CIRCULAR ECONOMY IN EU 27 AGRIBUSINESS. OPERATIONAL FACTORS OF INTEGRABILITY

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Abstract

Recent global events are increasingly highlighting the need to review and renew the current social and economic system of the European Union. Although the economic crisis of 2008 was followed by a significant boom, the way out of the shock caused by the social, political and economic events of the 2020s is not yet in sight. Despite the fact that the European Union has the strategic goals necessary for this, the development and implementation of tactical and operational plans still await. However, this delay - according to empirical experience - causes serious disturbances and damages both in agriculture and in the entire value chains based on agricultural production, in agribusiness.

In relation to the change in social and economic policy approach and renewal, the question arises as to how ready the EU - as a community - is to eliminate the linear economic model and to adapt the circular economy to agribusiness. Another important dilemma is the extent to which the member countries that joined in 2004 managed to catch up, which is a basic condition for the integration of the circular economic model into agribusiness. Taking into account the role of agribusiness in the community of the European Union, as well as the set economic goals of the community, the connection of the circular economic model and agribusiness, which fundamentally determines national economies, and the acceleration of this process cannot be postponed any longer.

In connection with the above, our study explores the fundamental factors that, as indicators, indicate the preparedness and shortcomings of the European Union in the field of implementing the circular economy. At the macro- and micro-economic level, we analyzed the components whose development either indirectly or directly affects agribusiness. Within this, we examined the evolution of emissions, energy consumption, waste production, and the correlations between them. With reference to agribusiness, we examined the results of agricultural production, the situation of food processing, and the development of the food foreign trade balance.

Based on our results, a European Union with a different economic system with respect to the member countries is revealed. In this heterogeneous economic environment, the transition of agribusiness to a circular economy raises countless questions. The first dilemma that arises is whether it is possible to approach the success and progress of this process with GDP as an output-based indicator in the aspect of the economic spatial structure of the European Union.

Keywords: *agribusiness, circular economy, energy consumption, waste production, economic spatial structure*

JEL: *Q5, R12*

Introduction

Recognizing the global problems of the 21st century and the resulting challenges, the question in developed countries and communities is no longer whether changes are necessary, but at what pace and regulation these social-economic evolutions can be implemented. We can also experience all of this in connection with the European Union, where the theory and philosophy of the circular economy has become the focus of the community's strategic plans to renew the economy (and at the same time the social attitude). In connection with all this, the key role of the value chain based

on agricultural production, agribusiness, must be highlighted. In addition to food production, which is considered traditional, the opportunities and capabilities of agriculture (and thus agribusiness) in the fields of industrial raw material production and energy management, which are now almost completely relegated to the background, must be brought to the fore again.

In December 2015, the European Commission adopted the legislative proposals that contained target values related to waste management and recycling. In parallel, an action plan was formulated in order to implement the "closed chain product cycle". Prior to this, the Commission formulated the need to move towards a circular economic model within the framework of the Europe 2020 sustainable growth strategy (EC, 2014).

In practice, it can be seen that the model of the circular economy is connected at countless points to the philosophy of the economy and society of sustainable development, which also form the basis of the strategic plans of the European Union. In the new economic model, in contrast to the conventional, linear model that characterizes the economy of developed countries, no or only minimal waste is generated. The used material is not removed from the cycle (unlike the linear model), but appears as the raw material of a new product. According to Fogarassy and Horváth (2018), the circular economy means a cross-system development path for all sectors, which alternately means linear solutions, a closed loop, and a self-sufficient production structure (Fogarassy-Horváth, 2018). According to Horváth and Bereczk (2021), the goal of the circular economy is to use as little material and energy as possible in the production process, and by recycling a greater proportion of materials, only minimal material falls out of the cycle and ends up in landfills (Horváth-Bereczk, 2021). According to the definition of the Ellen MacArthur Foundation, the goal of the circular economy is to eliminate the generation of waste by redesigning not only products, but also business models (MacArthur Foundation, 2014). The theoretical foundations of the circular economy are environmental economics, industrial ecology and ecological economics. Since the circular economy theory focuses on the relationship and interaction between the environment and the economy, this model can be considered an alternative to neoclassical economics (Bocken et al. 2016; Ghisellini et al. 2016). In a global aspect, the example of China can be highlighted as a model of the social and economic relationship of today's leading economic power to the circular economy. According to the findings of Ghisellini and his co-authors (2016), China treats the circular economy model as a component of a social-economic transformation. Thus, there is a top-down national program to introduce the new economic model (Ghisellini et al. 2016).

Regarding the circular economy, Morseletto (2020) points to the three main areas of the economic model, mitigation, reuse and recycling. At the forefront of mitigation is the need to reduce materials during the production and consumption processes, and at the center of reuse is the use of used products by other consumers. In addition to all this, recycling means the reprocessing of used material or its application in another area (Morseletto, 2020). Regarding the model, however, attention should be drawn to the fact that often only the process of recycling is understood in the circular model, the circular model is simply identified with the waste collection process, so it is not interpreted and managed as a system (Kirchherr et al. 2017).

According to Pomázi and Szabó (2019), "The concept of circular economy has become more and more popular in the last decade, because both decision-makers and business actors are looking for alternatives to the current economic model. One of the main goals of the circular approach is to separate economic growth from the use of resources, thereby improving resource productivity. The transition to a circular economy can create new economic and employment opportunities, and in terms of more efficient use of resources can bring significant environmental and social benefits. The group of developed countries, including the European Union, plays an important role in the

development and implementation of circular economy models" (Pomázi - Szabó, 2019). Kurcsik and his colleagues (2021) came to the conclusion during the analysis of the "European Green Agreement" belonging to the perspective of the circular economy, that although the environmental policy of the European Union is very ambitious, the implementation of the plans was seriously threatened due to the era of the coronavirus epidemic. According to their results, a new trend is starting to emerge across Europe, according to which the protection of environmental values and sustainable economic ideologies are gaining more and more space in European politics (Kurcsik et al. 2021). We would like to add to all of this that the post-Covid19 pandemic resilience processes were (and are currently) hindered to a large extent by the geopolitical and energy market events following the health crisis. Horváth - Bereczk (2021) studied industrial symbiosis relationships as a means of sustainable resource management in connection with the circular economy. According to their findings, significant economic and environmental benefits can be achieved by connecting businesses based on symbiosis. Factors that have a positive effect on the processes and advanced theoretical methodological frameworks are available for the development of relations, but at the same time many obstacles can be identified at the micro, meso and macro levels. A significant part of the obstacles can be traced back to the fact that the enterprises do not have enough information about the possibilities of industrial symbiosis cooperation, the methods of cooperation, the existence and functioning of related markets, and they are also not aware of the benefits that can be achieved through cooperation (Horváth - Bereczk, 2021). Kozma et al. (2021) researched the possibilities of measuring the circular economy with composite indicators. In their study, they ask the research question whether "the circular economy can be characterized by a well-founded indicator, because the development of the concept also shows that it is a very complex topic. As a result, only very cautious conclusions can be drawn with respect to each country for each measurement method. Obviously, the achievement of the goals formulated for the sake of the circular economy can be one of the benchmarks in the comparison of individual countries, as this also shows the degree of commitment to the circular economy. In addition, however, with the help of the available indicators related to the circular economy, its "efficiency" can also be measured" (Kozma et al. 2021).

