. It must design practice, influence the real sector, monitor, analyze and direct it. The role of science and research must come to the fore especially in periods such as the present, a period of turbulent events, times of crisis, when larger and more decisive steps are being taken in order to change the country's economic system as a whole.

Science and the improvement of the economic environment must be seen together. Improvement without science remains unreasoned, ill-conceived, ungrounded, and thus the chances of success are reduced. If the measures that are taken are not based on the results of research, on facts, convincing arguments, but on the impressions, opinions, reasoning of influential individuals or politicians, the improvement, the improvement of the west into a "dead end street". Science is expected not only to closely monitor the development and improvement of the economy, the implementation of the reform itself, but also to be a much more active participant in positive events, from the beginning, from the emergence of the idea of reform. In this phase, the role of science and research is irreplaceable. Improvement and reform programs will encounter, as many examples show today, considerable difficulties that can hardly be overcome without research. Therefore, research should not be avoided, it should not be understood as something impossible - and such an understanding is present in certain circles and acts as an attack on the reform, as a denial of its values, as a search for what is negative in it

in order to destroy it. Critical review is necessary. Research is also necessary for the defense of all economic improvement activities and its reform against unjustified criticisms and lump sum assessments, which are not uncommon.

Is our economic science, and to what extent, ready to accept its share of responsibility in the conception and implementation of economic reform and is society ready to see its role in this, to recognize it and to expect from it what it can provide ?

Economics as a science has not been involved in reforms as much as it should have been, given its orientation, character, interest and possibilities, so far, it should be emphasized. Of course, part of the responsibility also applies to economic experts, who somehow “stayed on the sidelines” even when they had the opportunity to influence the very course of the improvement and reform program and some of its solutions, but others, certainly a significant part of the responsibility, bear certain social structures that deal with this activity, because they did not address the profession to a sufficient extent, they did not demand from it decisive positions on certain issues, they did not offer research that would verify individual proposed solutions, nor were financial and other conditions created that would enable them to businessmen are better organized in order to perform the tasks that they objectively can and that society can and should ask of them. Therefore, it is necessary to create the conditions for economic science to be more quickly involved in economic development and reform, to be at the center of all this and, as a critical science, to provide answers to the questions posed by economic development programs and to use it to the results obtained through research - directs, not just interprets and explains. The situation, therefore, must change in the sense that economic science really becomes a direct and active factor in changing the economy. Because, she cannot be just an interested observer, and to some extent an interpreter of executive changes, but an active participant in that process, who will have appropriate tasks in creating the planned changes, and therefore certain responsibilities.

The role of the profession is often reduced to monitoring the changes that society has undertaken in this area, while its role in creating, establishing, and theoretically establishing the changes is not sufficiently expressed.

The experience so far in Bosnia and Herzegovina shows that the economy followed the changes taking place in economic life and society faster than the profession managed to follow and follow the changes in the real sector itself. And this is one of the reasons why the economy mainly decided to study the roads, ways to implement improvements, to examine the tools that contribute to the effective implementation of the reform, and less to examine

the concept itself. According to some opinions, economics as a science and profession should deal with exactly that. However, such an understanding is wrong, it reduces the economy to the technology of the economy itself. The role of economics cannot be reduced only to the study of ways to improve the state of the economy and reform - to the search for methods, means, forms, organizations that best contribute to this, but it must also discuss the concept itself, its foundations and justification, based on analysis of reality, answers to the question of how far the basic attitudes and solutions of the reform are in accordance with that reality and the laws of its development, and to determine what are the possibilities for the realization of those ideas, what are the conditions for achieving the set goal.

When we talk about the fact that the very conception of the economic system should be subject to scientific verification, we mean checking the congruence of the conception and the goals of the economy, that is, examining whether such a conception corresponds to the set goal, to what extent it enables such a goal to be realized. About the goals that society sets and determines in accordance with its political determinations, in accordance with the perspectives of its development, the understanding of man and his development, depending on the very conditions, traditions, etc. we are not talking here.

History so far shows that reform is initiated primarily for social, political and ideological reasons. This is a fact that must be reckoned with and it is not in dispute. However, whether the right steps will be taken that will ensure the achievement of the goals depends to a significant extent on whether and to what extent the results of science were taken into account when establishing the new concept and introducing the reform. Therefore, the concepts of building a system of economic development cannot be solved without scientific research - not only economic, but also social (psychological, sociological, demographic, etc.).

### **3. The need to initiate research and systematic monitoring**

It should be emphasized that research, instead of only referring to ways of achieving improvement, to the realization of “concepts - realization”, which has been the most common case so far, should also find its place in the realization of “the goal of the economy - conception, i.e. the system of the country’s economy”. Science should have a more active role in establishing the concept, in proposing and educating the changes that should be made.



Based on the results of the research conducted, it is necessary to anticipate changes, predict and demand, when there is a need for it. Such a role of science, a profession, must be fought for.

