
COVID-19 PANDEMIC AND THE ECONOMIC RESULTS OF AGRICULTURE IN THE EUROPEAN UNION

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ABSTRACT

The Covid-19 pandemic has brought numerous economic challenges to countries around the world. The specificities of certain economy sectors determined the character and intensity of the impact of this health crisis on their results. The purpose of the paper is to analyse the impact that the Covid-19 pandemic has had on the economic results of agriculture in the European Union countries. Comparative analysis and cluster analysis are used in the research. The general conclusion of the paper is that the Covid-19 pandemic did not change the economic importance and role of agriculture in the individual European Union countries. In addition, the European Union countries differ significantly according to the impact of the Covid-19 pandemic on the contribution of agriculture to gross domestic product, while a significant difference between the countries has not been determined according to the impact of the pandemic on the contribution of agriculture to employment.

Introduction

The Covid-19 pandemic has put the whole world in front of a big challenge. In order to limit the spread of this infectious disease, governments have introduced restrictions on movement, both domestic and international. Thus, the health crisis turned into a global economic crisis, causing high unemployment and decline in gross domestic product

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(GDP). The global GDP growth rate decreased from 2.61 in 2019 to -3.27 in 2020, while the unemployment rate increased from 5.36 in 2019 to 6.57 in 2020 (The World Bank, 2022). All aspects of the economy suffered heavy losses, especially the travel industry, with a double-digit decrease in the number of flights and a drastic decrease in tourist traffic, while the price of oil fell to a level not seen in the last two decades (Luković & Stojković, 2020; Beckman & Countryman, 2021). Even though agriculture was not at the center of attention for the negative impact of Covid-19 at the beginning of the pandemic, the closure of hotels, restaurants and schools led to the disruption of supply chains and the inability of agricultural producers to reach the buyers. Movement restrictions and lockdowns had far-reaching consequences on employment in agriculture, due to the inability of workers to reach their farms, as well as the loss of seasonal labor, which is mostly migrant. Agriculture employees large numbers of daily wage earners, who “suddenly found themselves without a source of income and unable to continue their work from home” (Gupta et al., 2021, p. 467). In addition, restrictions on the export of agricultural products have been introduced or such measures have been considered in some countries in order to ensure sufficient food supplies for the population (Popescu & Andrei, 2011; Botezatu, & Andrei, 2012; Štreimikienė et al., 2020). As a result, agricultural employment and the income of agricultural producers decreased and poverty became more pronounced.

Agricultural production is a very important sector in all economies of the world, because it provides the population with a sufficient amount of healthy and safe food for survival. This fact became very important during the Covid-19 pandemic, because there was a global concern regarding food security, that is, the ability of the system to provide the population with a timely, reliable and nutritionally adequate food supply. The contribution of agriculture to key macroeconomic indicators, such as GDP and employment, is significant, especially in developing countries, which emphasizes the negative effects of the crisis even more. When it comes to employment, a significant drop in the contribution of agriculture to total employment caused by the negative consequences of the crisis can be noticed. However, as far as the contribution of agriculture to GDP is concerned, it cannot be unequivocally claimed that this participation has decreased. Some countries even show an increase in the contribution of agriculture to GDP in 2020 compared to 2019. This can be explained by the fact that food production is a sector that is necessary for the population’s life and that agriculture had to provide a sufficient amount of food for normal functioning, regardless of the imposed restrictions and problems (Nakat & Bou-Mitri, 2021). In addition, during the pandemic period, a decrease in demand for luxury goods (such as cars, travel) was noted, while the demand for food, due to fear of shortages and uncertainty, increased.