In addition to all this, it can be seen that researches related to the economic development of the European Union only examine the practical issues of the integration of the circular economy to a small extent. The basis for the planning of the operational processes is the important question of whether the member countries are fundamentally prepared and in their current state suitable to start the transition, without it causing significant economic and social anomalies for both the individual member countries and the European Union as a whole in his system. Research on the topic also pays little attention to the question of which are the areas that can be measured and evaluated statistically, as well as the indicator values that characterize them, which can accurately characterize the movement of the EU 27 economy towards a circular economy. The present research aims to establish this direction, as well as to prepare further research on the subject.

Material and method

For the interpretation and processing of the data, we chose the GDP produced in the respective countries as a basis. GDP was defined in the usual way: GDP is the value of the total amount of goods (products and services) intended for final use produced in a given area during a given time. During the tests, we took into account the (nominal) GDP values at current prices.

Our study primarily focuses on the territorial economic processes of the European Union community. Within this, the members of the agribusiness value chain of agricultural production, food processing and foreign trade have a prominent role. The research sought answers to the following main questions:

1. Did the member states that joined the European Union after the 2004 expansion manage to catch up with the economic performance level of the founding member states and the member states that joined before 2004 during the last two decades?
2. Is the European Union ready to phase out the linear economic model and switch its economy to the circular model?

The data needed to answer the research questions were collected from the Eurostat and World Bank databases. The research data structure contains dynamic data for the period 2000-2022 on the one hand, and static data for 2021 on the other. In line with the analytical work, we mainly processed macroeconomic data. The results of the literature research are based on the relevant research results of the Hungarian and international literature, in connection with which we conducted extensive research.

The methods of mathematical statistics were used during the data processing. The analysis of macroeconomic and regional data was primarily based on the methodology of dynamic and coordination ratios. Within this, the use of base and chain ratios came to the fore.

For the European Union, considering the year 2021, we used the weighted average method to analyze the spatial structure of agribusiness. The mathematical basis of the method:

$$\bar{x} = \frac{\sum(x_i \cdot w_i)}{\Sigma w_i}$$

where:

xi = the indicator value of the ith member country for the given area

wi = weighting factor for the ith member country

The steps and factors of the applied method are as follows:

1. Determination of the weighting factors (wi): As a weighting factor for each member country, we took into account the mathematical average of the GDP realized by the member countries, measured in euros, between 2012 and 2021. According to our estimate, the ten-year interval is sufficient for the individual member countries to compensate for possible external or internal economic and social causes that distort the data.
2. Definition of the performance indicator of agriculture (xi): We chose the contribution of agriculture to the GDP for the year 2021 as the indicator of the area.
3. Indicator of food processing (xi): the added value realized in the food industry served as an indicator of processing.
4. Indicator of foreign trade (xi): The value of food exports of the member countries realized in 2021 in euros.

Knowing the weighted averages, we determined the distance of the performance of the member countries from the weighted average in each area. The member countries arranged in ascending order based on the distance were classified into quartiles. To analyze the spatial structure, based on the summation of the places occupied in the quartiles, we classified the member countries into three groups with the same class gap, and then visualized the result as shown in Figure 9. The following groups were used for the evaluation (minimum score available: 3; maximum score available: 12):

- Stable performance (between 3 and 6 points)
- Medium performance (between 6.1 and 9 points)
- Critical performance (between 9.1 and 12 points)

During the analyses, the member countries were classified into two basic groups. The grouping was based on the date the member country joined the community. During the research work, group classification and naming were consistently used. In some cases, where the geographical location made this necessary, we used the term Western bloc for the base countries, and Eastern bloc for the focus countries. The classification is given in Table 1., and Figure 1. the spatial location of the group members.

Table 1: Members of the member country groups

Countries that joined before 2004 (western bloc)	Countries that joined after 2004 (East block)
BASE COUNTRIES	FOCUS COUNTRIES
Austria	Bulgaria
Belgium	Cyprus
Denmark	Czechia
Finland	Estonia
France	Croatia
Greece	Poland
Netherlands	Latvia
Ireland	Lithuania
Luxembourg	Hungary
Germany	Malta
Italy	Romania
Portugal	Slovakia
Spain	Slovenia
Sweden	

Source: Own edit (2024)
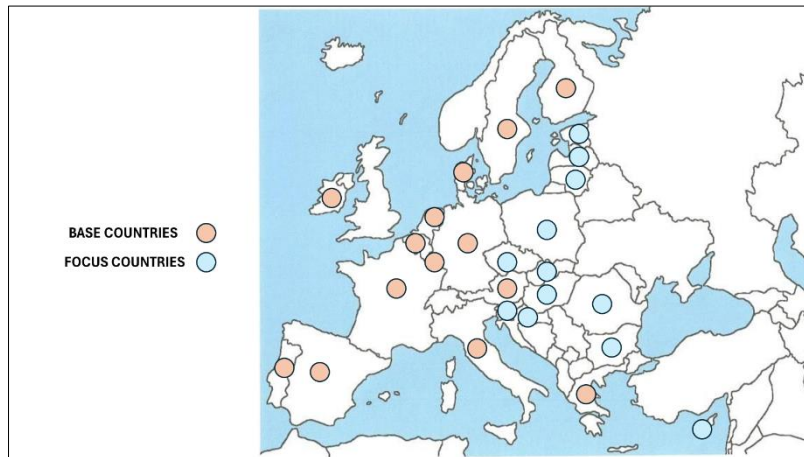
Figure 1: Spatial structure of the classification of member countries
Source: Own edit (2024)

In the areas where the available data allowed (energy consumption, waste production), we prepared a linear forecast to analyze the future development of the data. The forecast was made based on past data, using the linear regression method. When applying the method, the equation of the fitting line is:

$$a + bx$$

where:

$$a = \bar{y} - b\bar{x}$$

and:

$$b = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\Sigma(x - \bar{x})^2}$$

When determining the values, the confidence interval was defined as the 95% value accepted in the economic field.

