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Ljubiša Balanović
Dejan Tanikić

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PREFACE

On behalf of the Organizing Committee, it is a great honor and pleasure to welcome all esteemed participants of the 54th International October Conference on Mining and Metallurgy (IOC 2023), scheduled to take place at the picturesque Bor Lake, Serbia, from October18th to 21st 2023.

The collaborative efforts of the University of Belgrade, the Technical Faculty in Bor, and the Mining and Metallurgy Institute Bor have meticulously organized this year's IOC. Our focus remains unwavering on showcasing the latest research findings and advancements in geology, mining, metallurgy, materials science, technology, environmental protection, and other engineering disciplines. Our primary objective is to foster a dynamic environment where academics, researchers, and industry professionals can come together to share their knowledge, experiences, and innovative ideas while exploring opportunities for collaborative research endeavors.

Our conference agenda is rich and diverse, encompassing plenary sessions, engaging invited lectures, technical presentations, enlightening oral and poster sessions, informative technical tours, a diverse exhibition, and memorable social gatherings. At the heart of this event lies our strong commitment to sustainable development within the mining and metallurgy sector. We are dedicated to exploring ecologically conscious methodologies, responsible resource extraction practices, and cutting-edge technologies that reduce the industry's environmental impact and enhance the well-being of local communities.

The conference proceedings comprise 129 papers authored by individuals from universities, research institutes, and industries in 22 countries. We are proud to welcome participants from Bosnia and Herzegovina, Bulgaria, Canada, China, Croatia, Germany, Greece, India, Iran, Kazakhstan, Libya, North Macedonia, Montenegro, Morocco, Romania, Russia, Slovakia, South Africa, Spain, Turkey, United States, and, of course, Serbia.

We are excited to host the 8th International Student Conference on Technical Sciences (ISC 2023) as part of IOC 2023. This event offers students from Serbia and the wider region a unique chance to showcase their research and discuss the future of their fields with experts.

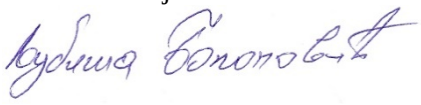
We sincerely thank the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia for their generous financial support. In addition, we express our profound gratitude to all our sponsors, exhibitors, and friends of the Conference for their contributions and unwavering support for playing a pivotal role in ensuring the success of IOC 2023.

We would like to express our heartfelt thanks to all authors, committees, reviewers, speakers, and chairpersons for their invaluable contributions in shaping IOC 2023.

We look forward to welcoming you to the 55th International October Conference on Mining and Metallurgy (IOC 2024), which will be held in October 2024.

On behalf of the 54th IOC Organizing Committee,

Prof. dr Ljubiša Balanović



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POSITION OF EUROPEAN COUNTRIES IN SUSTAINABLE RESOURCE MANAGEMENT

Anđelka Stojanović, Ivica Nikolić, Isidora Milošević

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Abstract

The emergence of new crises, along with old global trends in production and consumption, impose serious challenges on planetary boundaries regarding pollution, climate change, and severe depletion of natural resources. With the further development of industry in recent decades, the problems relating to the environment became pronounced and provoked global interest. As a result, the United Nations proposed Sustainable Development Goals to promote practices and targets for reducing adverse effects caused by socio-economic development. This paper presents an approach to assessing sustainable resource management practices measured through indicators of responsible consumption and production available in the Eurostat database. The Evaluation Based on Distance from Average Solution (EDAS) method has been used to evaluate the efforts of 27 European countries according to indicators that are part of sustainable development goals. The results indicate the spatial division of EU countries in implementing environmentally oriented sustainable practices. This research can imply that more developed European countries should promote successful practices and help the rest to the whole of Europe reach sustainability until targeted 2030.

***Keywords**: sustainable resource management, EU countries, EDAS*

1. INTRODUCTION

Globalization, innovations, and the development of information and communication technologies, as well as recent economic, pandemic, and war crises, have shaped the world's society and economy and significantly impacted production and consumption. Growing production and consumption undoubtedly deplete natural resources reaching and overcoming planetary boundaries [1]. With more climate changes, land degradation, and biodiversity losses, environmental issues have become more prominent and critical challenges for sustainability [1,2]. Along with the world, the European economies have passed turbulent times recently. After a constant annual increase in the value of sold production from 2014-2018, the outbreak caused by COVID-19 significantly impacted production and consumption in European Union (EU). The value of sold production in 2020 decreased by 7%, while in 2021 increased again by 8% compared with the previous year [3]. In addition, the newest war crisis in European territories will undoubtedly have an influence that will need analysis in the future.

