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IMPACT OF INVESTMENTS ON FOOD SECURITY ACCESS: CASE OF EU AND NON-EU MEMBER COUNTRIES

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ABSTRACT

Agriculture around the world faces a number of challenges. The aim of this paper is to investigate the impact of gross investments and agriculture investments on the level of food security in the member countries of the European Union (EU) and non-EU member countries. In the paper as a method of research hierarchical regression analysis was used. The results of the research showed that there is a statistically significant influence of gross investments and agriculture investments on the level of food security in the EU and non-EU member countries. The largest amount of gross investments and investments in agriculture was recorded in Croatia and Slovenia, as a EU members countries, which have the highest level of food security. On the other hand, the lowest volume of gross investments and investments in agriculture was recorded in Bosnia and Herzegovina, as non-EU member country, which has the lower level of food security.

Introduction

The term food security originated at the World Food Conference and food security definition at the time had the focus on food availability and price stability. Therefore, the primary focus was primarily on food supply problems, that is, on ensuring adequate supply and, as far as possible, price stability of basic agricultural and food products at the national and international level (FAO, 2003).

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Later, in 1983, FAO expanded this concept by including the issue of access to food by vulnerable people. This emphasizes that food security “should ensure that all people at all times have both physical and economic access to the basic food products they need” (FAO, 2003: 27). Subsequently, the World Bank Report on “Poverty and Hunger” from 1986 further broaden the concept of food security as the definition included “access by all people at all times to sufficient food necessary for an active and healthy life” (FAO, 2003: 27). At the same time, it was found that poverty and lack of income, rather than food supply, were the main obstacles to access to food. Thus, at the World Food Summit in 1996, the concept of food security was expanded (Diaz-Bonilla, Thomas, Robinson, Cattaneo, 2006). The definition of food security that is most frequently used was created in 1996 at the World Food Summit, and it indicates that “food security, at the individual, household, national, regional and global levels, is achieved when all people, at all times, have physical and economic access to sufficient quantities of safe food of adequate nutritional value to meet their nutritional needs and preferences necessary for an active and healthy life” (FAO, 1996: 1).

Important policy goal of all countries is reducing food insecurity for all individuals which can be achieved in a variety of ways: increasing world food supply, improving access to food, and increasing consumer food purchasing power (Chavas, 2017; Koveljenić, et al., 2021). So in order to design adequate policies and programs necessary to improve the diets of people, it is necessary to understand the factors that cause malnutrition and how they affect vulnerable groups and households. Through understanding the factors that influence food security, it is necessary to direct policies towards reducing the impact of these factors on hunger and malnutrition. In addition, it is necessary to direct policies towards determining the adequate price of resources and their efficient allocation together with investments in human and natural resources (Babu, Gajanan, Sanyal, 2014).

The food production in the last 40 years has been achieved largely thanks to the investments in agriculture and application of new technology, which has had the effect of increasing productivity and reducing production costs. However, despite investments in agriculture and the usage of new technologies in agriculture that have increased production, there is still food shortages around the world in developing countries, large number of poor and food insecure.

Nowadays, about 700 million people are still poor and they are mostly in rural areas. In addition, despite significant advances in reducing undernourishment and improving nutrition levels, nearly 800 million people are chronically hungry, while 2 billion lack micronutrients (FAO, 2018). Undernourishment and poverty are the main causes of illness and death that occur every day in the world (Ruiz, 2010).

So, in order to reduce food insecurity, it is necessary to implement significant reforms and investments that will have a positive influence on economic growth. Economic growth stimulates economic development and involves a number of structural changes. He represents a key factor in reducing malnutrition and food insecurity, but only

if it provides opportunities for the poor, who do not have enough capital and who are uneducated (Mergos, Papanastassiou, 2017). Investments in agriculture have a positive impact on the growth and development of agriculture and therefore also on food security. The importance of investments was especially pointed out during 2015, when the United Nations announced the Sustainable Development Goals for 2030, which envisages the elimination of hunger, achieving food security and promoting sustainable agriculture. In order to achieve these goals, investments that will enable the improvement of agricultural production capacities are needed. They can generate a wide range of development benefits, as they enable the development of certain sectors and the improvement of their market position.

The aim of the research is to analyze the impact of gross investments and agriculture investments on the level of food security in the countries of the former Yugoslavia viewed from the point of membership to European Union (EU). The countries of the former Yugoslavia which are members of EU: Slovenia and Croatia. On the other hand, countries of the former Yugoslavia which are not members of EU: Serbia, Bosnia and Herzegovina, North Macedonia and Montenegro. The impact of investments on the level of food security has not been researched enough in this countries and these research are important given the challenges of maintaining food security in the EU and non-EU countries.

The paper is divided into four sections. In the first section the impact of investments on food security is explained. Second section refers to the material and statistical method that was used in the paper. In the third section results of the research are shown. In the last section discussion and conclusion are presented.

Investments and Food Security

In the second half of the twentieth century there was an increase in agricultural productivity and economic growth which led to large-scale food security, however this did not happen in some parts of developing countries.

For developing countries, it is characteristic that natural potentials are insufficiently used, there is a low level of specialization in farm production, as well as an extremely low level of employee motivation, due to low average wages. The equipment of modern machines is not at the required level, which results in reduced yields. The participation of individual agricultural farms and their symbolic organization into cooperatives is dominant and there is also a low level of production intensity.

The main constraints for farmers in developing countries are the little available capital, insufficient use of the technology and market risks. In order to increase production, profits and productivity in developing countries, investments are needed. In the past, policy practices were directed to increasing output and agriculture productivity. However, agriculture now has to be internationally competitive and sustainable. Farmers, need to be profitable and meet environmental standards and regulations, while they are buried with information about new technologies from various government and industry

sources. So in response to agricultural policies that include environmental conditions farmers need to change their production and management practices (Kuyvenhoven, Ruben, Roseboom, 2001).

Agricultural investment plans in developing countries must consider their impact on agriculture and food security, and also their contribution to economic growth, job creation and poverty reduction. In these countries, agricultural policies are required to adopt a systemic approach, which sets out investments and policies at the farm level within sector-level strategies and programs.

Investments in agriculture are key to eradicating hunger and reducing the number of poor, as it affects multiple dimensions of food security. They have a positive effect on increasing productivity, which leads to an increase in rural incomes and lower food prices, thus making food available to the poor, which also increases their food security. Lower prices of basic food products allow consumers to improve their diet, by consuming a variety of foods. Investment in agriculture can also reduce the vulnerability of food supply to shocks, thereby promoting stability in consumption (FAO, 2012). An increase in investments in agriculture is one of the most influential strategies for achieving food security, especially in rural areas where the majority of the world's poor live. This is supported by the fact that GDP growth in agriculture has proven effective in reducing poverty, as agriculture accounts for a large share of GDP and most of the poor live in rural areas (World Bank, 2008). Investments in agriculture that lead to infrastructural changes, modernization of agriculture, lead to the development of rural areas and raising the quality of life of rural communities, and create synergy effects of joint action of local authorities and farmers (Kulenović, Ivanković, 2016).

The importance of investments and their impact on food security has been pointed out by numerous authors in their research papers. Usman, Ahmed, Javed (2017) analyzed R&D investment in agriculture and their effect on agricultural productivity and food security. Gaffney et al. (2019) found that investments in agricultural innovation by both the public and private sector can ensure production of an adequate food supply, alleviate poverty, achieve better health and nutrition for a growing population and conserve natural resources. Coleman, Berger and Brewin (2019) state that public and private investments in agriculture are identified as global priorities in the Sustainable Development Goals. Fuglie (2016) states that investments in agricultural R&D is an important tool to foster agro-productivity and food security. Lobell, Baldos and Hertel (2013) found that investments in climate adaptation in agriculture represent a good opportunity for climate mitigation, it also benefits poverty reduction and enhances food security.

Investments in agriculture are considered high-risk, because the expected effects can largely depend on environmental conditions that investors cannot influence. Agricultural production significantly depends on natural resources, climate, adoption of new technologies, which can lead to greater or lesser fluctuations in annual production, greater market risk and farmers income instability. So the production process is mostly related to land, which causes certain technological-organizational and economic-political problems.

In developing countries agriculture participates to a large extent in the formation of the national income and also it is the main source of accumulation for the development of industry. Agriculture was neglected in the beginning of industrialization, and its share decreases along with the development of industry. In the countries of the former Yugoslavia, agriculture is largely represented in the creation of total gross value added, regardless of whether they are members of the EU. Agriculture of the former Yugoslavia countries is characterized by small and noncompetitive economies, fragmented land, large number of old farms, low level of adoption of technology and low productivity. Such agriculture is noncompetitive, and in its current state it cannot be a factor in sustainable development and maintaining food security (Kovljenić, Raletić Jotanović, 2020).

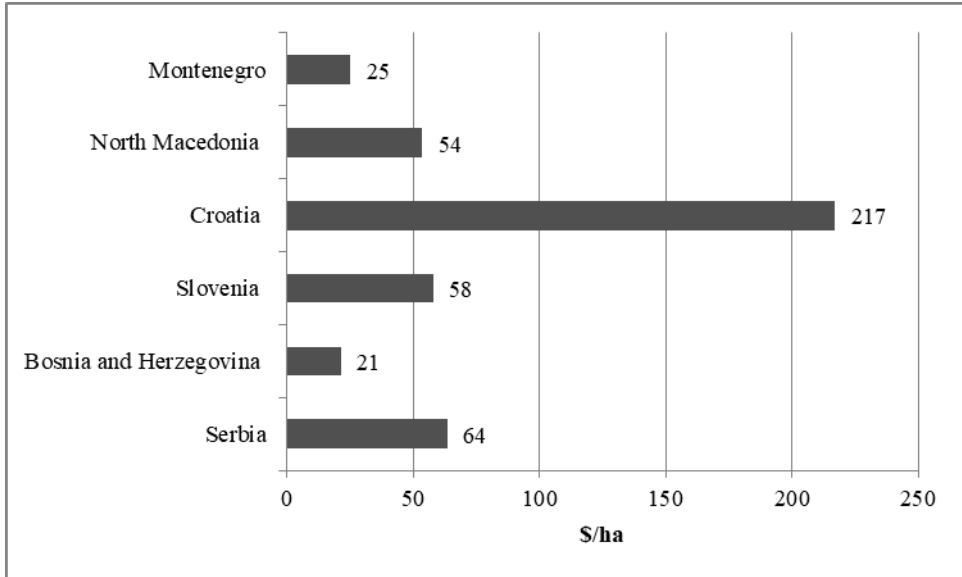
In the countries of the former Yugoslavia, regardless of whether they are members of the EU, problems with investment in agriculture are numerous and varied depending on different periods of agricultural development. The state of agriculture was significantly affected by:

- sanctions of the international community;
- policy of depressed prices of agri-food products in the Socialist Federal Republic of Yugoslavia;
- disintegration of the SFRY after which there was an economic recession,
- occurrence of hyperinflation;
- reduction of agricultural production in the period from 1992-1995 and
- inequality of allocations between the funds intended for the agrarian budget and agriculture contribution to the creation of GDP.

In addition to budget allocations in the countries of the former Yugoslavia for agriculture, countries also have access to European Union funds – IPARD (Pre-Accession Assistance for Rural Development). From the former Yugoslavia countries, only Bosnia and Herzegovina is not a beneficiary of IPARD funds, as this option is only available to candidate countries. However, the new regulations provide for the deletion of candidate status as a precondition for the use of all five IPA components, so that potential candidate countries, such as Bosnia and Herzegovina, would be able to use pre-accession funds for agriculture and rural development.

Figure 1 shows the average agricultural investments in the countries of the former Yugoslavia in the period from 2006 to 2018. Based on **Figure 1**, it can be concluded that in the observed period, the highest average investments in agriculture were recorded in the Croatia (217 \$/ha), and the lowest were recorded in Bosnia and Herzegovina (21 \$/ha). Croatia is the member of EU, while Bosnia and Herzegovina isn't member of EU. Compared to Croatia, other countries of the former Yugoslavia, have significantly lower amounts of investment in agriculture. After Bosnia and Herzegovina, a lower amount of investment was recorded in Montenegro. North Macedonia and Slovenia have approximately the same level of average investments in agriculture in the observed period.

Figure 1. Average agricultural investments in the countries of the former Yugoslavia for the period from 2006 to 2018 (\$ per ha)



Source: Authors’ calculations based on national statistics (2006-2018)

Given the process of rapid urbanization, increasing population, restraints of agriculture land, decreasing crop production and biodiversity, demand for food has significantly increased. So investments in agriculture are necessary. Investments in agricultural sector especially in new technologies lead to an increase in production. Also investments have a powerful knock-on effect to the rest of the economy by: creating jobs in neighbouring sectors such as food processing and input supply as well as directly in farming, increasing the supply of affordable food, stimulating and supporting wider economic growth and development (Tripp, 2005).

Material and methods

The paper analyses the six countries of the former Yugoslavia (Serbia, Bosnia and Herzegovina, Slovenia, Montenegro, Croatia and North Macedonia) over a 13-year period (2006-2018). The countries of the former Yugoslavia which are members of EU are Slovenia and Croatia, while countries of the former Yugoslavia which are not members of EU are Serbia, Bosnia and Herzegovina, Montenegro and North Macedonia. This research includes data obtained from several sources: FAOSTAT database (FAOSTAT, 2020), World Bank (The World Bank, 2020), as well as the national statistics of the countries of the former Yugoslavia (Statistical Office of the Republic of Serbia, 2020; Agency for Statistics of Bosnia and Herzegovina 2020; Republic of Slovenia Statistical Office, 2020; Croatian Bureau of Statistics, 2020; State Statistical Office Republic of North Macedonia, 2020; Statistical Office of Montenegro—MONSTAT, 2020).

In order to examine the the impact of gross investments and investments in agriculture

on food security in the countries of the former Yugoslavia, multiple regression analysis was used. The level of food security was operationalized as a percentage of malnutrition and in the regression analysis, this is a dependent variable.

Investments in agriculture were observed through total realized investments in fixed assets by technical structure. Gross investments were observed through total realized investments in fixed assets by technical structure, investor's activity and head office.

The analysis showed that the dependent variables do not have a normal distribution, therefore it was necessary to further transform the data. The Log transformation brought the data closest to the normal schedule, because that is where the least skewness and the least kurtosis occurred.

The relationship between the dependent variable Y and the independent variable x_1, x_2, \dots, x_m is represented by linear regression relations:

$$Y = \alpha * x_1^{\beta_1} * x_2^{\beta_2} \dots x_m^{\beta_m} / \log$$

Y - percentage of malnutrition

The set of independent variables includes:

x_1 – expenditure on food and non-alcoholic beverages;

x_2 – poverty rate (%);

x_3 – real consumer price index;

x_4 – gross investments (per capita);

x_5 – investments in agriculture (\$ per ha);

x_6 – rural population (growth in %).

Results of research

Results of research, descriptive statistic and multiple regression analysis will be shown in this section.

Table 1 shows the results of descriptive statistics. Within the obtained results, it is important to point out that the lowest percentage of malnutrition was recorded in Slovenia and Croatia (values in all years were less than 2.5). Slovenia stood out in relation to the other countries of the former Yugoslavia, with the lowest poverty rates in the observed period (the average rate was 13 %). Croatia stood out as the country with the largest investments in agriculture (average agricultural investments was 217 \$/ha).

Table 1. Descriptive statistics

	Minimum	Maximum	Mean	Standard Deviation	Skewness	Kurtosis
Percentage of malnutrition	2.39	6.10	3.37	1.33	1.11	-.440
Expenditure on food and non-alcoholic (annual average in dollars)	2039.52	4597.85	3629.17	606.99	-.07	-.54
Poverty rate (%)	4.90	31.10	19.08	6.09	-.25	-.64
Real consumer price index	88.55	137.25	102.77	5.05	4.08	28.55
Gross investments (constant 2010 dollars)	244.87	4620.09	1705.44	1078.68	0.88	-.28
Investments in agriculture (constant 2010 dollars)	21.05	957.11	200.27	211.62	2.26	5.14
Rural population (growth in %)	-1.79	.49	-.6745	.5239	.035	-.122

Source: Authors' calculations

In *Model 1*, the set of independent variables included: poverty rate, real consumer price index, expenditure on food and non-alcoholic beverages and investment in agriculture.

The regression model was statistically significant ($R^2=0.742$; $F(77, 4)=56.384$; $p<0.000$; Durbin-Watson (DW)=2.357). Based on a set of independent variables, it is possible to explain the dependent variable. The percentage of explanation of the variance of the dependent variable is 74%.

Table 2. Results of regression analysis (Model 1)

Model 1	β	Standard error	T	Significance
(constant)		.813	-1.655	.102
LG10Poverty rate	.560	.045	9.496	.000
LG10Real consumer price index	.163	.352	2.788	.007
LG10Expenditure on food and non - alcoholic beverages	-.563	.091	-9.586	.000
LG10Investment in agriculture	-.210	.017	-3.547	.001

Source: Authors' calculations

In *Table 2 (Model 1)*, based on the results of regression analysis, it can be concluded that the poverty rate, real consumer price index, expenditures on food and soft drinks and investments in agriculture explain the percentage of malnutrition in the countries of

the former Yugoslavia, regardless of whether they are members of the EU. The highest contribution to the explanation of the dependent variable is given by the poverty rate in the positive direction and expenditures on food and non-alcoholic beverages and investment in agriculture in the negative direction. At the same time research results show that the real consumer price index explains the malnutrition rate to a lesser extent. The poverty rate statistically significantly in a positive direction explains the rate of malnutrition in the countries of the former Yugoslavia. Expenditures on food and non-alcoholic beverages make an equal contribution in the negative direction, with an increase in expenditures, the malnutrition rate decreases. This information can be supplemented by a real consumer price index, which shows that as the real index increases, so does the percentage of malnutrition. The examined rate is explained in a negative direction by investments in agriculture, with the growth of investments, the rate of malnutrition decreases.

In *Model 2*, the set of independent variables included: gross investments, expenditure on food and non-alcoholic beverages, poverty rate and percentage of growth of rural population.

The regression model was statistically significant ($R^2 = 0.732$; $F(77, 4) = 39.699$; $p < 0.000$; $p < 0.05$; Durbin-Watson (DW) = 1.969). Based on a set of independent variables, it is possible to explain the dependent variable. The percentage of explanation of the variance of the dependent variable is 71%.

Table 3. Results of regression analysis (Model 2)

Model 2	β	Standard error	T	Significance
(constant)		.422	8.811	.102
LG10Gross investments	-.096	.041	-2.359	.022
LG10Expenditure on food and non - alcoholic beverages	-.896	.123	-7.291	.000
LG10Poverty rate	.335	.057	5.879	.000
LG10Percentage of growth of the rural population	.055	.022	2.535	.014

Source: Authors' calculations

Based on the results given in *Table 3 (Model 2)*, it can be concluded that gross investment, poverty rate, expenditure on food and non-alcoholic beverages, and rural population growth rate explain 71% of the percentage of malnutrition in the countries of the former Yugoslavia, regardless of whether they are members of the EU. Each of the independent variables explains the dependent variable statistically significantly ($p < 0.001$ and $p < 0.05$). The highest contribution to the explanation of the dependent variable is given by the poverty rate in the positive direction, as well as expenditures on food and non-alcoholic beverages in the negative direction. Based on these findings, it can be concluded that malnutrition in the countries of the former Yugoslavia can be explained on the basis of the poverty rate. On the other hand, the growth of expenditures

on food and non-alcoholic beverages, as well as the growth of gross investments, reduces malnutrition. At the same time, a higher percentage of rural population growth in a positive direction explains the dependent variable.

Discussion

The results of research show that:

- Gross investments affect the level of food security in countries of the former Yugoslavia, regardless of whether they are members of the EU.
- Agricultural investments impact the level of food security in countries of the former Yugoslavia, regardless of whether they are members of the EU. In the presented models, investments in agriculture showed greater statistical significance, in comparison to gross investments.

Data from national statistics showed differences between countries of the former Yugoslavia in the amount of investments and food security, and the regression results indicated the statistically significant impact of investments on food security in all countries of the former Yugoslavia, regardless of whether they are members of the EU. Largest amount of gross investments and investments in agriculture was recorded in Croatia and Slovenia, which also have the highest level of food security. Croatia recorded the highest amount of investments in agriculture per hectare, in comparison to the other former Yugoslavia countries. Both Croatia and Slovenia are members of EU. According to the gross investments per capita, Slovenia stands out as the country that in the observed period from 2006 to 2018 recorded the largest amount of gross investments. After Croatia, Serbia records a higher amount of investments in agriculture per hectare, compared to other former Yugoslavia countries. However, Serbia has a significantly lower level of gross investment per capita and a lower level of food security. North Macedonia records approximately the same level of investment in agriculture per hectare as Slovenia. However, in terms of gross investment per capita, it records a lower level compared to other former Yugoslavia countries. In North Macedonia, lower food security was recorded compared to the level recorded in Croatia and Slovenia. A significantly lower level of investment in agriculture per hectare was recorded in Montenegro, compared to other countries of the former Yugoslavia. According to gross investments per capita, in the last years of the analysis in 2017 and 2018, a higher amount of investments was recorded, compared to Serbia, North Macedonia and Bosnia and Herzegovina. However, over the years, a higher number of food insecure people has been recorded, and thus a lower level of food security. The results of the research showed that the lowest volume of gross investments and investments in agriculture was recorded in Bosnia and Herzegovina, which also has the highest number of food insecure.

Bearing in mind the results of the research, it can be concluded that differences in food security exist between EU members countries (Slovenia and Croatia) and non-EU members countries (Serbia, Bosnia and Herzegovina, Montenegro and North

Macedonia). So, it can be concluded that part of Yugoslavia, which consists of the present-day countries of Slovenia and Croatia, and which are EU members countries, have the the highest amount of investments and the highest level of food security. On the other hand, the countries of the former Yugoslavia that are non-EU members countries have a lower volume of investments and a lower level of food security, in comparison with EU members countries. Countries of the former Yugoslavia that are non-EU members countries, Serbia and North Macedonia, have a medium level of investments and medium level of food security. While, the remaining two of the non-EU members countries, Bosnia and Herzegovina and Montenegro, have a lower level of investments and lower level of food security.

In the future, in order to increase the level of food security, in the countries of the former Yugoslavia, agriculture will be required to increase productivity which will enable meeting the growing demand for food. In order to increase productivity, investments in agriculture are necessary, especially in non-EU members countries, where lower investments were recorded, namely Bosnia and Herzegovina and Montenegro. Investments will have a positive impact on productivity which will also affect the increase in food security in non-EU members countries of the former Yugoslavia. Also, it is not disputed that productivity in agriculture is basically determined by the level of economic development of the country and resource-ecological conditions (Zekić, Gajić, Lovre, Trkulja, 2004).

It is important to emphasize that smallholder farmers in countries of former Yugoslavia remain in the dark regarding investments and usage of modern technologies. So there is a need for informing farmers on the importance of improved farming practices, adaptation to new technologies and better utilization of land through coordinated efforts of agricultural research with developmental organizations. This is particularly important in developing countries, because agriculture remains a central element of the economy and investments are the key to the agricultural growth needed to reduce poverty (Dhehibi, Rudiger, Moyo, Dhraief, 2020). In non-EU members countries of the former Yugoslavia, the agricultural sector is economically and socially important for its contribution to achieving food security and employment.

Conclusion

In most countries of the former Yugoslavia, regardless of whether they are members of the EU, agricultural production still has a high level of production for its own needs. This is primarily a consequence of the limited production capacity of small family farms, which do not produce more than their own needs, but also the lack of opportunities to sell sporadic surpluses of agricultural products. Therefore, the task of each country is to promote investments in agriculture in order to increase the agricultural farms productivity, modernize production and increase the quality of agricultural products, with the ultimate goal of achieving an appropriate level of food security.

Based on the results of research and obtained data, international policies, national policies, and strategies can be created in such a way to increase the amount of investments in agriculture and the level of food security. Recognizing the importance of investments is extremely important for the purpose of increasing food security in Montenegro and Bosnia and Herzegovina, because as non-EU members countries they have the lowest investments in food security. As for Slovenia and Croatia, which are EU members countries, and which according to the results of the research, have recognized the great influence of investments on food security, they should maintain such tools that recognize the role of investments in food security.

Agriculture plays a paradoxical role in the development process. In developing countries, such as countries of the former Yugoslavia, increase in productivity is required in order to improve rural incomes, maintain food production and food security. These contributions of agriculture to economic development require a specifically defined policy framework that offers appropriate incentives to farmers to improve productivity (OECD, 2001). It is also necessary that policies and investments, in addition to focusing on agricultural development, be focused on the development of other activities available to the poor in rural areas in countries of the former Yugoslavia. This includes expanding coverage of basic health, food and education services, social protection, as well as safety nets for the poor (FAO, 2017). All this can generate significant benefits for the agricultural sector and increase its contributing to economic growth and poverty reduction.

There are a number of factors influence the extent to which the poor benefit from investments that create changes in agricultural productivity through and adoption of new technology. The results indicate that agricultural modernization has a positive effect on both measures of economic growth and human development (Self, Richard, 2007). Investments have a positive impacts on employment and food prices. Employment is of critical importance to the livelihoods of the poor. Especially investments in new technology increases demand for labour, which is of great importance to the poor in countries of the former Yugoslavia, regardless of whether they are members of the EU. Adoption of new technology have a positive effect on increasing productivity, which leads to an increase in rural incomes and lower food prices, thus making food available to the poor, which also increases their food security. However, an increase in production can also lead to a decrease in prices to the extent that producers' incomes fall. Thus, where productivity increases due to technology match or even outpace the corresponding fall in prices, both net consumers and net producers can benefit (Tripp, 2005).

Given that agriculture is a major driving force for the former Yugoslavia countries, regardless of whether they are members of the EU, and the connection between agriculture, economic growth, and food security, greater investment in agriculture are necessary. Economic growth is particularly important in reducing poverty and food insecurity, and agriculture is an important driver of economic growth. Investments in agriculture are especially important in less developed countries for stimulating economic growth and poverty reduction. Agriculture investments create the basis for increasing agricultural production, reducing food insecurity, increasing food supply and increasing incomes.

The research has certain limitations related to data availability. Future research will be directed towards greater coverage of data and the inclusion of additional factors such as political factors that affect food security.

Conflict of interests

The authors declare no conflict of interest.

References

1. Agency for Statistics of Bosnia and Herzegovina, (2020). Retrieved from: <https://bhas.gov.ba/?lang=en> (May 22, 2020).
2. Babu, S. C., Gajanan, S. N., & Sanyal, P. (2014). *Food Security, Poverty and Nutrition Policy Analysis: Statistical Methods and Applications* (2nd ed.). Oxford: Elsevier.
3. Chavas J.P. (2017). On food security and the economic valuation of food. *Food policy*, 69, 58-67. doi:10.1016/j.foodpol.2017.03.008.
4. Coleman, J., Berger, T., & Brewin, S. (2019). Agricultural Investments under International Investment Law. Retrieved from: SSRN: <https://ssrn.com/abstract=3335193> (May 10, 2020).
5. Croatian Bureau of Statistics 2020. Retrieved from: https://www.dzs.hr/default_e.htm (May 22, 2020).
6. Dhehibi, B., D., Rudiger, U., Moyo, H. P., & Dhraief, M. H. (2020). Agricultural Technology Transfer Preferences of Smallholder Farmers in Tunisia's Arid Regions. *Sustainability*, 12(1), 1-18. doi: 10.3390/su12010421.
7. Diaz-Bonilla, E., Thomas, M., Robinson, S., & Cattaneo, A. (2006). Food Security and the World Trade Organization: a Typology of Countries. In E. Diaz-Bonilla, S. E. Frandsen, S. Robinson (Ed.), *WTO Negotiations and Agricultural Trade Liberalization: The Effect of Developed Countries' Policies on Developing Countries*, (pp. 162–183). Wallingford: CABI.
8. FAO, (1996). Rome Declaration on World Food Security and the World Food Summit Plan of Action. World Food Summit 13-17 November 1996. Rome.
9. FAO, (2003). *Trade reforms and food security: Conceptualizing the linkages*. Rome: FAO.
10. FAO, (2012). *The State of Food and agriculture - investing in agriculture for a better future*. Rome: FAO.
11. FAO, (2017). *The future of food and agriculture: Trends and challenges*. Rome: FAO.
12. FAO, (2018). *The State of Food Security and Nutrition in the World: Building climate resilience for food security and nutrition*. Rome: FAO.

13. FAOSTAT, (2020). Retrieved from: <https://www.fao.org/faostat/en/#data> (May 29, 2020).
14. Fuglie, K. (2016). The growing role of the private sector in agricultural research and development world-wide. *Global Food Security*, 10, 29-38. doi:[10.1016/j.gfs.2016.07.005](https://doi.org/10.1016/j.gfs.2016.07.005).
15. Gaffney, J., Bing, J., Byrne, P.F., Cassman, K. G., Ciampitti, I., Delmer, D., Habben, J., Lafitte, H. R., Lidstrom, U. E., Porter, D. O., Sawyer, J. E., Schussler, J., Setter, T., Sharp, R. E., Vyn, T. J., & Warner, D. (2019). Science-based intensive agriculture: Sustainability, food security, and the role of technology. *Global Food Security*, 23, 236-244. doi: [10.1016/j.gfs.2019.08.003](https://doi.org/10.1016/j.gfs.2019.08.003).
16. Kovljenić, M., & Raletić Jotanović, S. (2020). Food security issues in the former Yugoslav countries. *Outlook on Agriculture*, XX(X): 1-9, doi: 10.1177/0030727020930039.
17. Kovljenić, M., Raletić-Jotanović, S., Netrov-Bizonj, J., Vladislavljević, R., Živkucin, S. (2021). Demographics characteristics of consumers as factors in the purchase of cereal products in the Republic of Serbia. *Economics of Agriculture*, LXVIII (2), 503-515. ISSN: 0352-3462.
18. Kulenović, Ž., & Ivanković, D. (2016). Rural revitalization strategies - the example of the Republic of Croatia and the Republic of Serbia. International scientific conference - ERAZ 2016: Knowledge based sustainable economic development, Belgrade: Association of Economists and Managers of the Balkans, 400-405.
19. Kuyvenhoven, A., Ruben, R., & Roseboom, J. (2001). *Assessing sustainable technologies in developing countries: measuring environmental, economic and social impacts*. Adoption of Technologies for Sustainable Farming Systems. Netherland: Wageningen Workshop Proceedings.
20. Lobell, D. B., Baldos, U. L. C., & Hertel, T. W. (2013). Climate adaptation as mitigation: the case of agricultural investments. *Environmental Research Letters*, 8, 1-12. doi:10.1088/1748-9326/8/1/015012.
21. Mergos, G., & Papanastassiou, M. (2017). Food Security and Sustainability: Globalisation, Investment and Financing. In G. Mergos, M. Papanastassiou (Ed.), *Food Security and Sustainability: Investment and Financing along Agro-Food Chains*, (pp. 1-34). Cham: Palgrave Macmillan.
22. OECD, (2001). Adoption of technologies for sustainable farming systems. WAGENINGEN WORKSHOP PROCEEDINGS.
23. Republic of Slovenia Statistical Office, (2020). Retrieved from: <https://www.stat.si/statweb/en> (May 22, 2020).
24. Ruiz B. F. J. (2010). Human rights, development and hunger in the world: ethical and legal proposals. In C. M. R. Casabona, L. E. S. Epifanio, A. E. Cirion(Ed.), *Global food security:ethical and legal challenges*, Wageningen: Wageningen Academic Publishers, 189-193.