We looked for a correlation between the data of some areas. The correlation coefficient was calculated according to the following mathematical formula:

$$C(x, y) = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\sqrt{\Sigma(x - \bar{x})^2 \Sigma(y - \bar{y})^2}}$$

Results and Discussion

Development of the GDP average in the base and focus groups

Although the economic analysis of the introduction of the circular economy in itself represents a well-defined and exact research task in the field of agribusiness, an introductory examination of the economic performance of the EU 27 is indispensable, given the role of agribusiness in the national economy and in the social system of the member states. All of this makes it significantly easier to explore and interpret the barriers and opportunities for the integration of the circular economy into agribusiness. In accordance with the above ideas, as a first step we analyzed the economic performance of the EU 27, on the one hand, in terms of the entire national economic network, and on the other hand, in terms of the focus and base countries. The economy following the global economic crisis of 2008 continued to maintain the significant difference between the western and eastern member states. According to the results, there was a significant difference in GDP production between the base countries and Central and Eastern Europe. In terms of nominal GDP, the Middle Eastern region clearly lags behind the Western region of the EU. Between 2013 and 2022, about 89% of the GDP produced in the EU was produced in the base countries and only 11% in the Central and Eastern European member states. In terms of individual years, the Central-Eastern bloc was able to realize 11.5-14.5% of the economic performance of the base countries. In addition to all this, the imbalance between the leading economies of the EU 27 and the performance of the economic community is clearly visible. In the examined time interval, the aggregate performance of the first three countries with the highest average performance (Germany, France, Italy) accounted for nearly 60% (55.5%) of the total performance of the EU 27. Based on the comparison of the two investigation groups, the prominent role of Poland also became visible. In terms of the Central-Eastern bloc, its leading position emerged, as it accounted for more than 1/3 of the total performance of the focus group (35.2%), and more than 3.5% of the average performance of the entire EU (3.7 %) produced by Poland. In addition to all this, both member country networks took advantage of the opportunities provided by the economy, but the growth dynamics of the focus group exceeded the growth dynamics of the base countries. The result is shown in Figure 2. Based on the results, the growth rate of both study groups relative to nominal GDP changed hectically during the study interval. With the exception of 2016, the result of the Central and Eastern European block was more favorable than the performance of the base countries, both in the previous year and in the base examination tied to 2013. In terms of balance,

the Middle East bloc produced a worse result in the field of convincing sustainability. Despite all this unpredictable economic performance, the Middle East section surpassed the result of 2013 by almost 75% (73.4%), compared to the group of base countries, where this result was only 33.8%.
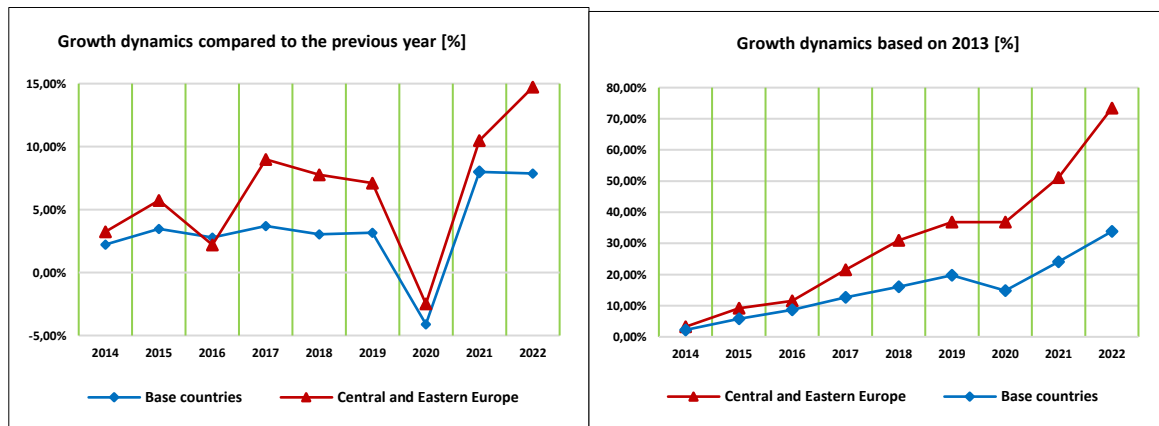
**Figure 2: Growth dynamics of nominal GDP**
Source: own editing based on Eurostat data (2024)

After 2022, the rhapsodic GDP change continued in the first and second quarters of 2023, triggering a comprehensive economic recession in the EU 27 economic network. The first quarter of 2023 brought average GDP growth just above zero in both groups (Focus countries 0.06%; Base countries 0.16%). This trend reversed in the second quarter of 2023 and led to the advance of the Middle East bloc, when the average of the countries of the focus group was already close to 0.5%. In addition to all this, the weak performance of the base group continued, in this period they produced an average growth result of 0.08%, which was even below the first quarter.

Circular economy – Energy

One of the important strategic issues of integrating the circular economy policy into agribusiness is energy production and use. One of the reasons for this is the dual role of agriculture and the food industry in relation to energy resources. According to empirical experience, the production and processing of food raw materials, in addition to the fact that it involves significant energy consumption, is itself a prominent energy resource-producing sector. All of this will be weighed as a distinguished aspect in connection with the energy crisis of global proportions that unfolded in 2022, which pointed to the vulnerability of the current economic policy, as well as the difficulties of integrating the circular economy into agribusiness. In connection with all of this, the energy consumption study of the focus and base group countries, similar to the results of the GDP study, showed a significant difference between the Middle East and the West. During the analysis, we primarily took into account the use of electricity. Figure 3 illustrates the amount of electricity used by the member countries between 2012 and 2021. Summing up the consumption per country, the result clearly shows the significant energy consumption surplus of the base country group, compared to the economies of the Central-Eastern bloc. Even the base group can account for 85% of the total consumption, while the Middle Eastern focus group only participated in 15% of the consumption. With regard to Central and Eastern European economies, only Poland and the Czech Republic are among the top ten largest user economies (in Europe-wide terms), Poland is in 6th place with a consumption of 119,267,139 GWh, and the Czech Republic is in 9th place with a