On the other hand, governments and world organizations are trying to find appropriate strategies to deal with emerging issues and to reach long-term prosperity. To help the world become more sustainable, United Nations proposed Sustainable Development Goals to promote practices and targets for reducing adverse effects caused by socio-economic development and, among them, environmental issues [4]. Under Goal 12, Ensure sustainable consumption and production patterns of 2030 Agenda for Sustainable Development, it is defined the developed countries leading role in implementing the programs for sustainable management and efficient use of natural resources. Certainly, the critical part in achieving sustainability goals belongs to developing countries and their abilities to change towards sustainable production and consumption.

The industries also seek the appropriate business strategies to balance constant pressures to reduce environmental impact and economic performance. Therefore, sustainable resource management

(SRM) has been defined as the way of using natural resources to maximize people's well-being and minimize environmental impact [5]. SRM includes a set of practices that effectively and efficiently improve environmental performance and sustainability. Therefore, in literature, SRM is often described with multidimensional models and measurable parameters. This study aims to determine the positions of European counties in implementing SRM practices using the multi-criteria decision analysis tool The Evaluation Based on Distance from Average Solution (EDAS). The ranking of 27 EU countries will be computed based on six indicators that are part of SDG12 targets. Quantitative values for each indicator were retrieved from the Eurostat database. The study contributes to identifying the current position of EU countries in SRM to establish benchmarking and guide lower-ranking countries to make effective improvements toward sustainable practices.

2. DATA AND METHODS

2.1 Data

This quantitative research uses data from the Eurostat database over the six sustainable production and consumption (SPC) indicators explained in the Table 1.

Table 1 – SPC indicators

Label	Indicator	Description	Unit
SPC1	Energy productivity	The indicator measures the amount of economic output that is produced per unit of gross available energy. The gross available energy represents the quantity of energy product necessary to satisfy all demands of entities in the geographical area under consideration.	Euro per kilogram of oil equivalent
SPC2	Raw material consumption	The material footprint represents the global demand for the extraction of materials (minerals, metal ore, biomass, fossil energy materials) induced by the consumption of goods and services within a geographical reference area.	Tonnes per capita
SPC3	Average CO2 emissions per km from new passenger cars	Average carbon dioxide (CO2) emissions per km by new passenger cars in a given year. The reported emissions are based on type approval and can deviate from the actual CO2 emissions of new cars.	
SPC4	Circular material use rate	Measures the share of material recovered and fed back into the economy in overall material use. The CMU is defined as the ratio of the circular use of material to the overall material use.	Percentage
SPC5	Generation of waste, excluding major mineral wastes by hazardousness	Measures all waste generated in a country. Due to the strong fluctuations in waste generation in the mining and construction sectors and their limited data quality and comparability, major mineral wastes, dredging spoils, and soils are excluded.	Kilograms per capita
SPC6	Gross value added in environmental goods and services sector	The gross value added in EGSS represents the contribution of the environmental goods and services sector to GDP. It is defined as the difference between the value of the sector's output and intermediate consumption.	Percentage of gross domestic product (GDP)

2.2 Methodology

EDAS method belongs to the outranking group of methods proposed by Keshavarz and associates [6]. One benefit of the EDAS method, as compared to other MCDA techniques, is its simplicity and ease of understanding. Additionally, there is no requirement for the normalization of the initial matrix. As a result, EDAS has been widely used in several engineering and decision-making problems [7]. The main approach offered by EDAS presupposes the assessment of alternatives in terms of distance from an average solution. An appraisal score (AS) can be calculated for each alternative by determining the positive and negative distances from averages and their weighted sums to rank alternatives. The detailed procedure is presented in [6].

As described previously, the SRM is measured with six indicators used as criteria in the proposed model. The criteria weights are equally distributed. The type of criteria and the summary statistics are presented in the Table 2. The 27 EU countries were used as alternatives.