There is a significant number of papers that analyse the changes that the Covid-19 pandemic has brought to agriculture. However, most of these papers for the subject of research have food security, export restrictions, and disruptions in supply chains in pandemic conditions (Adhikari et al., 2021; Ceballos et al., 2020; Cortignani et al., 2020; Cranfield, 2020; Kalogiannidis & Melfou, 2020; Lauren et al., 2020). There isn’t

still a sufficient number of papers that analyse the impacts of the Covid-19 crisis on the economic effects of agriculture, nor have significant efforts been made to perform a comparative analysis between countries. Therefore, with this paper, the authors attempt to fill a gap in the literature. The subject of the paper is the review of changes in the economic results of agriculture in the European Union (EU) countries in the period of the Covid-19 pandemic. The economic results are measured by the contribution of agriculture to GDP and by the contribution of agriculture to employment. The aim of the paper is to determine the effect of the pandemic on the importance of agriculture for the economic performance of EU countries, as well as the heterogeneity, that is, the homogeneity of EU countries regarding the effect of the Covid-19 pandemic on the contribution of agriculture to economic growth and employment. The paper is structured from several parts. First of all, a brief review of the literature regarding the effect of the Covid-19 pandemic on agriculture is conducted. After that, methods section is given. Finally, the last segment of the paper refers to the research results and the discussion, within which two parts can be distinguished. First, a cross-country comparison is made according to the share of agriculture in GDP and the share of agriculture in employment for a two-year period (2019 and 2020), but also according to the intensity of the impact that the pandemic had on the economic results of agriculture in 2020 compared to 2019. Second, the results of the cluster analysis are presented.

Literature review

The global health crisis caused by the Covid-19 pandemic has spread very quickly to the economic sphere and affected almost all sectors of the economy. Strict blockade measures and lockdown have stopped the main economic activities. This situation has led to enormous uncertainties, not only regarding the economic growth and people's livelihoods, but also regarding the very future of capitalist development in its current form (Ramakumar, 2021). Given that the lockdown meant disruption of production and delivery of adequate quantities of goods, it was expected that such a pandemic had a negative impact on the agricultural sector as well. Travel restrictions have caused numerous problems for agricultural producers, from purchasing inputs, sowing and labor availability, to harvesting, marketing and processing, difficulty in movement of goods and stock increase in warehouses caused by problems in supply chains (Kalogiannidis & Melfou, 2020). Agricultural income in Europe decreased during the first wave of the pandemic in many European countries, while labor shortages in the harvest season were evident and resulted in the production decrease globally (Sharma et al., 2020). The Covid-19 pandemic has highlighted the importance of maintaining resilient food supply chains. Since there have been no concerns about food shortages, the EU agricultural sector has so far responded exceptionally well to the challenges of this crisis. Due to sustained food demand, the EU agriculture was relatively less affected compared to rest of the economy that has suffered significantly stronger blow by isolation measures. However, certain agricultural sectors were hit harder than others (European Commission, 2020b). The negative impact of the Covid-19 pandemic on agriculture is reflected in the reduction of labor availability, the loss of jobs in various

agricultural value chains, increased production costs, and the increase in prices of agricultural products (Ceballos et al., 2020; Cranfield, 2020).

The Covid-19 pandemic has negatively affected the agricultural employees, particularly the seasonal agricultural worker group. Quarantine measures reduced the availability of labor for important agricultural activities, such as planting vegetables and picking fruits, resulting in harvest delays and increased food losses, most affecting perishable goods (Adhikari et al., 2021; Cortignani et al., 2020). In addition, the lockdown and restrictions on the “mobility of workers across borders have contributed to labor shortages, mainly in countries that rely on seasonal workers” (Bochtis et al., 2020, p. 2). Consequently, the majority of migrant, informal, seasonal agricultural employees lost their jobs, which has contributed to an increase in agricultural unemployment (Poudel et al., 2020). These challenges are compounded by the fact that agricultural production requires many people to work together in close proximity at the same time, which makes physical distancing difficult and the risk of infection particularly problematic (Ridley & Devadoss, 2020; Cho et al., 2020). Bochtis et al. (2020) proved that about “50% of the agricultural workforce is at moderate to high risk of contracting a disease at their workplace” (p. 1). Also, many domestic workers became infected or look after a sick family members or children, due to school closures, which further affected the availability of seasonal staff (Martin, 2020). Therefore, it can be concluded that the Covid-19 pandemic has increased unemployment in agriculture, not only as a result of the closure of companies and the impossibility of working from home, but also due to the workers’ fear of a high possibility of infection.