25. Self, S., & Grabowski, R. (2007). Economic development and the role of agriculture technology. *Agricultural Economics*, 36, 395-404. doi: 10.1111/j.1574-0862.2007.00215.x.
26. State Statistical Office Republic of North Macedonia, (2020). Retrieved from: https://www.stat.gov.mk/Default_en.aspx (May 22, 2020).
27. Statistical Office of Montenegro—MONSTAT, (2020). Retrieved from: <https://www.monstat.org/eng/> (May 22, 2020).
28. Statistical Office of the Republic of Serbia, (2019). Retrieved from: <https://www.stat.gov.rs/> (May 22, 2020).
29. The World Bank, (2020). Retrieved from: <https://data.worldbank.org/> (May 29, 2020).
30. Tripp, R. (2005). Technology and Its Contribution to Pro-Poor Agricultural Development. London: UK Department for International Development (DFID).
31. Usman, M., Ahmed, U.I., & Javed, M. (2017). Agricultural productivity and food security: Role of public and private sector investment in research and development. *Journal of Environmental and Agricultural Sciences*, 12, 1-10.
32. Zekić, S., Gajić, M., Lovre, K., & Trkulja, Đ. (2004). Capital and agricultural development. In Gajić, M., Lovre, K. (Ed.), Subotica: Faculty of Economics Subotica, 91-102.
33. World Bank, (2008). Agriculture for Development. World development report. Washington, DC: World Bank.

DETERMINATIONS OF PROFITABILITY IN THE AGRICULTURAL SECTOR IN SERBIA

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ABSTRACT

This research paper considers performance determinants at firm and industry level from the perspective of agricultural industry since this industry is recognized as one of key drivers of Serbian national economy. Sample is consisted of 115 large and medium-sized firms as they participate around 50% in total sector turnover, during years 2017 - 2021. The Generalized Method of Moments was used to analyze how firm factors (lagged profitability, leverage, labor cost, size, liquidity, sales growth) and industry factors (market share and capital intensity) affect profitability. Research results showed that profitability is strongly positively affected by its past values and strongly negatively affected by leverage, labour costs and industry factor capital intensity. The results suggest that internal factors are key determinants of the performance of agricultural firms rather than external factors and that leverage is the most significant determinant of profitability therefore managers should pay more attention to debt policy.

Introduction

The agricultural sector is a specific sector as it highly depends on natural factors from one side and state subsidies and agricultural policies from another. Agriculture is one of the most important sectors in Serbian national economy. Production of food for domestic market reduces demand for import and benefits to national economy by developing rural areas and employment (Dašić et al, 2022).

According to the national accounts published on Statistical Office of the Republic of Serbia [hereinafter SORS] in 2022 agricultural sector in Serbia contributes with 6.3% in total Gross Domestic Product (GDP), while agricultural sector in EU contributes with 1.3% (Eurostat, 2022) in total EU GDP. This sector plays essential role in Serbian economy as total output value was 394,576 million RSD in 2021 which places the agricultural on fourth place, behind manufacture sector, trade, and real estate sector. Agriculture employs 15.2% of total employees in 2021 in Serbia and is on third place

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behind service and manufacture industries. Participation of agricultural sector in GDP and employment is decreasing (SORS, 2023) but still has a very important role in domestic economy. Agriculture dominates rural areas and secures minimum levels of food and social and economic stability (Volk et al, 2014).

Determination of factors which influence the performance of agricultural firms can be crucial for management and policy makers. There are two opposites theories on what factors are decisive for firm performance. The theory of the Industrial organization was developed in 1950s. It studies the economic process, how markets and companies are organized and what strategies are applied (Uzunidis, 2016). Structure – conduct – performance model (S-C-P) represents the school of point that industry characteristics like barriers to entry, product differentiation, industrial concentration are determinants of firm performance (Bain, 1956). This model accepts industry characteristics as decisive elements of firm performance.

Resource- advantage theory was developed during the 1990s as a reaction to industry structure theory. Firm strategic resources are not homogeneous and can create competitive advantages by using and developing superior resources (Barney, 1991). This theory focuses on firm specific, internal resources and factors. Barney (1991) suggested VRIN criteria (valuable, rare, imperfectly imitable, and not replaceable) for creating competitive advantage which can lead to high performance. The main company advantage is management's ability to combine individual technologies and skills and build competence to create opportunities (Prahalad & Hamel, 1990).

Most studies confirm the influence of both firm specific and industry factors as determinants of profitability; however, results are not consistent. The main goal of this research was to determine driving factors of profitability in Serbian large and mid-sized agriculture firms. The results were studied in relation to Theory of the Industrial organization (Bain, 1956) and Resource- advantage theory (Barney, 1991; Prahalad & Hamel, 1990) though five-year period (2017-2021).

Many papers and scholars are focused on investigating determinants of firm profitability as profitability is the ultimate measure of every firm's success. The focus of this research are internal and external determinants of financial performance of firms operating in agricultural industry since this industry is recognizes as one of key drivers of national economy (share in GDP, share in total employment, etc.).

Literature review

When analyzing factors which determine a firm's profitability, empirical studies recognize two different types of factors: internal and external (industry and macroeconomic level indicators). Some research papers are only focused on **external determinants** of firm's profitability like Callado & Soares (2014) or McGahan & Porter (1997, p29) showing that industry have impact on profitability and are more persistent over time and "...

Some papers are focused only on **internal** determinants. Mijić & Jakšić (2017) investigated internal factors that influence profitability of agricultural companies in SEE region. Lagged profitability, leverage, liquidity, and growth showed positive, and size and capitalization showed negative impact on profitability of examined companies in Hungary and Romania. Lagged profitability, growth and liquidity showed positive impact on profitability of examined companies in Serbia and Bosnia and Herzegovina. Nguyen & Nguyen (2020) showed that firm size, financial leverage, and liquidity have positive impact on ROA in study from Vietnamese listed enterprises. Kryszak et al. (2021) examined if farm size has an impact on farm profitability in EU region. In the study it is highlighted that high level of equity turnover is important and that leverage is a negative determinant in almost all group sizes. Dahmash et al. (2021) also analyzed only firm specific factors for listed companies in Jordan, showing that size and assets growth have positive and tangibility negative effect on its profitability, while leverage does not have significant effect. Martinho (2022) showed that current assets and current liabilities have positive and leverage negative impact on financial performance of farms from the former 28 EU countries.

Most papers focus on **both types of factors**. Analyzing listed companies in China from agricultural sector, Liu et al. (2021) showed that size, long term leverage and growth are positively while leverage, capital and export intensity are negatively related to profitability. Authors argued that internal factors have more significant impact on firm performance, same as Yazdanfar (2013). On the other hand, Korneta (2019) stated that although external determinants are not controllable should also be considered during the business process. Pervan et al. (2019) designed three categories to determine what influence on profitability in the manufacturing industry in Croatia. Results showed firm-specific determinants: lagged profitability and firms age have positive and labor cost negative impact, sector-specific: HHI index has negative impact and macroeconomic determinants inflation and growth of GDP have positive impact. Stierwald (2010, p2) showed that profitability is mostly determined by firm characteristics on example of large firm in Australia. And that industry effects are significant but to considerably lower extent. Blažková & Dvouletý (2018) studied food processing companies in Czech. The paper determined that both industry determinants and firm level determinants have significant influence on profitability. Market concentration (CR4) and market share (MS) have a positive impact implying that higher profitability can be achieved in a more concentrated sector. And age, leverage and short risk have negative impact as young firms can quickly react to any change in examined food processing sector (Blažková & Dvouletý, 2018, p40). Fernández et al. (2019) showed that performance of large and small Spanish firms is predominately explained by firm factors, but medium firm's performance is predominately explained with industry effects.

Materials and methods

For this research paper data were obtained from Serbian Business Registers Agency [hereinafter SBRA]. Selection of sample was based on following criteria: active

firms classified in Sector A (Agriculture, Forestry and Fishing) according to Serbian Regulation of Classification of Economic Activities (Official gazette of the Republic of Serbia, 2010) with submitted financial statements for observed period. Having in mind that there are almost 4,000 agricultural companies in Serbia, and large and medium-sized agricultural companies have market share of 52% in total sector (SBRA, 2021) large and medium companies are selected. Criteria for determine large and medium companies was based on Accounting Law in Serbia, article 6 (Official gazette of the Republic of Serbia, 2021). The final sample is consisted of 115 companies (N=115) which are observed during period 2017-2021 (T=5). The model has 575 observations, there are no missing data, so we are dealing with a strongly balanced panel.

Selection of variables

Based on data availability and literature review Liu et al. (2021), Pervan et al. (2019), Stierwald (2010), Blažková & Dvouletý (2018) Fernández et al. (2019) selected are two types of variables. Variables specific for each large and middle-sized agricultural firm in Serbia – internal and specific for the whole agricultural sector – external. The dependent variable is an indicator of performance calculated as return on total asset – ROA.

Table 1. Calculation of selected variables

Determinants of profitability - Variables		Calculation	References
Dependent variable	Profitability: Return on Asset (ROA)	Ration of firm's net profit and total asset	Blažková & Dvouletý (2017), Nguyen & Nguyen (2020), Pervan et al. (2019), Liu et al. (2021), Mijić & Jakšić (2017)
Firm specific variable	Lagged Profitability: Return on Asset (ROA1)	Lagged ROA	Yazdanfar (2013), Pervan & Mlikota (2013), Stojcic & Vojvodic (2012), Mijić & Jakšić (2017), Pervan et al. (2019)
	Debt Indicator (DR)	Ratio of firm's total long- term and short-term debt and total assets	Blažková & Dvouletý (2017), Nguyen & Nguyen (2020), Liu et al. (2021), Mijić & Jakšić (2017), Dahmash et al. (2021)
	Current ratio (Liq)	Ratio of firm's current assets and total assets	Andrašić et al (2018), Nguyen & Nguyen (2020), Pervan et al. (2019), Liu et al. (2021), Milošev (2021)
	Labor cost (Labcost)	Ratio of firm's labor costs and total sales	Williams et al. (1989) Pervan et al. (2019), Korneta (2019)
	Size (Size)	Natural logarithm of firm's assets book value	Yazdanfar (2013), Andrašić et al. (2018), Nguyen & Nguyen (2020), Pervan et al. (2019), Liu et al. (2021), Dahmash et al. (2021), Singh & Bagga (2019), Milošev (2021)

Firm specific variable	Sales growth (Salesgr)	(Current year firm's sales - previous year firm's sales) / previous year firm's sales	Andrašić et al (2018), Mijić & Jakšić (2017) Liu et al. (2021), Singh & Bagga (2019)
Industry specific variable	Market Share (CRn)	Ratio of firm's sales and total industry sales	Pervan & Mlikota (2013), Feeny & Rogers (2000), Blažková & Dvouletý (2017). Andrašić et al. (2018), Stojcic & Vojvodic (2012)
	Capital intensity (Cap)	Ratio of firm's fixed assets and total sales	Liu et al. (2021), Mijić & Jakšić (2017), Singh & Bagga (2019)

Source: Author illustration based on Pervan et al., 2019

Lagged profitability, leverage, liquidity, size, cost of labor and potential of sales growth are used as *firm specific variables*. Bearing in mind that firm performance depends on its past values, a **lagged profitability** variable is used in this model as an independent variable. It is proved that profitability from previous year has positive impact on current profitability (Mijić & Jakšić, 2017; Yazdanfar, 2013).

Debt indicator is widely used variable in research papers which are determining profitability of companies. Findings are consistent in some papers, authors (Yazdanfar, 2013; Kryszak et al., 2021; Korneta, 2019, Liu et al., 2020; Andrašić et al.; 2018, Marinho, 2022; Milošev, 2021) find negative relationship. Some papers claim (Mijić & Jakšić, 2017) that performance of agriculture companies in Romania, Hungary and Bosnia and Herzegovina is positively affected by leverage or is statistically insignificant (agricultural companies in Serbia). Nguyen & Nguyen (2020) confirmed negative impact on debt indicator to ROE and ROS, but positively to ROA indicator.

Results in many studies find that relationship between **firm size** and profitability (Liu et al., 2020; Nguyen & Nguyen, 2019; Dahmash et al., 2021), and relationship between ratio of current to total assets and profitability (Andrašić et al., 2018; Nguyen & Nguyen, 2019; Mijić & Jakšić, 2017; Marinho, 2022) is positive, however some papers show negative relationship regarding size (Andrašić et al., 2018; Stojcic & Vojvodic, 2012, Milošev, 2021).

Williams et al. (1989, p281) showed that **labor costs** in British manufacture industry determine profitability when profit is relatively small. According to Pervan et al. (2018, p.977) labor cost has significant impact on determining profitability of manufacturing companies in Croatia. Higher costs decrease profitability, so cost strategy is very important in the traditional manufacturing industry. Korneta (2019) show significant and negative influence of salaries to profitability of Polish agricultural distributors.

Sales growth potential is used to represent the size of agricultural market in Serbia and if demand is growing. Andrašić et al. (2018), Mijić & Jakšić (2017), Liu et al. (2021), Blažková & Dvouletý (2017) show that performance is positively affected by growth.

Industry specific variables market share and capital intensity are included in the model to

analyze if industry specific effects contribute to firm profitability. Relationship between industry and specific effects are complex (McGahan & Porter, 1997, p15) as they are not consistent in each industry sector. **Market share (CRn)** is one of the most relevant ratios to measure market concentration beside the Herfindahl-Hirschman Index - HHI. In this model is used CRn and not HHI as market share data for all agricultural company in Serbia were not available. Market share represents company share in relevant industry. Low value of CR represents high level of competition in particular industry (Naldi & Flamini, 2014, p5). Positive effect is confirmed in papers Pervan & Mlikota (2013), Hirsch et al. (2014), Blažková & Dvouletý (2017), and Andrašić et al. (2018). On the example of large firms in Australia Feeny & Rogers (2000) showed U-shaped relationship of profitability and market share, highlighting that profitability is declining at the beginning and rising when market share is above 30%. In agricultural companies in China (Liu et al., (2021), agro cooperatives in U.S. (Singh & Bagga, 2019) agricultural companies in Hungary and Romania (Mijić & Jakšić, 2017) profitability is negatively affected by **capital intensity**. In agricultural companies in Bosnia and Herzegovina and Serbia (Mijić & Jakšić, 2017) impact is not significant.

Estimation method

Examination of profitability determinants in the agricultural sector in Serbia is research goal and next hypothesis is defined:

H1: Firm specific variables (lagged profitability, leverage, liquidity, labor costs, size, and sales growth potential) and industry specific variables (market share and capital intensity) determine profitability of large and medium agricultural companies in Serbia.

Many relationships in the economy have dynamic aspects. It is already mentioned in this paper that financial performance of agricultural companies in Serbia depends on its past values. Therefore, dynamic element as a lagged profitability variable is used in this model:

$$ROA_{i,t} = \beta_0 + \beta_1 ROA_{i,t-1} + \beta_2 DR_{i,t} + \beta_3 Liq_{i,t} + \beta_4 Labcost_{i,t} + \beta_5 Size_{i,t} + \beta_6 Salesgr_{i,t} + \beta_7 Cap_{i,t} + \beta_8 MS_{i,t} + \sum_{n=1}^5 \beta_n dum t_n + \eta_i + \varepsilon_{i,t} \quad (1)$$

Where: ROA represents *profitability* as dependent variable, *i* stands for *number of observed agricultural companies* ($i=1, 2, \dots, 115$), *t* represents *observed period of five years*, firm specific variables are *leverage, liquidity, labor cost, growth potential and size, capital intensity and market concentration* presents industry specific variables. Dependent variable from previous years, *lagged profitability*, is included in model as independent variable to control of bias and inconsistency. To consider specific year effect *time dummies* variable is also included in the model (y^*). The *regression coefficients* of independent variables are β , ε represents a *random error*.

Results and discussion

Descriptive statistics of Serbian agricultural sector for 5-year period (2017-2021) is presented in the *Table 2*, the model had 575 observations. The agricultural sector had low profitability as an average profitability was 3.03% and most theories believe reference value should be above 10% (Mijić & Jakšić, 2017, p162). The mean ROA was partly reduced by the effect of limiting the minimum ROA value at -0.259108 and maximum ROA value at 0.218391 after adjusting the outliers in the 99th and 1st percentile. The debt ratio had a mean of 45,36% implying that agricultural companies relied on debt as a way of financing business. The average liquidity of the observed companies was 2.29, and size was 14.39. Labor cost participated in average 10,94% in total sales. Market share in average was 0.4%, with minimum values of 0.01% and maximum 0.3% showing that agricultural market in Serbia was very competitive. Variables profitability and lagged profitability were adjusted for outliers using Winsorize method in STATA. In Appendix 1 are presented values before adjustment.

Table 2. Descriptive statistics of Serbian agricultural sector

Variable	Obs	Mean	Std. Dev.	Min	Max
roa_w	575	.0303965	.058048	-.259108	.218391
roal_w	460	0.797795	.0898612	-.159218	.218391
dr	575	.4536188	.3101597	.011839	2.10453
liq	575	2.299656	3.711358	.077906	60.2663
size	575	14.39828	.9444567	12.3576	18.7377
labcost	575	.1094107	.1102613	.000214	.773606
cr	575	.0041159	.0042187	.0001034	.0302241
cap	575	1.243425	1.465071	0	9.74136
salesgr	575	.4750551	1.51065	-.98526	19.3812

Source: STATA, Authors' elaboration

To test if there was multicollinearity problem in the model the correlation among the variables was analyzed through Pearson correlation matrix (*Table 3*). Performance had low, positive, and significant correlation with its lagged variable, liquidity, and market share; low, negative, and significant correlation with leverage and capitalization and low, negative but not significant with company size and sales growth. Moderate, negative, and significant correlation was shown between performance and labor cost and moderate, positive, and significant correlation between capitalization and size, capitalization and labor cost and market share and size.

Table 3. Pearson correlation analysis of profitability and its determinants

	roa_w	roal_w	dr	liq	size	labcost	cr	cap	salesgr
roa_w	1.0000								
roal_w	0.2412* 0.0000	1.0000							
dr	-0.2455* 0.0000	0.0242 0.6040	1.0000						
liq	0.1376* 0.0009	0.0414 0.3759	-0.3598* 0.0000	1.0000					
size	-0.0736 0.0777	-0.1042* 0.0255	-0.3287* 0.0000	0.0400 0.3380	1.0000				
labcost	-0.4469* 0.000	-0.1565* 0.0008	-0.1353* 0.0011	0.0884* 0.0340	0.2142* 0.0000	1.0000			
cr	0.1179* 0.0046	0.0487 0.2969	-0.0118 0.7778	-0.0561 0.1791	0.5375* 0.0000	-0.1646* 0.0001	1.0000		
cap	-0.2992* 0.0000	-0.1411* 0.0024	-0.2627* 0.0000	0.0349 0.4041	0.4005* 0.0000	0.4954* 0.0000	-0.2092* 0.0000	1.0000	
salesgr	-0.0687 0.1001	-0.0984* 0.0349	0.1072* 0.0101	-0.087* 0.0362	0.0062 0.8818	0.0384 0.3577	-0.0545 0.1915	0.0327 0.4335	1.0000

* Statistical significance at 5% level.

Source: STATA, Authors' elaboration

Variance Inflation Factor (VIF) was used as superior test. There was no multicollinearity problem (Table 4) in the model as results are below 10.

Table 4. VIF multicollinearity test for profitability and its determinants

Variable	VIF	1 / VIF
size	2.71	0.368353
cr	2.25	0.443816
cap	2.09	0.477867
labcost	1.38	0.724535
dr	1.36	0.732730
liq	1.16	0.859089
roal_w	1.05	0.951670
salesgr	1.01	0.966651
Mean VIF	1.63	

Source: STATA, Authors' elaboration

Model was facing heteroskedasticity (BP (8, 451) = 4.81 Prob > F= 0.0000) and the endogeneity problems (DW (9,460) = 0.9348137). Generalized Method of Moments was used to work around autocorrelation within panels of groups, heteroskedasticity and endogeneity. Roodman (2009, p.102) introduced G.M.M. in Stata and suggested to use lagged dependent variable as independent i.e., to instrument variable to work around endogeneity problem. The model, internal and external determinants of profitability,

(Table 5) showed that instruments are valid. The model had 5 instruments for one endogenous variable. The null hypothesis that instruments are valid cannot be rejected as the Hansen (1982) J statistic was not significant and model was correctly specified. The second order of autocorrelation was excluded as Arellano-Bond test AR (2) was not statistically significant. In our model a time dummy variable (Sarafidis, et al., 2009) was added to prevent cross section dependence and to consider the specific year effect.

Table 5. Internal and external determinants of profitability

Dependent variable: Profitability – roa_w	Model two step system GMM		
	Coefficient	Corrected Std. Err.	P> t
roa_w	.4942642	.1362104	0.000***
dr	-.657133	.01884623	0.001**
liq	-.0000272	.0004381	0.951
labcost	-.1239455	.0503485	0.015*
size	-.002203	.00458	0.631
cap	-.0065121	.0014385	0.000***
cr	.3773895	.9423669	0.690
salesgr	.0031164	.0036197	0.391
year	.0250224	.0092353	0.008**
yr3	.0607405	.0143853	0.000***
yr4	.0399579	.0081282	0.000***
_cons	-50.48934	18.65055	0.008***
No of observations	460	F (11, 114)	30.02
No of groups	115	Prob > F	0.000
No of instruments	17	AR (2)	0.051
Year Dummies	Yes	Hansen test chi2(5) = 7.04	0.218
Obs per group	4		

Note * significance at the level of 5%, ** at the level of 1% and *** at the level of 0.1%.

Source: Authors' calculation, Software used: STATA

The gained results demonstrate that regarding firm specific factors, the previous year's performance has a significant and positive effect on performance. Labor cost and leverage have significantly and negative effect on performance of large and medium agricultural firms in Serbia. Gained results demonstrate that firms achieve higher performance if their liquidity is higher, but the relation is not statistically significant. Positive but not significant result is obtained between size and performance.

The capital intensity indicator, as industry factor, is confirmed to be determinant of performance for agricultural firms in Serbia. This variable also has a significant negative effect but with lower coefficient than firm specific factors. Capital intensity may affect performance as an entry barrier (Pervan et al., 2019, p977). Market share has a negative but not significant impact on the performance of observed companies.

Conclusions

The results suggest that internal factors are key determinants of the performance of agricultural firms rather than external factors. The results show that profitability is strongly positively affected by its past values and strongly negatively affected by leverage, labor costs and industry factor capital intensity. The empirical results suggest that leverage is the most significant determinant of profitability and that managers should pay more attention to debt policy. When level of leverage and the level of labor costs to sales are increasing profitability (measured as Return on Asset – ROA) of agricultural firms in Serbia is decreasing. Liquidity, size, growth potential, and market share do not have impact on profitability according to the results of this study.

Selected sample can be the limitation of this study. Further research might take into consideration small and micro sized firms from the agricultural sector or other sectors which have more impact on GPD – for example manufacture industry or longer time periods.

Conflict of interests

The authors declare no conflict of interest.

References

1. Andrašić, J., Mijić, K., Mirović, V., & Kalaš, B., (2018). The modeling factors of agricultural companies performances. *Custos e Agronegocio*, 14(4), 154-173. ISSN 1808-2882 (Available at: <http://www.custoseagronegocioonline.com.br/numero4v14/OK%2010%20performance.pdf> date of access 18.02.2023.)
2. Bain, J. (1956). *Barriers to New Competition: Their Character and Consequences in Manufacturing Industries*. Cambridge, MA and London, England: Harvard University Press. <https://doi.org/10.4159/harvard.9780674188037>
3. Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17(1), 99–120. <https://doi.org/10.1177/014920639101700108>
4. Blažková I. & Dvouletý, O. (2017). Drivers of ROE and ROA in the Czech Food Processing Industry in the Context of Market Concentration. *Agris on-line Papers in Economics and Informatics*, 9(3), 3-14. doi: 10.7160/aol.2017.090301
5. Blažková I. & Dvouletý, O. (2018). Sectorial and firm-level determinations of profitability: A multilevel approach. *International Journal of Entrepreneurial Knowledge*, 6(2), 32-44. doi: 10.2478/IJEK-2018-0012
6. Callado, A. L. C., & Soares, K. R. (2014). Analysis of the use of performance indicators in the context of agribusiness, *Custos e Agronegocio*, 10(2), 272-284
7. Dahmash, F., Salamat, W. A., Masadeh, W. M. & Alshurafat, H. (2021). The effect of a firm's internal factors on its profitability: Evidence from Jordan. *Investment Management and Financial Innovations*, 18(2), 130-143. doi:10.21511/imfi.18(2).2021.11

8. Dašić, D., Stanić, T., & Živković, D. (2022). Market of agricultural and food products in the Republic of Serbia: Possibilities and implications. *Economics of Agriculture*, 69(1), 57–74. <https://doi.org/10.5937/ekoPolj2201057D>.
9. Eurostat (2022). Performance of agricultural sector. Eurostat. (Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title= Performance_of_the_agricultural_sector](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Performance_of_the_agricultural_sector) date of access 10.03.2023.)
10. Feeny, S. & Rogers, M (2000). The Role of Market Share and Concentration in Firm Profitability: Implications for Competition. *Economic Analysis and Policy*, 30 (2), 115-132, [https://doi.org/10.1016/S0313-5926\(00\)50015-0](https://doi.org/10.1016/S0313-5926(00)50015-0).
11. Fernández, E., Iglesias-Antelo, S., López-López, V., Rodríguez-Rey, M., Fernandez-Jardon, C. M. (2019). Firm and industry Effects on Small, Medium-Sized and Large Firms' Performance. *BRQ Business Research Quarterly*, 22 (1), 25-35, <https://doi.org/10.1016/j.brq.2018.06.005>.
12. Hansen, L. P. (1982). Large Sample Properties of Generalized Method of Moments Estimators. *Econometrica*, 50(4), 1029–1054. <https://doi.org/10.2307/1912775>
13. Hirsch, S., Schiefer, J., Gschwandtner, A. Hartmann, M. (2014). The Determinants of Firm Profitability Differences in EU Food Processing. *Journal of Agricultural Economics*. 65(3), 703-721. <https://doi.org/10.1111/1477-9552.12061>
14. Korneta, P. (2019). Determinants of sales profitability for Polish agricultural distributors, *International Journal of Management and Economics*, Warsaw School of Economics, Collegium of World Economy, 55(1), 40-51.
15. Kryszak Ł., Guth M., Czyżewski B. (2021): Determinants of farm profitability in the EU regions. Does farm size matter? *Agricultural Economics*, 67(3),90–100. doi:10.17221/415/2020-AGRICECON
16. Liu, L., Xu, J., Shang, Y. (2020). Determining factors of financial performance of agricultural listed companies in China. *CustoseAgronegocioonline*. 16(4). ISSN 1808-2882 (Available at: https://www.researchgate.net/publication/349408981_Determining_factors_of_financial_performance_of_agricultural_listed_companies_in_China date of access 15.02.2023.)
17. Martinho, Vítor. J. P. D. (2022). Profitability and financial performance of European Union farms: An analysis at both regional and national levels, *Open Agriculture*, 7(1), 529-540. <https://doi.org/10.1515/opag-2022-0108>
18. McGahan, A. M., & M. E. Porter (1997). “How Much Does Industry Matter, Really?” Special Issue on Organizational and Competitive Influences on Strategy and Performance. *Strategic Management Journal*, 18 (1), 15–30.
19. Mijić, K. & Jakšić, D. (2017). The determinants of agricultural industry profitability: evidence from southeast Europe. *Custos e Agronegocio*, 13(1), 154-173. ISSN 1808-2882 (Available at: https://www.researchgate.net/publication/316957667_The_determinants_of_agricultural_industry_profitability_Evidence_from_southeast_Europe date of access 18.02.2023.)

20. Milošev, I. (2021). Impact of Debt Management on Profitability of Large Non-Financial Firms in Serbia. *Economic Themes*. 59(4). 461-477. DOI 10.2478/ethemes-2021-0026
21. Naldi, M. & Flamini, M. (2014), The CR4 Index and the Interval Estimation of the Herfindahl-Hirschman Index: an empirical comparison. (hal-01008144) (Available at: <https://hal.science/hal-01008144/file/NF-SSRN-2014.pdf> date of access 18.02.2023.)
22. Nguyen, T.N.L. & Nguyen, V.C. (2020). The Determinants of Profitability in Listed Enterprises: A Study from Vietnamese Stock Exchange. *Journal of Asian Finance, Economics and Business*. 7 (1), 47-58. <https://doi.org/10.13106/jafeb.2020.vol7.no1.47>
23. Official gazette of the Republic of Serbia, Classification of Activities “Official Gazette of RS”, no. 54/2010. (Available at: https://www.paragraf.rs/propisi/uredba_o_klasifikaciji_delatnosti.html date of access 15.3.2023) date of access 18.02.2023.)
24. Official gazette of the Republic of Serbia, Law on Accounting “Official Gazette of RS”, no. 73/2019 and 44/2021. (Available at: <https://www.paragraf.rs/propisi/zakon-o-racunovodstvu-2020.html> date of access 18.02.2023.)
25. Pervan, M., & Mlikota, M. (2013). What determines the profitability of companies: case of Croatian food and beverage industry. *Economic research-Ekonomska istraživanja*, 26(1), 277-286. DOI:10.1080/1331677X.2013.11517602
26. Pervan, M., Pervan, I. & Ćurak, M. (2019). Determinants of firm profitability in the Croatian manufacturing industry: evidence from dynamic panel analysis. *Economic Research-Ekonomska Istraživanja*, 32:1, 968-981, DOI: 10.1080/1331677X.2019.1583587
27. Prahalad, C.K., & Hamel, G. (1990). The Core Competence of the Corporation. *Harvard Business Review*, 68, 275-292.
28. Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata, *The Stata Journal*, 9(1), 86-136.
29. Sajwan, R. & Choudhury, S.B.R. (2018). How to test time series multicollinearity in STATA? [online] Project Guru. (Available at: <https://www.projectguru.in/time-series-multicollinearity-stata/> access 27.3.2023)
30. Sarafidis, V., Yamagata, T., & Robertson, D. (2009). A test of cross section dependence for a linear dynamic panel model with regressors. *Journal of Econometrics*, 148(2), 149 – 161, <https://doi.org/10.1016/j.jeconom.2008.10.006>.
31. Serbian Business Registers Agency, Financial Statements Annual Bulletins, Belgrade, (Available at <https://www.apr.gov.rs/registri/finansijski-izvestaji/publikacije/godisnji--bilten-finansijskih-izvestaja.2127.html> date of access 25.3.2023).
32. Singh, N. P., & Bagga, M. (2019). The Effect of Capital Structure on Profitability: An Empirical Panel Data Study. *Jindal Journal of Business Research*, 8(4), 65-77 <https://doi.org/10.1177/2278682118823312>

33. Stancic, K. (ed.) (2023). Trends Q4 2022. Statistical Office of the Republic of Serbia, ISSN1820-1148. [*in Serbian*: Stancic, K. (urednik) (2023). Trendovi IV kvartal 2022, Republički zavod za statistiku, ISSN1820-1148]. (Available at: <https://publikacije.stat.gov.rs/G2023/pdf/G20238001.pdf> access 27.3.2023)
34. Statistical Office of the Republic of Serbia (2022). National Accounts – Yearly national accounts. [*in Serbian*: Republički zavod za statistiku (2022). Nacionalni racuni - Godišnji nacionalni računi] (Available at: <https://publikacije.stat.gov.rs/G2022/HtmlL/G20221275.html> date of access 27.3.2023)
35. Statistical Office of the Republic of Serbia (2022), Economic Accounts for Agriculture, 2021. [*in Serbian*: Republički zavod za statistiku (2022). Ekonomski računi poljoprivrede, 2021] (Available at: <https://publikacije.stat.gov.rs/G2022/Pdf/G202210122.pdf> date of access 18.01.2023.)
36. Stierwald, A. (2010). Determinants of Profitability: An Analysis of Large Australian Firms. *Melbourne Institute Working Paper*, 3(10), 2-35. <http://dx.doi.org/10.2139/ssrn.1632749>
37. Stojcic, N. & Vojvodic, K. (2012). Determinants of profitability of firms in the retail sector: The case of Croatia. *MPRA Paper 109130, University Library of Munich, Germany*.
38. Uzunidis, D. (2016). Propaedeutics in the theory of the industrial organisation: the SCP (structure, conduct, performance) model. *Journal of Innovations Economics & Management* 20 (2). DOI:10.3917/jie.020.0197
39. Volk, T., Rednak, M., & Erjavec, E. (2014). Cross Country Analysis of Agriculture and Agricultural Policy of Southeastern European Countries in Comparison with the European Union. In: Volk, T., Erjavec, E., & Mortensen, K. (ed.) *Agricultural policy and European integration in Southeastern Europe*. Food and organization of the United Nations. Budapest, 2014. 9-39.
40. Williams, K., Williams, J., & Haslam, C. (1989). Do Labour costs really matter? *Work, Employment & Society*, 3(3), 281–305. <http://www.jstor.org/stable/23746499>
41. Yazdanfar, D. (2013). Profitability determinants among micro firms: Evidence from Swedish data. *International Journal of Managerial Finance*. 9(2), 151-160. <https://doi.org/10.1108/17439131311307565>

Appendix no 1. Minimum and maximum values before Winsorized adjustment of Agricultural industry in Serbia

Variable	Obs	Mean	Std. Dev.	Min	Max
roa	575	.0328676	.1077702	-.716254	1.99956
roal	460	0.0354547	.1123166	-.716254	1.99956
dr	575	.4536188	.3101597	.011839	2.10453
liq	575	2.299656	3.711358	.077906	60.2663
size	575	14.39828	.9444567	12.3576	18.7377
labcost	575	.1094107	.1102613	.000214	.773606
cr	575	.0041159	.0042187	.0001034	.0302241
cap	575	1.243425	1.465071	0	9.74136
salesgr	575	.4750551	1.51065	-.98526	19.3812

Source: STATA, Authors' elaboration

RISK EVALUATION OF LIVESTOCK COMMODITIES – VALUE-AT-RISK APPROACH

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ABSTRACT

This paper tries to assess the level of losses that investors in four livestock commodities might have. The analysis comprises live cattle, feeder cattle, lean hogs and milk class III, and for the risk calculation, we use parametric and historical VaR measures. Full sample is divided into pre-crisis and crisis subsamples. According to the results, lean hogs are the riskiest asset in the pre-crisis period, regarding both parametric and historical VaR. In the crisis period, milk is the riskiest asset in terms of parametric VaR in all probability levels. However, in terms of historical VaR, lean hogs have the highest potential of losses between 90-97% VaR, but at 99% VaR, milk takes upper hand. In the crisis period, the level of losses for lean hogs and milk exceeds 4% in one day at 99% probability, which means that these commodities should be hedged if investors want to avoid great losses. The results indicate that parametric VaR significantly deviates from historical VaR in both subsamples, which means that investors in livestock commodities should use historical VaR for downside risk measurement.