Table 2 – Data summary statistics and initial data for EDAS method

	SPC1	SPC2	SPC3	SPC4	SPC5	SPC6
	max	min	min	max	min	max
criteria weights	0.17	0.17	0.17	0.17	0.17	0.17
min	2.48	7.75	85.70	1.50	962.00	0.98
max	22.41	33.62	125.10	30.00	6291.00	6.24
mean	7.91	17.97	110.57	9.79	1833.50	2.65
std. deviation	4.18	6.82	10.07	6.71	1053.85	1.12

3. RESULTS AND DISCUSSION

Using the obtained data and the EDAS methodology, the rank of 27 EU countries according to the effectiveness of sustainable resource management was obtained (Table 3). According to the results, the Netherlands represents the leader in SRM implementation. The reason for these results lies in the commitment of the Dutch government to establish an innovation infrastructure that facilitates companies to move toward sustainability goals. That means permanent striving for innovation and sustainability across all sectors and close collaboration between business, science, and government [8].

Table 3 - Rank of 27 EU countries according to SRM indicators

Rank	**Country**	**AS**	**Rank**	**Country**	**AS**	**Rank**	**Country**	**AS**
1	Netherlands	0.932	10	Sweden	0.539	19	Croatia	0.461
2	Italy	0.812	11	Greece	0.532	20	Portugal	0.457
3	France	0.782	12	Czechia	0.522	21	Latvia	0.426
4	Ireland	0.714	13	Luxembourg	0.514	22	Cyprus	0.406
5	Denmark	0.676	14	Finland	0.508	23	Poland	0.387
6	Austria	0.644	15	Malta	0.501	24	Lithuania	0.368
7	Spain	0.633	16	Slovakia	0.480	25	Romania	0.315
8	Germany	0.616	17	Slovenia	0.479	26	Estonia	0.250
9	Belgium	0.550	18	Hungary	0.474	27	Bulgaria	0.239

Also, the results indicate regional divides within EU countries. First, two of the first three economies in the EU are at the top of the ranking: Italy at the second place (third contributor to EU GDP) and France at the third place (second contributor to the EU GDP). At the end of the ranking string relating to SRM are the countries with less than 1% contribution to EU GDP [9]. From a geographical standpoint, there seems to be a west-east pattern in the variation of SRM practices across Europe (Figure 1).

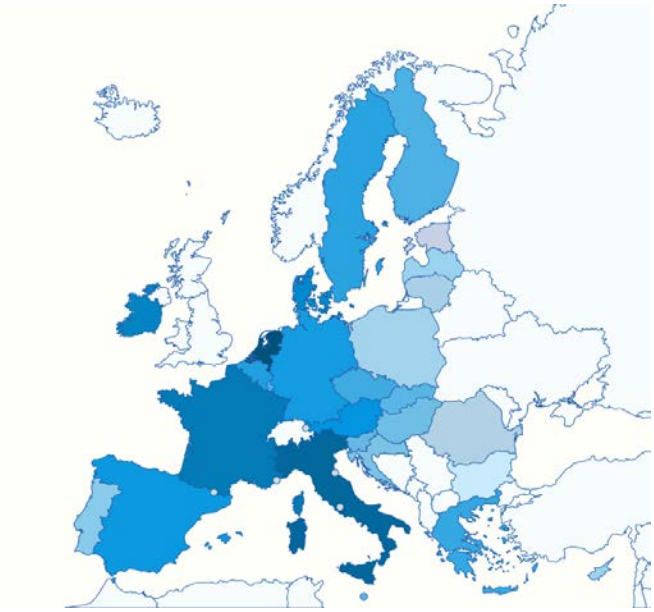

Figure 2 – Map of the SRM variation across the EU

4. CONCLUSION

After analyzing the results, it is clear that there are significant implications to consider. As outlined in SDG12, it is recommended that developed countries take a leadership role in implementing the proposed framework to achieve sustainable consumption of natural resources, reduce waste generation, and promote sustainable resource management practices among companies. These targets should remain a top priority. It is crucial to assist developing countries in enhancing their capabilities across various domains, including institutional, technological, and scientific aspects. Furthermore, promoting positive attitudes and sustainable production and consumption patterns are of great importance.

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