consumption of 80,724,863 GWh. The exceptionally high consumption of Germany, Spain and the Netherlands should also be highlighted. The mentioned three economies accounted for nearly half (46.6%) of the total consumption of the EU27 economy in the period under review.
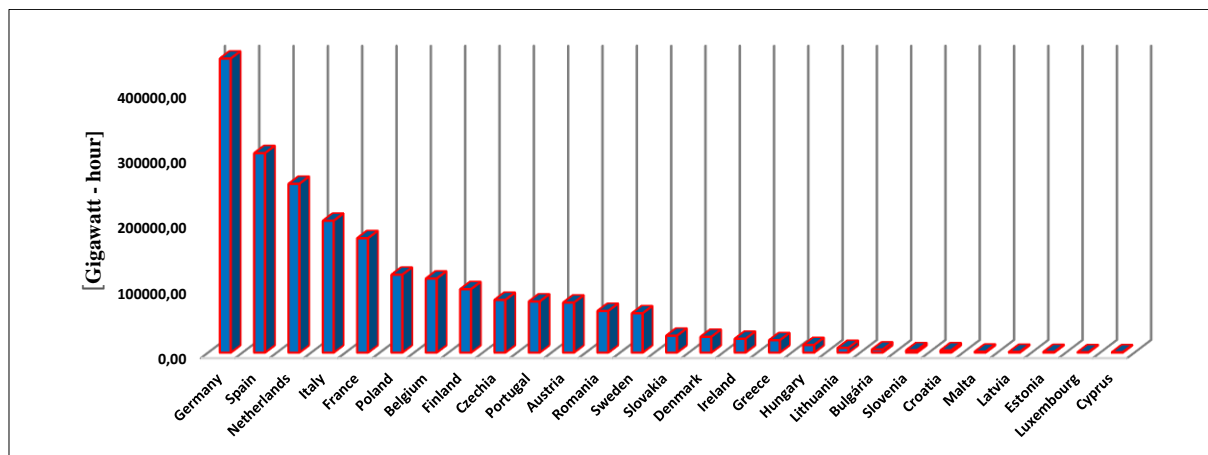
Figure 3: Total use of electricity in the EU27 member states between 2012 and 2021 (Gigawatt – hour)
Source: own editing based on Eurostat data (2024)

In order to estimate the electricity dependence of each member country, we performed a correlation analysis in the relation between electricity consumption and GDP production. The result is illustrated in Figure 4.
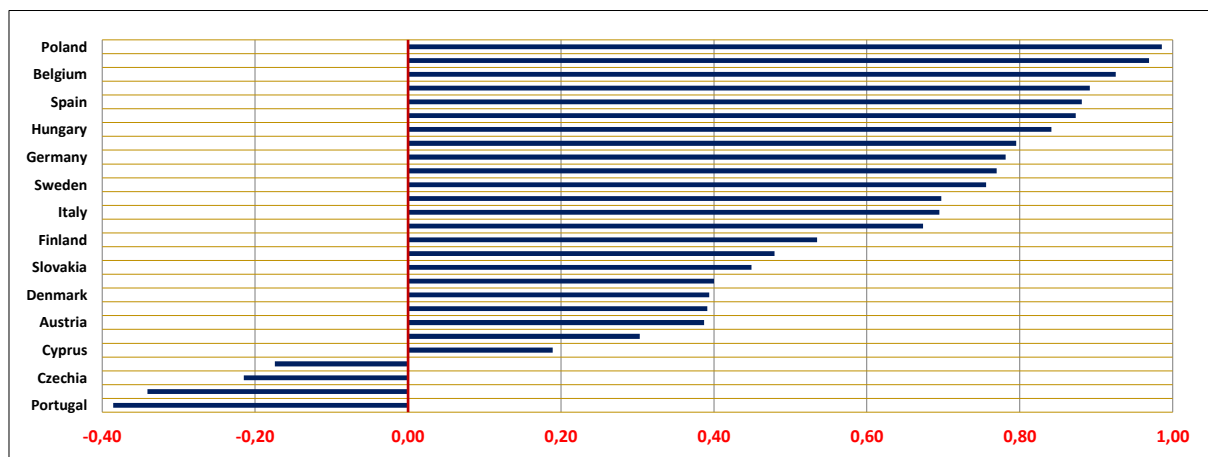
Figure 4: Correlation coefficients of electrical energy consumption - GDP production in the EU 27 member states.
Source: own calculation based on Eurostat data (2024)

Based on the results, the countries of the two study groups can no longer be divided as sharply into the Middle - East and West relationship as in terms of GDP production and electricity consumption. In 14 member countries, the correlation coefficient exceeds r = 0.6, which already indicates a strong dependence. Of course, in the near future, countless connections regarding the economic structure of the member countries must be clarified in connection with the deeper integration of the circular economy. This statement is supported by the fact that in 7 member

countries the value of the coefficient exceeds r = 8, which already means (may) be a functional relationship. Out of the 7 member states indicated, 5 member states (Poland, Belgium, the Netherlands, Spain, France) also belong to the leading states of the EU in terms of GDP production. In addition to all this, the sensitivity of the integration of the circular economy is supported by the result according to which 85.2% of the member countries showed a positive correlation in relation to electricity consumption.

Promoting the optimal use of available energy sources is one of the pillars of the circular economy policy. To analyze the economic use of energy, we examined the relationship between GDP production and energy consumption calculated in oil equivalent of the member countries. For the analysis, we used the average of the results of both the focus and the base countries. According to the results, the base countries are significantly ahead of the countries of the Central-Eastern bloc in the area of economical energy consumption. The result is shown in Table 2.

Table 2: Value of GDP produced from 1 kg of oil equivalent

[Euro per kilogram of oil equivalent]	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
The average of Central and Eastern European countries	3,08	3,04	3,17	3,16	3,32	3,46	3,62	3,77	3,86	3,87	3,82	3,96	4,12	4,26	4,43	4,51	4,53	4,53	4,70	4,96	5,05	5,18
The average of the base countries	7,16	7,12	7,17	7,10	7,18	7,32	7,53	7,83	7,89	8,00	7,87	8,23	8,31	8,48	8,88	9,15	9,21	9,36	9,61	9,89	10,50	10,62

Source: own calculation based on Eurostat data (2024)