Some authors noted that coronavirus pandemic has increased the need of people to strengthen immunity. As a consequence, “larger purchases and creation of stocks were noticeable, which led to an increase in demand for agricultural and food products” (Marković et al., 2022, p. 228). The lockdown measures adopted by most member states have led to “stock piling behavior at household level and short-lived spikes in retail sales” (European Commission, 2020b, p. 4), and the food that has benefited the most from this situation is a staple food. Although the pandemic has caused a surge in food demand due to fears of shortages and stockpiling, lockdown resulted in major supply chain disruptions. The food-away-from-home sector, such as hotels, restaurants, catering and outdoor markets, has suffered a global decline in demand. Short-term lockdown measures and the closure of sectors such as hospitality, tourism or travel have required a shift in supply from food services to direct purchases by consumers confined at home, with further challenges caused by different consumption habits and packaging (Garnett et al., 2020; Vuković & Ružičić Mosurović, 2020). Namely, a large increase in demand for electronic commerce and direct sales from farmers to consumers were noted (European Commission, 2020b).

Food-away-from-home (eating in restaurants or hotels) is a very important aspect of agriculture, therefore it is important to perceive the effects of Covid-19 on agriculture through this prism as well. Restaurants and hotels, that are key source of agricultural product consumption, were closed due to the lockdown, and visits to restaurants were

significantly reduced due to guests' fear of the pandemic infection (Gajić et al., 2022; Pulubuhu et al., 2020). Given that the food-away-from-home sector provides employment for many workers, the macroeconomic impacts of this consumption reduction generate a significant loss of GDP and an increase in unemployment. Beckman and Countryman (2021) proved that the effect of agriculture plays a significant role in the economy disruptions caused by the Covid-19 pandemic. Countries with high food-away-from-home spending, such as the United States, suffered the largest decline in agriculture-related GDP. The results showed that, "the impact from agriculture is still only one-third of the total economy shock, although this amount is higher than the 5.4% share of agriculture in the United States national economy" (Beckman & Countryman, 2021, p. 1597).

Materials and methods

The information base of the research consists of data on the economic results of agriculture in the European Union countries. Namely, data on the share of agriculture in GDP and the share of agriculture in employment in the European Union countries for 2019 and 2020 are used in the research. The authors also follow the percentage change in the mentioned indicators in 2020 as a crisis year compared to 2019 as a year of regular circumstances. The data is provided from the Eurostat database.

The methods used in the paper include comparative analysis and cluster analysis. The purpose of applying the comparative analysis is to identify the European Union countries in which there is a relatively greater economic importance of agriculture (measured by the share of agriculture in GDP and employment). The purpose of applying cluster analysis is to classify the European Union countries into certain groups according to the intensity of the impact of Covid-19 pandemic on the economic results of agriculture.

In accordance with the defined subject and aim of the research, the following hypotheses will be tested in the paper:

H₁: The Covid-19 pandemic has not changed the role and importance of agriculture for the macroeconomic performance of the individual European Union countries.

H₂: The European Union countries are not homogeneous when it comes to the effects of Covid-19 pandemic on the economic results of agriculture.

Results and discussion

In order to understand the role and importance of agriculture for the macroeconomic results of the countries of the European Union, Table 1 shows data on the percentage share of agriculture in GDP and the percentage share of agriculture in employment. Data are shown for 2019 and 2020. The percentage change of the analysed variables in 2020 compared to 2019 is also considered.

Table 1. The share of agriculture in GDP and employment in the European Union countries (2019 and 2020)