Introduction

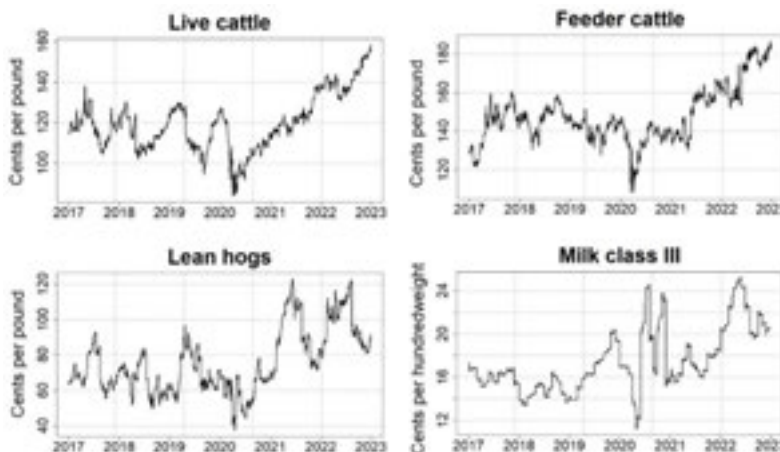
It is well known among academics and practitioners that agricultural commodities have unstable prices. This happens because various factors – natural, socioeconomic

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and geopolitical, affect agricultural commodities (see e.g. [Tuncer, 2022](#); Gong and Xu, 2022; Chen et al., 2022). Recent years were particularly turbulent for the world due to the two events. First, the world has been struck by the corona virus pandemic, while later on, the war in Ukraine broke out. These happenings had tremendous effect on the prices of all agricultural commodities, while livestock agricultural commodities were not an exception (Rawtani et al., 2022). In other words, broken supply chains and imposed counter pandemic measures exerted rising prices of all grains which transferred to the prices of livestock (Dogan et al., 2022). The war in Ukraine only intensified these effects because Ukraine is the fourth largest corn producer (Saâdaoui et al., 2022). The link between grains and livestock is direct because rising prices of grains spill over to the prices of cattle, causing a lot of risk in these markets. This poses a problem for cattle breeder or investors in livestock because unstable prices can inflict huge losses to these agents (Kuzman et al., 2021), so proper understanding of risk in these markets is of utmost importance.

According to the above, this paper tries to measure risk in four futures livestock commodities markets – live cattle, feeder cattle, lean hogs and milk class III. Figure 1 graphically illustrates the prices of these four commodities in the last six years, where the volatile nature of these prices is evident. High price volatility inevitably implies presence of high risk, and the task of this paper is to measure it accurately. According to our best knowledge, very few papers analysed livestock commodities from financial aspect, e.g. Bina et al. (2022) calculated hedge ratios of feeder cattle. However, we are not aware of any papers that have measured the risk of these agricultural commodities. This leaves room for our contribution, and this is where we find a motive for this investigation.

Figure 1. Empirical dynamics of the selected livestock commodities



Notes: One pound is 0.45 kg. One hundredweight is 50.8 kg.

Source: Authors' calculations

In the process of risk measurement, variance is the most common metric. However, this measure is biased because it gives an equal weight to positive and negative returns, while market participants are only interested in the size of losses, which is measured by downside risk (Tiwari et al., 2022). In order to overcome this issue, JP Morgan bank introduced Value-at-Risk (VaR) in 1994, and from there on, VaR became a standard measure of downside risk. VaR indicates potential losses that might occur, observing only a specific quantile at the left tail of distribution (Xu et al., 2021). In other words, VaR measures the maximum loss that an asset might endure, taking into account a specified time-frame with a certain level of probability. The most commonly used VaR in the literature is parametric VaR, which assumes certain type of distribution, and this means that accurate measure of downside risk depends on the accuracy of theoretical distribution (So and Yu, 2006). This could be a serious problem because if theoretical distribution does not recognize properly empirical distribution, risk evaluation could be very wrong. In practice, the most usually used type of VaR is parametric VaR that assumes normal distribution of an empirical time-series. However, daily commodity time-series are usually plagued with heavy tails and outliers, which is particularly true in the periods of market turmoil. This could produce inaccurate downside risk measures, which can be devastating for investors if wrong decision are made.

In this regard, besides calculating parametric VaR, we also compute historical VaR, which takes into account all prior empirical developments, i.e. all idiosyncratic features of a particular time-series (Chai and Zhou, 2018). In this vein, we can compare parametric and historical VaR, determining whether and how much parametric VaR diverge from historical VaR. These results can tell us whether parametric VaR is good and reliable measure of downside risk or not, i.e. whether it can be used for future downside risk measurement of the selected assets.

In order to be thorough in the analysis, the research is done from the two different angles. First, we intentionally observe the sample of six years, which gives us an opportunity to divide the whole sample into the pre-crisis period and crisis period, where both samples then covers three years. This is a rational step because Figure 1 clearly shows that all the commodities start to record rising prices in the early 2020, i.e. when the pandemic occurred. In this way, we can compare the results of the two subsamples and determine how much downside risk is bigger in the crisis period compared to the pre-crisis counterpart.

Another aspect of this research involves addressing different attitude toward risk which market participants might have. In other words, some investors are risk-takers and some are risk-averters. Therefore, we calculate parametric and historical VaR at different probabilities, which reflect different risk level that investors are willing to take. In this respect, we can see how the level of risk evolves when different left tail quantiles are observed.

As for the existing literature, there are papers which used VaR for risk calculation in the field of agriculture, but they are oriented towards grains. For instance, Xouridas

(2015) researched the kurtosis values of 60 agricultural commodities and presents evidence that the distributions of their returns are fat-tailed. However, he argued that usefulness of the value-at-risk and expected shortfall results as risk management tools is questionable. Morgan et al. (2012) examined three tail quantile-based risk measures – Value-at-Risk, Expected Shortfall and Spectral Risk Measures, applied to the estimation of extreme agricultural financial risk for corn and soybean production in the U.S. They compared estimated risk measures in terms of size and precision, and find that they are all considerably higher than Gaussian estimates. They concluded that estimated risk measures are quite imprecise as the risks involved become more extreme. Rehman et al. (2018) measured the five major crops market price volatility risks using the VaR model in China. They stated that the method of VaR can efficiently compute the instability of the market prices and the market risk of major crops as well. According to their computed values of various major crops market risk, they found that sizes of the different major crops market risks are different. The paper of Živkov et al. (2021) measured downside risk of six major agricultural commodities – corn, wheat, soybean, soybean meal, soybean oil and oats, using parametric and semiparametric approaches. They asserted that modified Value-at-Risk and modified Conditional Value-at-Risk give more accurate downside risk results than ordinary VaR and CVaR.

Besides introduction, the rest of the paper is structured as follows. Second section presents used methodologies. Third section introduces dataset. Fourth section is reserved for the results, regarding the pre-crisis and crisis sub-periods. The last section concludes.

Used methodologies

GARCH-NIG model

In order to calculate parametric VaR, first step involves creating residuals free of autocorrelation and heteroscedasticity. In this process, we use univariate GARCH model with innovative Normal Inverse Gaussian (NIG) distribution of Barndorff-Nielsen (1997). NIG distribution can recognize heavier tails than the normal distribution and has shape and density parameters (ν and κ). Mathematical specification of the mean and variance equations in the GARCH model are presented in equations (1) and (2), respectively.

$$y_t = C + \phi y_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim NIG(0, h_t, \nu, \kappa) \quad (1)$$

$$\sigma_t^2 = c + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (2)$$

where y_t depicts log-returns of the particular agricultural commodity. C and c represent constants in the mean and variance equations, while ϕ is an autoregressive parameter. σ_t^2 is conditional variance in period t . β captures persistence of volatility, while α gauges an ARCH effect. ε_t denotes residuals that follow NIG distribution.

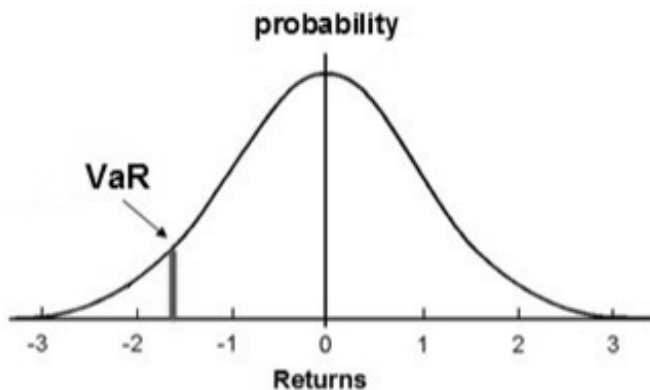
Value-at-Risk metric

This paper measures downside risk using VaR metric. Theoretically speaking, VaR calculates a loss that investor might have in a single day under certain probability. In other words, VaR observes a section or particular quantile on the left tail and does not go beyond this level. This research calculates both parametric and historical VaR, where parametric VaR assumes normal distribution, while historical VaR calculates losses of an empirical distribution. Believing that empirical distribution of the daily agricultural commodities follow Gaussian function is pretty strong assumption, and this is why deviation between parametric and historical VaR might occur. Calculating both types of VaR, we can determine how much historical VaR diverge from parametric VaR, i.e. these results can tell whether parametric VaR is good downside risk measure or not. Following Aloui and Hamida (2015), parametric VaR can be calculated by using the first two moments of normal distribution, which is as in equation (3):

$$VaR_{\alpha} = \hat{\mu} + Z_{\alpha} \hat{\sigma} \quad (3)$$

where $\hat{\mu}$ and $\hat{\sigma}$ refer to the estimated mean and standard deviation of a particular agricultural asset, respectively, and Z_{α} stands for the left quantile of normal standard distribution. Figure 2 graphically illustrates where the loss is placed on the normal distribution that VaR calculates. VaR observes only downside risk, which is the reason why VaR is on the left tail of distribution. The higher the probability, the closer the VaR is to the edge of the distribution. In other words, higher probability moves particular quantile to the end of distribution, which reflects greater losses. In order to reflect different risk propensities of investors, we calculate VaR at 90%, 93%, 95%, 97% and 99% probability.

Figure 2. Graphical illustration of the parametric Value-at-Risk



Source: Authors' calculations

Dataset

This paper uses daily near maturity futures of four agricultural commodities – live cattle, feeder cattle, lean hogs and milk class III, which are all traded on the Chicago Mercantile Exchange (CME). We investigate futures prices rather than spot prices because futures prices process new information much faster, making these prices more realistic. The sample covers six years, ranging from January 2017 to December 2022, and all the time-series are collected from the *investing.com* website. All time-series are transformed into log-returns according to the expression: $r_{i,t} = 100 \times \log(P_{i,t}/P_{i,t-1})$, where P denotes closing prices. Figure 3 shows transformed time-series, where can be seen that volatility is higher from 2020, which justifies dividing the analysis on the pre-crisis and crisis period. Table 1 contains full sample descriptive statistics of the four agricultural assets, i.e. the first four moments, Jarque-Bera coefficient of normality, Ljung-Box Q-statistics of level and squared residuals and the DF-GLS unit root test.

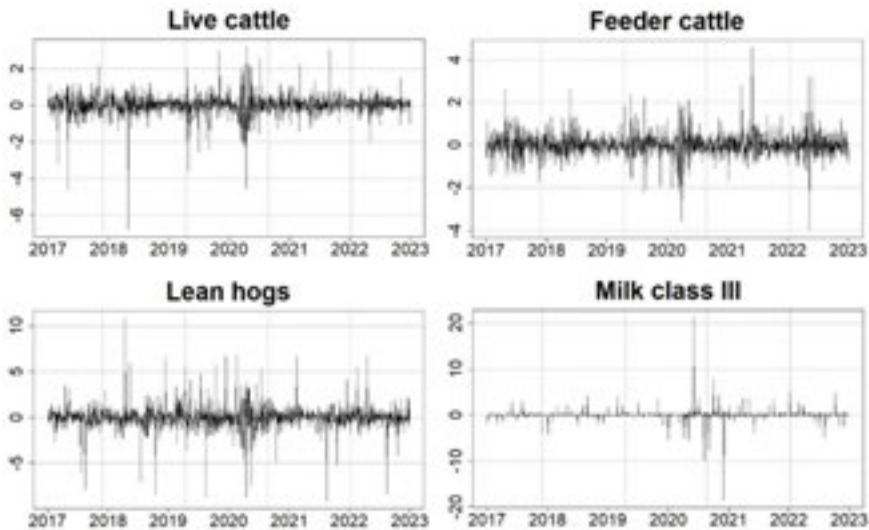
Table 1. Descriptive statistics of the selected agricultural commodities

	Mean	St. dev.	Skew.	Kurt.	JB	LB(Q)	LB(Q ²)	DF-GLS
Live cattle	0.009	0.589	-1.667	23.616	27675.0	0.000	0.000	-10.948
Feeder cattle	0.010	0.554	0.356	12.382	5602.5	0.000	0.000	-3.263
Lean hogs	0.009	1.255	-0.365	20.009	18393.7	0.009	0.000	-9.866
Milk class III	0.005	1.006	1.429	223.769	3060919.0	0.794	0.925	-38.533

Notes: JB is value of Jarque-Bera coefficients of normality, LB(Q) and LB(Q²) refer to p-values of Ljung-Box Q-statistics of level and squared residuals of 10 lags. 1% and 5% critical values for the DF-GLS test with 5 lags, assuming only constant, are -2.566 and -1.941, respectively.

Source: Authors’ calculation.

Figure 3. Log-returns of the selected agricultural commodities



Source: Authors’ calculations

According to Table 1, lean hogs have the highest standard deviation, while milk follows. This paper tries to measure risk of losses, which means that standard deviation is not an appropriate risk measure because it observes positive and negative returns equally. Risk of losses can be viewed better *via* kurtosis because kurtosis indicates presence of extreme values or outliers. However, kurtosis alone is not enough to properly measure the size of losses because it takes into account both positive and negative outliers, but it could be a good indicator. Table 1 shows that milk has by far the highest kurtosis, which is a clear sign of extreme values. In other words, milk recorded the highest daily changes in the observed period, which is clearly visible in Figure 3.

Looking at Figure 3, it could be stated that milk probably has the highest VaR in the crisis period, when VaR is measured with very high probability. This means that very edge of distribution is observed, and milk has the highest negative returns according to Figure 3. Besides, three out of four agricultural commodities have a problem with autocorrelation and heteroscedasticity according to the Ljung-Box tests, which means that GARCH model is an appropriate tool to handle these issues. All time-series are stationary according to the DF-GLS test, which is a necessary precondition for the GARCH modelling.

Table 2 contains estimated GARCH-NIG parameters, where can be seen that ARCH effect is found in the three out of four cases, while volatility persistence is present in all the time-series. Only shape distribution parameter is highly statistically significant in all the cases, which means that NIG distribution recognizes heavy tails very well. All residuals report no autocorrelation and heteroscedasticity according to the Ljung-Box tests, which means that all models are specified well. This means that estimated residuals can be used for the parametric VaR calculation.

Table 2. Estimated GARCH-NIG parameters

	Live cattle	Feeder cattle	Lean hogs	Milk class III
Panel A: GARCH parameters				
α	0.193***	0.057***	0.046	0.387***
β	0.708***	0.915***	0.938***	0.612***
Panel B: Distribution parameters				
ν – shape	0.584***	0.576***	0.158***	0.014***
k – skew	-0.077	0.055	0.049	-0.011
Panel C: Diagnostic parameters				
LB(Q)	0.150	0.183	0.255	0.996
LB(Q ²)	0.904	0.957	0.996	0.999

Notes: LB(Q) and LB(Q²) test denote p-values of Ljung-Box Q-statistics for level and squared residuals for 10 lags. *** represent statistical significance at the 1% level.

Source: Authors' calculations

Research results

Due to the fact that our sample comprises two intrinsically different periods – before the crisis and during the crisis, our intention is to see how the downside risk measures differ when these idiosyncratic periods are in focus. Therefore, the VaR results of the selected agricultural commodities are presented *via* the two subsections.

Pre-crisis period

This subsection presents the results of the calculated parametric and historical VaR in the relatively calm period, i.e. before the pandemic and the Ukrainian war. Table 3 contains the results, taking into account five different levels of probabilities, which reflect different attitude of investors towards risk. In other words, different probabilities observe different segment on the left tail of distribution, where lower probabilities are in line with investors who are willing to take risk, while higher probabilities are compatible with risk-averting investors. Figure 3 shows joint presentation of the calculated both parametric and historical VaR values.

Before addressing the results, it is important to say how the level of VaR risk is interpreted. Take, for example, the 90% parametric VaR of live cattle, which amounts -0.763. If empirical distribution follows normal function, this means that investor has 10% chance of losing 0.763% or more of his investment in a single day in the future. It can be seen in Table 3 that VaR increases as probability rise, which applies for both parametric and historical VaR. This is expected since higher probability observes VaR closer to the edge of distribution.

Table 3. Results of parametric and historical VaR in the pre-crisis period

Probability	Live cattle		Feeder cattle		Lean hogs		Milk class III	
	Parametric VaR	Historical VaR	Parametric VaR	Historical VaR	Parametric VaR	Historical VaR	Parametric VaR	Historical VaR
90%	-0.763	-0.519	-0.638	-0.545	-1.605	-1.048	-0.613	-0.180
93%	-0.880	-0.674	-0.736	-0.629	-1.849	-1.267	-0.707	-0.235
95%	-0.981	-0.788	-0.821	-0.730	-2.062	-1.539	-0.789	-0.299
97%	-1.123	-0.967	-0.940	-1.050	-2.359	-1.972	-0.903	-0.409
99%	-1.390	-1.958	-1.164	-1.437	-2.919	-2.699	-1.118	-1.947

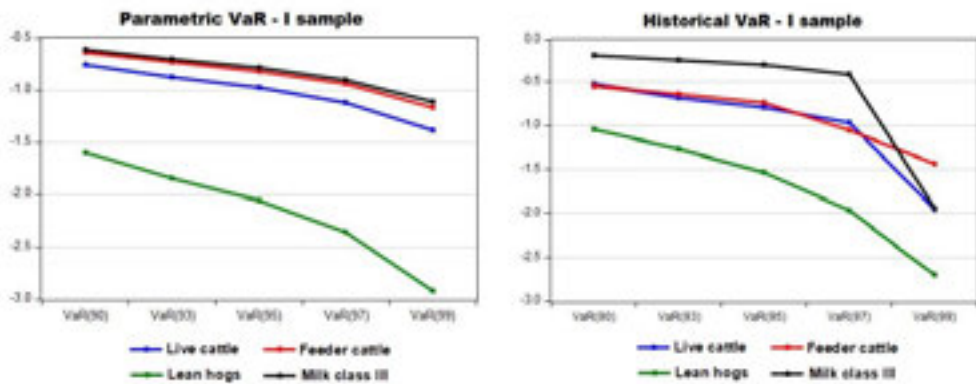
Source: Authors' calculations

Looking at Figure 4, it is interesting to note that all lines of parametric VaR are parallel, while in the case of historical VaR, some lines are intersected. All parametric VaR lines are aligned because parametric VaR is determined by the first two moments, which remain the same regardless of what probability is taken into account. On the other hand, for historical VaR this is not the case because it observes empirical VaR (empirical losses). Thus, it is very possible that historical VaR values change asynchronously at different probabilities, which is exactly what is happening in our case. In other words, up to 97% historical VaR, milk has the lowest risk, while at the 99%, historical VaR of milk significantly drops. However, at very high probability, i.e. beyond 99%, which

is not presented in Table 3, historical VaR of live cattle would probably be the highest because this asset has the biggest negative outlier in the first subsample (see Figure 3). Also, observing historical VaR, live cattle and feeder cattle frequently change the positions, and then, live cattle falls at 99%. This cannot happen with parametric VaR because for all livestock commodities the same theoretical distribution is assumed – normal distribution.

As for the relative VaR results, milk and feeder cattle have the lowest parametric VaR at all probabilities, while milk has the lowest historical VaR up to 97% according to Table 3 and Figure 4. Lean hogs are the riskiest commodity in the pre-crisis period taking into account all probabilities and both types of VaR. This means that lean hogs has the highest number of negative outliers in the pre-crisis period, which is well depicted in Figure 3.

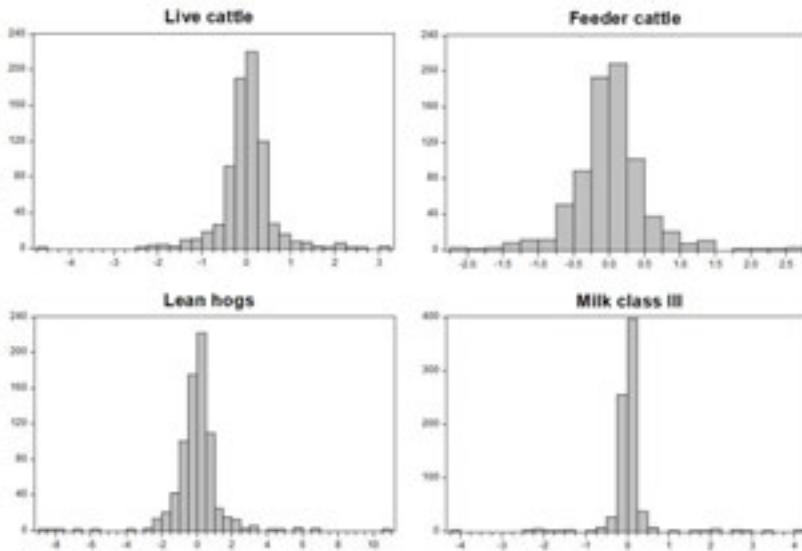
Figure 4. Parametric and historical VaR in the pre-crisis period



Source: Authors' calculations

Comparing parametric and historical VaR values, it can be seen how well parametric VaR recognizes historical VaR. According to Table 3, it is obvious that parametric VaR significantly deviates from historical VaR, which means that empirical distributions of the livestock commodities are much different than the Gaussian distribution. Figure 5 shows that all empirical distributions are leptokurtic, which means they have more kurtosis than the normal (mesokurtic) distribution. Leptokurtic distribution has higher peak and fatter tails than normal distribution, i.e. it contains more extreme values, which indicates greater tendency for outliers. This is the reason why historical VaR and parametric VaR values are so different. In other words, mesokurtic distribution has thinner tails and lower peak, and this explains why parametric VaR overestimate losses up to 97%, and underestimate losses at very high probability. This is a clear sign that parametric VaR is not a good risk measure for the livestock commodities. Our results are well in line with the papers of Xouridas (2015), Morgan et al. (2012) and Živkov et al. (2021), who all contended that classical parametric VaR is quite imprecise measure of losses.

Figure 5. Empirical distributions of the selected commodities in the pre-crisis period



Source: Authors' calculations

Crisis period

This subsection presents the results of the second subsample, which is more turbulent. In this way, we can determine how the level of risk changes in this more tumultuous period, and whether VaR positions of commodities changes. Table 4 contains calculated VaR values in the crisis subsample, while Figure 6 shows their graphical illustration. Even at the first glance, it is obvious that there are significant differences between the two subsamples.

As for parametric VaR, milk is now the riskiest commodity, while lean hogs follow. Live cattle and feeder cattle have much smaller parametric VaR at all probability levels than milk and lean hogs. However, at historical VaR, situation changes significantly. Milk is the least risky asset up to 97% probability, but it has steep fall at 99% probability. Lean hogs also record serious drop at 99% probability. These two commodities have the biggest outliers in the crisis subsample, and this explains sudden tumble at 99% probability. At probability higher than 99%, milk would probably have the highest historical VaR because it has by far the biggest outliers, which goes over -10 (see Figure 3).

Comparing the results of the two subsamples, it is clear that second subsample is much riskier, which justifies splitting full sample into the two subsamples. Also, this indicates that the pandemic and the Ukrainian war affected significantly livestock commodities, where milk and lean hogs have the highest historical VaR at 99% probability. In other words, historical VaR at 99% of lean hogs and milk is -4.297 and -4.365, respectively, which means that there is 1% chance that loss in a single day of these two commodities

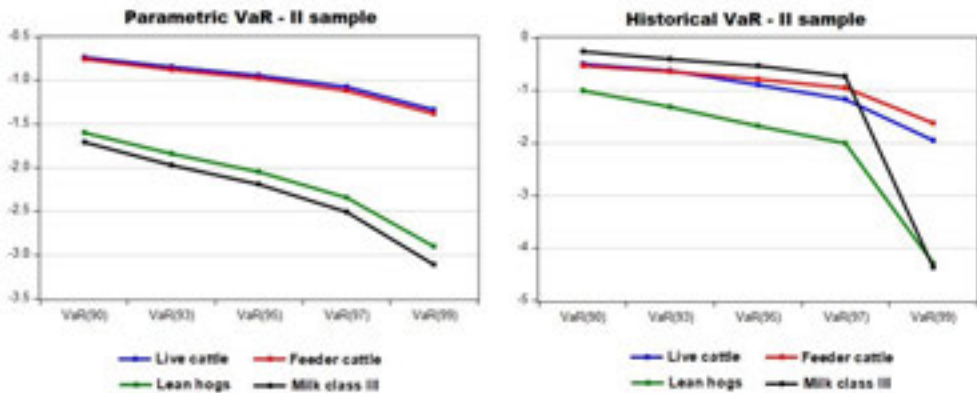
could be 4.297% and 4.365%, which is pretty high. Although the probability is relatively small, it could happen, so investors in milk and lean hogs should hedge their investments in order to evade great losses.

Table 4. Results of parametric and historical VaR in the crisis period

Probability	Live cattle		Feeder cattle		Lean hogs		Milk class III	
	Parametric VaR	Historical VaR	Parametric VaR	Historical VaR	Parametric VaR	Historical VaR	Parametric VaR	Historical VaR
90%	-0.730	-0.493	-0.757	-0.543	-1.595	-1.012	-1.709	-0.258
93%	-0.842	-0.628	-0.874	-0.645	-1.838	-1.311	-1.969	-0.403
95%	-0.940	-0.896	-0.975	-0.792	-2.050	-1.687	-2.195	-0.539
97%	-1.077	-1.172	-1.117	-0.963	-2.346	-2.006	-2.510	-0.745
99%	-1.335	-1.960	-1.385	-1.633	-2.904	-4.297	-3.106	-4.365

Source: Authors' calculations

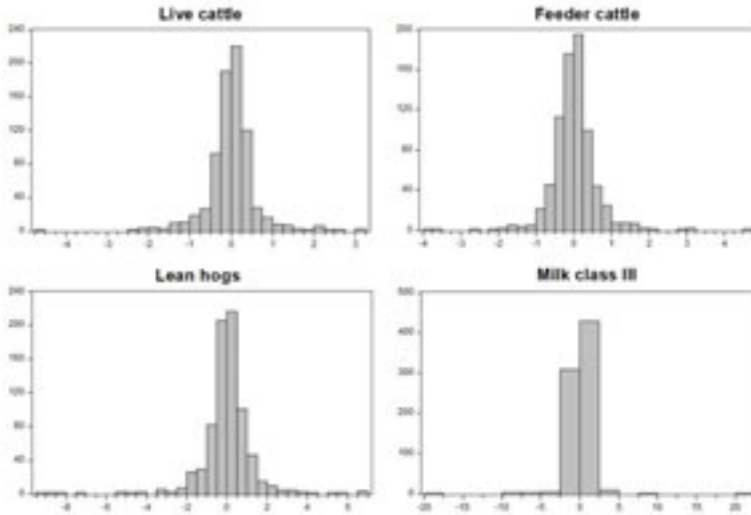
Figure 6. Parametric and historical VaR in the crisis period



Source: Authors' calculations

Similar to the first subsample, it is obvious that empirical distributions do not match normal distribution in the second subsample (see Figure 7). In other words, they are all leptokurtic, with very pronounced fat tails. Therefore, based on the results of both subsamples, investors who want to assess the level of potential losses should utilize historical VaR rather than parametric VaR because all empirical distributions significantly deviate from normal distribution.

Figure 7. Empirical distributions of the selected commodities in the crisis period



Source: Authors' calculations

Conclusion

This paper measures risk of losses of the four livestock commodities – live cattle, feeder cattle, lean hogs and milk class III. For the risk calculation, we use parametric and historical VaR measures. The analysis divides full sample into the two subsamples in order to see how the level of risk varies when the two diametrically different periods are observed.

Based on the results, we have several noteworthy findings to report. First, risk of losses is significantly higher in the crisis subsample, which justifies dividing the full sample into the two subsamples. Second, livestock commodities bear different level of downside risk, where lean hogs are the riskiest asset in the pre-crisis period, taking into account both parametric and historical VaR measures. On the other hand, in the crisis period, milk is the riskiest asset in terms of parametric VaR, regarding all probability levels. However, in terms of historical VaR, lean hogs have the highest potential of losses between 90-97% VaR, but at 99% VaR milk takes upper hand. In the crisis period, the level of losses for lean hogs and milk exceed 4% in one day at 99% probability, which means that these commodities should be hedged if investors want to avoid great losses.

An important finding is the fact that parametric VaR significantly deviates from historical VaR in both subsamples, which means that all empirical distributions are very different compared to normal distributions. In other words, all empirical distributions have leptokurtic shape, which is characterized by heavy tails and high peak, and this is the reason why parametric VaR overestimate risk up to 97% and underestimate risk at 99% probability. This means that parametric VaR is not a good risk measure for livestock commodities because it can lead investors to wrong conclusions.

This paper can help livestock farmers and investors to understand which livestock commodity is the riskiest, and what is the best way to measure risk of potential losses. In this regard, investors would know is there any need to hedge their investments in livestock or not.

Conflict of interests

The authors declare no conflict of interest.