The advantage of the base countries can be clearly seen from the data in the table. The presumably higher technical level, as well as the economic structure that makes better use of the opportunities of globalization, secured a better position for the western economies of the EU already at the turn of the millennium. In the first year of the interval, using 1 kg of oil equivalent, the average of the base countries reported 43% more GDP results. Although the trend of both groups increased, the growth of the Western bloc proved to be more dynamic. Thus, by 2021, the difference between the two groups increased to nearly 49% (48.7%). In addition to all this, based on the available data, we prepared a statistical forecast of the energy consumption of the two groups until 2035. The result is shown in Figure 5.
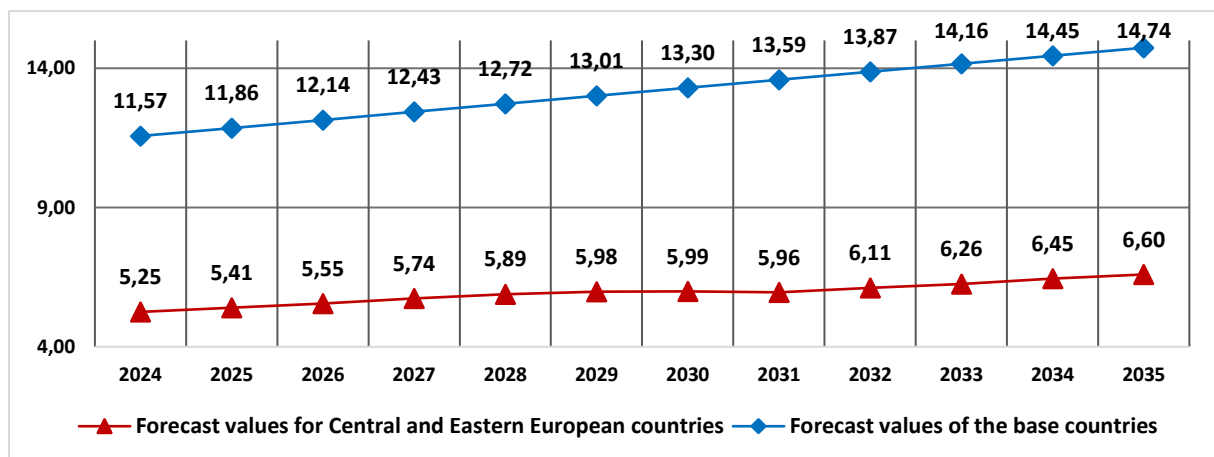

Figure 5: Prediction of the relationship between energy consumption and GDP production (Euro per kilogram of oil equivalent)
Source: own calculation based on Eurostat data (2024)

The forecast clearly indicates further progress in the economy of the base countries in relation to optimal energy use. However, all of this also means that the Middle Eastern bloc is still lagging behind in terms of the conservation and sustainable use of environmental resources.

Taking into account the particularly close relationship between agribusiness and circular economy policy, as well as the guidelines of the European Union's "Green Deal" program, one focus of the modernization of agribusiness is to strongly increase the share of renewable energy sources. In this regard, we analyzed the share of green sources in the energy production of the member countries. According to the results, between 2004 and 2021, the member countries were able to strongly increase the role of renewable energy sources in the field of energy consumption. In 2004, the Central and Eastern European member countries used the opportunities offered by renewable resources in an average of 12.6%, and even the base countries in 12.06%. Both study groups significantly increased the share by 2021, the central-eastern block used more renewable energy sources by 83.5%, and even the western block by more than 100% (114%). All this is a very significant step forward in terms of circular economy guidelines. Unfortunately, however, this growth took place with extreme urgency in both country groups. The relevant results are shown in Figure 6.
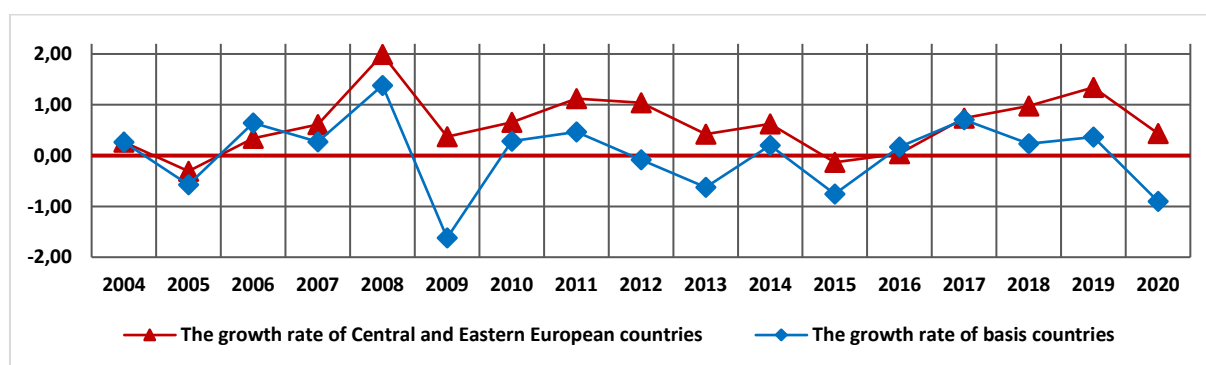
Figure 6: Change in the share of renewable energy sources compared to the previous year (%)
Source: own calculation based on Eurostat data (2024)

In both groups, the 2008 global economic crisis broke the strong growth that started in 2005. In addition to all this, encouraging progress was seen in the central and eastern member countries, despite all the fluctuations, even in the average results of the western countries, we experienced a slowdown in many cases. In this regard, we looked for a correlation between the GDP production of the member countries and the extent of the use of renewable energy sources. The results are summarized in Table 3. We only experienced a negative relationship in the case of three countries (Hungary, Romania, Greece). In these two Central and Eastern member countries, the strength of the relationship is remarkably strong, even in the case of Greece, a weak negative relationship was experienced (r = -0.13). The high proportion of correlation coefficients with a value of 0.8 in both groups can be positively evaluated. According to the results, the correlation coefficient exceeded the value of 0.8, indicating a strong positive relationship, in 53% of the member countries of the Central and Eastern group, and even in 57% of the member countries of the base group. The high correlation value of the leading economies of the EU 27 in relation to renewable energy sources further facilitates the consolidation of the circular economy. In 7 cases (70%) of the top ten countries producing the highest nominal GDP, we experienced a strong, functional relationship, which proves the EU's high level of commitment.

**Table 3: Correlation between GDP and the share of renewable energy sources in the EU 27 member states**

Central - Eastern European		Base countries	
Bulgária	0,20	Austria	0,64
Cyprus	0,90	Belgium	0,8
Czechia	0,82	Denmark	0,77
Estonia	0,90	Finland	0,93
Croatia	0,50	France	0,85
Poland	0,88	Greece	-0,13
Latvia	0,92	Netherlands	0,86
Lithuania	0,79	Ireland	0,83
Hungary	-0,71	Luxembourg	0,92
Malta	0,92	Germany	0,9
Romania	-0,50	Italy	0,33
Slovakia	0,86	Portugal	0,68
Slovenia	0,36	Spain	0,52
		Sweden	0,89

Source: own calculation based on Eurostat data (2024)

Circular economy - Waste management

The issue of waste management is not only a cornerstone of the circular economy model, but is also the focus of the European Union's directive on sustainable development. All of this closely affects/may affect EU agribusiness, since food processing and trade in the national economy itself produces a considerable amount of waste. In this regard, we analyzed the waste production of the EU 27 member states between 2004 and 2020.