Country	Share in GDP			Share in employment		
	2019 (% of total GDP)	2020 (%)	20/19 (%)	2019 (% of total employment)	2020 (%)	20/19 (%)
Austria	1.1	1.1	0	3.32	3.58	7.89
Belgium	0.7	0.8	14.29	0.85	0.83	-1.85
Bulgaria	3.2	3.5	9.38	6.49	6.42	-0.99
Croatia	2.9	3.2	10.34	5.56	6.07	9.15
Cyprus	1.8	1.9	5.56	2.06	2.2	6.88
Czechia	1.9	2.0	5.26	2.62	2.57	-1.97
Denmark	1.3	1.4	7.69	2.03	1.93	-5.12
Estonia	2.4	2.1	-12.50	3.32	3.06	-7.96
Finland	2.3	2.5	8.70	3.35	3.2	-4.71
France	1.5	1.6	6.67	2.39	2.25	-5.98
Germany	0.8	0.8	0	1.13	1.14	1.12
Greece	3.8	4.2	10.53	10.97	9.98	-8.96
Hungary	3.3	3.4	3.03	4.66	4.68	0.49
Ireland	0.9	0.9	0	3.61	3.57	-1.07
Italy	1.9	2.0	5.26	3.72	3.79	2.01
Latvia	4.2	4.3	2.38	7.34	7.25	-1.23
Lithuania	3.1	3.5	12.90	6.24	5.52	-11.64
Luxembourg	0.2	0.2	0	0.63	0.69	10.08
Malta	0.5	0.4	-20.0	0.92	1.02	10.30
Netherlands	1.6	1.6	0	1.78	1.75	-1.78
Poland	2.4	2.6	8.33	8.99	9.43	4.89
Portugal	2.1	2.2	4.76	3.41	3.23	-5.37
Romania	4.4	4.2	-4.55	19.06	18.53	-2.77
Slovakia	1.7	1.7	0	2.78	2.56	-7.97
Slovenia	2.0	2.1	5.0	3.69	3.51	-4.82
Spain	2.5	2.9	16.0	3.99	3.94	-1.26
Sweden	1.4	1.3	-7.14	1.33	1.29	-2.92
<i>Average</i>	<i>2.07</i>	<i>2.16</i>	<i>-</i>	<i>4.31</i>	<i>4.22</i>	<i>-</i>

Legend: Countries with the higher share of agriculture in GDP and employment than the average share in the European Union

Source: Eurostat, 2022

The countries where the participation of agriculture in GDP and the participation of agriculture in employment are higher compared to the European Union average are marked in the Table 1. If the insight is carried out by year, it can be concluded that 11 countries in 2019 and 10 countries in 2020 had the share of agriculture in GDP above the EU average. Only Estonia's share was slightly lower than the EU average in 2020 and it was higher in 2019. Therefore, the Covid-19 pandemic has not significantly changed the structure of European Union countries in which agriculture has relatively greater importance for GDP. According to the second observation criterion, i.e., the

participation of agriculture in employment, the eight countries that had a higher participation than the average for the European Union as a whole in 2019 are also the countries with an above-average participation in 2020. Therefore, the Covid-19 pandemic did not change the structure of countries where the importance of agriculture for employment is relatively higher. Based on the above mentioned, the first starting hypothesis of the research has been confirmed.

Table 1 also provides insight into the intensity of the impact of the Covid-19 pandemic on the economic results of agriculture in the European Union countries. Analysis of the percentage change in the share of agriculture in both GDP and employment in the observed years points to a couple of interesting facts. First of all, there are few countries in which the contribution of agriculture to GDP in 2020 decreased compared to 2019. The decrease occurred in only four countries: Estonia, Malta, Romania and Sweden. The share of agriculture in GDP remained unchanged in the following countries: Austria, Germany, Ireland, Slovakia and Luxembourg. In all other countries, the share of agriculture in GDP increased in 2020 compared to 2019. The analysis of the percentage change in the share of agriculture in employment indicates slightly different results. Namely, the negative effect of the Covid-19 pandemic is more pronounced here. There was a decrease in the percentage share of agriculture in employment in 2020 compared to 2019 in even 18 out of 27 observed countries. The results could be explained by the fact that, regardless of the imposed restrictions and problems in food supply chains, agricultural sector is obliged to provide enough food for the normal functioning of the population. In addition, Covid-19 pandemic increased demand for food, because of fear of uncertainty and shortages, and decreased demand for luxury goods, such as travel and cars. However, quarantine measures made it impossible for workers, who are often seasonal and migrant, to reach their farms, resulting in increased unemployment.

In order to group the countries of the European Union, whereby the classification criterion was the intensity of the impact of Covid-19 crisis on the economic results of agriculture, the cluster analysis is used in the paper, as a method of classifying variables into homogeneous groups. The Final Cluster Centers according to the selected variables are shown in Table 2. The type of cluster analysis that is applied in order to reach the Final Cluster Centers and divide the countries is the K-Means Cluster analysis.

