Research Inventy: International Journal of Engineering And Science
Vol.14, Issue 8 (August 2024), PP 15-24
Issn (e): 2278-4721, Issn (p):2319-6483, www.researchinventy.com

Increasing Resource Productivity By Building A Cluster For Circular Economy

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Abstract: *In today's dynamic conditions an important determinant of economic growth and well-being in each country is increasing resource productivity, which is a prerequisite for the transition to sustainable production and consumption. Achieving higher resource efficiency creates additional economic, social and environmental benefits and is the focus of the EU's growth strategy (European Green Deal). The main approach to achieving the goals of sustainable development is the realization of the principles of the circular economy. This process imposes a new strategy for development and doing business, need for strategic and flexible cooperation between the private and public sector, between different companies, educational and research institutes, which can be implemented most effectively in the cluster union.*

The aim of the proposed study is by applying a statistical and correlation method to make: 1) resource productivity analysis in selected nine countries in the Balkan region, 2) assessment the possibilities for realization of the principles of the circular economy as a factor to increasing resource productivity in the Balkan Cluster, by developing a conceptual model to be empirically tested among cluster managers who work in Bulgaria and have active cooperation with partners from the Balkan countries.

Keywords: *Resource Productivity, Circular Economy, Cluster*

Date of Submission: 13-08-2024 Date of acceptance: 27-08-2024

I. INTRODUCTION

Economic activity depends on a continuous flow of natural resources. As economies grow, more and more material resources (biomass, minerals, metals and fossil energy materials) are being extracted, and the increase in material consumption is intensifying competition for resources. Based on projected global population growth (up to over 9 billion people) and economic growth that will triple the wealth per capita compared to the current level, the International Energy Agency predicts that demand for materials will double by 2050 [1]. OECD report projects a doubling of global primary materials use between today and 2060 [2].

In this context, the study offers a vision to accelerate companies' transition in the Balkan region towards circular use of materials and create additional opportunities to strengthen businesses' and economies' competitiveness. By keeping products and materials in use, the circular economy reduces the needs and consumption of materials in the economy, leading to a more efficient use of resources.

The study presents a comparative and quantitative analysis of resource productivity in relation to the potential for developing a circular economy in the Balkans. The research aims to assess the following: 1) important aspects of the socio-economic development of the Balkan countries; 2) domestic material consumption and resource productivity in the period 2009-2019; 3) the possibilities for realizing the circular economy principles as a factor to increasing resource productivity in the Balkan Cluster.

The development of resource consumption is examined in the context of changes in economic activity and living standards in the selected countries. The models resource use and their productivity in nine countries of the Balkan region are outlined, namely Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, North Macedonia, Romania, Serbia and Slovenia. The challenges facing resource efficiency and the circular economy's development in the economies under review have been comparatively analyzed.

Resource productivity in this study is defined as gross domestic product (GDP) per unit of domestic material consumption (DMC). Eurostat databases are a source of data and indicators on economic performance, resource consumption and resource productivity.

II. RESEARCH

2.1. Analysis of Material Consumption and Resource Productivity in the Countries of the Balkan Region

The efficient use of material resources reduces environmental impacts. Achieving higher resource productivity is a particular focus of a European Green Deal - the EU's ambitious economic growth strategy that works through a framework of new regulation and legislation setting targets [3]. In the context of the Strategy, an essential challenge for Member States, in addition to decoupling economic growth from resource consumption, is to increase material efficiency and competitiveness. The circular economy model, and in particular waste management, recycling, sustainable production, and resource efficiency, are among the main pillars for implementing the Green Agenda for the Western Balkans [4].

Economic growth and improving living standards, population growth, and international trade growth, investment in construction and infrastructure increase demand and consumption of material resources. Changes in demand and supply of materials are linked to the increasing demand for raw materials, which in turn is driven by the growth of developing economies and the emergence of new technologies [5]. During the period 2009 - 2019, except for Greece, the surveyed economies recorded positive real GDP growth rates - between 1% (Croatia) and 3.1% (Romania). More dynamic are the economies of Albania, North Macedonia, Bulgaria, Bosnia and Herzegovina, with an annual growth rate between 2% and 3%. During the same period, the real GDP growth rate is somewhat weaker in Serbia (1.9%) and Slovenia (1.8%). In Greece, real GDP contracted by 2.1%.