References

1. Aloui, C., Hamida, H.B. (2015). Estimation and performance assessment of Value-at-Risk and expected shortfall based on long-memory GARCH-class models. *Finance a úvěr-Czech Journal of Economics and Finance*, 65(1), 30-54.
2. Barndorff-Nielsen, O. E. (1997). Normal inverse Gaussian distributions and stochastic volatility modelling. *Scandinavian Journal of Statistics*, 24(1), 1–13. DOI: [10.1111/1467-9469.00045](https://doi.org/10.1111/1467-9469.00045)
3. Bina, J.D., Schroeder, T.C., Tonsor, G.T. (2022). Conditional feeder cattle hedge ratios: Cross hedging with fluctuating corn prices. *Journal of Commodity Markets*, 26, 100193. DOI: 10.1016/j.jcomm.2021.100193
4. Chai, S., Zhou, P. (2018). The Minimum-CVaR strategy with semi-parametric estimation in carbon market hedging problems. *Energy Economics*, 76, 64–75. DOI: 10.1016/j.eneco.2018.09.024
5. Chen, J., Xu, L., Xu, H. (2022). The impact of COVID-19 on commodity options market: Evidence from China. *Economic Modelling*, 116, 105998. DOI: [10.1016/j.econmod.2022.105998](https://doi.org/10.1016/j.econmod.2022.105998)
6. Dogan, E., Majeed, M.T., Luni, T. (2022). Analyzing the nexus of COVID-19 and natural resources and commodities: Evidence from time-varying causality. *Resources Policy*, 77, 102694. DOI: [10.1016/j.resourpol.2022.102694](https://doi.org/10.1016/j.resourpol.2022.102694)
7. Gong, X., Xu, J. (2022). Geopolitical risk and dynamic connectedness between commodity markets. *Energy Economics*, 110, 106028. DOI: [10.1016/j.eneco.2022.106028](https://doi.org/10.1016/j.eneco.2022.106028)
8. Kuzman, B., Petković, B., Petković, D. (2021). Evaluation of optimal economic and technical indicators for agriculture stock trading decision. *International Journal of Economic Practice and Policy*, 18(2), 124-140. DOI: 10.5937/skolbiz2-34986
9. Morgan, W., Cotter, J., Dowd, K. (2012). Extreme Measures of Agricultural Financial Risk. *Journal of Agricultural Economics*, 63, 65–82. DOI: [10.1111/j.1477-9552.2011.00322.x](https://doi.org/10.1111/j.1477-9552.2011.00322.x)
10. Rawtani, D., Gupta, G., Khatri, N., Rao, P.K., Hussain, C.M. (2022). Environmental damages due to war in Ukraine: A perspective. *Science of the Total Environment*, 850, 157932. DOI: 10.1016/j.scitotenv.2022.157932

11. Rehman, A., Jian, W., Khan, N., Saqib, R. (2018). Major crops market risk based on Value at Risk model in P.R. China. *Sarhad Journal of Agriculture*, 34, 435-442. DOI: [10.17582/journal.sja/2018/34.2.435.442](https://doi.org/10.17582/journal.sja/2018/34.2.435.442)
12. Saâdaoui, F., Jabeur, S.B., Goodell, J.W. (2022): Causality of geopolitical risk on food prices: Considering the Russo–Ukrainian conflict. *Finance Research Letters*, 49, 103103. DOI: [10.1016/j.frl.2022.103103](https://doi.org/10.1016/j.frl.2022.103103)
13. So, M.K.P., Yu, P.L.H. (2006). Empirical analysis of GARCH models in value at risk estimation. *International Financial Markets, Institution and Money*, 16, 180–197. DOI: [10.1016/j.intfin.2005.02.001](https://doi.org/10.1016/j.intfin.2005.02.001)
14. Tiwari, A.K., Abakah, E.J.A., Adewuyi, A.O., Lee, C-C. (2022). Quantile risk spillovers between energy and agricultural commodity markets: Evidence from pre and during COVID-19 outbreak. *Energy Economics*, 113, 106235. DOI: [10.1016/j.eneco.2022.106235](https://doi.org/10.1016/j.eneco.2022.106235)
15. [Tuncer](#), G. (2022). The relationship between agricultural raw materials and oil price: An empirical analysis. *Ekonomika poljoprivrede*, 69(4), 975-989. DOI: [10.5937/ekoPolj2204975G](https://doi.org/10.5937/ekoPolj2204975G)
16. Xouridas, S. (2015). Agricultural Financial Risks Resulting from Extreme Events. *Journal of Agricultural Economics*, 66, 192–220. DOI: [10.1111/1477-9552.12083](https://doi.org/10.1111/1477-9552.12083)
17. Xu, Q., Jin, B., Cuixia Jiang, C. (2021). Measuring systemic risk of the Chinese banking industry: A wavelet-based quantile regression approach. *North American Journal of Economics and Finance*, 55, 101354. DOI: [10.1016/j.najef.2020.101354](https://doi.org/10.1016/j.najef.2020.101354)
18. Živkov, D. Joksimović, M., Balaban, S. (2021). Measuring parametric and semiparametric downside risk of selected agricultural commodities. *Agricultural Economics – Zemedelska Ekonomika*, 67(8), 305-315. DOI: [10.17221/148/2021-AGRICECON](https://doi.org/10.17221/148/2021-AGRICECON)

MANAGING THE PRODUCTION PROCESSES - OPTIMIZATION OF THE TECHNOLOGICAL PROCESS OF BANANA RIPENING BY APPLYING THE SIMPLE ADDITIVE WEIGHTING METHOD

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ABSTRACT

The realization of company goals is greatly influenced by the manager's decisions in the activities of managing production processes. To make decisions, managers use different decision-making methods, taking into account different criteria on the basis of which they choose the best alternative. The paper presents the optimization of the technological process of banana ripening using the simple additive weighting (SAW) method. The research monitored temperature correction, ripening gas dosage concentration, duration of treatment, commodity loss, including correction of accompanying factors of green banana fruit ripening. By applying the SAW method on 400 performed ripenings in the period from 2017 to 2020, the best results were achieved at a temperature of 18.5 °C, with an ethylene concentration of 840 ppm, process time of 112 h and achieved kalo of 233 kg. The total cost of ripening based on the examined parameters is 250.12 € which can save 81.42 € and meet the finishing standards.

Introduction

The management in the company strives for the realization business with minimal consumption of resources and achieving the highest possible quality of products and services with maximum profit. Due to the above mentioned, managers are faced with a large number of challenges (risks, uncertainties) and decisions that need to be implemented in order to achieve the best possible business results.

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Better efficiency and effectiveness in business provide the company with greater competitiveness in the market, and this is achieved by a continuous effort to match costs in reproduction and minimize investment of resources, thus obtaining maximum results. However, due to the complexity of production, including the effect of external and internal factors, there are often deviations in reproduction that incur additional costs.

In order to achieve efficiency and maximize profits in the company, costs need to be managed in all segments during the business engagement. The costs first need to be located and formulated and appropriate analyzes should be conducted in order to have them adequately planned and implemented. Production costs are influenced by a large number of factors (purchase price of means, costs of production elements, transport costs, etc.). The greatest significance and deviations in this segment are caused by the costs of means and reproduction itself, consumption of elements (materials) of production that enter the process of creating certain goods, costs of realization and services, labor costs (Coase, 2005; Stanciu et al., 2019; Stoica et al., 2022).

In order to meet the needs of the increasingly demanding global market, the agri-food industry is forced to constantly find new solutions during the production of healthy food. The technology of ripening fruits and vegetables is gaining more and more importance in modern society. The importance of this technology is reflected in the fact that the semi-finished product is provided with longer shelf life, better transport conditions, facilitates storage, provides adequate processing conditions, provides better quality, ensures the market with continuous supply, provides greater satisfaction of users, reduces business costs, etc. (Socoliuc et al., 2018; Maksimović, 2018).

Banana is a climacteric fruit that is harvested green, where after receiving it in the country of the importer, it is subjected to thermal treatment in special chambers intended for ripening. The treatment of ripening of fruits and vegetables, and thus the economy and final quality of the product, depend on a large number of factors that influence the process, as well as on the decisions for the selection of adequate parameters. External factors that affect the quality of the fruit before, during ripening, and after (in distribution and sale) are: health of the semi-finished product, transport and storage conditions, country of origin, application of agro-technical measures during cultivation, physiological and physical changes in fruit, etc. Apart from external ones, the ripening process is also affected by internal factors that are far more important, such as: ripening temperature, dosing concentration of ripening gas (ethylene), time it takes fruit to ripen, storage conditions, human factor, etc. All factors, both external and internal, are interconnected and the outcome and the course of the process, distribution and sale of bananas depend on their correlation (Dadzie & Orchard, 1997; Dumitrașcu et al., 2013; Chivu et al., 2020).

Today, there is yet no fully standardized, i.e. defined process of ripening green fruit - it depends on the factors that affect the ripening as well as the decisions of the manager. Therefore, on the basis of certain rules and processes from the previous period of work (observation, planning, data collection, etc.), including experience, innovation,

training, etc. managers analyze a large number of options, in order to select the most acceptable alternative for achieving business success. The most important issues and decisions faced by managers in the technological process of ripening are reduced to:

- 1) What is the ideal temperature for thermal treatment of fruit?
- 2) What is the optimal concentration or dosing time of ripening gas?
- 3) How much time (or working hours) is needed for successful ripening?
- 4) How to realize minimal investment of resources and minimal costs in business, achieve minimal commodity losses?
- 5) How to produce the best quality that will meet the requirements of consumers and provide maximum profit to the company?

Due to the great importance of ripening technology in the world, as well as the need for continuous improvement and modernization of processes, particularly in Serbia, the research has been conducted in the Logistics Distribution Center (Nis). The paper studies the factors (temperature, ethylene, time, kalo, electricity consumption) that most affect the ripening process and production costs. By analyzing 400 ripenings, 4 treatments are defined, where the application of the Simple Additive Weighting (SAW) method leads to a compromise solution and determination of the most acceptable alternative. The objective of this paper is to select the best parameters for ripening of bananas to achieve greater efficiency in business and improve technology, i.e., produce better product quality at lower costs.

Materials and methods

Ripening gas supplied by “MESSER” (Tehnogas, Belgrade) was used to start the process of ripening banana fruit. Ripening gas is a mixture containing 95% nitrogen (N) and 5% ethylene (C₂H₄). The flow of gas into the ripening system is carried out under pressure of 3 bar. The concentration of ripening gas in the decompression rooms for ripening is from 8 to 12 l / m³. During one minute of dosing of ripening gas in the ripening chamber, about 0.714 l/min of gas is consumed for this type of ripening plant. The price of a 50 l bottle of ripening gas during the research averaged 48.58 € (Euro). For one hour of operation of the decompression room, including heating and cooling, i.e. operation of fans, heaters, compressors, etc., about 8.33 kWh is consumed, which is an average of 200 kWh in one day (24 h). For the ripening of the green banana fruit, the time average of the process is about five days and about 1.000 kWh of electricity is consumed for that period. The average price of commercial electricity for the observed period for small and medium enterprises is 55.84€, i.e. 0.06 € per kWh, to which excise and VAT as well as other benefits that depend on the company should be added.

The “ebro” TLC 720 thermometer (Germany) was used to measure the temperature at the reception. The Bizerba BS 800 CE scale and the Bizerba ST scale (Germany) were used to measure the weight of the fruit. The quality of the fruit was controlled

by organoleptic methods and the mentioned instruments by the technologist at the reception. The process of ripening banana fruit is controlled via a central computer and an appropriate software program developed for this type of activity. The temperature of the fruit in the chambers is monitored through a puncture probe manufactured by "Elektrika-Hladilnistvo-Ogrevanje" DOO (Lasko, Brezno). The degree of fruit ripeness was determined by a ripeness degree scale of from 1 to 7: 1) dark green shade; 2) light green shade; 3) more green than yellow shade; 4) more yellow than green shade; 5) yellow color with green tips; 6) completely yellow shade; 7) completely yellow shade with brown spots (Kader, 1992).

The influence of factors was examined on the Cavendish banana fruit imported from different countries (Ecuador, Costa Rica, Colombia, Panama, Honduras etc.) and different brands (Derby, Slobana, Chiquita, Sentiliver, Pamela, Amigo, Bonanza, Consul etc.). The purchase price of green bananas for the mentioned period is 0.75€.

Ripening was carried out in a ripening plant with a total capacity of 245.000 kg, which consists of six hermetic ripening chambers and one warehouse for storing green bananas. The capacity of the decompression room for ripening is 20.000kg, which is the value of the goods of about 15.000€ (calculated at purchase price). Ripening plant belongs to the company "MERCATOR S" (Serbia) and is located in the Logistics Distribution Center (Nis).

Depending on the quality of the fruit and the need for processing for market launch, process managers (technologists) set the appropriate ripening parameters with higher or lower values on the central computer: the temperature that the fruit should reach ranging from 17°C to 20°C; ripening gas dosing concentration ranging from 20 to 40 minutes; air circulation, i.e. ventilation of the chambers every three to six hours from 20 to 45 minutes; ventilation blockage from 12 to 24h when the chamber is under gas. Depending on the needs of ripening, they correct the temperature, gas concentration, ripening time, etc. When the fruit reaches the predicted degree of ripeness, the banana is cooled to an initial temperature of 13°C and stored until further distribution.

In the first part of the paper, an analysis of 400 ripenings having been conducted during the practical work in the ripening chambers in Nis in the period from 2017 to 2020 was performed. Statistical processing separated 4 treatments with average values of all ripenings that had the most frequent application in the company's operation. The criteria by which the treatments are grouped are the parameters used by the technologists during ripening in the South of Serbia. Their choice and decision for ripening parameters (fruit ripening temperature, ethylene concentration, air circulation, etc.) were influenced by internal and external factors such as: fruit quality at reception and during storage, weather conditions, seasons, transport, sales and distribution projection, market influence and price, conditions in the storage and in the ripening chambers, etc. The greatest emphasis in the analysis is on the fruit loss, i.e. loss (commodity weight loss before and after ripening) caused by fruit weight reduction due to biochemical and physiological changes that take place in the fruit during the ripening process of climacteric fruit.

The second part presents the application of the Multiple-criteria decision-making (MCDM) to optimize the technological process. Multi-criteria analysis is often used for modern decision-making in the agri-food industry (Srđević, 2003; Talukder et al., 2017; Gésan-Guiziou et al., 2020; Veselinović et al., 2022; Namiotko et al., 2022). These methods are often used to manage risk in the agricultural supply chain (Yazdani et al., 2021; Septiani et al., 2016), for the water resources management in agriculture (Radmehr et al., 2022), selection of agricultural machinery (Blagojević et al., 2012), development of rural tourism (Nedeljković et al., 2022), ecotourism and sustainable tourism (Garabinović et al., 2021), for evaluating the efficiency of agricultural enterprises (Lukić et al., 2021) as well as for assessing the agriculture sustainability (Cicciù et al., 2022; Issa et al., 2022; Talukder et al., 2018; Pantić et al., 2022; Talukder et al., 2017).

The basic stages of the multicriteria method are: determination of appropriate criteria and alternatives, evolution of alternatives, determination of numerical value (weight) for each criterion, use of cumulative functions for determining rank (Pomerol & Barba-Romero, 2000).

The SAW (Simple Additive Weighting) method was used in the paper. From the offered four alternative solutions from the analysis of 400 carried out ripening, the best parameters for green fruit ripening were determined, which have the greatest importance for optimizing the ripening technological process, reducing costs and obtaining fruit of satisfactory quality using the SAW method.

The SAW method is characterized by its simplicity and because of that it is often used for multi-criteria decision making on attributes (Jain, 2013). Another reason for using this method is that it usually gives similar results as the more advanced methods (Blagojević i sar. 2012). The basic logic of the SAW method is to obtain a weighted sum for evaluating the desirability of each alternative within all attributes (Adriendi, 2015). The SAW method consists of the following stages (Triantaphyllou & Lin, 1996):

- Formation of the decision-making matrix;
- Normalization of the decision matrix;
- Multiplication of the normalized matrix by weighted coefficients;
- Addition of “difficult” parameters for each alternative i
- Determining the best alternative.

The decision matrix (1) has almost the same form for all methods of multicriteria decision making, with data ranking and comparative evaluation ($m \times n$) of the set m alternative / type A_i ($i = 1, 2, \dots, m$) and the set n criteria / columns (attributes) C_j ($j = 1, 2, \dots, n$) (Zavadskas et al., 2008) where x_{ij} represents the performance of the i alternative in relation to the j criterion / attribute, m represents the number of alternatives and n represents the number of criteria / attributes.

$$D = \begin{matrix} A_1 \\ A_2 \\ \vdots \\ A_m \end{matrix} \begin{bmatrix} C_1 & C_2 & \dots & C_n \\ x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad (1)$$

The decision maker should assign an appropriate weight or weighted coefficient to each criterion, where the following condition must be met:

$$\sum_{j=1}^n w_j = 1 \quad (2)$$

The normalization of alternatives in relation to all criteria is done on the basis of the formulas given below, namely: for the maximized criteria (benefit attribute), the following formula is used:

$$r_{ij} = \frac{x_j}{x_j^{\max}} \Big|_{j \in J^{\max}}, \quad i = 1, \dots, m. \quad (3)$$

While minimized (cost attributes) value is defined by applying the formula:

$$r_{ij} = \frac{x_j^{\min}}{x_j} \Big|_{j \in J^{\min}}, \quad i = 1, \dots, m. \quad (4)$$

The second step of the SAW method refers to the formation of weight normalization of the decision matrix $V = [v_{ij}]_{m \times n}$, where the value v_{ij} is expressed by the formula:

$$v_{ij} = w_j \cdot r_{ij}, \quad i = 1, \dots, m; j = 1, \dots, n \quad (5)$$

The third step of the SAW method is to determine the overall performance index of each alternative. The resulting / aggregate / cumulative indices denoting the total performance indices S_i are calculated according to the following formula:

$$S_i = \sum_{j=1}^n v_{ij}, \quad i = 1, \dots, m \quad (6)$$

The last fourth step is choosing the best (ranked) alternative. Alternatives are ranked in ascending order based on S_i values. The best ranked alternative is the one where S_i has the highest value and it expressed by the formula:

$$A^* \in \left\{ A_i^* \mid \max_i S_i \right\} \quad (7)$$

Results and discussion

Temperature is one of the most important factors influencing fruit ripening. Most banana varieties require a temperature of 14.4 to 18°C for commercial ripening (Robinson, 1996; Turner, 1997). Whitehead (2012) states that in order for a green banana to ripen (depending on the quality and condition in which the fruit is currently in), a temperature of 15 to 20°C is required, and a relative humidity of 90-95%, while the CO₂ level must not be higher than 1% to avoid ethylene suppression.

The statistical processing of the parameters of 400 carried out ripening in the Logistics Distribution Center Niš for the period 2017 to 2020 yielded the average values shown in table 1.

Table 1. Average values of 400 carried out ripening for the period 2017. to 2020.

Temperature (°C)	Ethylene (ppm)	Gas dosing time per minute	Fruit ripening time (h)	Commodity loss (kg)
18,43	825,3	27,51	117,2	276,84

Source: Author's calculations

Research carried out in the warehouse for storing and ripening green bananas at the company "IDEA" in Nis, showed that at a temperature of 20°C the fruits reached consumption maturity in 98.9 hours, while at a lower temperature of 18°C it took about ten more hours (110.5h) (Stojanović, 2015). Therefore, the higher the temperature, the faster the process and the shorter the ripening time Whitehead (2012). Depending on the influence and correction of ripening factors (average temperature, ethylene, fruit condition, etc.), the process of ripening banana fruit can take less than four days at a temperature of 18°C, and can be extended to 8 to 10 days at a temperature of 14°C (Robinson, 1996; Turner, 1997). Similar observations were made in this study.

According to Stojanovic (2015), fruits of the Cavendish variety that were exposed to a higher concentration of ethylene (1200 ppm) reached consuming ripeness ten hours earlier compared to treatment with a lower amount of ethylene (1140 ppm). Ethylene is a plant hormone that initiates and accelerates ripening, stimulates the development of color and taste of the fruit (Adkins et al., 2005). With the increase in the amount of ethylene, all processes within the banana fruit take place much faster (Siriboon Banlusilp, 2004; Kathirvelan & Vijayaraghavan, 2020). Low ethylene concentration of 10 to 50 µL L⁻¹ is sufficient for fruit ripening (Thompson & Seymour, 1982). Ethylene concentration of 1000 µL L⁻¹ and fruit exposure to ethylene from 24 to 48 h are used for commercial ripening (Robinson, 1996; Thompson & Burden, 1995; Paulo et al., 2022). According to Whitehead (2012), ripening of banana fruit can be carried out at an ethylene concentration of 100-150 mL L⁻¹.

Although Whitehead (2012) pointed out that an ethylene concentration of 100-150 mL L⁻¹ is used for ripening, this concentration was not achieved in these areas. But savings have been made compared to the commercial 1000 mL L⁻¹ discussed by other authors

(Robinson, 1996; Thompson & Burden, 1995). The reason for the deviation from Whitehead (2012) may be the consequence of insufficiently developed technology in this area, poor airtightness of the chambers, insufficient education of technologists about the process of fruit ripening, etc.

The increase in commodity loss or weight loss is mostly influenced by longer exposure of the fruit to the ripening process, higher ripening temperature and higher concentration of ethylene, which was concluded by different authors (Mariott, 1980; Evans et al., 2020; Al-Dairi et al. 2023). However, these factors do not always have to be combined to act on the loss. As it can be seen from the paper, commodity loss increases with decreasing temperature, decreasing ethylene concentration but increasing ripening time. At a higher temperature and a higher concentration of ethylene, there may also be a reduction in the ripening time, and the commodity loss may increase, which is a consequence of the action of other by-factors. By-factors may be the ones discussed by the different studies (Thompson et al., 2019; Al-Dairi et al., 2023; FAO, 1989), i.e. the loss of water from the fruit and therefore the loss of weight occurs under the influence of temperature, relative humidity, poor air circulation, physiological, pathological and physical changes.

In this research, conducted in the Logistics Distribution Center Niš, the most used parameters for ripening, i.e. the parameters that gave the best results, are presented in table 2. The parameters were chosen based on the conditions and suitability of the fruit for ripening, i.e. the following were included in the creation: the current state of the fruit (quality), the storage time of the green fruit in the warehouse, the season and weather conditions when the fruit is ripe, the needs of the market, the storage conditions of the ripe fruit and distribution, sales, etc. Considering that the best results in terms of fruit quality and costs were achieved in this way in the given conditions, these parameters will be further used as alternatives in the process of deciding on the optimization of the banana ripening process.

Table 2. Four best alternative solutions (out of 400 conducted ripenings)

Temperature (°C)	Ethylene (ppm)	Gas dosing time per minute	Fruit ripening time (h)	Commodity loss (kg)	Total cost (€)
17,5	1020	34	123	264	283,02
18	960	32	117	222	247,14
18,5	840	28	112	233	250,12
19	810	26	105	245	254,24

Source: Author's calculations

The selection of the best alternative was made using the SAW multi-criteria decision-making method. The parameters from Table 2 were used in the further course to determine the most important set of criteria and evaluation of the alternative. The selection of attributes (influence of *temperature*, *ethylene* concentration, *duration* of the process, and their influence on *commodity* loss and fruit *quality*) was carried out and a quantitative decision matrix was formed (Table 3).

Table 3. Quantified matrix

Name	Temperature	Ethylene	Time	Loss	Total cost	Quality
UoM	°C	ppm	h	kg	€ (Evro)	High-low
Weight	0,09	0,09	0,09	0,21	0,21	0,31
Optimization	min	min	min	min	min	max
	C1	C2	C3	C4	C5	C6
Alternative						
A ₁	17,5	1020	123	264	283,02	Very low (1)
A ₂	18	960	117	222	247,14	Medium (5)
A ₃	18,5	840	112	233	250,12	High (7)
A ₄	19	810	105	245	254,24	Low (3)

Source: Authors' calculations based on data obtained from the decision makers

Legend: °C-temperature in Celsius; ppm-part of a million ($\mu\text{L L}^{-1}$); h-hour; kg-kilogram; min.-minimum; max-maximum; UoM – Unit of measurement.

It should be noted that in this case, a subjective approach was used to determine the weights of the criteria based on the information received from the decision maker, i.e. from the experts (technologists) in charge of the banana fruit ripening process, where the necessary condition is met:

$$\sum_{j=1}^n w_j = 1 \quad (3)$$

$$\sum_{j=1}^n w_j = 0.09 + 0.09 + 0.09 + 0.21 + 0.21 + 0.31 = 1.0$$

Based on the data from Table 2, and the importance of criteria, the following decision matrix is obtained:

$$D = \begin{matrix} & \begin{matrix} 0.09 & 0.09 & 0.09 & 0.21 & 0.21 & 0.31 \\ \text{min} & \text{min} & \text{min} & \text{min} & \text{min} & \text{max} \end{matrix} \\ \begin{matrix} A_1 \\ A_2 \\ A_3 \\ A_4 \end{matrix} & \begin{bmatrix} 17.5 & 1020 & 123 & 264 & 283.02 & 1 \\ 18 & 960 & 117 & 222 & 247.14 & 5 \\ 18.5 & 840 & 112 & 233 & 250.12 & 7 \\ 19 & 810 & 105 & 245 & 254.24 & 3 \end{bmatrix} \end{matrix}$$

By calculating, the best alternative is obtained, that is, the one with the maximum value of S_i , which in this case is the alternative A_3 .

$$S = \begin{matrix} A_1 \\ A_2 \\ A_3 \\ A_4 \end{matrix} \begin{bmatrix} 0.539 \\ 0.895 \\ 0.902 \\ 0.685 \end{bmatrix} \begin{matrix} 4 \\ 2 \\ 1 \leftarrow \\ 3 \end{matrix}$$

It means that the best results are achieved at a temperature of 18.5°C, at an ethylene concentration of 840 ppm, a process duration of 112 hours, which resulted in a commodity loss of 233 kg, average economic profitability and high fruit quality. All ripenings that were carried out in the research successfully completed the ripening process and achieved a value of 4 (ideal color for retail) on the ripeness scale.

The obtained values have slight deviations compared to the research using the TOPSIS method where, in an experiment conducted on a sample of 80 ripenings in the period from 2015 to 2016 in hermetic ripening chambers at the Logistics Distribution Center in Niš, the best quality with minimal investments and losses was achieved at a temperature of 18°C, with with an ethylene concentration of 920 ppm and the time required to complete the process of 120 hours (Stojanović et al., 2017). The deviations are mostly due to the fact that in this research more importance was given to the practical application in relation to the parameters of ripening in idealized conditions, as well as the aspiration to adjust and obtain parameters from a larger sample, which will give greater efficiency in business and better quality of fruit.

No matter how much the top management wants to influence the efficiency, i.e. business with minimal investments with maximum profit, if the fruit of poor quality is produced, as a result there is a decrease in sales caused by deviations from the standard. There is a lower profit, and there will be an increase in the loss of goods due to the write-off of long-kept (unsold) goods. Therefore, although during the research the attention was focused on reducing costs, the basic meaning in production was not abandoned: to preserve the standard and quality of bananas for sales that will cause consumer satisfaction. According to Kader (2002), value and quality assessment are the assessment of the end user. Regardless of the ripening technology, the quality of the fruit is crucial to determine the final price, and therefore influences the consumer's decision to buy the product (Xie et al., 2023).

Larger deviations in terms of the offered solutions from the research may give worse results. Poor parameter selection can affect the process itself, and consequently the storage and sale of bananas. As it can be seen from the paper, even a small correction of the values for alternatives A_4 and A_7 , caused certain deviations, which can cause serious problems for a longer period of time. In the ripening process, the management must decide which technological parameters should be followed.

For example, if temperatures are too high - above 25°C, the flesh will soften and the fruit will look as if cooked (Robinson, 1996; Turner, 1997). At the mentioned temperature, the fruit has a rapid color development, but there is a loss of weight (high relative humidity), the shelf life is reduced and the fruit decays rapidly (Marriott & Palmer, 1980). For the mentioned reasons, the temperature of the fruit during heat treatment must not exceed 20°C, because it is always higher for 1 to 2°C in the fruit itself compared to the room temperature. In addition to damage to the inner part of the fruit uneven color may occur on the exocarp or skin of the fruit.

Uneven ripening can be a consequence of inadequate ripening technique, insufficient concentration of ethylene, lack of time to which the fruit is exposed, etc. (Whitehead, 2012). At lower temperatures (between 15.5 and 18°C) during the ripening process, the fruit skin gets the best appearance, and the shelf life is longer. However, bananas have a sour taste, so it takes 2 to 3 days for the fruit to taste better (Kader & Mitcham, 2008). Exposure of the fruit to temperatures below 13°C cause damage in the form of darkening of the skin and ‘frostbites’ on the fruit.

According to Jayanty and Song (2002), insufficient amounts of ethylene can cause uneven ripening. After the fruit ripens, the excess ethylene in the chambers causes the fruit to decay. Therefore, in order to prevent it, it is necessary to remove or inhibit ethylene (Massolo et al., 2011). The reduction of ethylene in the chambers is achieved by more frequent ventilation (circulation of outside air).

It should always be borne in mind during the ripening process that the banana is a climacteric fruit, in which in the final stage of ripening there is a sudden respiratory jump or increase in respiratory intensity, carbon dioxide release, moisture loss, ethylene production, etc. (Abeles et al., 2012). During ripening, many physicochemical changes occur in terms of fruit softening due to the decomposition of the cell wall under the influence of enzymes, hydrolysis of starch, increased sugar, reduced content of organic acids and phenolic compounds, etc. (Fischer & Bennett, 1991). Once started, the process does not stop. Certain factors are sometimes difficult to control and their undesirable effects can have a bad effect on the entire ripening process. The goal of every manager of the technological process of ripening should be focused primarily on the production of a quality and health-safe product, with less consumption of resources that will not threaten the process and violate standards. In this way, the company ultimately achieves better business results and greater business efficiency.

Modernization of technology in the agri-food industry is important because it increases food productivity (Jamroen et al., 2022). This technology is still a novelty in Serbia, it has its advantages and disadvantages, so significant innovative solutions and improvements are needed. Serbia has not so bad technical solutions, however, training of managers and standardization of processes should be carried out. The paper has just sought to provide better practical solutions and expand theoretical knowledge in this area.

Conclusion

The technology of ripening bananas is influenced by many external factors, and internal factors are far more important for the ripening process itself including: temperature, ripening time, ethylene concentration, human factor, etc. The factors of production are interrelated, and the ripening process itself, i.e. the consumption of production elements, fruit quality and economic profitability of the business depend on their correction as well as the decision of the manager which parameters to choose.

From the processed data, it was concluded that the largest cost of the examined factors was caused by kalo of goods, followed by the consumption of electricity and finally

the consumption of ripening gas. Although alternative A_2 had better financial results, alternative A_3 gave generally better results and better quality of goods, which was the goal, therefore this cannot be taken as a disadvantage.

In order to modernize and improve the process in this area, to facilitate the decision of managers which of the parameters to apply for successful ripening, an analysis was conducted and the selection of the most acceptable solution was made. The best results in the technological process of ripening were achieved due to the following parameters: temperature of 18.5°C, concentration of dosing of ripening gas of 840 ppm for 28 minutes, time required to complete the process of 112 h, with the commodity loss (kalo) of 233 kg.

In the technological process of ripening green fruit, there is still no ideally defined solution and mathematical method that would give unique parameters according to which ripening will be carried out. This research provides satisfactory and proven practical solutions for the production of a quality product at lower production costs. However, ripening is a consequence of the factors and the current state in which the fruit is, so the manager's decision should be oriented towards that direction.

Conflict of interests

The authors declare no conflict of interest.