Between 2004 and 2020, only 29% of the waste generated in the economy of the European Union was produced in Central and Eastern Europe, and another 71% was generated in the countries of the base group. All this meant an average of 49,828.4 thousand tons of waste per year in the Central-Eastern bloc, and an average of 113,413.3 thousand tons of waste in the countries of the base group. In relation to waste generation, a positive result was experienced in the average of the countries of the Middle Eastern bloc. In this study group, the amount of waste was reduced by 21,423.8 thousand tons compared to the base amount in 2004, which represented a decrease of nearly 34%. In contrast, the annual average of the countries of the base group showed an increase, albeit at a variable rate and amount. The 102,063.7 thousand tons in 2004 increased by 11.4% by 2020, reaching 115,182.7 thousand tons. In terms of efficiency, although the Central and Eastern European member countries achieved improvement between 2014 and 2020, the base countries were significantly more efficient in terms of the relationship between GDP production and waste generation. Even in the focus group in 2014, the production of 1 euro of GDP was associated with an average of 0.56 kg of waste production, while in the base countries this indicator was 0.15 kg/euro. Nevertheless, by 2020, the base countries were able to reduce the indicator of waste production - GDP production by only 0.02 kg/euro, even the countries of the Central and Eastern bloc by an average value of almost 0.2 kg/euro. However, all this did not mean a general regularity in the result of the correlation study between GDP calculated at current prices and waste production. In both groups, hectically varying results were obtained in the value of the correlation coefficient. In the Middle Eastern bloc, four countries also showed an inverse linear relationship (Romania, Poland, Estonia, Bulgaria), even in the base group, only Sweden, the Netherlands and Denmark could achieve this result. Within all of these, Bulgaria came close to it (r = -0.78), and even Romania exceeded the value of -0.8 (-0.91). Among the base countries, only Sweden produced an inverse, functional relationship. The forecast made on the basis of the available data also showed a negative development of waste production in the base countries, hindering the integration of the circular economy. The results of the forecast calculation are shown in Figure 7.
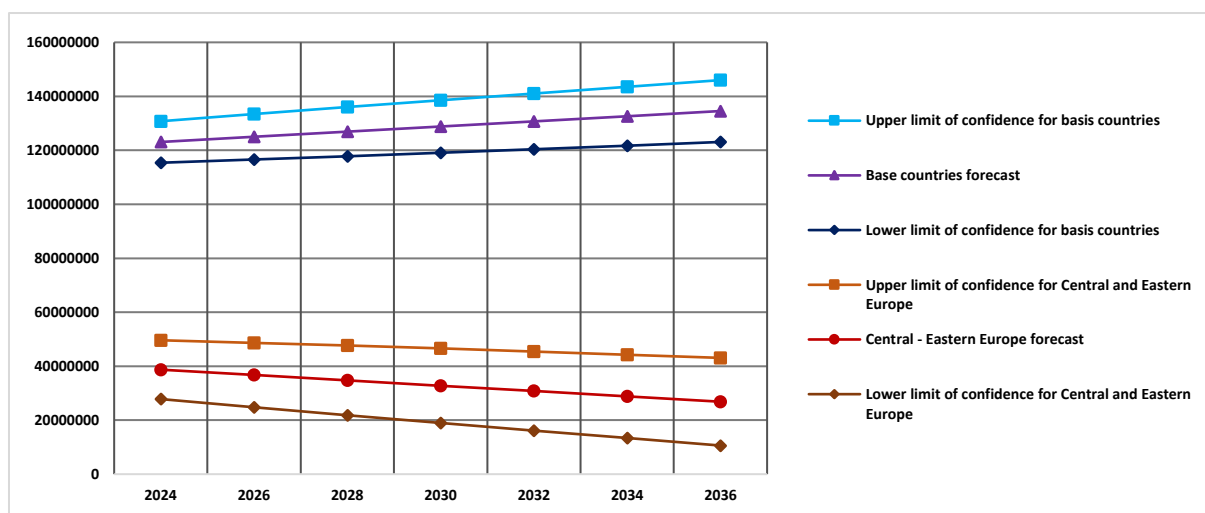
Figure 7: Result of waste production - forecast calculations in the examined country groups (thousand tons)

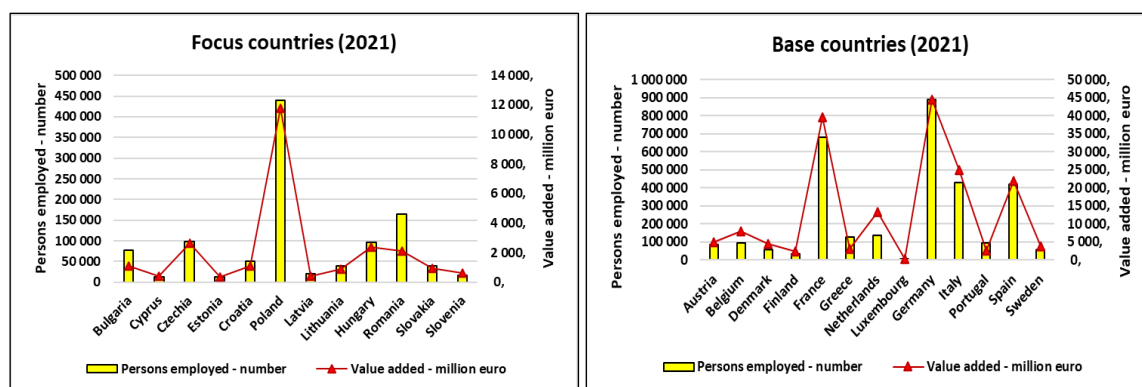*Source: own calculation based on Eurostat data (2024)*

Based on the results, if the impact of the economic, technological and social factors influencing waste production, as well as the dynamics of change of these factors, remains almost constant, then a further increase in the amount of waste production in the Western countries, which play a leading and decisive role in the EU 27 economy, is expected. On the other hand, an improvement (decrease) can be assumed in the Eastern bloc in the next 10 to 12 years. However, it is expected that all of this will not speed up the integration of the circular economy in the EU economy.