Natural resources providing essential raw materials are the foundation of the well-being. Maintaining the modern standard of living from economic activity leads to the consumption of more and more natural materials. Compared to other economies, Slovenia achieves a living standard that is closest to the EU-27 average. In 2019, Slovenia had the highest GDP per capita among all countries included in this comparison at 11% below the EU average. In Serbia, North Macedonia, Albania and Bosnia and Herzegovina, GDP per capita is between 50% and 68% lower than the EU average. Romania, Greece and Croatia reach GDP levels between 30% and 35% lower than the European Union average. In Bulgaria, GDP per head reaches 47% of the EU average. In all the countries surveyed, the expected growth in income per capita and approaching the level of income in the EU is a prerequisite for increasing resource consumption. In order to maintain and further increase well-being, improving resource productivity have to be an important priority in the Balkans region.

In the context of resource scarcity and competition, the economies of countries with low living standards should develop more efficient growth models in the process of economic convergence. Simultaneously, as well-being increases, new approaches to resource management and an increase in demand for environmentally friendly goods and services that protect the environment and materials arise. The transformation of linear material flows into circular ones is a prerequisite for improving well-being through higher resource productivity. In a circular economy, products' value and utility are expanded, and production and consumption wastes are utilized as secondary resources, promising solutions and co-benefits to a range of economic and environmental issues [6].

Population changes are also key factors for material consumption, especially of industrial materials and metals. The decline of the population in most of the selected countries affects the value of the indicator DMC per capita. Between 2009 and 2019 positive demographic development was only found in Slovenia and North Macedonia were the population increased by 1.7% and 1.1 % respectively. During the same period, the largest population decline of 9.1% is observed in Bosnia and Herzegovina. Population decline between 4-6% is in Bulgaria, Croatia, Romania and Serbia. In Greece, the population decreased by 3.5%, and in Albania by 1.9%.

Natural resources use is unevenly distributed among the countries analyzed in this study (Table 1). In 2019, except for Greece, the populous countries had the largest absolute amount of materials consumed. In 2019, absolute material consumption was the highest in Romania - 476 million tonnes, or 7.2% of total EU consumption. Bulgaria's economic activity also uses a large amount of materials, as measured by domestic material consumption - nearly 145 million tonnes, or 2.3% of material consumption in the European Union. Resource consumption is lowest in Northern Macedonia - 17.7 million tonnes or 0.28% of the EU average.

The total DMC per capita of the EU economy is higher than global DMC per capita, reaching 14.2 tonnes in 2019. The average per capita consumption in the EU is relatively stable, falling from its highest of 15.2 tonnes per capita in 2011 to 14.2 tonnes per capita in 2019. In 2019 DMC varies significantly across countries (Table 2), ranging from 24.5 tonnes per capita (Romania) and 7.6 tonnes per capita (Albania).

Table 1. Domestic material consumption, thousand tonnes

	2017	2018	2019
EU-27_2020	6 254 485	6 355 076	6 325 358
Bulgaria	139 220	142 911	144 655
Greece	120 112	118 263	104 554
Croatia	41 226	42 585	45 851
Romania	417 639	449 786	475 536
Slovenia	27 081	29 889	30 804
North Macedonia	17 747	17 756	:

Albania	21 750	:	:
Serbia	113 890	118 850	:
Bosnia and Herzegovina	36 256	:	:

Source: Eurostat

In Bulgaria, 20.7 tonnes per capita of materials are consumed, and 17 tonnes per capita in Serbia. Material consumption is lower than the EU average in Croatia (11.2 tonnes per capita), and in Bosnia and Herzegovina (10.3 tonnes per capita). In Greece and North Macedonia, DMC per capita is far below the EU average consumption - of 9.7 and 8.6 tonnes per capita, respectively. Eurostat data show that, with the exception of Romania, Bulgaria, Serbia and Slovenia, all other countries of the surveyed region reach DMC per capita lower than the EU average (Table 2).