References

1. Abeles, F.B., Morgan P.W. & Salveit Jr. M. E. (2012), *Ethylene in Plant Biology*, Academic Press, New York
2. Adkins, M. F., Hofman, P. J., Stubbings, B. A. & Macnish, A. J. (2005), Manipulating avocado fruit ripening with 1-methylcyclopropene. *Postharvest Biology and Technology*, 35(1), 33-42. <https://doi.org/10.1016/j.postharvbio.2004.05.021>
3. Adriyendi, S. (2015), Multi attribute decision making using simple additive weighting and weighted product in food choice. *Information Engineering and Electronic Business*, 6, 8-14. <https://doi.org/10.5815/ijieeb.2015.06.02>
4. Al-Dairi, M., Pathare, P. B., Al-Yahyai, R., Jayasuriya, H., & Al-Attabi, Z. (2023), Postharvest quality, technologies, and strategies to reduce losses along the supply chain of banana: A review. *Trends in Food Science & Technology*. 134, 177-191. <https://doi.org/10.1016/j.tifs.2023.03.003>
5. Blagojević, B., Matić-Kekić, M., Ružić, D., & Dedović, D. (2012), Application of SAW, TOPSIS and CP methods in the tractors ranking based on the ergonomic characteristics. *Contemporary agricultural engineering*, 38(4), 327-337.
6. Ciccì, B., Schramm, F., & Schramm, V. B. (2022), Multi-criteria decision making/aid methods for assessing agricultural sustainability: A literature review. *Environmental Science & Policy*, 138, 85-96. <https://doi.org/10.1016/j.envsci.2022.09.020>

7. Chivu, L., Andrei, J. V., Zaharia, M., & Gogonea, R. M. (2020). A regional agricultural efficiency convergence assessment in Romania—Appraising differences and understanding potentials. *Land Use Policy*, 99, 104838.
8. Coase, R. H. (2005), The institutional structure of production. In *Handbook of new institutional economics* (pp. 31-39). Boston, MA: Springer US. https://doi.org/10.1007/0-387-25092-1_3
9. Dadzie B.K. & Orchard J.E. (1997), *Routine Post-Harvest Screening of Banana/Plantain Hybrid: Criteria and Methods*. International Plant Genetic Resources Institute
10. Dumitrașcu, L., Moschopoulou, E., Aprodu, I., Stanciu, S., Râpeanu, G., & Stănciuc, N. (2013). Assessing the heat induced changes in major cow and non-cow whey proteins conformation on kinetic and thermodynamic basis. *Small Ruminant Research*, 111(1-3), 129-138.
11. Evans, E. A., Ballen, F. H., & Siddiq, M. (2020), Banana production, global trade, consumption trends, postharvest handling, and processing. *Handbook of banana production, postharvest science, processing technology, and nutrition*, 1-18. <https://doi.org/10.1002/9781119528265.ch1>
12. FAO (1989), Prevention of post-harvest food losses fruits, vegetables and root crops a training manual. Food and Agriculture Organization of the United Nations, Rome. ISBN, 92-5-102766-8.
13. Fischer, R. L., & Bennett, A. B. (1991), Role of cell wall hydrolases in fruit ripening. *Annual review of plant biology*, 42(1), 675-703. <https://doi.org/10.1146/annurev.pp.42.060191.003331>
14. Garabinović, D., Papić, M., & Kostić, M. (2021), Multi-criteria decision making trends in ecotourism and sustainable tourism. *Economics of Agriculture*, 68(2), 321-340. <https://doi.org/10.5937/ekoPolj2102321G>
15. Gésan-Guiziou, G., Alaphilippe, A., Aubin, J., Bockstaller, C., Boutrou, R., Buche, P., ... & van der Werf, H. M. (2020), Diversity and potentiality of multi-criteria decision analysis methods for agri-food research. *Agronomy for Sustainable Development*, 40, 1-11. <https://doi.org/10.1007/s13593-020-00650-3>
16. Issa, H. R., Dašić, M., & Todorov, J. (2022). The role of logistics in creating company value. *Oditor*, 8(3), 143-168. <https://doi.org/10.5937/Oditor2203143H>
17. Jain, V. and Raj, T. (2013), Evaluation of flexibility in FMS using SAW and WPM. *Decision Science Letters*, 2(4), 223-230. <https://doi.org/10.5267/j.dsl.2013.06.003>
18. Jamroen, C., Komkum, P., Yoopum, P., Pinsakol, S., & Kerdnoan, K. (2022), Improvement of an open sun drying system for dried banana product using solar tracking system: a case study in Thailand. *International Journal of Green Energy*, 19(10), 1085-1097. <https://doi.org/10.1080/15435075.2021.1982718>
19. Jayanty S. & Song J. (2002) Temporal relationship between ester biosynthesis and ripening events in bananas. *Journal of American Society of Horticultural Science*, 127(6), 998–1005. <https://doi.org/10.21273/JASHS.127.6.998>

20. Kader A.A. & Mitcham B. (2008), Optimum Procedures for Ripening Mangoes, In: Fruit Ripening and Ethylene Management, Univ. Calif. Postharvest Technology Research and Information Center Publication Series 47-48.
21. Kader A.A. (2002), Technical Editor: Postharvest Technology of Horticultural Crops, Third Edition, University of California, Agricultural and Natural Resources Publication No. 3311. Oakland, California. (ISBN: 1-879906-51-1)
22. Kathirvelan, J., & Vijayaraghavan, R. (2020), Review on sensitive and selective ethylene detection methods for fruit ripening application. *Sensor Review*, 40(4), 421-435. <https://doi.org/10.1108/SR-10-2019-0251>
23. Lukić, R., Kljenak, D. V., Anđelić, S., & Gavrilović, M. (2021), Application of WASPAS method in the evaluation of efficiency of agricultural enterprises in Serbia. *Economics of Agriculture*, 68(2), 375-388. <https://doi.org/10.5937/ekoPolj2102375L>
24. Maksimović, B. (2018), *Proizvodnja i izvoz voća i preradevina iz Srbije: stanje i međunarodni faktori uspeha*. Institut za ekonomiku poljoprivrede, Beograd.
25. Marriott, J., & Palmer, J. K. (1980). Bananas-physiology and biochemistry of storage and ripening for optimum quality. *Critical Reviews in Food Science & Nutrition*, 13(1), 41-88. <https://doi.org/10.1080/10408398009527284>
26. Massolo, J. F., Concellón, A., Chaves, A. R., & Vicente, A. R. (2011), 1-Methylcyclopropene (1-MCP) delays senescence, maintains quality and reduces browning of non-climacteric eggplant (*Solanum melongena* L.) fruit. *Postharvest Biology and Technology*, 59(1), 10-15. <https://doi.org/10.1016/j.postharvbio.2010.08.007>
27. Namiotko, V., Galnaityte, A., Krisciukaitiene, I., & Balezentis, T. (2022), Assessment of agri-environmental situation in selected EU countries: a multi-criteria decision-making approach for sustainable agricultural development. *Environmental Science and Pollution Research*, 29(17), 25556-25567. <https://doi.org/10.1007/s11356-021-17655-4>
28. Nedeljković, M., Puška, A., & Krstić, S. (2022), Multicriteria approach to rural tourism development in Republic of Srpska. *Economics of Agriculture*, 69(1), 13-26. <https://doi.org/10.5937/ekoPolj2201013N>
29. Pantić, N., Mikulić, K., & Leković, M. (2022). The influence of claims payments on the investment portfolio of insurance companies. *Oditor*, 8(3), 42-71. <https://doi.org/10.5937/Oditor2203042P>
30. Paulo, B. K., Almeida, G. K. D., & Bender, R. J. (2022), Ethylene concentrations and temperatures on degreening of bananas from a subtropical area. *Ciência Rural*, 53, e20210381. <https://doi.org/10.1590/0103-8478cr20210381>
31. Pomeroy, J. C., & Barba-Romero, S. (2000), *Multicriterion decision in management: principles and practice* (Vol. 25). Springer Science & Business Media. <https://doi.org/10.1007/978-1-4615-4459-3>

32. Radmehr, A., Bozorg-Haddad, O. & Loáiciga, H. A. (2022), Integrated strategic planning and multi-criteria decision-making framework with its application to agricultural water management. *Scientific Reports*, 12(1), 8406. <https://doi.org/10.1038/s41598-022-12194-5>
33. Robinson, J. (1996), *Bananas and Plantains*. CAB-International, University Press, Cambridge, UK
34. Septiani, W., Marimin, M., Herdiyeni, Y. & Haditjaroko, L. (2016), Method and approach mapping for agri-food supply chain risk management: A literature review. *International Journal of Supply Chain Management*, 5(2), 51-64.
35. Siriboon, N. & Banlusilp, P. (2004), A study on the ripening process of 'Namwa' banana. *AU Journal of Technology*, 7(4), 159-164.
36. Srđević, B. (2003), Metodi i rešenja višekriterijumske analize u poljoprivredi. *Agroeconomica*, 32: 307-312.
37. Stojanović I., Manić A., Nerić N. (2017), Određivanje najprihvatljivijeg tretmana za tehnološki proces dozrevanja ploda banana primenom topsis (MCDM) metode, *Zbornik radova Visoke poslovne škole strukovnih studija, Leskovac*, (2017) 291 – 309.
38. Stoica, M., Antohi, V. M., Alexe, P., Ivan, A. S., Stanciu, S., Stoica, D., ... & Stuparu-Cretu, M. (2022). New strategies for the total/partial replacement of conventional sodium nitrite in meat products: *A review. Food and Bioprocess Technology*, 1-25.
39. Stanciu, S., Virlanuta, F. O., Dinu, V., Zungan, D., & Antohi, V. M. (2019). The perception of the social economy by agricultural producers in the north-east development region of Romania. *Transformations in Business & Economics*, 18.
40. Stojanović, I. (2015), Vreme dozrevanja plodova banane u kontrolisanim uslovimai udeo konzumno zrelih plodova, *Zbornik radova Visoke poslovne škole strukovnih studija, Leskovac*, 164 – 176.
41. Socoliuc, M., Grosu, V., Hlaciuc, E., & Stanciu, S. (2018). Analysis of social responsibility and reporting methods of Romanian companies in the countries of the European Union. *Sustainability*, 10(12), 4662.
42. Talukder, B., Blay-Palmer, A., Hipel, K. W., & VanLoon, G. W. (2017), Elimination method of multi-criteria decision analysis (mcd): A simple methodological approach for assessing agricultural sustainability. *Sustainability*, 9(2), 287. <https://doi.org/10.3390/su9020287>
43. Talukder, B., Hipel, K. W., & vanLoon, G. W. (2018), Using multi-criteria decision analysis for assessing sustainability of agricultural systems. *Sustainable Development*, 26(6), 781-799. <https://doi.org/10.1002/sd.1848>
44. Thompson A. K. & Burden O. J. (1995), Harvesting and fruit care, In: S. Gowen (ed) *Bananas and Plantains*, Chapman and Hall, London, 403-433. https://doi.org/10.1007/978-94-011-0737-2_14

45. Thompson, A. K., & Seymour, G. B. (1982), Comparative effects of acetylene and ethylene gas on initiation of banana ripening. *Annals of Applied Biology*, 101(2), 407-410. <https://doi.org/10.1111/j.1744-7348.1982.tb00837.x>
46. Thompson, A. K., Supapvanich, S., & Sirison, J. (2019), *Banana Ripening: Science and Technology*. Springer Nature. <https://doi.org/10.1007/978-3-030-27739-0>
47. Triantaphyllou, E., & Lin, C. T. (1996), Development and evaluation of five fuzzy multiattribute decision-making methods. *international Journal of Approximate reasoning*, 14(4), 281-310. [https://doi.org/10.1016/0888-613X\(95\)00119-2](https://doi.org/10.1016/0888-613X(95)00119-2)
48. Turner, D. W. (1997), Bananas and plantains. In: S.K. Mitra (ed) *Postharvest Physiology and Storage of Tropical and Subtropical Fruits*, CAB Intl, Wallingford UK, 47-83.
49. Veselinović, J., Perović, A., Šiljak, V., & Bačevac, S. (2022). Challenges of modern sport management. *Oditor*, 8(1), 111-134. <https://doi.org/10.5937/Oditor2201109V>
50. Whitehead, S. C. (2012), *Banana Postharvest Ripening Manual*, http://postharvestacademy.net/uploads/3/1/6/8/3168676/banana_ripening_manual.pdf, preuzeto 27.06.2020.
51. Yazdani, M., Gonzalez, E. D., & Chatterjee, P. (2021), A multi-criteria decision-making framework for agriculture supply chain risk management under a circular economy context. *Management Decision*, 59(8), 1801-1826. <https://doi.org/10.1108/MD-10-2018-1088>
52. Xie, R., Zhang, Y., Luo, H., Yu, P., & Chen, Z. (2023), Optimizing decisions for post-harvest ripening agricultural produce supply chain management: a dynamic quality-based model. *International Transactions in Operational Research*. 30(6), 3625-3653. <https://doi.org/10.1111/itor.13285>
53. Zavadskas, E. K., Kaklauskas, A., Turskis, Z., & Tamošaitiene, J. (2008), Selection of the effective dwelling house walls by applying attributes values determined at intervals. *Journal of civil engineering and management*, 14(2), 85-93. <https://doi.org/10.3846/1392-3730.2008.14.3>

DOES TRANSPARENCY PAY OFF FOR GREEN BONDS' ISSUERS? EVIDENCE FROM EU STATE AGENCIES' GREEN BONDS

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ABSTRACT

This paper investigates the impact of transparent allocation of proceeds on green bonds' yields, providing insights to green bonds' issuers for optimizing their financing terms. Using data from the EU state agencies' green bond market, we applied a Prais-Winsten regression model with correlated panels corrected standard errors and common AR(1) to estimate the relationship between green bonds' yields and various factors, including the transparency of proceeds. Transparent allocation of proceeds has a negative effect on green bonds' yields, confirming that investors require lower returns when they are well-informed about a bond's environmental goals. Additionally, higher credit ratings, and shorter remaining maturity are associated with lower green bonds' yields. Transparent use of proceeds significantly influences green bonds' yields, demonstrating that specifying the use of bond proceeds for environmentally friendly projects can lead to more favorable financing terms. Future research direction should provide additional classification of the green bonds' transparency.

Introduction

The global financial landscape has witnessed a profound transformation towards sustainability in the environment of growing concerns about climate change. Within

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this paradigm change, green bonds have become a potent financial tool that aims to balance the demands of capital markets with environmental responsibility. The idea behind green bonds is based on the understanding that traditional financial markets can significantly contribute to solving today's pressing environmental and social problems. Green bonds link investors looking to align their portfolios with sustainability goals and issuers dedicated to fostering a more environmentally responsible and resilient future. Since their inception by the European Investment Bank in 2007, there has been an increasing interest because they are effective methods for financing environmentally sustainable projects. Green bonds differ from traditional ones since their proceeds are limited to financing projects with positive environmental outcomes.

Our research examines how green bonds' proceeds affect bonds' yields to address the question: Does transparent allocation of proceeds lead to decreased bonds' yields, ultimately benefiting bond issuers? This study is motivated by the aspiration to provide valuable insights to green bonds' issuers, aiding them in gaining a deeper understanding of the factors influencing green bonds' yield dynamics. Such insights may assist the issuance of green bonds under more favourable financing terms, ultimately contributing to efforts in combating climate change.

We hypothesize that investors' motivations to choose green bonds differ from those of traditional bond investments. Economic factors that drive investor decisions shaped traditional bond yields theories. However, investors in green bonds are additionally motivated by environmental goals. We assume that when the use of the funds raised by green bonds is clearly defined and aligned with the environmental preferences of investors, it can increase their confidence and willingness to accept lower returns in exchange for contributing to environmental objectives.

Academic interest in green bonds has grown, with one of the central debates related to the existence of a green bond premium (yield discount), which suggests that green bonds may offer issuers certain financial advantages compared to conventional bonds. The literature on the existence of a green bond premium presents a complex and multifaceted picture, where certain studies reported evidence of a green bond premium (Hachenberg and Schiereck, 2018; Bachelet, Becchetti and Manfredonia, 2019; Gianfrate and Peri, 2019; Nanayakkara and Colombage, 2019; Zerbib 2019; Hyun, et al., 2020; Baker et al. 2021; Fatica et al., 2021; Immel et al. 2021; MacAskill et al 2021; Li et al., 2022. In contrast, other research, including Partridge and Medda (2020), Larcker and Watts (2020), Tang and Zhang (2020) and Hyun et al. (2020), have not found substantial support for the existence of such a premium.

This ongoing debate highlights the importance of identifying determinants of green bonds' pricing and yield behaviour and forms another stance of literature. Considering the evolving landscape of green finance and investor preferences, the list of key factors influencing green bonds' pricing and yield behaviour is spreading, and researchers are making significant efforts to identify them. Among the determinants are factors such as regulatory supervision, as demonstrated in the study by Dou and Qi (2019), adherence

to the Green Bond Principles, as explored by Nanayakkara and Colombage (2021), and third-party certification of green bonds, as indicated in the research by Wang et al. (2019), Hyun, Park, and Tian (2020, 2021), Nanayakkara and Colombage (2021), and Janković, Kovačević, and Ljumović (2022). Additionally, Li et al. (2020) underlines that higher credit ratings, possession of green certificates, and stronger Corporate Social Responsibility (CSR) scores contribute to reducing the financing costs for green bonds' issuers. Furthermore, factors such as high liquidity (Chang et al., 2021), bond's credit rating, issue size, and maturity (Wang et al., 2019) have been identified as variables that exert downward pressure on green bond yields. Finally, the broader economic context and investor sentiment can impact green bonds' yields (Fatica et al., 2021).

Recent studies argue that the proceeds of green bonds are a principal determinant of pricing/yield behaviour (Russo et al., 2021). It is essential for attracting investors looking for environmentally sustainable investments that align with their values. Examining green bonds issued by corporations and banks, Fatica et al. (2021) found a price premium in the case of corporate green bonds. However, they did not find a similar premium for bonds issued by banks. They concluded that corporations typically issue green bonds to fund specific projects, whereas banks tend to securitize green bonds. With bond baskets used by banks, investors may have uncertainties regarding the allocation of proceeds from the green bonds, which could lead to hesitancy in their investments. Furthermore, transparent use of proceeds may exhibit higher liquidity, contributing to favourable pricing dynamics, as Chang et al. (2021) stated.

Jankovic et al. (2022) have empirically demonstrated a favourable impact on reducing green bonds' yields when these bonds are issued explicitly for financing a single, well-defined, environmentally friendly project. This contrasts with green bonds intended for a broader array of projects or those where the use of proceeds remains unspecified. The authors have introduced the term *Green bond transparency* to categorize green bonds based on their transparency levels. Bonds aimed at funding a particular environmentally friendly project are classified as transparent, while all others fall into the non-transparent category. In a separate study, Su and Lin (2022) analysed the Chinese green bond market and found that, among various factors investigated, the precise designation of the use of proceeds has a notable impact on the liquidity of green bonds. When transparent, specific, and aligned with investor preferences, proceeds can contribute to lower yields and more favourable pricing conditions (Jankovic et al., 2022). While the body of literature regarding green bond transparency remains limited, available research indicates a favourable impact of a specific allocation of proceeds in lowering the yields of green bonds.

This study adds to the existing literature by offering novel perspectives on how designating proceeds affects green bonds' yields. Furthermore, it investigates the concept of green bonds' transparency and introduces a new classification. While Jankovic et al. (2022) categorized green bonds as transparent when they finance a single project, our research defines green bonds as transparent if they fund projects within a single environmental category based on the Climate Bonds Initiative (CBI),

2021) classification. This classification holds practical significance, particularly for financial institutions financing multiple projects, such as EU state agencies.

We provide empirical testing in the green bond market area with limited research attention – EU state agencies’ green bonds. There are two reasons for our focus on this segment. Firstly, EU state agencies play a pivotal role in the broader financial landscape, extending beyond the issuance of green instruments. They are key players in financing various critical EU-level projects through diverse channels. Consequently, the transparency aspect of green instruments issued by these institutions holds particular significance compared to smaller corporate or commercial bank issuers, which have been extensively studied. However, the state agency segment of the green bond market has been relatively underexplored until now, prompting our interest in delving into the transparency aspect of these instruments and their broader financial implications. Secondly, our study presented a unique opportunity to investigate the entire population of green bonds issued by a specific category of issuer. As a result, our sample encompasses the entirety of EU state agencies’ green bonds, representing the upper limit regarding sample size for this category.

Materials and methods

For this study, we consider green bonds that finance projects falling within one concrete class of environmental projects, following the Climate Bonds Initiative (CBI, 2021), to be transparent, while those that finance different projects or for which the use of proceeds is not predetermined are non-transparent.

We focus on the under-researched EU segment of the green bond market, and to avoid potential bias resulting from different asset classes or mixed geographical areas, we test the whole population of active EU state agencies’ green bonds during the period 17 September 2014 – 31 December 2021, including 37 bonds with daily data series. The available data for each bond is taken from the *Refinitiv Eikon* platform. Details on the number of observations for this unbalanced panel dataset are provided in the Appendix (Table A.1).

The description of the variables and their potential impact on bond yields is presented in Table 1.

Table 1. Variables’ description and potential impact

Label	Name	Unit of measure	Role	Potential impact
Bid yield	Green bonds’ bid yields	Percentages	dependent	
Amount	Amount of green bonds issued	Euros	explanatory	negative
Interest rate	Green bonds’ interest rates	Percentages	explanatory	positive

Label	Name	Unit of measure	Role	Potential impact
Rating	Green bonds' credit ratings	1 if a rating is AAA, 0 otherwise	explanatory	negative
Use of proceeds	Specification of green bonds' use of proceeds	1 if a specific project is financed or the projects are in one Climate Bonds Initiative (CBI 2021) investment sector, 0 otherwise	explanatory	negative
Remaining maturity	Green bonds' remaining maturities	Days	explanatory	positive
Euribor	Euro interbank offer rate	Percentages	explanatory	positive

Source: Authors

Table 2 presents descriptive statistics for the dependent and explanatory variables.

Table 2. Descriptive statistics

	Bid yield	Amount (in mill)	Interest rate	Rating	Use of proceeds	Remaining maturity	Euribor	
Mean	0.032	869.559	0.609	0.970	0.150	2647.110	-0.371	
Median	-0.083	500.000	0.500	1.000	0.000	2594.000	-0.356	
Std. Deviation	0.444	926.689	0.575	0.170	0.360	1276.233	0.1432	
Skewness	1.363	3.490	0.928	-5.420	1.950	2.309	0.522	
Std. Error of Skewness	0.015	0.020	0.015	0.020	0.020	0.015	0.015	
Kurtosis	4.200	13.790	0.130	27.400	1.810	11.197	-0.194	
Std. Error of Kurtosis	0.030	0.030	0.030	0.030	0.030	0.030	0.030	
Percentiles	10	-0.437	500.000	0.000	1.000	0.000	1308.000	-0.528
	20	-0.338	500.000	0.050	1.000	0.000	1695.000	-0.520
	30	-0.259	500.000	0.200	1.000	0.000	2054.000	-0.513
	40	-0.178	500.000	0.375	1.000	0.000	2351.000	-0.468
	50	-0.083	500.000	0.500	1.000	0.000	2594.000	-0.356
	60	0.037	500.000	0.750	1.000	0.000	2815.000	-0.307
	70	0.230	1000.000	0.750	1.000	0.000	3045.000	-0.270
	80	0.440	1000.000	1.000	1.000	0.000	3325.000	-0.245
	90	0.624	2000.000	1.375	1.000	1.000	3570.000	-0.212

Source: Authors' calculations

After defining the initial assumptions, we estimate the linear cross-sectional time series $Bid_Yield_{it} = \alpha + \beta_1 \cdot Amount_{it} + \beta_2 \cdot Interest_rate_{it} + \beta_3 \cdot Rating_{it} + \beta_4 \cdot Use_of_proceeds_{it} + \beta_5 \cdot Remaining_maturity_{it} + \beta_6 \cdot Euribor_{it} + \varepsilon_{it}$

where $i = 1, \dots, m$ is the number of groups; $t = 1, \dots, T_i$ is the number of periods in group i ; and ε_{it} is the residual of the model. α is the intercept, and β_j are unknown coefficients, which must be estimated.

Our main research hypothesis is that when green bonds have transparent use of proceeds, it reduces bond yields.

Results

Before estimating the panel regression model, we examined whether there was multicollinearity of the explanatory variables and found none (all tolerance statistics are greater than 0.55, or all VIF values are smaller than 1.82). After using OLS to estimate the panel regression model, we began the model diagnostics by checking autocorrelation in the panel data and using a cross-section dependence test for the residual diagnostics. The presence of autocorrelation in the panel data was tested using Durbin-Watson statistics (DW stat = 0.011) and the Wooldridge test ($F(1, 36) = 910.962$, Prob > F = 0.000). We tested residual cross-section dependence with Breusch-Pagan LM (Statistic = 222993.8, Prob. = 0.000), Pesaran scaled LM (Statistic = 6091.743, Prob. = 0.000), and Pesaran CD tests (Statistic = 411.2268, Prob. = 0.000). The tests showed autocorrelation and cross-section dependence (correlation) in the panel data.

The suitable model to use when panel data is unbalanced is the Prais-Winsten regression model with correlated panels corrected standard errors (PCSEs) and panel autocorrelation. We estimated panel autocorrelation with common AR(1).

Table 3 shows the results of the defined panel regression model.

Table 3. Prais-Winsten regression with correlated panels corrected standard errors and common AR(1)

Bid_yield	Coef.	Panel-corrected Std. Err.	z	P> z	[95% Conf. Interval]
Amount	-2.40e-11	6.75e-13	-35.5300	0.000	-2.53e-11 -2.27e-11
Interest_rate	0.1180	0.0045	26.3400	0.000	0.1090 0.1270
Rating	-0.7560	0.0252	-29.9000	0.000	-0.8500 -0.7060
Use_of_proceeds	-0.0634	0.00181	-35.0200	0.000	-0.0670 -0.0706
Remaining_maturity	0.000156	0.00000168	93.1100	0.000	0.000152 0.000159
Euribor	1.5100	0.0390	38.8600	0.000	1.4400 1.5900
_cons	0.8710	0.0300	29.0400	0.000	0.8120 0.9300
Observations	27,566				
Adjusted R-squared	0.6029				

Note: The group variable is a number, and the time variable is a date. Panels are correlated (unbalanced). Autocorrelation is common AR(1). Common AR(1) is 0.7937609.

Source: Authors' calculations

The analysis results indicate that the specified use of proceeds has a negative effect on the green bonds' yields. This result goes in favour of our research hypothesis. When investors become familiar with a green bond's investment goals, they require lower returns. In addition, we confirm the positive effect of the interest rate and Euribor on green bonds' yields. At the same time, higher ratings and lower remaining maturity lead to lower bonds' yields, which is under economic logic and the risk-averse behaviour of investors. Bonds with a higher rating and shorter remaining maturity are perceived as lower-risk investments from which investors require a lower return.

Robustness tests

As mentioned, we identified contemporaneous correlation in the analysed panel data, and the panels were not balanced. Hence, the regression with panel-corrected standard errors (PCSE) is the correct approach in this analysis. Within the scope of the analysis, for the sake of robustness testing, we implemented several adjustments. First, instead of common AR(1), we implemented the panel-specific AR(1) autocorrelation. Second, a method for computing autocorrelation, instead of autocorrelation of residuals, is based on Durbin-Watson statistics. Third, we used normalized standard errors by $N-k$ (instead of N), where k is the number of parameters estimated, and N is the number of observations. Fourth, we added the explanatory variable, *Maturity*, in panel data estimation. Ultimately, we used *Ask yield* to test the sensitivity of the analysis results instead of the dependent variable *Bid yield*. After all the robustness and sensitivity tests, the results remain the same, and inferences do not change. (For the sake of brevity, we did not provide these results in the paper, but we can provide them to all interested parties upon request).

Discussion

This study offers evidence of determinants affecting the yields on green bonds. Both issuers, who want to get favourable financing terms, and investors, who want to match their portfolios with sustainability goals while maximizing financial returns, should well understand these drivers. Our findings indicate that all analysed determinants had significant impact in the model. While using a sample of bonds from EU state agencies, our results are in line with those reported in the current academic research.

Our study emphasizes the role of the transparent use of proceeds in influencing green bonds' yields, in line with the findings of Russo et al. (2021). The transparent use of proceeds has a negative effect on the green bonds' yields, as in Janković et al. (2022), Fatica and Panzica (2021) and Chang et al. (2021). This finding is partially consistent with Fatica et al. (2021) who found a price premium only in the case of corporate green bonds, while this premium was not identified for bonds issued by banks.

Interest rates, including benchmark rates like Euribor (Euro Interbank Offered Rate), play also important in the pricing and yields' behaviour of financial instruments, including green bonds. Using Euribor as the referent benchmark in the EU state

agencies case, we found positive effect on green bonds' yields as is confirmed in Coudert and Salakhova (2020) and Pietsch and Salakhova (2022). Our findings are also aligned with research by Chang et al. (2021), emphasizing the importance of liquidity, which can be influenced by interest rates. However, even though interest rates are often recognized as significant determinants, the extent of their impact may vary based on market conditions and investor sentiment.

As Li et al. (2020) and Wang et al. (2019) noted higher credit ratings contribute to reducing financing costs for green bonds' issuers. Our observations show that higher ratings and lower remaining maturity decrease bonds' yields and are perceived as lower-risk/lower-return investments. This result aligns with economic logic, as longer-maturity bonds typically carry higher yields to compensate investors for the increased risk associated with a longer investment horizon.

Conclusions

Green bonds are new, significant financial instruments which aim to tackle climate change. Our goal was to shed light on green bonds' pricing behaviour. We find empirical evidence that transparency of green bonds' use of proceeds is an important determinant of green bonds' yields. In addition, we investigate other factors affecting government agencies' green bonds' behaviour and conclude that risk-reducing factors such as high credit rating, low remaining maturity, and low level of interest rates result in lower green bonds' yields. Despite their importance, the state agencies' green bonds have received comparatively less attention in previous studies. We believe it is equally relevant for the state issuers to benefit from specifying the use of bonds' proceeds as it enables them to finance environmentally friendly projects under more favourable conditions.

A potential path for future research is to expand the classification of green bonds beyond the current binary distinction between transparent and non-transparent. This could involve the identification of different shades of green transparency through a pooling of green bonds into more than two categories based on the level of detail provided on the use of proceeds and the degree to which they align with specific environmental goals.

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Conflict of interests

The authors declare no conflict of interest.

References

1. Bachelet, M. J., Leonardo B., & Stefano M. (2019). The green bonds premium puzzle: The role of issuer characteristics and third-party verification. *Sustainability* 11 (4): 1098. doi:10.3390/su11041098

2. Baker, M., Daniel B., George S., & Jeffrey W. (2021). The pricing and ownership of US green bonds. *Annual Review of Financial Economics* 3 (1): 41–85. doi: 10.1146/annurev-financial-111620-014802
3. Chang, K., Yan L. F., Wang L., Ning L., & Sheng Z. L. (2021). The impacts of liquidity measures and credit rating on corporate bond yield spreads: Evidence from China's green bond market. *Applied Economics Letters* 28 (17): 1446–1457. doi: 10.1080/13504851.2020.1824062
4. Climate Bonds Initiative (CBI). (2021). *Climate Bonds Taxonomy*. https://www.climatebonds.net/files/files/Taxonomy/CBI_Taxonomy_Tables-08A%20%281%29.pdf
5. Coudert, V., & Salakhova, D. (2020). Do mutual fund flows affect the French corporate bond market?. *Economic Modelling*, 87, 496-510. doi: 10.1016/j.econmod.2019.12.013.
6. Dou, X., & Shuxiu Q. (2019). The choice of green bond financing instruments. *Cogent Business & Management* 6 (1), 1652227. doi: 10.1080/23311975.2019.1652227
7. Fatica, S., Roberto P., & Michela R. (2021). The pricing of green bonds: are financial institutions special? *Journal of Financial Stability* 54, 100873. doi: 10.1016/j.jfs.2021.100873
8. Gianfrate, G., & Mattia P. (2019). The green advantage: Exploring the convenience of issuing green bonds. *Journal of Cleaner Production* 219, 127–135. doi: 10.1016/j.jclepro.2019.02.022
9. Hachenberg, B., & Dirk S. (2018). Are green bonds priced differently from conventional bonds? *Journal of Asset Management* 19 (6), 371–383. doi: 10.1057/s41260-018-0088-5
10. Hyun, S., Donghyun P., & Shu T. (2020). The price of going green: the role of greenness in green bond markets. *Accounting & Finance* 60 (1), 73–95. doi: 10.1111/acfi.12515
11. Hyun, S., Donghyun P., & Shu T. (2021). Pricing of green labeling: A comparison of labeled and unlabeled green bonds. *Finance Research Letters* 41, 101816. doi: 10.1016/j.frl.2020.101816
12. Immel, M., Britta H., Florian K., & Dirk S. (2021). Green bonds: Shades of green and brown. *Journal of Asset Management* 22 (2), 96–109. doi: 10.1057/s41260-020-00192-z.
13. Janković, I., Kovačević, V., & Ljumović, I. (2022). Municipal green bond yield behaviour. *Ekonomika preduzeća*, 70(3-4), 206-214. doi: 10.5937/EKOPRE2204206J.
14. Jankovic, I., Vasic V., & Vlado K. (2022). Does transparency matter? Evidence from panel analysis of the EU government green bonds. *Energy Economics* 114, 106325. doi: 10.1016/j.eneco.2022.106325.