Table 2. Final Cluster Centres

Variables	Cluster		
	1	2	3
Share in GDP [20/19(%)]	-11.05	8.43	3.17
Share in employment [20/19(%)]	-0.84	-5.05	3.49

Source: Authors' research

The Final Cluster Centers shown in Table 2 indicate certain specificities of the effect of the crisis on the contribution of agriculture to GDP and the contribution of agriculture to employment in the European Union countries. Namely, it is not possible to clearly

single out the clusters with the worst and best performances, taking into account both criteria together (that is, the percentage change in the share of agriculture in GDP and the percentage change in the share of agriculture in employment in the observed period). Cluster 1 can conditionally be rated as the cluster of the worst performance, in which the negative effect of the Covid-19 pandemic on the economic results of agriculture is the greatest, due to the negative values of both variables. Cluster 2 is a very specific cluster and according to the information in Table 2, it consists of the countries with the largest positive contribution of agriculture to GDP and the largest negative contribution of agriculture to employment. Cluster 3 can conditionally be rated as the cluster of the best performance, in which there is no negative effect of the pandemic on the economic results of agriculture or it is negligible, due to the positive values of both variables.

Table 3 shows the results of Multiple Comparisons, i.e., Post Hoc Test. The intention of applying this methodological procedure was to test the statistical significance of the difference among the defined clusters of European Union countries.

Table 3. Multiple Comparisons (Post Hoc Test)

Variables	(I) Cluster	(J) Cluster	Mean Difference (I-J)	Std. Error	Sig.
Share in GDP [20/19 (%)]	1.00	2.00	-19.47917*	2.65034	0.000
		3.00	-14.22023*	2.68029	0.000
	2.00	1.00	19.47917*	2.65034	0.000
		3.00	5.25894*	1.91619	0.029
	3.00	1.00	14.22023*	2.68029	0.000
	2.00	-5.25894*	1.91619	0.029	
Share in employment [20/19 (%)]	1.00	2.00	4.21583	2.62924	0.264
		3.00	-4.33114	2.65895	0.253
	2.00	1.00	-4.21583	2.62924	0.264
		3.00	-8.54697*	1.90094	0.000
	3.00	1.00	4.33114	2.65895	0.253
	2.00	8.54697*	1.90094	0.000	

*Legend: * The mean difference is significant at the 0.05 level*

Source: Authors' research

The data shown in Table 3 indicate that there is a statistically significant difference between the defined clusters in terms of the percentage change in the share of agriculture in GDP in 2020 compared to 2019. This is valid for the comparison of all three clusters. If the percentage change in the share of agriculture in employment in 2020 compared to 2019 is observed, the statistical significance of the difference is confirmed only between cluster 2 and cluster 3. The statistical significance of the difference between cluster 1 and cluster 2 and between cluster 1 and cluster 3 is not confirmed. However, such findings indicate that the second hypothesis is only partially confirmed. The countries of the European Union are heterogeneous in terms of the impact of the Covid-19 pandemic on the contribution of agriculture to GDP. On the

other hand, there are no significant oscillations regarding the impact of the Covid-19 pandemic on the contribution of agriculture to employment between countries in cluster 1 in relation to those in cluster 2, or in relation to those in cluster 3. Table 4 shows the structure of the cluster, i.e. which countries make up cluster 1, 2 or 3, as well as the number of countries in each cluster.

Table 4. Membership of countries in clusters

Cluster	Number of countries in cluster	Countries
1	4	Estonia, Malta, Romania, Sweden
2	12	Belgium, Bulgaria, Czechia, Denmark, Finland, France, Greece, Lithuania, Portugal, Slovakia, Slovenia, Spain
3	11	Austria, Croatia, Cyprus, Germany, Hungary, Ireland, Italy, Latvia, Luxembourg, Netherlands, Poland

Source: Authors' research

According to the intensity and direction of the impact of the pandemic on the economic results of agriculture in the European Union countries, i.e., the intensity and direction of changes in the percentage share of agriculture in GDP and the intensity and direction of changes in the percentage share of agriculture in employment, the countries of the European Union are grouped into three clusters whose structure is as follows:

- Cluster 1 - Estonia, Malta, Romania, Sweden: this cluster consists of countries with the greatest negative effect of the Covid-19 pandemic on the contribution of agriculture to GDP and with a relatively moderate negative impact of the crisis on the contribution of agriculture to employment;
- Cluster 2 - Belgium, Bulgaria, Czechia, Denmark, Finland, France, Greece, Lithuania, Portugal, Slovakia, Slovenia, Spain: this cluster is characterized as a specific cluster and consists of countries with the largest positive changes in the contribution of agriculture to GDP in 2020 compared to 2019 and with the largest negative effect of the Covid-19 pandemic on the contribution of agriculture to employment;
- Cluster 3 - Austria, Croatia, Cyprus, Germany, Hungary, Ireland, Italy, Latvia, Luxembourg, Netherlands, Poland: this cluster consists of countries where the negative effect of the Covid-19 pandemic on the contribution of agriculture to GDP and employment was not registered, or countries where this negative impact was very moderate.

The simultaneous analysis of the data shown in Table 1 and the defined clusters did not show any connection between the importance of agriculture for the economic performance of individual countries and the intensity of the impact of pandemic on the economic results of agriculture in the European Union member states. It could have been expected that those EU countries in which the importance of agriculture for economic performance is greater supported this sector with stronger measures in order to mitigate the negative effects of the crisis. However, the data on the contribution

and change in the contribution of agriculture to GDP, as well as on the contribution and change in the contribution of agriculture to employment do not confirm this at all. The reasons for a greater or lesser negative impact or the absence of a negative impact in individual countries should be sought in other factors, such as the incentive policy of agricultural production or the policy of reducing the number of employees as a response to the crisis. Namely, the European Commission adopted few packages of measures to support agricultural sector of the EU. Some of these measures included exceptional derogation from EU competition rules, private storage aid, higher advances of payments and flexibility in the use of financial instruments in order to increase the cash flow of farmers (European Commission, 2020a). The measures were aimed at increasing the cash flow of farmers in order to preserve the business of agricultural plants and farms and maintain agricultural employment at the pre-crisis level.

Conclusions

The health crisis caused by the Covid-19 pandemic turned into an economic crisis and dealt a strong blow to almost all sectors of the economy. Agriculture, as one of the most insecure and unpredictable sectors, has been significantly affected by this crisis. Agricultural workforce, as well as the whole society, was faced with measures of social distancing, travel restrictions, closures and self-isolation, in order to curb the spread of the virus. Movement restrictions of farm workers, especially seasonal ones, who are often migrants, resulted in harvest delays and increased food losses, with the greatest consequences for perishable goods. As a consequence, there was a decrease in the share of agriculture in total employment. The closure of countries and the restriction of exports have led to the disruption of supply chains. Nevertheless, despite the mentioned negative consequences for agriculture, the crisis caused by the Covid-19 pandemic did not reduce the contribution of agriculture to GDP, which may be a consequence of the increased demand for agricultural products caused by the fear of uncertainty and stockpiling.

The subject of analysis in the paper was the effect of the Covid-19 pandemic on the economic results of agriculture in the EU countries. The results of the research indicated that the Covid-19 pandemic has not changed the importance of agriculture for the economic performance of individual countries. Namely, those EU countries in which the participation of agriculture in GDP and employment was higher than the EU average before the crisis are countries with participation above the average in 2020 as well. The direction of the impact of the Covid-19 pandemic on the economic results of agriculture in the EU countries was further analysed. The research results indicated that the Covid-19 pandemic in most of the EU countries did not have a negative impact on the contribution of agriculture to GDP. While certain sectors, like tourism, suffered a huge shock, it seems that this is not valid for agriculture as well. In addition, the increase in the contribution of agriculture to GDP certainly came at the expense of a decrease in the contribution of some other, more crisis-affected sectors. On the other hand, employment in the agricultural sector was also sensitive to the impact of the Covid-19 pandemic in many countries of the European Union. At the same time, the largest percentage decrease

in the participation of agriculture in employment was recorded in countries where the importance of agriculture for total employment is relatively higher (such as Greece and Lithuania). It can be concluded that these countries also sought a way out of the crisis by reducing the number of employees, among others, in the agricultural sector. Cluster analysis did not confirm the heterogeneity of EU countries when it comes to the effect of the pandemic on the economic results of agriculture based on both observed criteria. Namely, while the heterogeneity of countries can be discussed when it comes to the impact of the pandemic on the contribution of agriculture to GDP, the same cannot be said for the impact of the pandemic on the contribution of agriculture to employment.