Table 2. Domestic material consumption, tonnes per capita

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
EU-27	14.9	14.4	15.2	14.1	13.7	13.8	13.7	13.7	14.0	14.2	14.2
Bulgaria	16.4	16.3	18.2	17.6	17.1	18.8	21.3	18.9	19.7	20.3	20.7
Greece	17.8	15.9	14.3	13.2	12.4	12.7	12.3	11.6	11.2	11.0	9.7
Croatia	12.3	10.4	10.4	9.5	10.0	9.2	9.8	10.1	10.0	104	11.2
Romania	17.4	13.7	19.0	18.0	18.0	18.8	22.5	22.9	21.3	23.1	24.5
Slovenia	17.0	16.0	14.4	12.5	12.2	13.1	13.3	12.8	13.1	14.4	14.8
North Macedonia	:	9.0	9.9	9.5	9.2	9.3	9.3	9.1	8.6	8.6	:
Albania	:	7.0	7.1	7.2	8.0	7.9	9.,1	9.9	7.6	:	:
Serbia	14.3	15.2	15.4	14.0	15.3	14.5	15.5	16.9	16.2	17.0	:
Bosnia and Herzegovina	:	:	:	:	:	:	9.7	11.8	10.3	:	:

Source: Eurostat

The closest to the EU average is material consumption in Slovenia - 14.8 tonnes per capita. In 2019, the resource consumption per capita in Romania and Bulgaria was 10.3 and 6.5 tonnes higher than that of the average European. In 2017, for which Eurostat data are the latest, Serbia's average citizen consumes 2.8 tonnes more materials than the average European. Countries experience different dynamics in terms of material consumption. The downward trend in material consumption per capita throughout the study period was clearly expressed in Greece, where material consumption decreased by 38.9%. The country is experiencing both a population decline and a prolonged downturn in GDP. With already high consumption per person in 2009 of 17.4 tonnes, Romania's economy increased its consumption to 24.5 tonnes per capita in 2019.

Resource productivity refers to the efficiency of using natural resources within economic system. Resource productivity increases are gaining importance in the context of resource scarcity and future economic growth, especially in the economies of the Western Balkans. Resource productivity in the EU is EUR 2.2 per kilogram (using current price data for GDP) in 2019. In 2019, resource productivity in Greece reached 1.9 EUR/kg, in Slovenia 1.6 EUR/kg, in Croatia 1.2 EUR/kg (Table 3). North Macedonia's economy has generated 0.6 euros of GDP. Romania and Albania have resource productivity of 0.5 euros worth of GDP created per kilogram of material used. For every kilogram of material consumed, EUR 0.4 of gross domestic product are generate in Bosnia and Herzegovina, Bulgaria and Serbia.

Expressed in purchasing power standards per kilogram, (using current price data for GDP converted into purchasing power standards), resource productivity varies among different countries (Table 4). The difference between the countries with the lowest productivity (Serbia and Bulgaria) and the EU average is significant. Resource productivity is highest in the four countries with the highest living standard (measured in GDP per capita, Table 4).

Table 3. Resource productivity 2009-2019, Euro per kilogram

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
EU-27	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.1	2.1	2.1	2.2
Bulgaria	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4
Greece	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.5	1.6	1.9
Croatia	0.9	1.0	1.0	1.1	1.0	1.1	1.1	1.1	1.2	1.2	1.2
Romania	0.4	0.5	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5
Slovenia	1.0	1.1	1.3	1.4	1.5	1.4	1.4	1.5	1.6	1.5	1.6
North Macedonia	:	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	:
Albania	:	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.5	:	:
Serbia	0.3	0.4	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.4	:

Bosnia and Herzegovina	:	:	:	:	:	:	0.4	0.4	0.4	:	:

Source: Eurostat

In 2019, the EU average productivity is 2.2 purchasing power standards (PPS) per kilogram (Table 4). The indicator varies widely between individual countries. Resource productivity in the same year is highest in Greece, where it reaches the average European levels. Greece is the first in terms of resource productivity in the Balkan region and ninth in the EU. Taking into account price differences, the comparison between countries shows that second highest resource productivity values were recorded in Slovenia and Croatia (1.8 PPS/kg). In 2019 measured in PPS per kilogram, resource productivity in Slovenia and Croatia is over 80% of the EU average.

Table 4. Resource productivity, GDP and DMC, by country, 2019

	GDP_{PPS} per capita (PPS per capita)	DMCper capita (tonnes per capita)	Resource Productivity (PPS per kilogram)	GDP_{PPS}/DMC (index EU-27=100)
EU-27_2020	31 105	14.2	2.2	100.0
Bulgaria	16 414	20.7	0.8	36.0
Greece	21 040	9.7	2.2	97.9
Croatia	20 183	11.2	1.8	80.9
Romania	21 568	24.5	0.9	40.0
Slovenia	27 220	14.8	1.8	83.8
North Macedonia (*)	11 306	8.6	1.3	60.0
Albania (**)	8 944	7.6	1.2	53.7
Serbia (*)	11 983	17.0	0.7	32.0
Bosnia and Herzegovina (**)	9 046	10.3	0.9	39.7