15. Larcker, D. F., & Edward M. W. (2020). Where's the greenium? *Journal of Accounting and Economics* 69 (2–3), 101312. doi: 10.1016/j.jacceco.2020.101312
16. Li, Q., Zhang, K., & Wang, L. (2022). Where's the green bond premium? Evidence from China. *Finance Research Letters*, 48, 102950. doi: 10.1016/j.frl.2022.102950.
17. Li, Z., Ying T., Jingya W., Junfeng Z., & Qi L. (2020). The interest costs of green bonds: Credit ratings, corporate social responsibility, and certification. *Emerging Markets Finance and Trade* 56 (12), 2679–2692. <https://doi.org/10.1080/1540496X.2018.1548350>
18. MacAskill, S., Roca, E., Liu, B., Stewart, R. A., & Sahin, O. (2021). Is there a green premium in the green bond market? Systematic literature review revealing premium determinants. *Journal of Cleaner Production*, 280, 124491. doi: 10.1016/J.JCLEPRO.2020.124491.
19. Nanayakkara, K., Galoluwage M., & Sisira C. (2021). Does compliance with Green Bond Principles bring any benefit to make G20's 'Green economy plan' a reality? *Accounting & Finance* 61 (3), 4257–4285. doi: 10.1111/acfi.12732.
20. Nanayakkara, M., & Sisira C. (2019). Do investors in green bond market pay a premium? Global evidence. *Applied Economics* 51 (40), 4425–4437. doi: 10.1080/00036846.2019.1591611.
21. Partridge, C., & Francesca R. M. (2020). The evolution of pricing performance of green municipal bonds. *Journal of Sustainable Finance & Investment* 10 (1), 44–64. doi: 10.1080/20430795.2019.1661187.
22. Pietsch, A., & Salakhova, D. (2022). Pricing of green bonds: drivers and dynamics of the greenium. *ECB Working Paper* No. 2022/2728. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4227559, accessed on 6 October 2023.
23. Russo, A., Massimo M., & Alessandra C. (2021). Exploring the determinants of green bond issuance: Going beyond the long-lasting debate on performance consequences. *Business Strategy and the Environment* 30 (1), 38–59. doi: 10.1002/bse.2608.
24. Su, T., & Boqiang L. (2022). The liquidity impact of Chinese green bonds spreads. *International Review of Economics & Finance* 82, 318–334. doi: 10.1016/j.iref.2022.06.019.
25. Tang, D. Y., & Yupu Z. (2020). Do shareholders benefit from green bonds? *Journal of Corporate Finance* 61, 101427. doi: 10.1016/j.jcorpfin.2018.12.001.
26. Wang, Q., Yaning Z., Li L., & Junping J. (2019). Research on the factors affecting the risk premium of China's green bond issuance. *Sustainability* 11 (22), 6394. doi: 10.3390/su11226394.
27. Zerbib, O. D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. *Journal of Banking & Finance* 98, 39–60. doi: 10.1016/j.jbankfin.2018.10.012.

Appendix

Table A.1 presents the number of observations for the bonds analysed in the sample (n=37).

Table A1. Number of observations for analysed bonds

Bond	Number of observations
LRENT-1	1,651
AFD-1	1,903
NDLWR-1	1,652
NRWBK-1	1,604
KFW-1	1,466
NRWBK-2	1,337
CDCEC	1,263
KFW-2	1,209
KMUNK-1	1,197
KITUS-1	1,109
NRWBK-3	1,123
CSDPR	852
KFW-3	833
NRWBK-4	915
KMUNK-2	912
IDCOL-1	713
KFW-4	683
NRWBK-5	759
KITUS-2	648
NRWBK-6	579
NDLWR-2	590
KMUNK-3	554
AFD-2	490
IDCOL-2	308
LRENT-2	334
KFW-5	374
SFIL	290
NRWBK-7	489
KITUS-3	318
KMUNK-4	346
IDCOL-3	140
KFW-6	188
NRWBK-8	238
LRENT-3	133
NRWBK-9	113
KFW-7	73
NDLWR-3	180

CROP ATTRIBUTES, FARM DECISIONS CROP SPECIFIC POLICIES IN THE CONTEXT OF SUSTAINABILITY OF PRODUCTION IN ETHIOPIA

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ABSTRACT

Ethiopia's government has created a number of policies and programs to address the urgent issue of rising food prices. Extension and regulation initiatives aiming at influencing the production and marketing are frequently used in conjunction with them. However, lack of indices on relative importance of individual crops results poor policy outcomes. Analyzing household decision dynamics and how household decisions respond to policies is crucial to reduce persistent complaints from recipients and avoid negative policy outcomes. For this study, data from 392 randomly chosen households of Kewot woreda was used. Sorghum found with higher calorie index per profit while mung bean was found higher profit index. Crop diversification found inefficient that arise from profitability differences and return to scale. Additionally multiple objectives could be met using tradeoffs among different crop benefits. This study also summarizes major findings from previous crop-related policies and linked them to specific crop characteristics. It is advised that policies be adjusted to reflect the value, character, and utility of crops.

Introduction

Both industrialized and developing nations have used agricultural policies to boost agricultural output, social welfare, and economic redistribution. Numerous agricultural policies are advised in a large body of literature in order to increase agricultural output and rural social welfare. Agriculture's economy is significantly impacted by agribusiness policies (Shikur, 2020). Developing nations use agricultural policy to keep

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the cost of agricultural products below market rates, allowing consumers to buy food at reasonable prices. To enhance crop yield and social welfare, many Asian and Latin American countries have implemented various price support and stability measures. The price instability that has harmed output since the 1960s is routinely controlled in Asian nations through the deployment of price support policies. These techniques have sped up the implementation of advances from the Green Revolution that enhanced crop productivity (Hazell, 2010).

Numerous agricultural policies have been implemented by the Ethiopian government with the goals of boosting productivity, stabilizing food prices, and as effective interventions. Removal of tariffs on agricultural equipment as part of its agricultural export plans to boost output and productivity. While edible oil, sugar, and rice are exempt from both import tax and any other kind of tax charge when sold locally, wheat is not subject to import tax. When imported and sold domestically, spaghetti and macaroni are exempt from value-added tax (VAT). Additionally, GoE imports food products using public funding, such as wheat, sugar, rice, and cooking oils, to fill the local supply shortfall and stabilize the home market. These imported food products are sold at discounted prices by means of regional cooperative unions and consumer associations (MOFED, 2022). The government of Ethiopia is also making continuing and encouraging efforts to change the food system, including requiring the fortification of staple foods and establishing multi-sectoral nutrition projects. The Ethiopian government implemented a number of policy measures, including monetary, fiscal, and structural ones, to curb price increases, but inflation rates are still in the double digits.

No matter who may legally be the owner of such property inside the home, the household head in Ethiopia practically has ultimate control over decisions on the use and disposal of property. Despite the wide variety of cultures, religions, and patrimonial traditions that constitute Ethiopia, both within and between regions, this system is applicable throughout the whole nation (Torkelsson and Tassau, 2008). Due to the increasingly uncertain climatic circumstances and market prices for agricultural inputs and products, more research is needed to fully understand these pathways (Barrios et al., 2008). This is especially true when trying to find compromises and win-win scenarios for agriculture's numerous objectives, including soil protection, carbon sequestration, time and labor savings, yield, revenue, and nutrition (Remans et al., 2011). Understanding the decision-making process' patterns will speed up policy implementation and reduce the cost of supervision.

Ethiopia's external debt to GDP is increasing and forcing the nation to become one of the world's Heavily Indebted Poor Countries. Today, debt and economic policy are closely related. This could force the nation to reduce its support for agriculture, which in turn would require only supporting certain crops in a systematic manner. Finding crop-specific solutions and ranking crop kinds according to particular criteria could be helpful in this approach. Utilizing income diversification to manage risk rather than insurances costs a comparative advantage. In order to determine the relative importance of crops, this study will use productivity and dietary metrics, as well as trade-off usage

gaps in crop-related policy. Both diversifications are used to be solution for adaptations but losing efficiency for insurance covered and lack of long term investments.

Review of Related Literatures

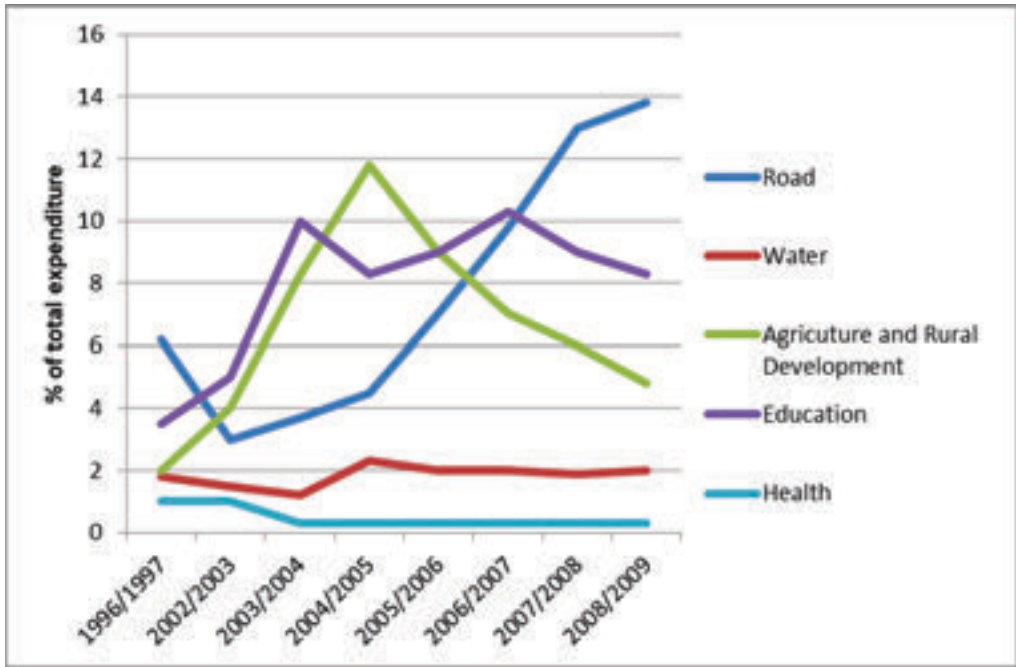
In the next ten years, it is expected that climate change will significantly influence the yields and distribution of staple food crops throughout Africa and elsewhere. Agriculture is thought to be the activity most at risk from climate change, according to some forecast reports (Raza, 2019). Climate change's possible effects could either improve or hinder crop-growing conditions in different regions. which could lead to changes in the types of crops grown in a particular area. According to FAO (2014), Ethiopia presented an agricultural development strategy that builds on the contributions of both corporate farmers and smallholder farmers in order to increase domestic food supplies. To eradicate hunger, it is planned to increase per person food production, especially cereal yields, by half, mostly by using more fertilizer. It's crucial to discover an effective crop selection and crop mix to lower production risk and increase production because the countries' diverse agro-climatic zones make the region conducive to cultivating a variety of crops (Ayal & Filho, 2017).

Governments and organizations working on development agree on the need to develop public policies that can facilitate agricultural transformation toward safeguarding food security and inclusive rural development in Africa. Increased employment and faster poverty reduction are two benefits of strong agricultural growth rates for the economic development of low-income countries. A dispersed spatial pattern of non-agricultural growth is produced by agricultural growth because it multiplies the employment benefits of the rural nonfarm sector (which includes small market towns) (Van Der Velde et al., 2007). To increase crop output without further depleting soil and water resources, farmland management must be improved.

Agricultural Policies of Ethiopia

Between the service, agricultural, and industrial sectors, there has been ongoing discussion about which should dominate Ethiopia's economy. In the past, the government has implemented the ADLI and GTP programs, with the main principles of agriculture led and reciprocal growth, respectively. Agriculture is among the main significant sectors in the recently launched ten-year economic growth plan of Ethiopia (GOE) (2021-2030). Over the following 10 years, the agriculture sector is anticipated to increase at a 6.2% annual rate (MoA, 2020). Public spending on sectors that benefit the poor has increased from 57% in 2004–2005 to 23% in 2016–17. The percentage of spending that has changed to be in favor of the poor and development is depicted in Fig. 1. In the coming years public investment in agriculture is expected to increase the new approached need to be adopted.

Figure 1. Trends in Pro-poor expenditure



Source: Adapted from von Brown et al. (2004)

The first Growth and Transformation Plan (GTP I), which was officially launched in 2006 E.C., included the Agricultural Transformation Agenda as a platform for addressing the most pressing systemic bottlenecks impeding the achievement of the government’s goals and targets for the agriculture sector.

Agricultural policies have been adopted by industrialized and developing countries to increase agricultural output and productivity, enhance social welfare, and redistribute wealth. The objectives of agricultural policies adopted by countries include achieving self-sufficiency, spreading income among economic players, assuring food supplies and reasonable prices for consumers. Industrial countries use agricultural policies to raise agricultural product prices above market prices, which transfers income from consumers to farmers, whereas developing countries use agricultural policies to lower agricultural product prices below market prices, giving consumers access to affordable food (Krueger et al., 1988). The welfare of rural households is influenced by agricultural assistance programs by developed nations (World Bank, 2003). Countries in Asia and Latin America have used various price support and stability measures to boost crop output and social welfare. Contrarily, several underdeveloped African nations relied on insufficient or nonexistent price support schemes to control the volatility of agricultural prices, which slowed productivity improvements and increased reliance on food imports. Low social welfare among producers is a result of the lack of price support measures in Africa (Demeke et al. 2012).

For the purpose of stabilizing domestic prices and promoting oilseed, plus, and coffee exports that may have a favorable influence on social welfare; the Ethiopian government has placed limits on the export of cereal products. The government has implemented export controls and tariffs on many agricultural commodities as part of its agricultural export policies. Following a drop in coffee prices on the world market, the tax on coffee exports was eliminated in 2002. To lower the cost of food for urban consumers, the government prohibited the export of important food grains. In an effort to lower domestic grain prices, teff, wheat, maize, and sorghum export bans were implemented in December 2006. A few agricultural inputs, including tractors, combine harvesters, insecticides, and herbicides, have been imported and made available to farmers by private businesses. Farmers' fertilizer distribution is handed to cooperatives as a monopoly (Habte et al. 2020).

Statement of the Problem

Since agriculture is a crucial sector for Ethiopia's economy, it must be transformed effectively if the nation is to meet its domestic food needs and improve economic performance. Ethiopia's population is expected to reach 145 million by 2030, according to World Bank (2022), necessitating the need for better decision-making procedures built on stronger institutional and human planning and execution capabilities. It forces the need for centralized agriculture and necessitates the employment of crop-specific distorting policies by the government. It is crucial to consider trade-offs between crops that might be cultivated in similar agro climatic zones as well as the advantages of each crop (Lencucha et al., 2020). Understanding the factors affecting crop choice and related issues is essential to making this policy effective in addressing the question of why good policies never come to pass as planned.

There are some pro-poor measures implemented by the Ethiopian government, however it is uncertain whether they will have the desired results. The various approaches must be assessed in order to create policies that bring about sustainable changes and comply with farmers. If effective, crop policy could have an impact on consumers and producers at the same time, affecting inflation and productivity, respectively. It may be claimed that as a result, how policy is handled in various circumstances will have a significant impact on how the country evolves in the future. In Ethiopia, various methods are used for various crops depending on their characteristics and economic significance. Among the frequent forms of intervention on which authors have opinions are subsidies and rules. The policy researches need to put more emphasis on how these limits and subsidies should be placed, to which crops and to what extent or how much. Therefore the objective of this study is to examine how farming decisions are made and interact with policies. The study is significant in Identification and estimation of calorie- revenue trade off help to uncover motivations in government attempts of redirecting farmers' crop choice.

Materials and methods

Data gathered through a questionnaire at the household level are used in the study. From March 2017 to March 2018, the survey was done as a part of a PhD thesis funded by Ambo University. 400 homes were included in the sample, however 8 were not used because of technical issues. A representative sample was chosen using a multi-stage sampling process. Purposeful selection of the Kewot woreda, which has a large number of smallholder farmers farming mung beans, was the first stage. Second, using a random sample technique, five woredas—Yelen, Shoarobit, Abay atir, Tere, and Kure Biret were chosen. The sample plan used Yamane’s (1996) estimating formula and was proportionate and representative. Numerous subjects were explored, such as household demographics, consumption habits, levels of spending, agriculture, livestock, production, and marketing. To create the variables used to gauge the degree of agricultural commercialization, the analysis used survey data.

Tradeoffs

Comparing calories produced by each crop form certain area

Comparing the profit per land allotted

Based on the two values crop usefulness index was computed.

Game theory approach to farm decision to policy link

Using the game theory rationality assumption, the decision-making of farmers was examined. The choice of that could be cultivated and its link with the strategic options A1, A2, A3,... And that will be presented in the form of a payment matrix. Table 1 will display this matrix.

Table 1. Pay of matrix of strategies

A	S			
	S ₁	S ₂	...	S _n
	P ₁	P ₂	...	P _n
A ₁	R ₁₁	R ₁₂	...	R _{1n}
A ₂	R ₂₁	R ₂₂	...	R _{2n}
⋮			⋮	⋮
A _m	R _{m1}	R _{m2}	...	R _{mn}

A = Set of strategic alternative A_i (for $i = 1, 2, \dots, m$)

S = Set of faced condition by S_j (for $i = 1, 2, \dots, n$)

R = Set of payoff R_{ij} by choosing strategic alternative A_i if facing S_j situation. P = Probability distribution of S

Source: Adapted from Adeoye (2012)

Making decisions about strategic alternatives involves deciding what crop will be planted. Assuming all farmers are rational and work to maximize their profits, the set of conditions they encounter includes risk and regulatory interventions. According to Adeoye et al. (2012), there are various characteristics to consider when utilizing game theory to determine the optimum strategic alternative for managing farming hazards.

Prior to establishing the risk management practices of horticulture farmers in accordance with the selection criteria, the measurement function must be built. According to Maximax standards, the farming industry is one that bears little risk. It shows that they are ready to take on any farming risks. The Maximin Criteria state that farmers are risk averse and would not be at all prepared to take this risk if anything terrible occurred or if they received the lowest price. The maxima criteria is a tactic for the optimistic person. The decision-maker will select the choice that, after accounting for all potential maximum rewards, will result in the best result. These constraints will produce results that are consistent with decision-makers that favor the greatest rewards and don't hesitate to take risks (Pazek, 2009).

Results

Women in farm decisions

Gender mainstreaming has increased gender engagement in non-agricultural activities (Dittoh, 2015). Their capacity to impact household decisions, particularly those pertaining to agriculture, received less attention ((Kinati & Mulema, 2016). This study aims to identify the role, level, and preferences of women's participation in agricultural decisions. Activities Women's participation in agricultural production and decision-making are influenced by social norms (Fernando, 2020). Effective decision-making on farms also requires consideration of the person making the decision. In addition to cooking and taking care of the household, women are observed to be involved in agricultural production activities.

Cleaning, seeding, and weeding are the particular tasks in which women are very engaged. Women are reported to be less involved in agricultural decision-making notwithstanding their involvement. For instance, as shown in table 10, 52% of respondents say they always consult their women while making farm decisions, whereas the other 48% only do so occasionally. According to 85% of respondents, women have a voice in deciding which crops are grown. This conclusion broadly agrees with those of Mulugeta and Amsalu (2014). Eighty percent of those who are hungry are women, and two thirds of them reside in climate change-prone regions.

Table 2. Women involvement in farm decisions

Variable	Category	Frequency	Percentage
Wife tell	Always	202	51.53
	Sometimes	184	46.94
	Never	6	1.53

Variable	Category	Frequency	Percentage
Role in crop choice	No	56	14.89
	Yes	320	85.11
Preference	Consumption		78
	Profit		22
Involvement in sales	High	176	44.5
	Low	216	55.1
Food purchase	Both	264	70.2
	Only women	112	29.8

Source: Own survey, (2018)

Table 2 shows that men (husbands) predominated in crop sales, with 55% of respondents rating the role of women in crop sales as low. Vegetables are even associated with low participation, which results in women having less liquidity than their male counterparts. Ednah et al. (2016) discovered similar outcomes when they discovered that females were losing control over income. Women's lack of financial resources affects their ability to bargain and changes their crop selection from one based on profit to one based on home consumption.

The results show that women's engagement in production decision-making is generally better than their marketing side. Even while it appears that women make decisions at the family level and in agricultural production operations, their influence in this area is negligible in comparison to that of men. Participants in both kebeles' agreed that the gender division of labor, which results in differences between husband and wife in the degree of decision-making authority, is a factor in the reasons for/restraints on women's participation in agricultural production decision-making. Even when husband and wife consult one another about their home and other matters, the husband typically makes the final choice. However, due to people's increased access to education, this trend is changing.

Productivity, calorie and revenue comparisons

It is feasible to assess trade-offs between two dimensions by figuring out how much of one dimension must be lost to make up for a change in the other when comparing the effect of these alterations on the rating. The two biggest tradeoffs are the calorie-revenue tradeoff and the risk-return tradeoff. Due to urbanization and population expansion, there is a decreasing amount of arable land; therefore, a quantitative approach to yield and other attributes will be crucial for optimal exploitation and future algorithm improvement.

Although each crop has a distinct function to play and set of traits, this study evaluates each crop's relevance based on its productivity, dietary advantages, and economic impact. One can evaluate the contributions of different crops to food security by creating index-based calorie contribution and revenue per hectare. This could guarantee that commercialization benefits both equity and efficiency: Germond (2013b) proposes a division between national and farm level interests, with the former focusing on feeding more people through crops on the same amount of land, which may be approximated by

calories per ha, and the latter, which might be represented as revenue per ha, optimizing revenue through crops. Instead than concentrating on trendy crops, this index will help to determine the type of food security actions.

Table 3. Calorie and revenue comparisons

Crop type	Productivity	Price per Q	Calorie per kg	Calorie per ha	Revenue per ha
Teff	14	2700	3660	62220	27000
Sorghum	25	1845	3390	91530	46125
Onion	90	2800	400	37200	644000
Mungbean	14	2506	3500	45500	35000

Source: Own computations, (2018)

The study discovered a trade-off between revenue and caloric content for the chosen crops. According to table 3, sorghum has the highest caloric content per hectare while mung beans have the lowest, even if onions yield more money than the other crops. Both the focus group discussion and the interview with development agents made it clear that while there is some lobbying on the part of development agents to influence crop choices, the most effective way to carry out such interventions would be through compensations. The index value was 0.3, which indicates that sorghum now provides 220 more calories while giving up 1 birr in revenue that onion growing could have produced. Farmers that choose to grow more caloric-dense crops will experience lower profitability from a food security perspective. If the government were to encourage sorghum farmers, either that revenue loss could be made up for or 200 more calories could be made affordable by subsidizing 1 Birr.

Investment

Looking on farmer's asset ownership only 6% of their asset is directly linked to agriculture. Even the richer farmers are found with no pump and modern farm equipment despite owning vehicles and other business firms. This will lead all agricultural investments are either forced or none and lead to long term investments on agriculture is expected only from government. Such lack of investments on agriculture could contribute to rural urban gap. Part of agricultural revenues should be forced to be reinvested on agriculture and in the area of production geographically.

The basic goal of commercializing agriculture is to increase farmer income. However, there are questions about how farmers are spending their extra income and their investments which are trading on non-agricultural commodities and transport vehicles. 60% of the farmers in this survey have investments, which are not primarily related to agriculture. Financial flow needs to be partially managed as a sector. Although agriculture should help other sectors flourish, in our country it has a propensity to become financially dry. Any legislation might ensure that even a tiny amount of the additional revenue stayed in the production region as well as in the sector, allowing

long-term agricultural investments like irrigation and soil management to be self-financing and better correlated with a balanced urbanization rate. Theoretically, production and conservation goals may be more effectively aligned if resource users were paid to protect environmental features (Anrew et al, 2023).

Discussions

Farmer-government Payoff

Table 4 lists the strategies available to farmers, along with the results of each strategy. In this instance, the government has made ensuring the availability of food a top priority, and farmers are viewed as rational producers looking to maximize their financial yields.

Table 4. Farmer payoff table

Farmer	No condition; No intervention	All farmers are expected to grow one crop highest revenue per ha	Mono cropping and specialization
	Condition; Risk	Market prediction (experience)	Multiple cropping
	Subsidy	Making revenue of all crops equal	Mono cropping

Source: Own (2018)

Agricultural subsidies are an important factor affecting farmers’ production decision-making behavior, and they are an effective incentive that significantly affects farmers’ green production behavior (FGPB) (Chen et al., 2017). On the one hand, agricultural subsidies can reduce the expected cost of farmers adopting green production technology and then increase the expected net income of farmers, thus promoting FGPB (Pietola, 2001). On the other hand, subsidies for means of production can reduce the real prices of polluting factors of production, which will make farmers increase their investment. Table 5 lists many strategies that the government could employ to strengthen crop choice. One popular strategy is the application of restrictions, which the Ethiopian government did when producing wheat, although farmers criticized this approach, and its viability is called into doubt. If farmers paid/subsidized the gap between what they would have earned if they had grown what they wanted and what they got from wheat, would provide better results.

Table 5. Government payoff table

Government	No intervention	Free market but distorted	Inflation and food insecurity
	Restrictions	Market prediction (experience)	Not sustainable and high supervision cost
	Subsidy	Cost and market distortion	Food security Food price stability

Source: Own (2018)

Policy alternatives

Here policy options that could be available are presented on table 6, where tradeoffs estimated in the previous sections can be efficiently exploited. This is only from the study area point of view for the national interest it is subject to inclusions and comparisons of all crops and all ecologies and productivities.

Crop related policies

The United Nations Food and Agriculture Organization (FAO) estimates that 828 million people, or 10% of the world's population, go to bed hungry each night, an increase of 46 million from the previous year. The future outlook for hunger suggests that it will continue, with more extreme weather events having a destructive impact. According to Ellis (1993), farm families work toward a number of objectives at once, such as ensuring a sufficient supply of food and other necessities for the family, as well as optimizing monetary gain. "Even if the price of food commodities increased globally, country-level price rises vary because different countries have distinct policies. (Tothova, 2023)

For instance, several nations use consumer subsidies to fix prices for consumers and protect them from market swings at the expense of the national budgets for a limited number of products. The resilience and capacity of nations to adapt to food shocks are weakened by cumulative global economic shocks, particularly sharp market disruptions and skyrocketing food prices. In several significant food crises, economic shocks have superseded conflict as the main cause of acute food shortages and malnutrition.

Table 6. Crop specific policy

Crop type	Advantage	Policy type	Policy Recommendation	Subsidize form
Sorghum	Higher calorie per area of production	Food security and income transfer	Subsidize	Inputs+ cash+ government purchase
Onion	High earning	-	No compensation	
Mung bean	High earning	Macro- economic stability	Subsidize	Subsidize insurance
Teff	High earning	-		

Source: Own (2018)

Farmers have adequate knowledge of their produce, but they have limited knowledge of integration, which is crucial. In this study, specific investment decisions made by the government for Ethiopian agriculture were examined, along with the beneficiaries of those initiatives. In addition, how the government uses institutions and regulations to sway farmer decisions in favor of its own interests, along with the resulting price and trade distortions, are all studied. Public spending must promote equitable resource allocation, lower inequality, and follow the correct transfer of resources.

Wheat

Recently with dream of being self-sufficient and a major wheat exporter in Africa, the government of Ethiopia is forcing farmers to grow wheat. No argument wheat could play important role in food self-sufficiency. The study found the approach associated with backlash with farmers (see Appendix D). Another complaint posed by Bale farmers was the restriction on to whom they sold their produce. Farmers were restricted from selling wheat in the open market and were forced to sell only to farmer cooperatives, which paid below the market price and costlier follow up (Yilma 2023). The sole crop that the Ethiopian government advises being subsidized as part of its pro-poor initiatives is wheat. Success are registered (see attachment B), which will assist in addressing inflation and preventing recurrent bread and floor subsidies. The government can stabilize the price of wheat by subsidizing production, or it can use contract farming to convert some of the safety net funds into in-kind transfers of wheat and support the establishment of food banks. It would make the choice separate by separating personal consumption from commerce.

Fertilizer subsidy

To help farmers with supply issues and price increases in the fertilizer market, the government is looking into loan options and subsidies. However, these subsidies are becoming burdensome because the government requested 21 billion birr for a one-year fertilizer subsidy (see Appendix D), which has a significant negative impact on the budget deficit and is also unsustainable. This study suggests fertilizer subsidies for only those crops that contribute more to food security, as measured by the crop usefulness index, in order to address this problem.

Table 7. Policy framework recommendations

Existing policy	Problems/what could be achieved	Recommended change
Safety net	Food security/inflation	Make ½ of it using in kind (from subsidized crop)
Fertilizer subsidy	Reduce government expenditure	Only for selected crop for subsidy
Crop choice manipulations	National plan and climate change adaptation	Compensate using revenue trade off from higher revenue crop in the same area
Agriculture investment	Enable to have Community financed irrigation schemes	More financial restrictions that could keep with in the sector
Insurance	Reduction of vulnerability	Make sure every productivity has insurance coverage
Farm clusters	Avoid conflicts and reduce cost of governance	Promote centralized specialization

Productive safety net

Social payments like school meals and safety nets are more crucial now than ever because of the crisis of food security and the increase of food prices. To ensure food security, the government might pay for half of it in kind. This enables the establishment of a food bank and the use of wheat subsidies rather than payments between the government and farmers.

Insurance subsidy

Since risk is the issue to be addressed, the government should change and subsidize insurances for other crops like mung bean and coffee because they are highly profitable. In this regard, the government is focusing on expanding insurances and creating an agricultural bank, which is great, but insurance may be subsidized at commercial banks until that time. Additionally, by making each production activity underinsured, this will assist farmers in concentrating on a particular activity rather than viewing income diversification as risk mitigation. There are insurance subsidies in many nations, but they vary greatly in terms of coverage, government engagement, subsidy level and rate, implementation standards, and institutional framework.

Conclusions

The government discovers an easier approach to accomplish its pro-poor goal by using agriculture policy. But for this to be in line with liberalization and sustainable, there must be clear crop purposes. Crop related policies are found implemented by the government of Ethiopia with the objective of securing higher productivity and achieving welfare. Those policies are not crop and area specific. The policies are found less sustainable because of farmer government links.

All crops do not deserve subsidy the one having higher contribution to food security should get subsidies. Profitable crops areas should finance their own improvement research and adaptation.

Availability of dietary important crops in the market enabled farmers to meet the family's need and focus on commercialization.

Farmers' investment decisions were not directly associated with agriculture which will affect long term investment in agriculture and aggravate rural urban balance. Women involvement in decisions in production and marketing activities had a wider difference.

Crop produced are found with different attributes which lead to trade off among this benefits. Both calorie-revenue and Risk-revenue tradeoffs existed. Mung bean found with the highest revenue and highest risk and sorghum found with higher calorie. Crops have been discovered with a range of attributes, and strategies for sustainability and lowering intervention costs could take advantage of these. Increased independence in agriculture should result from rising food prices.