Circular economy - Agribusiness sectors

The adaptation of circular economy practices to agribusiness is primarily determined by the basis of agribusiness, agricultural production (or its possible development/development opportunities). Therefore, the role of agricultural production in the economy of individual member states cannot be ignored when preparing operative plans to help implement the EU strategy aimed at this. In this regard, we analyzed the economic performance of the agriculture of the member country groups in relation to GDP production. During the analysis, we monitored the development of the average of the focus and base country groups between 1995 and 2022. In the first years of the observed period, the traditionally strong presence of agriculture in the economic structure of the Middle Eastern countries is clearly visible. Even in the Western European countries, the average contribution of agriculture was around the usual, relatively low 3% in the OECD countries, while in the Middle Eastern countries it exceeded the value of 6%. Romania's 18.2% and Bulgaria's 20.5% value should be highlighted, which well exemplify the direction of the economic structure development strategy (and economic policy) prior to the political and economic system change in East-Central Europe. Compared to all of this, from 1995 onwards, significant changes took place in the countries of the focus group and (in some member countries) with remarkable dynamics. In the base countries, the initial average contribution of 3.2% decreased to 1.4% by 2010 and stabilized between 1.6% and 1.7% thereafter. This result is well below the value accepted in OECD countries. At the same time, the average of the focus countries decreased from the 6.8% value reached in 1997 to 3.2% in 2011, which is less than half of the result achieved a decade and a half earlier. Later

on, the result stabilized at between 3.0% and 2.8%. All this demonstrates the rapid development and advance of the secondary and tertiary sectors in Central and Eastern Europe.

In relation to agribusiness, the second major issue of the development of the circular economy is the situation and prospects of the food industry. Its exceptionally significant role in agribusiness on the one hand, and in the entire national economy on the other, is ensured by its not only economic but also other social functions. In this regard, from the data available to us, we examined the net turnover of the food industry and the development of added value for the year 2021 in each group of member countries. Before the actual analytical work, we analyzed the employment in the food industry as a macroeconomic factor. In 2021, the average employment in the base countries was more than twice as high as in the focus countries (2.25). Even in the focus countries, an average of 89,300 people worked in the field of food processing, while the average employment in the base countries exceeded 200,000 people, so in the EU sectoral system, 69% of the base countries and 31% of the focus countries employed for food industry workers. In addition to all this, there was an appreciable correlation between sectoral employment and the population of each country, as well as its geographical size (area). In both groups of countries, there was a strong relationship between the size of the population and the number of people working in the food industry. In contrast, different results were observed in relation to the territory of the countries. In this case, even in the focus countries, there is a close relationship between the geographical area and sectoral employment ($r = 0.93$), while this value can only be classified as medium in the case of the base countries ($r = 0.51$). All of this indirectly highlights the need for differentiation in the aspect of the development of the circular economy with regard to individual countries. The need for this deviance is further strengthened by examining the averages of the net turnover. Based on the results, a significant difference emerges between East and West. In the year of the study, the processors in the Eastern Bloc had an average turnover of only 11,372.86 million euros, compared to 57,054.08 million euros achieved in the Western member states. This significant difference is also reflected in the analysis of the average net turnover per person in the sector. According to the results, an employee in the sector generated an average turnover of 0.1 million euros in the focus countries, and even in the base countries this value was 0.3 million euros. Examining the net turnover from a pan-European perspective, the dominant role of Germany, Italy and Spain is clearly visible. These three countries accounted for more than half (55.3%) of the total net turnover of the EU 27. The disadvantage of the Eastern Bloc is clearly shown by the fact that, among the focus countries, only Poland was able to take the 5th place out of the first 10 places with a share of 8.4%. The 1.7% contribution of the Czech Republic and Romania was only enough for 12th to 13th place. In addition to all this, we also experienced a significant discrepancy in terms of added values. Figure 8 illustrates the number of employed people and the development of added value in relation to the country groups. In terms of those employed in the food industry, the added value per capita in the focus countries was 24,000 euros, compared to 59,000 euros measured in the base countries. Nevertheless, a remarkable correlation between GDP and added value was observed in both groups of countries, which also draws attention to the sensitivity of the performance of the food industry in the EU economic system (Measured relationship between GDP and added value: base countries $r = 0.98$; focus countries $r = 0.96$). The result of the correlation analysis between the number of employees and the added value in both groups of countries was also a common point. In both cases, we measured a high value close to $r = 1$. All this also highlights the important role of the sector in the structure of the agribusiness of the member countries.

Figure 8: The number of employed people and the development of added value in the country groups
Source: own editing based on Eurostat data (2024)

Regarding food trade, we analyzed the food foreign trade performance and balance of the member countries for the period 2013-2022. According to the results, members of both study groups increased the nominal value of food exports. However, the growth took place at a significantly different rate and pace in East and West. In the base countries, the total value in 2013 rose from 23,569.4 million euros to 36,244.6 million euros in 2022, which represented a 65% increase in GDP export content. In contrast, the increase in the focus countries was only close to 50% (49.5%). In nominal value, the food export component of GDP increased from 3,940.5 million euros to 7,956.4 million euros. According to the comparison of the two groups, only 17.3% of the nominal food export value measured in the base countries was produced in the focus countries. In addition to all this, there was a significant difference in its growth dynamics as well. According to the data, the value of food exports in the base countries increased by an average of 19,717 million euros per year, compared to 5,800.7 million euros measured in the focus group. In the case of food imports, there was also a significant increase in both country groups. The average of the focus countries increased by 50%, while the increase in the base countries was 65%. In nominal terms, the base countries significantly exceeded the import average of the focus countries. The import value of the Eastern bloc reached only 18% of the similar figure of the Western bloc. Even the combined result of the base countries increased from the initial 20,978.6 million euros to 32,466.8 million euros by 2022, while the similar figure of the focus countries increased from 3,467.2 million euros to 6,927.8 million euros. In connection with the advancement of the circular economy, the fact of the increase in imports experienced by the base countries during the Covid19 pandemic is particularly noteworthy. Even in the focus countries, food imports increased with the dynamics characteristic of almost the entire interval. until then, the import of the Western bloc was characterized by a sharp break in 2020. Thus, measured on the basis of 2020, the nominal value of food imports increased by 7.7% by 2021 and by 29.7% by 2022. All this gives a good impression of the resilience problems of the leading economies of the EU27 in (international) food trade, and thus indirectly in the field of agribusiness.