So, if some important issues of economic improvement or its reform, which is currently being carried out in our economic system, have not been previously checked, decisive measures should be taken and research should be started, in systematic monitoring and checking of introduced measures in order to determine their good and bad sides, examination their efficiency, especially from the point of view of the set goals that these improvement activities want to achieve. Such research, i.e. critical and objective consideration of all issues and problems of the improvement program based on the results of the research, should enable to “repair” what shows weaknesses, what is inadequate, what cannot withstand objective criticism of arguments, and to replace it with what is better and more efficient. In addition, the very realization of both conceptions would point to our problems, raise some questions that could not be foreseen at the time of its foundation. The previous experience, and especially the problems that have arisen, should be a significant source for research, and to a considerable extent a roadmap for further improvement and improvement of the economic system. That’s why we need to start seriously studying the experience so far, in a comprehensive and critical analysis of the current practice and determine which solutions have proven to be good and which should be changed. In this sense, a larger-scale project should be launched, the experiences and practices of a larger number of business entities in developed economies should be analyzed and thus the advantages and disadvantages of their programs for improving the economy should be determined.

Improvement or reform is not a one-time act, but a very complex and long-lasting process. That is why it is necessary to permanently monitor and improve its individual solutions, as well as the concept as a whole at the level of the state, of the entire economy. The improvement or reform of the economy represents a huge area for research because it offers a wealth of problems that can be the subject of scientific research. Economic science cannot remain outside of it. She has to get involved in that process and constantly search for new and better solutions. No solution can be permanent and final. It is the rapid development of science, technique, and technology that dictates such constant work. Being satisfied with what has been achieved so far would be very detrimental to further progress. Therefore, permanent changes are necessary. Because, let’s use the statement that has the force of a maxim in our society: “That nothing is so sacred that it cannot give way to

something that is even better and more progressive”. When we talk about the need for permanent research, we mean the constant critical review of everything that is undertaken in this area. It also implies that the development of outcomes is monitored and that changed conditions are taken into account. Therefore, research cannot only reflect the current state, accept it as something static, given and unchangeable, but, on the contrary, it must grasp phenomena in development, show them in this way, and put their dynamics and development in the foreground.

The analysis of our economic reality appears here as the most important task. We need to carefully study what we have, see the true state of things, and not engage in guesswork and sink into abstractions. We must study all the situations in which the businessman finds himself. And right there, in the real sector, in the economic reality, we can check how much what we wanted is being achieved, how certain models are usable, to see what is good and what is not, to see if corrections are necessary and how they can be done. . In this way, from the aspect of science, the path that should be taken more decisively must be observed. Science cannot be separated from practice or develop outside of it. The economy cannot be built from the aspect of pure theoretical science, nor as some kind of abstract science. It should base its principles and theories on the knowledge gained through the study of practice, to turn to economic reality, to analyze, to examine the characteristics, specifics, possibilities of the real sector and work in it with regard to the concrete conditions in which it is realized. In this way, the ways that enable the efficient operation of the economic system, direct practice and contribute to the overall improvement will come to the fore. In fact, it is the way for the economy to be a more active participant in events in the area of improving the lives of citizens, to become a significant factor in changing the state of society as a whole.

## CONCLUSION

Although it was pointed out in the paper, we are far from denying the social, ideological and political dimension to the programs of development, improvement and reform, to deprive it of that, because that would mean denying the social character and significance of economic development, its determination and falling into positions of ideological mediocrity . We must advocate for the understanding that any improvement of the economy and economy of Bosnia and Herzegovina and the countries of the region can neither be conceived nor realized without science, its results and without research.

Emphasizing the need to study the economic reality, we believe that it is necessary to emphasize the importance of studying the positive practices of some of our economic organizations and the advanced experience of businessmen, because this is a particularly neglected source of economic knowledge in Bosnia and Herzegovina. Of course, one should be very careful in doing so, because there is a danger of unjustified generalization of limited experience, i.e. experience gained in special specific working conditions.

It should also be emphasized the need for special caution when adopting solutions that have been reached in other countries, considering that errors may appear. In fact, we should be sufficiently “open” to other people’s experiences, but also sufficiently critical of the solutions that are offered to us in that way. We cannot take over the experiences of other countries directly, transfer them to our economic system, the real sector, that is, to our reality, without prior verification and research.

Therefore, we have to check other experiences in practice, as well as our own solutions that we undertake, much more than we have done so far. We must accept practice as a criterion of the truth of our ideas, of what was created as a result of science and research.

When we advocate for research in this very important area, we mean research that serves the purpose of improving and perfecting the economy as a whole and some of its subsystems. Therefore, research should be much more focused on the study of current issues and problems of economic life. In this way, the needs of the society are directly met and thus provide wider support of that society and probably greater help for the realization of such projects. The transformation of the economy and the establishment of its system on a scientific basis is today a current issue that provides an abundance of material and content for research. Therefore, economic science should not and cannot bypass current issues of economic problems.

The current moment in which the economy in Bosnia and Herzegovina is located, due to the rapid changes in economic practice and the problems that arise in it, requires above all operational and applied research, i.e. research that is more directly related to practice, which includes certain current problems of practice and seeks answers at them.



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