The contribution of the paper, in a theoretical sense, is reflected in the attempt to resolve the debate about the effect of the Covid-19 pandemic on agriculture, especially about the contribution of agriculture in the creation of GDP and total employment. In a practical sense, the paper can contribute to the policy creators for agricultural recovery after the crisis, especially when it comes to employment, pointing to those countries where the decline in the contribution of agriculture to total employment was higher. The restriction of the research to the European Union countries can be considered as a limitation, considering that the role of agriculture in total economy declines with the country development. A more comprehensive analysis for future research would include all countries of the world, with special emphasis on the less developed countries that base their economic development on agriculture and which could have suffered a more significant blow of the pandemic crisis.

Conflict of interests

The authors declare no conflict of interest.

References

1. Adhikari, J., Timsina, J., Khadka, S. R., Ghale, Y., & Ojha, H. (2021). COVID-19 impacts on agriculture and food systems in Nepal: Implications for SDGs. *Agricultural Systems*, 186, 102990. <https://doi.org/10.1016/j.agsy.2020.102990>
2. Beckman, J. & Countryman, A. (2021). The Importance of Agriculture in the Economy: Impacts from COVID-19. *American Journal of Agricultural Economics*, 103(5), 1595-1611. <https://doi.org/10.1111/ajae.12212>
3. Bochtis, D., Benos, L., Lampridi, M., Marinoudi, V., Pearson, S. & Sørensen, C.G. (2020). Agricultural workforce crisis in light of the COVID-19 pandemic. *Sustainability*, 12(19), 8212. <https://doi.org/10.3390/su12198212>
4. Botezatu, M., & Andrei, J. (2012). Implications of the environmental factors on the economic efficiency of capital investments. A Romanian perspective in terms of a sustainable economy. *Journal of Environmental Protection and Ecology*, 13(1), 382-391.

5. Ceballos, F., Kannan, S., & Kramer, B. (2020). Impacts of a national lockdown on smallholder farmers' income and food security: Empirical evidence from two states in India. *World Development*, 136, 105069. <https://doi.org/10.1016/j.worlddev.2020.105069>
6. Cho, S.J., Lee J.Y., & Winters, J.W. (2020). COVID-19 Employment Status Impacts on Food Sector Workers. *IZA discussion paper series*, 13334.
7. Cortignani, R., Carulli, G., & Dono, G. (2020). COVID-19 and labour in agriculture: Economic and productive impacts in an agricultural area of the Mediterranean. *Italian Journal of Agronomy*, 15, 172-181.
8. Cranfield, J. A. L. (2020). Framing consumer food demand responses in a viral pandemic. *Canadian Journal of Agricultural Economics/Revue Canadienne D'agroeconomie*, 68(2), 151-156. <https://doi.org/10.1111/cjag.12246>
9. European Commission (2020a). Coronavirus: Commission announces exceptional measures to support the agri-food sector, Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/IP_20_722 (November 4, 2022)
10. European Commission (2020b). Short-term outlook for EU agricultural markets in 2020, Retrieved from https://agriculture.ec.europa.eu/news/short-term-outlook-despite-challenges-arising-coronavirus-outbreak-eu-agri-food-sectors-show-2020-04-20_en#moreinfo (November 2, 2022)
11. Eurostat (2022). Database, <https://ec.europa.eu/eurostat/en/web/main/data/database> (October 31, 2022)
12. Gajić, T., Penić, M., & Vukolić, D. (2022). The impact of fear of COVID-19 infection on consumers' intention to visit restaurants. *Menadžment u hotelijerstvu i turizmu – Hotel and Tourism Management*, 10(1), 67-78. <https://doi.org/10.5937/menhottur2201067G>
13. Garnett, P., Doherty, B., & Heron, T. (2020). Vulnerability of the United Kingdom's food supply chains exposed by COVID-19. *Nature Food*, 1, 315-318. <https://doi.org/10.1038/s43016-020-0097-7>
14. Gupta, A., Zhu, H., Doan, M.K., Michuda, A., & Majumder, B. (2021). Economic Impacts of the COVID-19 Lockdown in a Remittance-Dependent Region. *American Journal of Agricultural Economics*, 103(2), 466-485. <https://doi.org/10.1111/ajae.12178>
15. Kalogiannidis, S., & Melfou, K. (2020). Issues and Opportunities for Agriculture Sector During Global Pandemic. *International Journal of Economics, Business and Management Research*, 4(12), 204-211
16. Lauren, M., Manfredo, M. & Richards, T. (2020). COVID-19 and Food Supply Chains. *Applied Economic Perspectives and Policy*, 43(1), 270-279. <https://doi.org/10.1002/aep.13085>