(*) 2018 instead of 2019, (**) 2017 instead of 2019
Source: Eurostat

Resource productivity stood at 1.3 PPS/kg in North Macedonia and at 1.2 PPS/kg in Albania, respectively 60% and 54% of the EU average. Bosnia and Herzegovina and Romania registered resource productivity of 0.9 PPS/kg. The resource productivity of the Romanian economy remains among the lowest in the countries surveyed, as well as that in Bosnia and Herzegovina - 40% of the EU average. Bulgaria had resource productivity of 0.8 PPS/kg in 2019, second lowest in the region, according to Eurostat data. Serbia had a lower resource productivity of 0.7 PPS/kg. In Serbia and Bulgaria, resource productivity is 64% and 68% lower than in the EU, with purchasing power-adjusted GDP. There are large differences between individual countries, both in absolute terms and in trends over time.

The change of resource productivity in the period under review varies between countries. Resource productivity in Greece increased from 1.28 euros per kilogram to 1.86 euros per kilogram due to the negative GDP growth rates, which lead to a decline in DMC[1]. Material productivity in Slovenia increased from EUR 1.1 per kilogram, to EUR 1.39 per kilogram. The efficient use of materials in Slovenia reduces environmental impacts and productivity achieved is at the heart of decoupling economic growth from the consumption of available resources. Resource productivity in Croatia and Romania increased slightly – from EUR 1 per kilogram to EUR 1.1 per kilogram. When using data on GDP chain volumes, resource productivity increased from EUR 0.32 per kilogram to EUR 0.33 per kilogram in Bulgaria and from EUR 0.28 per kilogram to EUR 0.31 per kilogram in Serbia.

Almost all EU Member States improved the productivity of their resources between 2000-2019 by best performing Slovenia, where resource productivity increased by 74.7%, followed by Greece (50.1%). Since 2000, resource productivity in Bulgaria's economy has increased by around 35% and Croatia's by 4.6%. Productivity decrease was observed in Romania (22.3%). In the period 2001-2018 Serbia achieved an increase of 39.4%. Between 2010 and 2018 in North Macedonia, resource productivity increased by 25.3%. Between 2010 and 2018 in Albania, resource productivity increased by 35.8%, and in Bosnia and Herzegovina 4% (between 2015 and 2018).

The study outlines differences between countries, with some of them achieving resource efficiency improvements by changing economies to generate more product from the same resources. Increasing resource efficiency is key to reducing resource consumption in economies that are catching up with higher living standards. The distinct heterogeneity in the models is related to a number of factors, including the available natural resources, the structure of the economy, economic development models, integration into the world economy, etc.

[1] Resource productivity is calculated using GDP in chain-linked volumes normalised to 2010 prices to show the development over time of the indicator excluding inflation.

Slovenia's economy achieves the highest GDP per capita with the resources consumed, with DMC lower than in Romania, Bulgaria, and Serbia. Slovenia achieves the best result in terms of resource productivity growth in the research region and is overtaken only by Greece in terms of resource productivity in 2019. The per capita wealth created in Greece and Croatia is closest to that of Slovenia and the EU-27, and the productivity of resources is closest to the EU average. The economies of Romania, Bulgaria, and Serbia, which have very high per capita DMC and low resource productivity, should develop more efficient resource use models. The study shows that there are significant differences in the consumption of material resources per capita, and resource productivity has not improved significantly. Countries with lower well-being and consumption in Western Balkans, as well as more dynamic economies, need to benefit from technology transfer and innovation, as well as external support for their development.

The results in the studied areas show that in addition to social and territorial cohesion, the sustainable future of the region implies a more efficient and circular use of resources. Increasing resource productivity is key to optimizing resource consumption in selected countries, allowing society to decouple economic growth from resource consumption. Increasing the productivity of resources brings benefits for the sustainability of development, while expanding the access to raw materials, strengthening the competitiveness. The results of the study and the conclusions made are important for improving approaches to social development and natural resource management.

Based on the concepts of the circular economy and the functioning of companies in the studied countries, the importance of attracting business to more innovative and circular forms of production and consumption is growing. One possible way to achieve these goals is to build a Balkan Cluster as a factor for the circular economy (CE) development.