For all crops grown in the nation, a crop usefulness index needs to be created. This would help efforts in boosting national calorie availability. Further research on the optimal crop for land allocation is required, and plans for non-agricultural investments must be coordinated with them.

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Conflict of interests

The authors declare no conflict of interest.

References

1. Adeoye, I. B., Yusuf, S. A., Balogun, O. O., & Alabuja, F. O. (2012). Application of game theory to horticultural crops in south-west Nigeria. *Journal of Agricultural and Biological Science*, 7(5), 372–375. <https://www.cabdirect.org/cabdirect/abstract/20123213203>
2. Ayal, D. Y., & Filho, W. L. (2017). Farmers' perceptions of climate variability and its adverse impacts on crop and livestock production in Ethiopia. *Journal of Arid Environments*, 140, 20–28. <https://doi.org/10.1016/j.jaridenv.2017.01.007>
3. Barrios, S., Bertinelli, L. and E. Strobl (2008). "Dry Times in Africa", CREDIT Working Paper, 03/07. <http://hdl.handle.net/11159/529984>
4. Chen, Y., Wen, X., Wang, B., and Nie, P. (2017): Agricultural pollution and regulation: How to subsidize agriculture? *Journal of Cleaner Production* 164, 258–264. <https://doi.org/10.1016/j.jclepro.2017.06.216>
5. Demeke, M., Dawe, D., Tefft, J. F., Ferede, T., & Bell, W. (2012). Stabilizing price incentives for staple grain producers in the context of broader agricultural policies: debates and country experiences. *RePEc: Research Papers in Economics*. <https://econpapers.repec.org/RePEc:ags:faoaes:288996>
6. Dittoh, S., Snyder, K. A., & Lefore, N. (2015): Gender policies and implementation in agriculture, natural resources and poverty reduction: case study of Ghana's Upper East Region. <https://doi.org/10.5337/2015.205>
7. Ednah Ngoma-Kasanda, Sichilima, Timothy, and Ikabongo Ikabongo. (2016). Gender and Decision Making in the Maize Sector. https://beamexchange.org/uploads/filer_public/67/70/677053c0-8171-4067-a55f-854ff476d189/gender_study_groundnuts_sector.pdf
8. Ellis Frankz. *Peasant Economics: Farm Households and Agrarian Development*. Wye Studies in Agricultural and Rural Development. New York: Cambridge University Press, 1988. 272 pp. https://www.academia.edu/25937108/Peasant_Economics_Farm_Households_and_Agrarian_Development_Frank_Ellis

9. Fernando, A. (2020): How Africa Is Promoting Agricultural Innovations and Technologies amidst the COVID-19 Pandemic. *Molecular Plant* 13(10), 1345–1346. <https://doi.org/10.1016/j.molp.2020.08.003>
10. Germond, C. (2013b): Preventing reform: farm interest groups and the common agricultural policy. In Palgrave Macmillan UK eBooks (pp. 106–128).
11. Habte, Z., Legesse, B., Haji, J., & Jaleta, M. (2020). Determinants of supply in the wheat value chain of Ethiopia. *Eastern Africa Social Science Research Review*, 36(1), 37–61. <https://doi.org/10.1353/eas.2020.0002>
12. Hazell P (2010) The Asian Green Revolution. In: Spielman DJ, Pandya-Lorch R (eds) Proven successes in agricultural development: a technical compendium to millions fed, an IFPRI 2020 Book. IFPRI, Washington D.C. The Asian Green Revolution (core.ac.uk) <https://doi.org/10.3390/agriculture12081191>
13. Kinati, W. W., & Mulema, A. (2015). Kinati, W. and Mulema, A.A. (2016): A gendered analysis of community profiles of target sites for small ruminant value chain interventions in Ethiopia. ICARDA/ILRI Project Report. Nairobi, Kenya: ILRI. ICARDA/ILRI Project Report. <https://cgspace.cgiar.org/handle/10568/79376>
14. Lencucha, R., Pal, N., Appau, A., Thow, A., & Drope, J. (2020). Government policy and agricultural production: a scoping review to inform research and policy on healthy agricultural commodities. *Globalization and Health*, 16(1). <https://doi.org/10.1186/s12992-020-0542-2>
15. MoFED (2022) Natural resources management directorates. Small-scale irrigation situation analysis and capacity needs assessment. MoFED, Addis Ababa
16. Mulugeta, M., & Amsalu, T. (2014): Gender, Participation and Decision Making Process in Farming Activities: the case of Yilman Densa District, Amhara Region, Ethiopia. *Journal of Economics and Sustainable Development* 5(1), 28–34. <https://iiste.org/Journals/index.php/JEDS/article/view/10273>
17. Pan, S., Di, C., Chandio, A. A., Sargani, G. R., & Zhang, H. (2022): Investigating the Impact of Grain Subsidy Policy on Farmers' Green Production Behavior: Recent Evidence from China. *Agriculture*, 12(8), 1191.
18. Pažek, K., & Rozman, Č. (2009). DECISION MAKING UNDER CONDITIONS OF UNCERTAINTY IN AGRICULTURE: A CASE STUDY OF OIL CROPS. DOAJ (DOAJ: Directory of Open Access Journals). <https://doaj.org/article/718ff40057ae49efb36e8c49b21de7d4>
19. Pietola, K. S. (2001): Farmer response to policies promoting organic farming technologies in Finland. *European Review of Agricultural Economics*, 28(1), 1–15. <https://doi.org/10.1093/erae/28.1.1>
20. Rashid, S., Assefa, M., & Ayele, G. (2007): Distortions to agricultural incentives in Ethiopia. RePEc: Research Papers in Economics. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2010/08/06/000333037_20100806002821/Rendered/PDF/560350NWP0ET0v16B01PUBLIC10Ethiopia.pdf

21. Raza, A., Razzaq, A., Mehmood, S. S., Zou, X., Zhang, X., Yan, L., & Xu, J. (2019a). Impact of Climate Change on Crops Adaptation and Strategies to Tackle Its Outcome: A Review. *Plants*, 8(2), 34. <https://doi.org/10.3390/plants8020034>
22. Remans, R., Flynn, D. F. B., DeClerck, F., Diru, W., Fanzo, J., Gaynor, K. M., Lambrecht, I., Mudiope, J., Mutuo, P. K., Nkhoma, P., Siriri, D., Sullivan, C., & Palm, C. (2011): Assessing nutritional diversity of cropping systems in African villages. *PLOS ONE*, 6(6), e21235. <https://doi.org/10.1371/journal.pone.0021235>
23. Shikur, Z. H. (2020): Agricultural policies, agricultural production and rural households' welfare in Ethiopia. *Journal of Economic Structures*, 9(1). <https://doi.org/10.1186/s40008-020-00228-y>
24. Torkelsson, Å., & Tassew, B. (2008): Quantifying women's and men's rural resource portfolios - empirical evidence from Western Shoa in Ethiopia. *The European Journal of Development Research*, 20(3), 462-481. <https://doi.org/10.1080/09578810802237623>
25. Van Der Velde, M., Green, S., Vanclooster, M., & Clothier, B. (2007). Sustainable development in small island developing states: Agricultural intensification, economic development, and freshwater resources management on the coral atoll of Tongatapu. *Ecological Economics*, 61(2-3), 456-468. <https://doi.org/10.1016/j.ecolecon.2006.03.017>
26. Welteji, D. (2018b): A critical review of rural development policy of Ethiopia: access, utilization and coverage. *Agriculture & Food Security*, 7(1). <https://doi.org/10.1186/s40066-018-0208-y>
27. World Bank (2022). *World Development Report 2008: Agriculture for Development*. Washington D.C.

MODIFICATION OF THE COBWEB MODEL INTO GENERALIZED LOGISTIC EQUATION FOR THE WHEAT PRICE ANALYSIS

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ABSTRACT

In the paper we constructed the new wheat growth model, based on the generalized logistic equation. Starting from the theoretical framework of the cobweb model, we adapted generalized logistic equation to better fit the real data of wheat prices, according to the presented wheat growth model. The aim of the paper is to present how logistic and generalized logistic equations can be used for both prediction of wheat prices and for the wheat price stability analysis. Data analysis showed better performances of the generalized logistic map in comparison with the conventional logistic map as a main result of this paper. For estimated parameters of the model the bifurcation diagrams also have been presented to show stability of wheat price over time. The conclusion is that the proposed model can be useful in predicting future wheat prices in the short-run period, as well as for the analysis of stability in conditions of uncertainty, which is also a recommendation for the application of the model in the future research.

Introduction

Since 1930 until now iterated maps were considered very important in the modelling and processing of many science fields. One of the most famous maps comes from the so called continuous logistic equation which was introduced by Verhulst in the middle of the 19th century. The dynamical behaviour of this continuous equation is

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trivial compared with that one presented by the discrete logistic map introduced in the 1960s (e.g., Ausloos and Miskiewicz, 2006; Lopez-Ruiz and Fournier-Prunaret, 2004; Stanojević and Kukić, 2018). The use of logistic equation for price stability analysis can be related with the famous cobweb model. The prices of non-storable goods are observed daily and are subject to strong fluctuations, while production of such goods requires a longer time. The cobweb model, originally presented by Kaldor in 1934, has been extensively investigated in a discrete time deterministic context. The model describes fluctuations of equilibrium prices as an independent market for non-storable good that takes one time to produce, so that producers must form price expectations one period ahead. Applications of the cobweb model mainly concern agricultural markets, such as the classical examples of cycles in wheat or corn prices (Goeree and Hommes, 2000). Within the early cobweb model producers simply form naïve expectations and demand and supply schedules are linear. It is important to explain the reasons why prices of goods in the agricultural sector fluctuate over time. According to the cobweb theorem, assuming that the supply and demand functions are linear, it can be shown that if the slope of the supply function is greater than the slope of the demand function, the oscillations around the equilibrium price and equilibrium quantity will decrease over time. If the opposite case holds, so that the slope of the demand function is greater than the slope of the supply function, then the oscillations will intensify, and the market will move away from equilibrium. This type of analysis within the cobweb theorem is particularly important in the field of agrarian economy, since agricultural production is known for the fact that supply oscillations often occur - due to the great influence of external factors, such as weather conditions, so the analysis of equilibrium stability is also important. According to the cobweb model, producers operate in market where production must be chosen before prices are observed, so their choices depend on prices they expect to prevail at harvest time. By assuming that producers take the current price as an estimate of the expected price, stability of the market equilibrium is shown to depend on relative elasticity of demand and supply functions. The traditional cobweb model therefore represents a very useful tool for the analysis of price dynamics (Milovanovic, 2011). One example of the agricultural production market that deserves the attention of analysts is certainly the wheat market. It has been shown in the literature that in the case of the wheat market there is a constant oscillation around the equilibrium price, so that a certain cycle can be observed in which the price of wheat alternately jumps and falls, depending on whether the supply is insufficient or excessive in relation to the demand. As a result of constant fluctuations in the price of wheat, the profitability of this agricultural activity is variable, which then points to the need for state intervention to stabilize the price of wheat with appropriate state measures and thereby prevent permanent fluctuations in the offer on the wheat market (Dieci and Westerhoff, 2009).

However, the traditional setting of the cobweb model, which assumes that the supply and demand functions are linear, has been modified over time, so a significant number of works have been published recently that start from different settings (Mitra and

Boussard, 2008; Evans and McGough, 2020). Also, the model has only theoretical value, and the possible range of dynamic outcomes is basically restricted to either dampened or exploding oscillations around the equilibrium price. As a result, the interest of researchers in creating new models that would enable the analysis of stability and price prediction of agricultural products, which would more realistically correspond to the observed characteristics of the market, is expanding. In the last twenty years, the growing popularity of nonlinear dynamics in economic analysis has brought about a renewed interest in cobweb models, and the basic setup has been modified in a way which include nonlinear elements. Some authors (e.g., Chiarella, 1988; Day, 1994; Hommes, 1998) considered nonlinear demand and supply functions with different adaptive expectations schemes.

The aim of the paper is to present how logistic and generalized logistic equations can be applied for the price stability analysis starting from the cobweb model – and eventually for making predictions about the future wheat price. To show the implementation of dynamic stability analysis in terms of difference equations we analyse the wheat prices. In general, the prices of agricultural products are very volatile during time, so it is important to examine the price stability for these products. This is valuable in recent period, as we are witnessing dramatic upheavals in the agricultural market due to different disruptions, e.g., Covid-19 pandemic or Russia-Ukraine war. We develop the new wheat growth model based on generalized logistic equation and test the power of the model based on real data of wheat prices. It should be emphasized that the new model may be valuable for researchers as it keeps mathematical elegance and also provides empirical accuracy. For that reason the model could be used as a replacement of the classical logistic equation in many applications, not only in economics. In the paper, it will be shown that the new growth model can be used for wheat price predictions in terms of stability, which may be interesting for different agricultural analysts. Considering the importance of wheat on a global level as a basic commodity, it is useful to create an appropriate methodological framework for the analysis of wheat price movements, especially due to the volatility of wheat prices on the world market.

Materials and methods

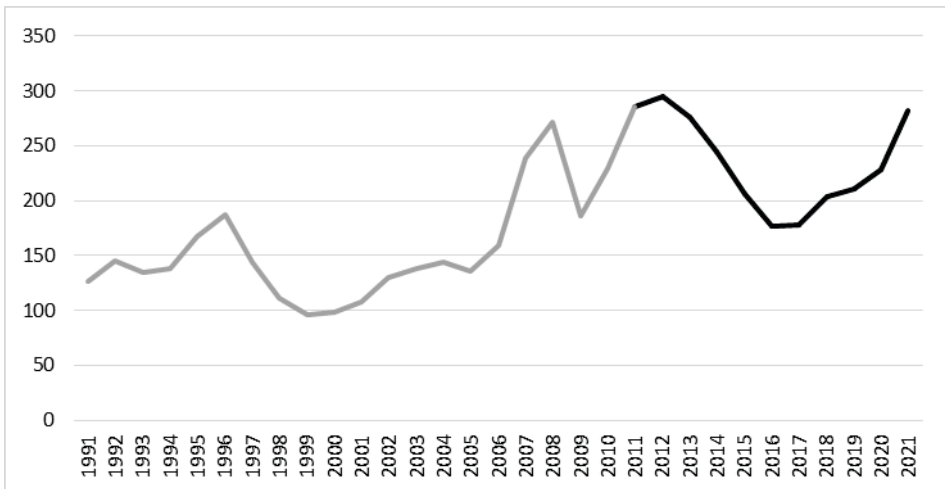
Wheat market characteristics within the framework of the price stability- Volatility of wheat prices

According to a recent FAO report (2022), it is expected that in the coming period, wheat price oscillations will be especially pronounced if we consider the decline in production with growing demand globally, which will cause the price of wheat to rise globally due to a lack of supply. As stated in the report, global wheat production in 2021 compared to 2020 decreased by nearly 1%, primarily due to the decline in wheat production in Russia, Canada, and the USA. However, wheat consumption is about 2% higher in 2021 compared to the previous year. The global increase in demand for wheat, as the report points out, reflects both the growth of the world population and

the increase in demand for food - especially in the EU, China, the UK, and the USA. As a result of these developments, the price of wheat on the world market increased from \$227/mt to \$281/mt, which represents a significant increase of about 25%. It is emphasized that the special attention of the states in the next period should be directed towards the adoption of measures that should mitigate the negative consequences of this trend in the price of wheat on the market, which are the result of disruptions caused by both the previous covid pandemic and the current crisis surrounding the Russian-Ukrainian conflict.

However, such frequent changes in the price of wheat are not typical. As can be seen from the Figure 1, historically, in the period from 1991 to 2021, significant fluctuations in the price of wheat can be observed on the world market. Until 2006, the price of wheat was relatively stable around the value of \$150/mt - except for 1999 and 2000, when the price was around \$100/mt. After 2006, as can be seen from the Figure, there are significant fluctuations in the price of wheat on the world market. Thus, the price of wheat decreased from \$270/mt in 2008 to \$185/mt, so the drop was as much as 30%. Immediately after that, there was a significant increase in the price of wheat at the global level from \$185/mt in 2009 to \$285/mt in 2010, so the price of wheat almost doubled in such a short period. Such pronounced price changes in this case are primarily a reflection of the disturbances caused by the global financial crisis in 2008. More significant changes in the price of wheat can be observed in the recent period, especially in the last ten years. Until 2016, a downward trend in the price of wheat was noticeable, followed by a period in which an increase in the price of wheat was recorded. This growing trend has been particularly pronounced in the last few years, as already pointed out in the FAO report.

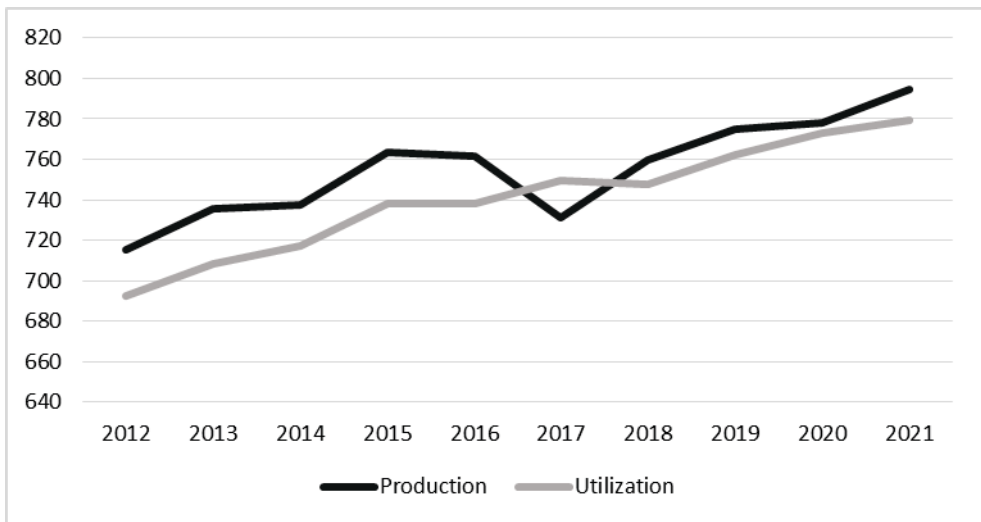
Figure 1. Wheat price trend at the world level, 1991-2021 (in \$/mt)



Source: FAO (<https://www.fao.org/faostat/en/#data>)

Such recorded volatility of wheat prices is not surprising but reflects the characteristics of the wheat market. As mentioned, demand is relatively stable, while supply is a subject to frequent changes due to the influence of external factors over which agricultural producers do not have influence. This situation is confirmed by the Figure 2, which shows the trends in wheat production and consumption in the period from 2012 to 2021. In this observed period of ten years, it can be noted that wheat production was higher than consumption during the entire observed period, except for 2017. Only in 2017, due to a poor agricultural season, wheat production was lower than consumption, which was reflected in the price of wheat. As can be seen from the Figure 1, until 2017, when the supply was greater than the demand, the price of wheat fell, after which there was a change in the trend, so that after 2017, the price of wheat gradually increased. This is quite in line with expectations, because if supply is greater than demand there is pressure for the price to fall, and if demand is greater than supply there is pressure for the price to rise.

Figure 2. Wheat production and utilization trends at the world level, 2012-2021 (in mill. tones)



Source: FAO (<https://www.fao.org/faostat/en/#data>)

Methods of logistic and generalized logistic map, with stability analysis

Although discrete logistic map was popularized in the 1970s by Robert May in his well-known paper published in the journal *Nature* (May, 1972), another complex map based on the iterated empirical reproduction curves of fish was introduced earlier by William Ricker in 1954 (Ricker, 1954). Furthermore, the analysis of many iterated maps was studied such as generating random numbers from the logistic map by John von Neumann in 1940 (Radwan, 2013).

Akhmet et al., 2014, state that irregularity is an inherent feature of reality and that regularity, as reflected in a constant solution of a model or a periodic and even almost periodic motion in mathematical sense, is a good assumption in natural science applications, but less so in social science. This, as they say, was pointed out in early scientific work and has been widely discussed in recent years (e.g., Rosser, 2000). One way of introducing irregularity in economics is by allowing for stochastic processes. A different approach is based on generating chaos in deterministic differential equations. The main property of a second approach is sensitivity, which can be interpreted as unpredictability in real world problems. In the literature, this is known as the butterfly effect (Lorenz, 1963). Differential equations have been used to model the dynamical characteristics of population system in the case of species with overlapping generations and by difference equations in the case of species with non-overlapping generations. Especially, when we cannot solve differential equation explicitly, we propose a finite difference scheme to solve result numerically. In the situation when population growth is not continuous but seasonal with overlapping generations, difference equations are also well models. The analysis of a nonlinear difference equation has been the high attractive topic in mathematics and many other fields in the resent years. In fact, the main problem is to find the closed-form solutions of the nonlinear difference equation, which is very challenging task. Today, there are many methods to transform nonlinear difference equations into linear form which solution is already known. With this transformation into linear form a large class of nonlinear difference equations were resolved in closed-forms (see El-Moneam and Alamoudy, 2014; Elsayed, 2014; Elsayed and Ahmed, 2016). Qualitative studies of a higher order rational difference equations and global asymptotic stability are also a topic of many resent papers (see Halim, 2015; Ibrahim, 2014).

The logistic map is a non-linear recurrence relation with a single control parameter r and in its first showing by Pierre Verhulst it described the population size x relative to the generation n as follows

$$x_{n+1} = f(x_n) = rx_n(1 - x_n) \quad (1)$$

and it is one of the simplest forms of a chaotic process (Li and Yorke, 2004). The parameter r is fixed and if we consider mapping as a function of r (since $f: [0,1] \rightarrow [0,1]$, then $r < 4$) it is well-known that chaos appears for some values of the parameter. The parameter r represents the growth rate of the population. After many iterations of x it reaches some values which are independent of its starting value for some values of the parameter. Some characteristic intervals for r that define different type of function behavior are given in the Appendix A.

Generalization of the logistic map (1) is introduced in the literature and has the following form

$$x_{n+1} = rx_n^p(1 - x_n^q), \quad x_n \in [0,1], \quad p > 0, \quad q > 0. \quad (2)$$

Analysis of (2) for parameters $p = 1, q = 2$ is done in Rak and Rak, 2015, and more advance analysis of the equation (2) for cases $(p, q) = (\alpha, \alpha), (p, q) = (1, \alpha), (p, q) = (\alpha, 1)$ is presented in Radwan, 2013. Since the model we propose in this paper is in the form (2), with $(p, q) = (1, \alpha)$, we will briefly present stability analysis for that case.

Denote left side of (2) as a function:

$$f(x, r, \alpha) = rx(1 - x^\alpha). \quad (3)$$

To achieve that $f: [0,1] \rightarrow [0,1]$ and also $f^n: [0,1] \rightarrow [0,1]$ for any iteration, the maximal value of the function must remain less than or equal to 1, so with this request we get first constrain for parameters' values. Consider (3) as a function of x , and denote

$f_{r,\alpha}(x) = rx(1 - x^\alpha)$. The maximum of the function is reached for

$$x_{max} = \left(\frac{1}{1+\alpha}\right)^{\frac{1}{\alpha}}. \quad (4)$$

From the demand that $f_{r,\alpha}(x_{max}) \leq 1$ we obtain that for fixed value of parameter α ,

the value of parameter r depends on α and the range for r is $\left[0, \frac{(\alpha+1)^{1+\frac{1}{\alpha}}}{\alpha}\right]$. As a next

step, we look for a fixed points with respect to r . Starting from $f(x^*, r, \alpha) = x^*$,

similar as in conventional logistic map, the fixed points are $x_1^* = 0$ and $x_2^* = \left(1 - \frac{1}{r}\right)^{\frac{1}{\alpha}}$, for $r > 1$. To consider stability we must investigate first derivative in the fixed points:

$f'_r(x) = r(1 - (\alpha + 1)x^\alpha)$. When we calculate values of the derivative in fixed points, we obtain $f'_r(x_1^*) = r$ and

$f'_r(x_2^*) = \alpha(1 - r) + 1$, so we conclude that for $0 < r < 1$ the only fixed point is x_1^* and it is stable. For $r > 1$, x_1^* becomes unstable and x_2^* is stable for

$|\alpha(1 - r) + 1| < 1$, which is for $r \in \left(1, \frac{\alpha+2}{\alpha}\right)$.

Results and Discussions

A producer wheat price growth model based on logistic map

The simple model is based on supply-demand model and the change of the price as a function of surplus of demand for wheat. It is well known that the simple supply-demand model is one of the typical examples of the use of dynamical systems in economics. The simplest linear supply-demand model with the naive price expectation in terms of stability does not show chaotic motion of prices. The use of adaptive price expectation instead of naive can show much more complicated dynamics, as presented in Hommes, 1991. In the Appendix A we presented overview of linear supply-demand model, which can be transformed into logistic equation. This linear supply-demand model gives equation: $p_{t+1} = \alpha p_t - \beta p_t^2$, where we denoted $p_t = P_t/P_{max}$ and P_t is a wheat price in the period t , P_{max} is maximal wheat price during the considered period, and the model may be transformed into logistic form ($z_{n+1} = f(z_n) = rz_n(1 - z_n)$), with appropriate change of variables. The dynamical analysis of the previous model is already well known in the literature, and we gave it in the Appendix A.

A producer wheat price growth model based on generalized logistic map

In this subsection we developed a new model based on nonlinear supply and demand functions. We choose the shape of the functions to obtain a model of the price growth which is reduced to generalized logistic equation ($z_{n+1} = f(z_n) = rz_n(1 - z_n^q)$). The model which we presented in the paper has arbitrary power q , which can be chosen to best fit the observed data and in this respect, this added parameter increase the flexibility of the system. Since the scientists' goals when they make a new model are mathematical elegance and empirical accuracy, we considered that the model we presented keeps the elegance of the logistic map while additional parameter increases empirical accuracy. In the Appendix B we presented transformation, step by step, of our model into generalized logistic form. In this subsection we gave only the main result.

Instead of linear supply-demand model we replaced appropriate equations by following:

$$D_t = a - bP_t^q, S_t = -c - dP_t^q$$

where $q > 0$ is arbitrary parameter, $a, b > 0$ and $c, d < 0$. In order to obtain chaotic wheat producer price growth model, we suppose that relative change in wheat price is

proportional with surplus of demand for wheat: $\frac{P_{t+1} - P_t}{P_t} = \theta(D_t - S_t)$. Further, we obtain:

$$P_{t+1} = P_t(1 + \theta(a + c) - \theta(b - d)P_t^q)$$

where a, b, c, d, θ and q are appropriate parameters. Again, in order to norm the price, we divided previous equation by P_{max} , denoted $p_t = P_t/P_{max}$, and obtained second model:

$$p_{t+1} = p_t(1 + \theta(a + c) - \theta P_{max}^q (b - d)p_t^q) = \alpha p_t - \beta p_t^\gamma.$$

Finally, with change of variable presented in the Appendix B ($z_t = \left(\frac{\theta P_{max}^q (b-d)}{1+\theta(a+c)}\right)^{1/q} p_t$), previous relation is equivalent to

$$z_{t+1} = (1 + \theta(a + c))z_t(1 - z_t^q) = r z_t(1 - z_t^q)$$

what is in the form of generalized logistic map. Further, it is possible to give stability analysis with the respect of the parameter $r = 1 + \theta(a + c)$ (more precisely, of parameters a, c, θ), what is beyond the scope of this paper. It should be bear in mind that with the introduction of the appropriate changes of variables, which leads to the generalized logistic equation, the previous interpretation of the corresponding parameters of the model (for which the stability analysis is performed) is lost – as new variables have been introduced. This is precisely one of the limitations of the presented model, which should be deal with in a broad analysis in the further research.

To test the power of developed model, we used data about wheat prices for Russia, China, Turkey, Australia, Serbia, and Brazil, during the period 1991-2021. Russia, China, Turkey, Australia, and Brazil were selected as the largest producing countries of wheat. However, in order to test sensitivity of the models, Serbia was also selected as a small producing country of wheat. Prices are in US\$/tone and available on www.fao.org.

First model is:

$$p_{t+1} = \alpha p_t - \beta p_t^2$$

and further may be transformed into logistic map. We have to estimate parameters α and β in this model.

We also analysed the wheat producer price growth with generalized logistic map, given with the suggested second model:

$$p_{t+1} = \alpha p_t - \beta p_t^\gamma, \gamma > 1.$$

To select the better model, it should be noted that the general framework for R^2 does not work out correctly if the regression model is not linear. Spiess and Neumeyer, 2010, investigated the effect of using R^2 to assess the goodness-of-fit for models that are not linear. Their study ran thousands of simulations and found that R^2 leads to false conclusions about which nonlinear models are better. Further, they explained that

computing R^2 for nonlinear model indicates the following problems: R^2 is consistently high for both excellent and appalling models; R^2 will not rise for better models all of the time; using of R^2 in order to pick up the better model leads to the proper model only 28-43% of the time. There are other goodness-of-fit measures which can be used for regression models that are not linear. For instance, it is common to use the standard error of regression and confidence interval. Smaller values of the standard errors and narrower confidence intervals indicate the better model.

In this part of the subsection, we provided estimates of all parameters for both models, α , β and γ , standard errors and 95% confidence intervals of those parameters, and for all considered countries the results are given in the Table 1.

Results suggested that generalized logistic model provides better estimates of the parameters. More precisely, standard errors are smaller and confidence intervals are narrower compared to the conventional logistic model. For this type of data nonlinear regression is much more flexible in the shapes of the curves that it can't fit. The previous model considers adaptive adjustments on the quantity of wheat produced instead of adaptive expectations on prices. From an economic point of view, chaos occurs more likely the faster producers adjust production and the more inelastic the market demand is.

Table 1. Parameter estimations, standard errors and 95% confidence intervals of the two models and six selected countries

	Param.	Estim.	Std.	95% Confidence interval	
			Error	Lower Bound	Upper Bound
Russia					
First model:	α	1.376	0.165	1.038	1.714
	β	0.603	0.221	0.148	1.058
Second model:	α	1.044	0.067	0.906	1.181
	β	0.431	0.145	0.133	0.729
	γ	9.942	6.385	-3.209	23.092
China					
First model:	α	1.156	0.076	1	1.312
	β	0.163	0.096	-0.035	0.362
Second model:	α	1.078	0.028	1.02	1.137
	β	0.196	0.058	0.076	0.315
	γ	14.865	9.527	-4.831	34.562
Turkey					
First model:	α	1.211	0.115	0.976	1.446
	β	0.329	0.165	-0.01	0.668
Second model:	α	1.03	0.044	0.94	1.12

	Param.	Estim.	Std.	95% Confidence interval	
			Error	Lower Bound	Upper Bound
	β	0.283	0.099	0.078	0.487
	γ	11.015	10.695	-10.969	32.998
Australia					
First model:	α	1.411	0.141	1.121	1.7
	β	0.612	0.2	0.202	1.021
Second model:	α	1.107	0.079	0.945	1.269
	β	0.418	0.12	0.171	0.665
	γ	6.068	3.72	-1.579	13.716
Serbia					
First model:	α	1.829	0.26	1.263	2.394
	β	1.138	0.338	0.402	1.873
Second model:	α	1.141	0.096	0.93	1.352
	β	0.593	0.158	0.246	0.94
	γ	8.719	5.212	-2.752	20.19
Brazil					
First model:	α	1.322	0.136	1.04	1.604
	β	0.451	0.189	0.058	0.844
Second model:	α	1.083	0.058	0.963	1.203
	β	0.327	0.113	0.09	0.563
	γ	8.426	5.683	-3.427	20.28

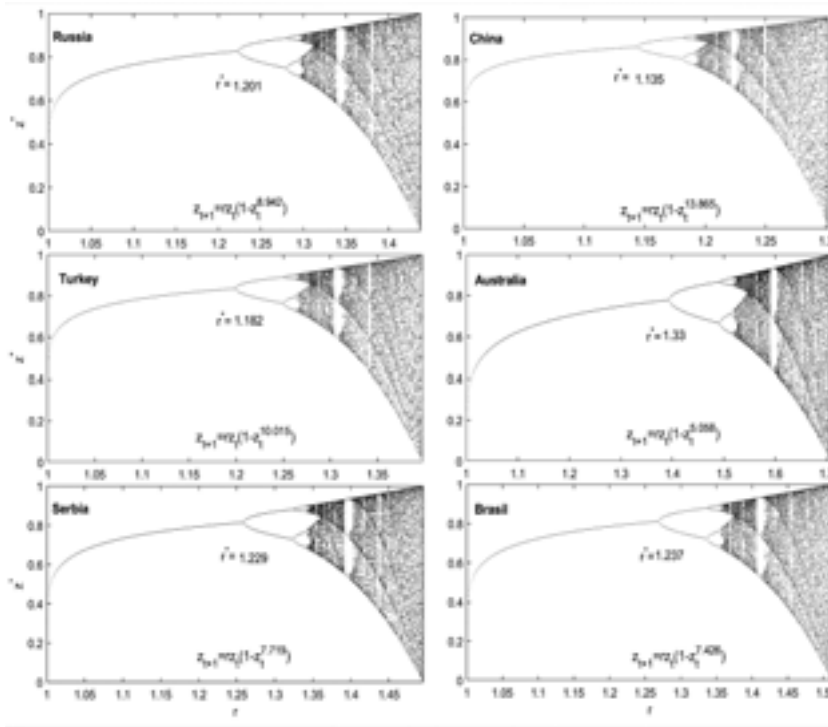
Source: Authors' calculations

Further, for each obtained value of γ we plotted bifurcation diagrams of generalized logistic map

$$z_{t+1} = rz_t(1 - z_t^{\gamma-1}).$$

From corresponding bifurcation diagrams (Figure 1) it may be concluded that for values of the coefficients from second model for each data set, the prices will converge toward stable steady state, with appropriate value of parameter r .