17. Luković, S., & Stojković, D. (2020). Covid-19 pandemic and global tourism. *Menadžment u hotelijerstvu i turizmu – Hotel and Tourism Management*, 8(2), <https://doi.org/10.5937/menhottur2002079L>
18. Marković, M., Krstić, B., & Popović, S. (2022). Competitiveness of agri-food exports of the Republic of Serbia in the COVID-19 conditions. *Economics of Agriculture*, 69(1), 227-239 <https://doi.org/10.5937/ekoPolj2201227M>
19. Martin, P. (2020). COVID-19 and California farm labor. *California Agriculture*, 74(2), 67-68. <https://doi.org/10.3733/ca.2020a0017>
20. Nakat, Z., & Bou-Mitri, C. (2021). COVID-19 and the food industry: Readiness assessment. *Food Control*, 121, 107661. <https://doi.org/10.1016/j.foodcont.2020.107661>
21. Popescu, G., & Andrei, J. (2011). From industrial holdings to subsistence farms in Romanian agriculture. Analyzing the subsistence components of CAP. *Agricultural Economics*, 57(11), 555-564.
22. Pulubuhu, D.A.T., Unde, A.A., Sumartias, S., & Seniwati, S. (2020). The Economic Impact of COVID-19 Outbreak on the Agriculture Sector. *International Journal of Agriculture System*, 8(1), 57-63. <http://dx.doi.org/10.20956/ijas.v8i1.2337>
23. Ramakumar, R. (2021). Agriculture and the Covid-19 Pandemic: An Analysis with Special Reference to India. *Review of Agrarian Studies*, 10(1), 72-110
24. Ridley, W., & Devadoss, S. (2020). The Effects of COVID-19 on Fruit and Vegetable Production. *Applied Economic Perspectives and Policy*, 43(1), 329-40. <https://doi.org/10.1002/aep.13107>
25. Sharma, R., Shishodia, A., Kamble, S., Gunasekaran, A., & Belhadi, A. (2020). Agriculture supply chain risks and COVID-19: mitigation strategies and implications for the practitioners. *International Journal of Logistics Research and Applications*, 1-27. <https://doi.org/10.1080/13675567.2020.1830049>
26. Štreimikienė, D., Baležentis, T., Volkov, A., Ribašauskienė, E., Morkūnas, M. & Žičkienė, A. (2022). Negative effects of covid-19 pandemic on agriculture: systematic literature review in the frameworks of vulnerability, resilience and risks involved. *Economic Research-Ekonomska Istraživanja*, 35(1), 529-545. <https://doi.org/10.1080/1331677X.2021.1919542>
27. The World Bank (2022). World Development Indicators, Retrieved from <https://databank.worldbank.org/reports.aspx?source=world-development-indicators> (30 October, 2022)
28. Vuković, P., & Ružičić Mosurović, M. (2020). Potentials for development food tourism in AP Vojvodina in the Republic of Serbia. *Ekonomika: časopis za ekonomsku teoriju i praksu*, 66(1), 77-92. <https://doi.org/10.5937/ekonomika2001077V>