2.2. Conceptual Model and Research Hypotheses

The cluster is a geographically concentrated voluntary association that includes interconnected companies, specialized suppliers of components, equipment and services, as well as specialized infrastructure, intermediaries, government and other institutions (universities, think tanks, agencies, trade associations), which provide specialized training, education, information, research, technical support and whose activity is based on competition and cooperation [7].

The geographical scope of the cluster varies from one region, country, or even one city, and may cover neighboring cities, regions, countries, as borders are constantly evolving (new companies and markets are emerging, and others are shrinking or dying out).

For the study purposes, the Balkan Cluster is defined as a union (horizontal, vertical, sectoral and intersectoral) of companies, public and scientific institutions from different countries in the region, or the creation of a cluster network that brings together clusters from different Balkan countries, as well as active cooperation and partnership between national clusters in the region.

The main factor ensuring the effective functioning the cluster is the presence of a core, leading company (often called an anchor), well-developed infrastructure, access to markets, raw materials, social services and financial resources. The realization of the CE requires mandatory involvement and active participation (from start to finish) investors, end users, small and medium-sized companies (with access to the experience of the leading company, to "good practices"), manufacturers and suppliers of equipment and raw materials, recycling companies and creating a market for recycled materials, waste management. An important starting point in the cluster activity is the eco-design of production processes and products so that they are used longer, repaired, modernized, processed and recycled, instead of being discarded. The leading company determines the standards, the requirements to the product, created at each stage of the general production. Other smaller companies develop their competencies and capabilities in the direction specialization and product differentiation within the limits and rules thus defined. In this way, the desired circular process can be carried out, which includes all stages of the product life cycle: raw materials, resources → product design → production → consumption, reuse → waste management and recycling → creation of new raw materials and resources for others production (Figure 1).

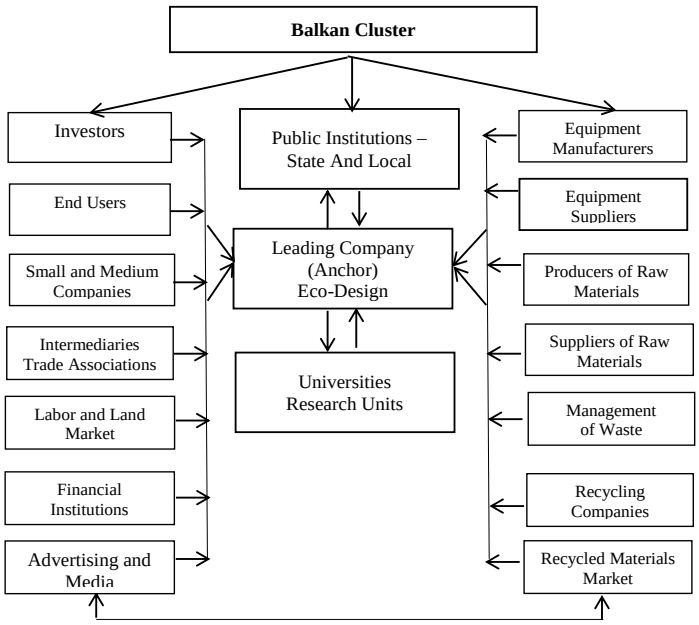

Figure 1. Structure and Organization the Balkan Cluster - a factor for the CE development and increasing resource productivity

The model of CE requires a new development strategy and a different approach to doing business [8], which allows the creation and realization of additional economic, social and environmental value for the client, stakeholders and society as a whole, and building competitive advantages for companies. The Balkan Cluster building enables entrepreneurs to take advantage potentially new product and territorial markets, and consumers to make rational choices through better information on the environmentally friendly characteristics different products, which determines the first hypothesis in the research:

H1: The Balkan Cluster building has a positive impact on the CE development and increasing resource productivity.

In a dynamic external environment in the cluster conditions are created for building new connections between interconnected companies and markets, improving the level of communication between the participating entities, partnership development, whether formally through agreements or informal relations, which is a strong factor in forming effective multidisciplinary teams. In practice, this means creating an integrated vertical management chain, which covers the whole circular process. The interaction between all participants in the vertical chain from beginning to end (production, use, recycling and re-use) is a strong factor for the CE realization, which determines the second hypothesis:

H2: Creating an integrated vertical management chain in the cluster has a positive impact on the CE development.