In relation to the above, the spatial structure of the member countries classified into classes based on the performance of agribusiness provides extremely valuable information. The result is shown in Figure 9.
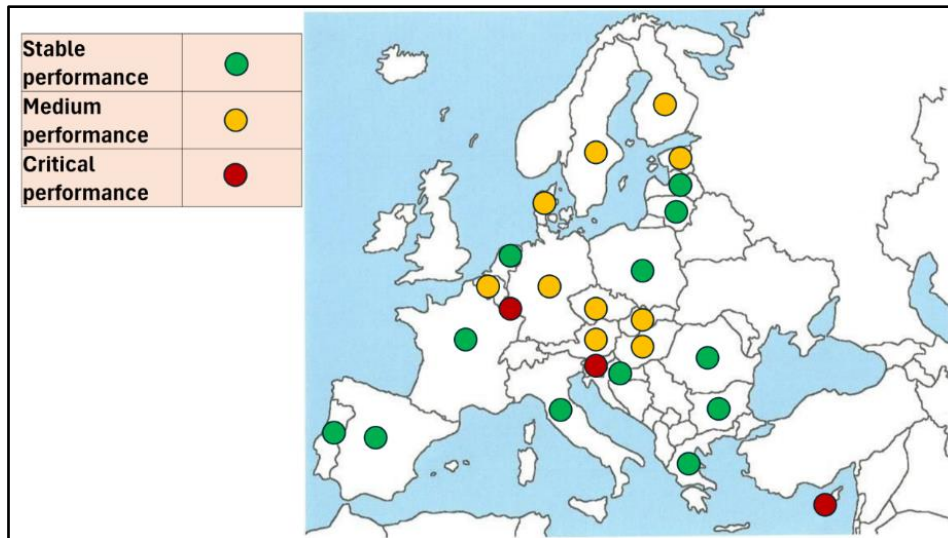
Figure 9: Spatial structure of agribusiness performance
Source: Own editing based on the results (2024)

According to the output of the analytical work, in addition to the selected indicators, three member countries, Luxembourg, Slovenia and Cyprus, provided critical performance in the year 2021. In the case of Slovenia and Cyprus, the contribution of tourism to the GDP is extremely high, which provides a good opportunity in the internal market of food products through services. Thus, from the point of view of our analysis, the balance of the foreign trade balance can be significantly distorted by a high proportion of imports. Average performance is typical for the Central and Northern European areas, while Eastern and Southern Europe and the Baltic member states also provided stable performance. All this information can be important in the development of operational plans that require cross-border measures in the field of integrating the circular economy into agribusiness.

Conclusion

According to the results of the research, both groups of countries were able to take advantage of the economy following the global economic crisis of 2008 and increase their GDP. Despite the fact that a significant part of the total economic performance of the EU 27 is produced by the Western bloc, the performance of the individual member countries in both groups changed hectically. All this points to significant instability in the aspect of individual national economies. It is likely that this imbalance of the EU economy is significantly influenced by the development of the international economic factors on the one hand, and the internal market factors of the EU on the other. Unfortunately, this hectic performance does not favor the EU's economic policy aspirations either in terms of the "Green Agreement" or the circular economy. In this regard, there are significant differences between the examined country groups and the members of the groups. Even today, the EU economy is characterized by significant energy dependence. Despite the fact that one of the important pillars of the circular economy is the question of the energy used (or its production), in a significant part of the member countries a prominent positive correlation can be shown between the value of the electrical energy used and the value of GDP. In the light of the energy consumption converted to oil equivalent, the advantage of the Western bloc over the

Eastern member states is clearly visible, which, according to empirical experience, can be explained on the one hand by the higher share of the tertiary sector, and on the other hand by the existing technical (technological) superiority. Regarding the increase of renewable energy sources, although positive progress has been made, the pace of growth still differs significantly from the desired rate in individual member countries. Waste production is subject to a double assessment. On the one hand, orders of magnitude less waste is produced in the focus group than in the group of base countries. Unfortunately, if no significant progress is made in the current conditions, such as in logistics technology, a further increase in the amount of waste in the base countries can be forecast for the next decade. This is an important question in relation to the circular economy, since whether we look at global or local food chains, the hygienic packaging of products is an inevitable technological step in the professional handling and trade of food. Here, however, attention should be drawn to the significant advantage of local, short food value chains, which have indisputable advantages in the national internal market in terms of possible waste generation.

The performance of agribusiness shows an extremely differentiated economic community in terms of both the examined country groups and the entire European Union. Based on the contribution of agricultural production to emissions, a significant majority of the focus countries performed above the weighted average of the EU community in 2021. The only exceptions to this are the agriculture of Malta, Slovenia and Cyprus. It can be seen that in the case of the integration of the circular economy, the focus countries are more strongly affected compared to the base countries. In terms of total output, the agricultural performance in these member countries is more sensitive, so the transition to a circular economy and presumably the resulting smaller or larger decline can cause a stronger stagnation. All these findings are supported by the work of Nagy (2021), who during his research examined the performance of Romanian agriculture in the period after EU accession. According to its results, Romania must develop an agricultural strategy that is able to meet global challenges and the efficient use of resources. In the case of processing, the leading role of Germany and France should be highlighted. The two base countries produced significantly more added value in 2021 than the weighted average of the EU. Only the members of the base countries can be found in the upper and middle fields. An exception in this respect is Poland, which occupies a place in the upper quarter, the only one from the group of focus countries. All of this also shows the more difficult situation of the focus countries in the aspect of integrating the circular model. It can be assumed that, taking into account the size of the smaller specific added value, the leading enterprises of the member countries have more limited equity resources and creditworthiness in terms of financing the investments necessary for the introduction of the circular model. Based on the contribution of food exports to the GDP, we also encounter the problem of heterogeneity in relation to integrability, which also draws attention in the area of the scheduling time linked to operational plans and the definition of indicators showing measurability and progress. In this case as well, it is recommended to examine the unique assessment and specific situation of the member countries, as well as the application of the principles of differentiation and fairness during the development of operational plans. All this is justified by the fact that, as part of the total output of the base countries, food exports are less decisive than in the focus countries.

In connection with the above, the question arises as to whether it is possible to measure and display the success of the circular economy using the currently widespread output-based indicator (GDP). In our opinion, in addition to GDP, a measure containing indicators that can adapt to the specificities of the circular economy may be needed.

The current results of the research made visible the complexity of the topic, the perceptible and latent intertwining of the individual investigated areas. In view of the importance of the topic, we

plan to continue the research related to the integrability of the circular economy, bringing the social and social aspects to the fore in addition to the economic approach. In our opinion, the results of this research provide / can provide a suitable basis for the planning and implementation of a larger-scale research on the issue of the integrability of the circulation model.

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