The building and effective management of the integrated vertical chain on the basis of competition is an important condition for stimulating innovation, increasing specialization, technologies development and their application in the creation of the final product, its recycling and reuse. As most innovations today are complementary rather than interchangeable, the cluster facilitates the integration and cooperation process between all actors in the vertical chain (customers, companies, suppliers, etc.) and their joint work in creating "open innovation", which defines the following research hypothesis:

H3: The innovation process in the cluster has a positive impact on the CE development.

The realization the circular economy principles requires a radical change in the strategic behavior, the companies activity, included in the cluster (and the cluster as a whole) and the creation of a new, sustainable business model. The better organization and management of this process should be aimed at creating a company structure in which a modern organization of simultaneous teamwork is required, an effective system of incentives to achieve the desired results and maintain the reputation of the cluster (and companies). Therefore, the fourth hypothesis for research is:

H4: Organizational and managerial changes in the cluster have a positive impact on the CE development.

The cluster brings together the efforts, potential, resources of the private and public sectors to work together. Public institutions play the intermediary role between the participating private companies, initiator of programs and specific implementation plans, listener to the problems, which must be quickly mastered and resolved. Especially important for the success of the cluster is the availability of an educated and skilled workforce, proximity to scientific and research activities, higher education, development of entrepreneurial spirit and culture that values education and knowledge. These services must be provided by public institutions, which determines the fifth hypothesis:

H5: The public institutions included in the cluster have a positive impact on the CE development.

The connections and dependencies between the indicated main characteristics of the cluster and the possibilities for development of the CE (defined hypotheses) are summarized in Figure 2.

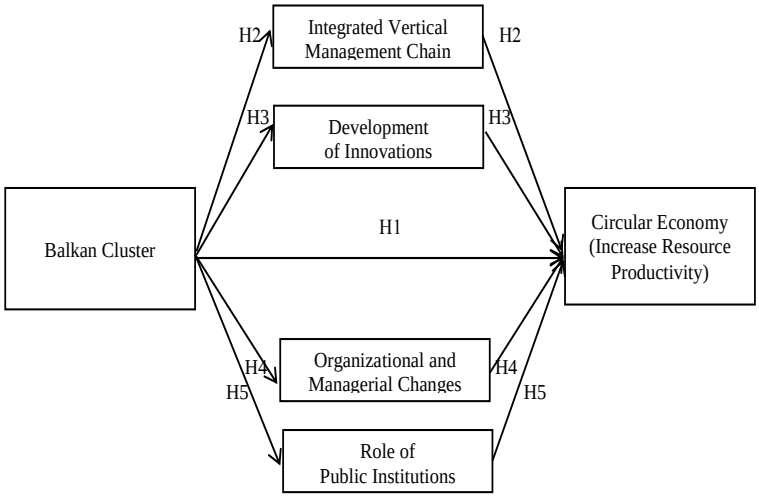

Figure 2. Conceptual Model and Research Hypotheses

III. RESULTS AND DISCUSSIONS

3.1. RESEARCH METHODS

3.1.1. Research Object

The testing of the formulated hypotheses was carried out through an empirical study, which includes 25 working clusters in Bulgaria, selected at random. They work in different sectors/markets of the economy - textile, construction, automotive, pharmaceutical industry, real estate and tourism, electric mobility, renewable energy sources, waste collection and recycling, information and communication technologies, health, wellness & SPA tourism, ecology and environmental protection, sustainable development, education, innovation, financial and legal consulting services, etc.

The surveyed clusters include over 200 companies - in the largest cluster 64 companies work, and in the smallest - 7. Most of them (18) have been working in the relevant markets for more than 10 years and have sufficient experience, and the rest - between 3 and 8 years and still have significant problems with position stabilization or survival.

Depending on the nature of the links between the participating companies, the studied clusters are both horizontal and single-sector, as well as vertical and intersectoral, which expands the research base. Horizontal and sectoral clusters are characterized by a policy of expanding vertical links or diversification through various forms of cooperation and partnership, which stabilizes their market positions.

What unites the studied clusters is, that they all have partners from the Balkan countries - Greece, Serbia, Romania, Croatia, Montenegro, North Macedonia. Partnerships are developed both between the cluster and individual companies, and between individual clusters by creating a cluster network. Cooperation with clusters or individual companies from Serbia in the field of innovation, information and communication technologies is particularly active.

3.1.2. Procedure and Research Tools

The information was collected through an online survey among managers at the cluster level (25) and managers of individual companies (85) participating in the cluster, or a total of 110 respondents. The research was conducted in the period September - December 2020 and was largely provoked by the new challenges for the development of the region [9].

The survey included a total of 30 questions, constructed as wordings, to which the respondents referred, noting their answers from 1 to 5 on the Likert scale (where 1 stands for "I fully disagree" and 5 stands for "I fully agree"). As the aim of the study is to determine the correlation between the Balkan Cluster building and the CE development, the questions are divided into two parts. The first part includes six questions related to a general assessment of the possibilities for CE realization and increasing resource productivity in the cluster (the first hypothesis). The second part includes 24 main questions, divided into 4 parts (the remaining hypotheses), each with 6 questions. They are related to the analyzed so far the Balkan Cluster characteristics and their influence (as independent variables) on the CE development (dependent variable).

The realization of the CE principles in the cluster is assessed by respondents through the possibility to reduce the amount of resources used, increase the share of recycled materials, waste management, the role of digitalization for sustainable production and consumption (H1).

The individual cluster characteristics were studied on the basis assessment of the competencies for product life cycle management, building long-term partnerships, knowledge transfer (H2), ability to develop and use specific assets in combination with other specific assets of other companies in the cluster, training and generation of new knowledge, the role of digitalization for the development of the innovation process (H3), as well as assessing the need for change, reconfiguration of key activities and resources, coordination, integration of all participants, which in practice will allow the creation of a circular process (H4). Issues related to the role of public institutions (H5) include assessment of their ability to create conditions for strategic partnership, coordination and financing of various programs and projects, maintenance of the necessary infrastructure (transport, social, education), and these indicators are separately assessed state and local institutions.

The study also used information collected and processed from workshops, shared opinions, assessments, experience of managers, employees in the surveyed clusters, annual reports, publications and analyzes in specialized publications, as well as analyzes in The Balkan Cluster Project [10].

3.2. Results and discussions

In analyzing the results of the study first calculated the average of the responses from an online survey conducted. On this basis, Pearson's correlation coefficient (R) was calculated for the whole sample to establish the relationship between the Balkan Cluster building and the CE development (Table 5), as well as between cluster characteristics (integrated vertical management chain, innovation, organizational and managerial change and public institutions) and the CE (Table 6). To add more explanatory power to the empirical results, a coefficient of determination/certainty (%) - R^2 was calculated and used in the analysis, which gives a more accurate estimate and shows what percentage of changes in the independent variable will lead to changes in the dependent (the remaining percentages up to 100 define the uncertainty coefficient).

The calculated Pearson's correlation coefficient – R (in Table 5 and Table 6) is statistically significant (it is assumed that if R=0, there is no linear relationship between the variables and if R=1 or R= –1, there is a perfect linear relationship between the two variables), which proves dependence and relationship between the studied variables and requires detailed analysis. Since the correlation coefficient is significantly greater than zero, this by definition allows the rejection of the null hypothesis for the independence of the variables.

The obtained results prove the existence of a significant positive correlation between the following variables:

• The Balkan Cluster building and the CE development (H1) - R=0.821.

• Creating an integrated vertical management chain in the cluster and the CE development (H2) - R=0.612.

• The innovation process in the cluster and the CE development (H3) - R=0.431.

• Organizational and managerial changes in the cluster and the CE development (H4) - R=0.568.

• Role of public institutions in the cluster and the CE development (H5) - R=0.319.

The two variables - the Balkan Cluster and CE have not only a very strong correlation, but also a high coefficient of variation - 67.40%. The coefficient of determination (and therefore uncertainty) is relatively high between the integrated vertical management chain and the CE, as well as between organizational and managerial changes and the CE. There is not a particularly high coefficient of variation between development of innovation and the CE and between role of public institutions and the CE, which does not, however, exclude dependence and connection between them.

Table 5. Correlation between the Balkan Cluster building and the Circular Economy (CE) development

		Circular Economy (CE)
Balkan Cluster	Pearson Correlation – R	0.821
	Coefficient of Determination (%) - R^2 N=110	67.40

Correlation is significant at the 0.01 level (1-tailed).
Source: Own calculations

Table 6. Correlation between cluster characteristics and Circular Economy (CE) development

		Circular Economy (CE)
Integrated Vertical Management Chain	Pearson Correlation – R Coefficient of Determination (%) - R^2 N=110	0.612 37.45
The innovation process in the cluster	Pearson Correlation – R Coefficient of Determination (%) - R^2 N=110	0.431 18.57
Organizational and Managerial Changes	Pearson Correlation – R Coefficient of Determination (%) - R^2 N=110	0.568 32.26
Role of Public Institutions	Pearson Correlation – R Coefficient of Determination (%) - R^2 N=110	0.319 10.17

Correlation is significant at the 0.01 level (1-tailed).
Source: Own calculations

The analysis of the results requires first of all to emphasize that there is a significant positive correlation (R=0.821) between the Balkan Cluster and the CE development (as a factor to increasing resource productivity), which fully supports the idea and confirms the first hypothesis (H1).

The results that examine the relationship between the different characteristics of the cluster and the CE development are different, which requires further explanation.

The study showed that the respondents attach the greatest importance to the creation an integrated vertical management chain in the cluster as a factor for the CE development (H2). The cluster efficiency is a function of the application integrated principles of eco-design and an integrative approach to different activities that are interconnected and complementary. This allows the circular process to be realized in practice, and the process of digitalization the economy facilitates the collection and use of data throughout the life cycle of the created final product. The integrated vertical management chain provides connection of all participants not only physically through the product, but also digitally, which allows expanding the activity by adding new services and increasing the added value.

The study also confirms the fourth hypothesis - a relatively strong correlation between the need for organizational and managerial changes in the cluster and the CE development (R=0.568). In the conditions of a dynamic external environment and growing economic, environmental and social requirements, it is necessary to move away from the adopted schemes and models of behavior, and a new understanding of the ongoing processes, forecasting and defining new directions for development. The decentralized company structure, the ability to coordination the different goals, different groups and the cluster as a whole, the creation of identity, culture, loyalty and reputation allow faster adaptation internal resources and competencies to external changes, development intangible assets (knowledge, learning, innovation), which in turn influence and develop tangible assets.

Although with a proven correlation, the results of the third and fifth hypotheses studied are surprising, as the correlation is not very significant.

The lower value of the correlation between the innovation process in the cluster and the CE development (R=0.431) is not a reason for definite conclusions about the relationship between them, as it is clear that the cluster and the circular economy have many different characteristics and dimensions.

In this case, the respondents share their concern about the not very great interest of universities and research units for joint work and the relatively difficult access to funding for various projects due to lack of experience or skills. However, the cluster organization creates incentives for new associations, cooperation, expansion of the activity, which increases the opportunities of participating companies for learning, generation of new knowledge and development of the innovations.

The correlation between the public institutions activity in the cluster and the CE development (H5) also shows a value below expectations (R=0.319). However, it should be emphasized that the respondents give a lower assessment the activity and role of state institutions and a higher assessment local institutions. There is a need for a more active role and intervention public institutions in a completely new, different aspect - increasing government spending on research, support for venture capital in small innovative companies, building of effective infrastructure (transport, social, educational), raising the qualification of the workforce through "lifelong learning".

A strong factor for promoting research and innovation, as well as for modernizing public institutions, improving the business climate and facilitating cooperation and unification between companies is the development of digital integration and building digital infrastructure in the region [11].

IV. CONCLUSIONS

The study focuses on the analysis opportunities to increasing resource productivity in selected nine countries in the Balkan region, which is key to optimizing consumption, and separating economic activity from material consumption. The comparative assessment trends and results outlines important aspects of the socio-economic development of the countries, domestic material consumption and resource productivity in the period 2009-2019 (Eurostat data). The specific models resource use and their productivity in the studied countries and the need for new policies are presented. The conclusions show that in addition to social and territorial cohesion, the sustainable region development requires and implies a more efficient and circular use of resources and orientation of business to more innovative and circular forms of production and consumption.

From this point of view, the study assesses the possibilities for realization the CE principles and increasing resources productivity in the Balkan Cluster. A conceptual model has been developed and five hypotheses have been defined, which have been empirically tested through an online survey of 110 respondents. Statistical and correlation analysis is applied when processing the results.

The study proves conclusively the positive relationship between the Balkan Cluster building and the CE development, as well as between the different cluster characteristics and the CE.

The different correlation values prove the need for a unified, complex approach in building the cluster. The simultaneous process of creating an integrated vertical management chain, a sustainable business model, innovation development, active cooperation with public institutions at state and local level can allow the realization the principles of the circular process. The expected results are increased resource efficiency, waste reduction, use recycled materials, sustainable production and consumption.

The proposed study and the relevant conclusions are important for improving the approaches for effective management natural resources as a factor for sustainable development of the countries in the Balkan region.

Conflict of interest

There is no conflict to disclose.

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