Figure 1. The dynamics of the second model. The three lines of panels present bifurcation diagrams for the wheat price with respect to the parameter r , for the six countries: Russia, China, Turkey, Australia, Serbia and Brazil



Source: Authors' calculations

A bifurcation diagram is a powerful tool for researching how the dynamical behaviour of a nonlinear model depends on a single parameter. As a model parameter changes, a bifurcation diagram is a qualitative change. For instance, a fixed point becomes unstable if one or more eigenvalues of the linearized dynamics around the fixed point cross the unit circle.

Figure 1 presents bifurcation diagrams for parameter r . The bifurcation diagram plots only stable equilibrium points and shows the long-term behaviour for all values of r at once. Bifurcation in the Figure 1 shows that for example, in the case of Russia, the wheat price is stable for $r \in (1, 1.201)$. With the increase in r , the first bifurcation occurs at $r^* = 1.201$ and the second between $r^* = 1.25$ and $r^* = 1.3$, the third around $r^* = 1.3$, ..., and then chaos occurs. Generally, a bifurcation occurs at a parameter value $r = r_0$ if the global dynamical behaviour of the function f_r undergoes some qualitative change as r passes through r_0 . There are number of different types of bifurcations that can occur, depending on the nature of the qualitative behaviour under consideration.

The bifurcations that are evident in the Figure 1, in the case of Russia, for the range $1 < r < 1.3$ are called *period doubling bifurcations*.

The bifurcation values for these six countries are $r = 1.201$, $r = 1.135$, $r = 1.182$, $r = 1.33$, $r = 1.229$, $r = 1.237$. It is therefore more useful to think of this point (bifurcation value for every country separately) as a period-doubling bifurcation. At that point a stable period-two orbit is born out. When r increases each of these two points bifurcates into two new points, as can be seen from the figure. These four points together constitute a period-four solution of the map. As r moves through a sequence of higher values, an infinite series of bifurcations is created by such period-doubling. It is easily illustrated that we move from stability through a sequence of a period doubling bifurcations to chaos.

Notice in figure the ‘windows’ occurring. Three are marked on the diagram. Such windows represent stable periodic orbits that are surrounded by chaotic behaviour (the dark regions).

Conclusions

In the paper we implemented generalized logistic equation in the chaotic wheat producer price growth model. Based on data analysis we showed better performances of the model compared to the conventional logistic map. The impact of estimated parameters in both models related to the wheat producer price has a sign in the expected direction. From the review of the generalized logistic map stability, we conclude that model predicts stable growth of the price, what is in the correlation with world’s trend of the foods’ prices growth, for the observed period. The analysis was performed using the data regards wheat prices in the period 1991-2021, after which the Ukrainian crisis followed, and therefore a big jump in wheat prices on the market occurred. In general, since it is difficult to predict prices even for a shorter period, we considered that the proposed model could more adequately predict price movements in the years to come. The mathematical apparatus used in this paper is well-known in the literature, but not with application in the field of market analysis of agricultural products, as far as the authors are aware. The paper also provides the theoretical frame of equilibrium point stability analysis, which represents a good basis for the further research.

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Conflict of interests

The authors declare no conflict of interest.

References

1. Akhmet, M., Akhmetova, Z. & Onur Fen, M. (2014). Chaos in economic models with exogenous shocks. *Journal of Economic Behavior and Organization*, Vol. 106, 95-108.
2. Ausloos, M. & Miskiewicz, J. (2006). Influence of information flow in the formation of economic cycle. In: *The logistic map and the Rout to Chaos*. Berlin: Springer-Verlang, 223-238.
3. Chiarella, C. (1988). The cobweb model: Its instability and the onset of chaos. *Economic modelling*, 5(4), 377-384.
4. Day, R. H. (1994). Complex economic dynamics-vol. 1: An introduction to dynamical systems and market mechanisms. *MIT Press Books*, 1.
5. Dieci, R., & Westerhoff, F. (2009). Stability analysis of a cobweb model with market interactions. *Applied Mathematics and Computation*, 215(6), 2011-2023.
6. El-Moneam, M. A., & Alamoudy, S. O. (2014). On study of the asymptotic behavior of some rational difference equations. *DCDIS Series A: Mathematical Analysis*, 21, 89-109.
7. Elsayed, E. M. (2014). Solution for systems of difference equations of rational form of order two. *Computational and Applied Mathematics*, 33(3), 751-765.
8. Elsayed, E. M., & Ahmed, A. M. (2016). Dynamics of a three-dimensional systems of rational difference equations. *Mathematical Methods in the Applied Sciences*, 5(39), 1026-1038.
9. Evans, G. W., & McGough, B. (2020). Equilibrium stability in a nonlinear cobweb model. *Economics Letters*, 193, 109-130.
10. FAOSTAT. (2023). Retrieved from <https://www.fao.org/faostat/en/#data/> (May 10, 2023)
11. FAO (2022). FMPA Bulletin. Food price monitoring and analysis. Retrieved from <https://www.fao.org/3/cc0908en/cc0908en.pdf> (May 8, 2023)
12. Goeree, J. K., & Hommes, C. H. (2000). Heterogeneous beliefs and the non-linear cobweb model. *Journal of Economic Dynamics and Control*, 24(5-7), 761-798.
13. Halim, Y. A. C. I. N. E. (2015). Global character of systems of rational difference equations. *Electronic Journal of Mathematical Analysis and Applications*, 3(1), 204-214.
14. Hommes, C. H. (1998). On the consistency of backward-looking expectations: The case of the cobweb. *Journal of Economic Behavior & Organization*, 33(3-4), 333-362.
15. Hommes, C. H. (1991). Adaptive learning and roads to chaos: The case of the cobweb. *Economics Letters*, 36(2), 127-132.
16. Ibrahim, T. F. (2014). Periodicity and Global Attractivity of Difference Equation of Higher Order. *Journal of Computational Analysis & Applications*, 16(1), 552-564.
17. Kaldor, N. (1934). The equilibrium of the firm. *The economic journal*, 44(173), 60-76.
18. Li, T. Y., & Yorke, J. A. (2004). Period three implies chaos. In *The theory of chaotic attractors* (pp. 77-84). Springer, New York.

19. López-Ruiz, R., & Fournier-Prunaret, D. (2004). Complex behaviour in a discrete coupled logistic model for the symbiotic interaction of two species. *arXiv preprint nlin/0401045*.
20. Lorenz, E. N. (1963). Deterministic nonperiodic flow. *Journal of Atmospheric Sciences*, 20, 130-148.
21. May, R. M. (1972). Will a large complex system be stable? *Nature*, 238(5364), 413-414.
22. Milovanovic, M. (2011). Microeconomic analysis. *Faculty of Economics, University of Belgrade*.
23. Mitra, S., & Bousard, J. M. (2008). A nonlinear cobweb model of agricultural commodity price fluctuations. *Department of Economics, Fordham University*.
24. Radwan, A. G. (2013). On some generalized discrete logistic maps. *Journal of advanced research*, 4(2), 163-171.
25. Rak, R., & Rak, E. (2015). Route to chaos in generalized logistic map. *arXiv preprint arXiv:1502.00248*.
26. Ricker, W. E. (1954). Stock and recruitment. *Journal of the Fisheries Board of Canada*, 11(5), 559-623.
27. Rosser, J. B. (2000). Chaos theory and complex macroeconomic dynamics. In *From Catastrophe to Chaos: A General Theory of Economic Discontinuities* (pp. 175-205). Springer, Dordrecht.
28. Spiess, A. N., & Neumeyer, N. (2010). An evaluation of R^2R^2 as an inadequate measure for nonlinear models in pharmacological and biochemical research: a Monte Carlo approach. *BMC pharmacology*, 10(1), 1-11.
29. Stanojević, J., & Kukić, K. (2018, January). Dynamical systems in economics. In *AIP Conference Proceedings* (Vol. 1926, No. 1, p. 020043). AIP Publishing LLC.

Appendix. Supplementary material

The following is the Supplementary material related to this article.

Appendix A

Suppose to have a good with the price P_t in the period t . The simplest dynamical system can be obtained with assumption that supply is function of expected price. The naive price expectation means that $P_t^e = P_{t-1}$ and $S_t = -c - dP_t^e$, $c, d < \mathbb{C}$, and by equating supply and demand we obtain simple discrete time cobweb model with well known stability of price, that can be stable, unstable or oscillate between two values in two-cycle. More complicated dynamics can be achieved either with use of adaptive price expectations or with nonlinear functions for demand or supply. The most often, as nonlinear supply function is chosen the S-shaped function $S_t = \arctg(\lambda \cdot (P_{t-1} - 1))$

As the demand function is decreasing function of the price, while the supply function is increasing function of the price, let us start from the linear functions:

$$D_t = a - bP_t \tag{5}$$

$$S_t = -c - dP_t \tag{6}$$

where $a, b > \mathbb{C}$ and $c, d < \mathbb{C}$. One can easily find the equilibrium price by equating supply and demand.

In order to obtain chaotic wheat producer price growth model, beside linear supply and demand functions (5) and (6), we suppose that relative change in wheat price is proportional with the surplus of demand for wheat:

$$\frac{P_{t+1} - P_t}{P_t} = \theta \cdot (D_t - S_t) \tag{7}$$

Substituting (5) and (6) into (7), we obtain:

$$P_{t+1} = P_t(1 + \theta(a + c) - \theta(b - d)P_t). \tag{8}$$

Relation (8) is in similar form as conventional logistic map:

$$x_{n+1} = f(x_n) = rx_n(1 - x_n) \tag{9}$$

what we will prove below.

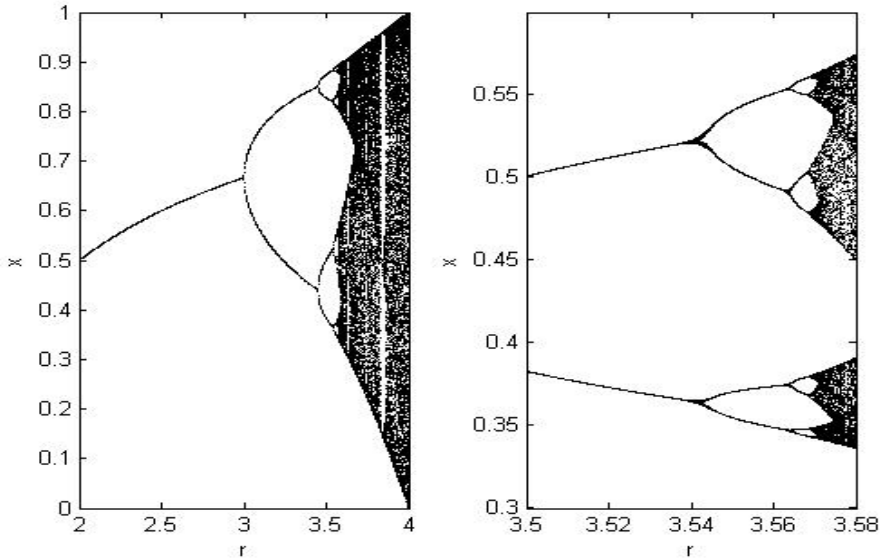
Some characteristic intervals for r that define different type of function behavior (and gives as stability analysis) are:

- $0 < r < 1$: the only stable fixed point is $x_1^* = \mathbb{C}$
- $r = 1$: in this case we have exchange of stability between two points, or transcritical bifurcation
- $1 < r < 2$: the fixed point x_1^* become unstable, but other fixed point $x_2^* = 1 - \frac{1}{r}$ becomes stable, and all solutions monotonically increase to x_2^*
- $2 < r < 3$: x_2^* is still stable fixed point, but solutions oscillatory converge towards it
- $r = 3$: flip bifurcation for x_2^* (see Figure 2)
- $3 < r \leq 1 + \sqrt{6}$: x_2^* becomes unstable and period 2 cycle shows up which is asymptotically stable
- $1 + \sqrt{6} < r \leq 3.544$: 2-cycle losses stability and 4-cycle arises and is asymptotically stable
- $3.544 < r \leq 3.5699$: process of period doubling continues to periods $2^2, 2^4, \dots$ and finally for $r \approx 3.5699$ chaos appears
- $3.5699 < r \leq 3.82$: transitions between periodical and chaotic behavior
- $3.82 < r \leq 3.85$: period 3 appears

- $3.85 < r < 4$: only chaotic behavior

Bifurcation diagram for logistic map, for r between 3.5 and 3.58 is given on the Figure 2.

Figure 2. Bifurcation diagram for logistic map (left) and enlarged part of bifurcation diagram (right), for r between 3.5 and 3.58



Source: Authors' calculations

Discrete dynamical system (8) is in the form similar to logistic map (9). In order to achieve the logistic map form, we must divide (8) with maximal value of the wheat price in the observed time series P_{max} . Denote $p_t = P_t/P_{max}$ and transform (8) to obtain:

$$p_{t+1} = p_t(1 + \theta(a + c) - \theta P_{max}(b - d)p_t). \tag{10}$$

Now, in (10), $p_t \in [0,1]$. To transform (10) into (9) we need to introduce one more change of variables:

$$z_t = \frac{\theta P_{max}(b-d)}{1+\theta(a+c)} p_t. \tag{11}$$

If we made additional assumption that coefficients a, b, c, d, θ and P_{max} are such that after change of variables (11) variable $z_t \in [0,1]$, then (10) can finally be transformed into form of (9):

$$z_{t+1} = z_t(1 + \theta(a + c)) \left(1 - \frac{\theta P_{max}(b-d)}{1+\theta(a+c)} p_t\right) = (1 + \theta(a + c))z_t(1 - z_t).$$

Since we briefly described well known behaviour of logistic map with dependence of parameter r (where $r = 1 + \theta(a + c)$), we will not get into the details here of the values where period doubling happens. We just mention that for $r \approx 3.835$ cycle of period three appears, and then the chaos appears, see Li and Yorke, 2004; famous paper.

Appendix B

We suggest non-linear supply-demand model instead of linear supply-demand model, with appropriate equations:

$$D_t = a - bP_t^q, S_t = -c - dP_t^q$$

where $a, b > 0$; $c, d < 0$ and $q > 0$ is arbitrary parameter. In order to obtain chaotic wheat producer price growth model, we suppose that relative change in wheat price is

proportional with surplus of demand for wheat: $\frac{P_{t+1} - P_t}{P_t} = \theta(D_t - S_t)$. Further, we obtain: $P_{t+1} = P_t(1 + \theta(a + c) - \theta(b - d)P_t^q)$.

Again, in order to norm the price, we divide previous equation by P_{max} , denote $p_t = P_t/P_{max}$, and obtain second model:

$$p_{t+1} = p_t(1 + \theta(a + c) - \theta P_{max}^q (b - d)p_t^q) = \alpha p_t - \beta p_t^q.$$

Finally, we introduce the change of variables: $z_t = \left(\frac{\theta P_{max}^q (b-d)}{1+\theta(a+c)}\right)^{1/q} p_t$, and from previous equation we obtain:

$$\left(\frac{\theta P_{max}^q (b-d)}{1+\theta(a+c)}\right)^{1/q} p_{t+1} = \left(\frac{\theta P_{max}^q (b-d)}{1+\theta(a+c)}\right)^{1/q} p_t(1 + \theta(a + c)) \left(1 - \left(\frac{\theta P_{max}^q (b-d)}{1+\theta(a+c)}\right)^{1/q} \cdot p_t\right)^q$$

.With change of variables, previous relation is equivalent to

$$z_{t+1} = (1 + \theta(a + c))z_t(1 - z_t^q) = rz_t(1 - z_t^q)$$

what is in the form of the generalized logistic equation.

ANALYSIS OF THE INFLUENCE OF THE PERFORMANCE OF THE PROFIT AND FINANCIAL POSITION IN THE PREDICTION OF BANKRUPTCY IN THE MEAT PROCESSING BRANCH

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ABSTRACT

The issue of solvency, i.e. the risk of bankruptcy of the company, is always a subject of concern for management and stakeholders, especially creditors and investors. Understanding the impact of indicators of profitability, liquidity and dynamic solvency on the risk of bankruptcy expressed by Altman's Z-score is the goal of the research, which is significant for both theory and practice. The research analyzes large companies from the branch of processing and preserving of meat of the Republic of Serbia for the five-year period 2018-2022. The findings for large companies for the processing and preserving of meat, based on regression analysis, show that ROA and Current Liquidity Ratio make a statistically significant contribution predicting the Altman Z score.

Introduction

Modern business is characterized by structural and dynamic changes, which implies uncertainty and a high risk of business loss for every market actor, which, as a condition of survival, orients companies to the minimization of risk in business. For rational business management, relying only on "feeling" is not a sufficient tool, but a continuous and systematic analysis of business risks is necessary, and in order to manage financial and operational risks for the sake of quick financial adjustment of

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the company. (Cavlin, et al, 2022). Namely, in order to maintain the vitality of the company, in addition to making a profit, the liquidity of cash flows and the security of financial maintenance in the long term must be respected, because otherwise the business-economic business slides into bankruptcy. Therefore, the methodological commitment of this platform of financial analysis of the company is oriented towards profit as a traditional, primary measure of maintaining vitality, i.e. factors of the profit position, and liquidity as a traditional, primary measure of the survival or disappearance of the company, i.e. factors of the financial position. (Malešević, Čavlin, 2020). Since there is no ideal performance measurement system, companies should strive to build an effective system that successfully connects critical success factors, goals and outcomes of work units and value streams with company goals and strategies (Todorović, Čupić, 2016). The identification of the performance of the profit and financial position, which significantly affect the possibility of predicting financial difficulties, aims to create an optimal analytical concept for predicting bankruptcy and maintaining the financial health of the company. In other words, the purpose of the analysis itself is to achieve a higher quality of the economy, ie. to look at the relationship between investment and results (Dončić et al., 2022; Dmitrović, 2015). Although the motives of the financial analysis can be focused on the analysis of the business capabilities of one's own company, the company's partner and the issuer of long-term securities, on the other hand, it should be borne in mind that insolvency and bankruptcy can have negative direct consequences for the company, as well as negative indirect consequences for social actors. The scope and dynamics of investment and financial decisions are determined by assessments and forecasts of bankruptcy, and good analytical practice, as suitable for a simple and quick assessment of the financial vitality of the company, is primarily highlighted by Altman's Z-core model (Čavlin, Tepavac, 2020). Financial vitality is the ability to ensure financial sustainability (liquidity) in crisis business conditions, which will not threaten the survival of the company (Čavlin, et al, 2022).

In accordance with the above, the following are the goals covered by this work, namely:

- ratio analysis of the profit and financial position of large enterprises in the meat processing industry in the Republic of Serbia, and
- analysis of the impact of key indicators of profit and financial position on the Altman Z score predictor of bankruptcy.

Our initial hypothesis is that there is an influence of financial performance on the prediction of bankruptcy, but there is no consensus on the direction and intensity of the influence of certain influencing factors, so the focus of the research is on large companies from the Branch - 101 Processing and preservation of meat and meat products of the Republic of Serbia, in order to create practical basis for system analysis and management of financial health of companies.

In order to achieve the goal of the paper, along with the analysis of relevant literature, in theoretical aspects, typical indicators of profitability indicators (ROA), liquidity indicators (Current liquidity, net cash flow), solvency indicators (dynamic solvency

ratio) and bankruptcy (Altman Z score) for companies from the meat processing industry sample in the Republic of Serbia has been analyzed, using data from official financial reports for the period from 2018 to 2022. The authors have performed the analysis of the quality of the impact of key financial performance indicators on the Altman Z score, using descriptive and statistical methods. The paper is structured as follows: an overview of the literature is presented below. The research method is then described, followed by results and discussion. The last section contains concluding remarks.

Literature review

The history of the development of models for bankruptcy forecasting begins with the univariate model, which is Beaver (1966), and the initial multivariate model for bankruptcy forecasting was developed by Altman (1968), who provided a key contribution to the development of bankruptcy forecasting, as evidenced by the fact that the article on platform Google Scholar collected more than 22,000 citations, and almost 5,000 citations on the Web of Science platform. (Srhoj, 2022).

In addition to Altman, in the past period, Ohlson (1980), Taffler (1983), Zmijevski (1984), Aziz et al. (1988), Koh (1992), Mossman et al., (1998), Hillegeist et al. (2004), Agarwal and Taffler (2008), Wu et al. (2010) and others tried to crystallize a late model for forecasting the risk of insolvency or bankruptcy.

Research attention relies on the formulation of classical balance-based models, which have in common that they mainly include measures of liquidity, leverage and profitability. The methodology of analytical models is based on the prevailing theoretical position that inadequate liquidity and profitability results in a high degree of leverage, which is directly related to a high probability of company bankruptcy. The essential differences in the construction of balance models for bankruptcy prediction are based on the number of selected variables and the application of certain statistical techniques for their testing. Namely, researchers are burdened, on the one hand, with the desire to use as few variables as possible without jeopardizing the representativeness of the outcome, and on the other hand, with the desire that an excessive number of selected variables in the model implies significant multicollinearity. The findings show that the prognostic reliability of the model is not primarily determined by the number of selected variables, because some analytical models built on the basis of 2 variables have very similar prognostic reliability as some prognostic models with 21 variables.

In fact, the primary challenge of the subject research is the identification of the most meritorious indicators in the function of creating an analytical platform for bankruptcy prediction, which focus on the following three aspects: stability of financial indicators over time, variation in financial indicators due to industry characteristics and creation of an information-focused financial indicator. (Sayari, et al, 2017). Namely, a significant number of authors (Ezzamelet al., 1987; Dašić, 2022; Pinches et al., 1973) find that financial indicators can be used to predict financial difficulties/bankruptcy if they show stable values over time. Then the authors (Gupta and Huefner, 1972; Johnson, 1979)

identify specific differences or variations in the value of financial indicators due to industry characteristics. While the authors (Chen and Shimerda, 1981; Pohlman and Hollinger, 1981) strive to reduce the level of multicollinearity between financial indicators to acceptable levels in building the model.

Therefore, the key support of the rational methodology of applying the analysis is the selection of an adequate system of relevant indicators that indicate the realization of the crisis, both according to individual business sub-criteria and for the entire company. Rational business decision-making requires an elaborate information system in which the analyst's profile plays a significant role. Namely, the analyst must possess the competencies and abilities to analyze and diagnose business disruptions at the earliest possible stage and to create reasoned proposals for a possible solution, inevitably relying on selected indicators as a meritorious information-analytical basis. Accordingly, theoretical and practical research, support for forecasting and predictors of bankruptcy are found in the performance of the company's profit and financial position (Savić & Milojević, 2022; Li & Du, 2011), of which the performance of profitability and liquidity, i.e. solvency, are most often used. In the principled theoretical approach and research related to the impact of profitability on financial health, it is very unlikely that a profitable company will have financial problems, and the most significant factor is return on asset-ROA (Putri & Dhini, 2019), although (Ananto) et al, 2017), (Curry & Banjarnahor, 2018) and (Dirman, 2020) find a negative impact of profitability on financial problems. The findings of a multiple linear regression analysis, show that the ratio of long-term sources and fixed assets in the group of processing and preserving of meat and meat products makes a statistically significant contribution predicting the return on assets (Čavlin et al., 2021).

When we analyze the impact of liquidity on financial health (Gamayuni et al., 2012) they find that if liquidity is higher, it is unlikely that company to have financial problems, while in (Dirman, 2020), testing of the relevant variables did not establish a statistically significant impact. In addition to the previously mentioned statements, the subject of attention is the impact on the financial the health of the size of assets, which results in the relationship that larger assets mean better financial health and the coverage of interest costs as an expression of dynamic solvency, which results in the relationship that the greater the coverage of interest and thus the greater the financial power, and vice versa.

Then, research also deals with the impact on financial health and bankruptcy risk of cash flows, in which Sayari & Mugan (2017) and Bernardin & Tifani (2019) found that a more generous net cash flow implies financial well-being health, while in (Dirman, 2020) no statistically significant impact was determined by testing the relevant variables. It can be further summarized that the disruption of financial health is significantly influenced by macroeconomic conditions (e.g. COVID, financial crises,...), and especially certain features of the company's context, such as performance, financial leverage and previously achieved financial results, while company size and activity they do not have a significant relationship with the impairment of financial health (Yazdanfar &

Öhman, 2020). While, according to research related to software activity, research and development costs are the most important predictor of company failure, followed by net sales and total revenue (Roumani et al., 2020). At the end of the review, it should be noted that the model was trained and validated using 27 selected financial variables from 2016 to predict the financial distress statement in 2017, and five variables were selected as significant predictors in the model: current ratio, return on equity, return on assets, debt ratio, and net working capital, and which shows that the value-added of the prediction model is its interpretability and high-performance accuracy (Pavlicko et al., 2021). Opting for profit and liquidity as the starting point of financial analysis and adhering at the same time to the general principle that there are relationships of mutual influence and mutual correlation between profit, liquidity and other performances of the company's financial system - it follows that the following indicators and norms of financial analysis are crystallized, which is a rational research format as follows:

Table 1. Overview of key indicators and norms of the company's profit and financial position

Rentability	
Return Operating Assets – “ROA”	net profit/ average business assets
Desirable theoretical norms: the higher the value of ROA, the better, and it depends on the activity of the company, although in principle, an ROA value of over 5% is generally considered good, and over 20% an excellent outcome.	
Static liquidity indicators	
Current liquidity ratio “CLR”	Current assets/Current liabilities
Desirable theoretical norms: the higher the value of CLR, the better, and it depends on the activity of the company, although in principle a CLR value of around 2 is generally considered an excellent outcome, while lower values are treated as bad outcomes, and neither higher values are considered good because they show inefficient use of funds	
Dynamic liquidity indicators - “cash flow”	
Net cash flow “NCF”	operating activity cash flow (CFO) + investment activity cash flow (CFI) + financing activity cash flow (CFF)
Desirable theoretical norms: in principle, a positive NCF value is better, and it depends on the company's activity, and a negative NCF is worse;	
Solvency	
Dynamic solvency-interest coverage “DSIC”	Operating profit/Interest expenses (by third parties)
Desirable theoretical norms: the higher the DSIC value, the better, and it depends on the company's activity, although in principle a DSIC value below 1.5 is generally considered questionable, around 2 is acceptable, and over 3 is an excellent outcome	
Altman Z score	$Z = EM \text{ Score} = 3,25 + 6,56X_1 \text{ (Current assets-Current liabilities/Total assets)} + 3,26X_2 \text{ (retained profit/loss/Total assets)} + 6,72X_3 \text{ (Operating profit/Total assets)} + 1,05X_4 \text{ (Equity/(Total liabilities-equity))}$
Desirable theoretical norms: $Z \text{ EMS} \geq 2.6$ “Safe zone” - the risk of bankruptcy and unfavorable financial position is very small; $Z \text{ EMS} \leq 2.39 \leq 2.59$ “Grey zone” - a zone of concern, but it is very likely that bankruptcy and an extremely unfavorable financial position will not occur in the next two years; $Z \text{ EMS} \leq 1.11 \leq 2.38$ “Grey zone” - zone of high risk of bankruptcy and extremely unfavorable financial position; $Z \text{ EMS} \leq 1.10$ “Unsafe zone” - risk of bankruptcy and extremely bad financial position according to the forecast 70% in within two years, or 95% within one year.	

Source: Authors' elaboration

Materials and methods

The research in the paper includes the analysis of key indicators of the financial position of large companies in branch 1011 - Meat processing and preservation (hereinafter: meat processing) in the Republic of Serbia for the period from 2018 till 2022. For the purposes of the research, a sample of companies was formed, classified by size as large and distributed in the meat processing branch - 1011 according to the methodology of the Republic Institute of Statistics of Serbia. The indicators were derived from publicly available information, i.e. official financial reports, which the companies in question submitted to the Agency for Economic Registers of the Republic of Serbia, and from direct inspection of the company's reports. In this research, a multiple regression analysis shall be used to determine what percentage of the variability of the dependent variable was explained by a particular set of independent variables and the relative contribution of each independent variable included in the regression analysis (Rosner, 2011; Radović Marković, Hanić, 2018). The independent variables taken into analysis for the period from 2018 till 2022 are the mean values of: Net cash flow, Current Liquidity Ratio, ROA, Solvency Ratio, Total assets. The dependent variable are the values of Altman Z score.

Results and discussion

The sample includes large enterprises from Branch - 101 Processing and preservation of meat and meat products, Area -10 Production of food products and Sector - C Processing industry. Out of a total of 2776 registered companies in the meat processing branch, 822 companies or 29.70% are active, and the sample includes large companies (8 in total) from Branch - 101 processing and preservation of meat and meat products, which make up 1.34% of the companies in the subject branch. According to published data, large enterprises in the meat processing branch that submitted annual financial reports for 2022 achieved a total of 80,291,077.00 dinars in total revenue, which represents 62.58% of the total revenue in the Branch - 101 Processing and preservation of meat and products, 6.91% of the total income of Area -10 Production of food products and 1.59% of the total income of Sector - C Manufacturing industry. The companies from the sample have 73,715,533.00 dinars in total assets, which represents 79.25% of the total assets of all active companies Branch - 101 Processing and canning of meat and products, 7.56% of the total assets of Area -10 Production of food products and 1.53% of total assets of Sector - C Manufacturing industry. The situation is similar throughout the researched period. Given that, the obtained results can be considered representative for the adoption of conclusions.

Developing analyzes of the financial position of the observed companies is based on the following statements:

- individual and average values of profitability indicators (ROA), liquidity indicators (Current illiquidity, net cash flow), solvency indicators (dynamic solvency ratio and Altman Z score) for companies from the meat processing industry sample.

Table 2. Overview of ROA indicator values in the meat processing industry

“ROA”	2018	2019	2020	2021	2022
Carnex d.o.o. IM Vrbas	0.04	0.03	0.04	0.05	0.05
IM Matijević, d.o.o.,Novi Sad	0.14	0.04	0.04	0.06	0.09
Mitros Fleischwaren d.o.o., S.Mitrovica	0.00	0.00	0.00	0.00	0.00
Neoplanata, do.o., IM Novi Sad	0.00	0.00	0.00	0.01	0.03
Vindija, d.o.o., Lajkovac	0.00	0.00	0.01	0.00	0.09
Yuhor, a.d., Jagodina	0.00	0.00	0.01	0.02	0.03
Zlatiborac, d.o.o., Beograd	0.05	0.01	0.03	0.03	0.06
ZZ Trlič, Ub	0.08	0.06	0.06	0.12	0.21
Mean value	0.04	0.02	0.02	0.03	0.07

Source: Authors' calculations

By analyzing the obtained results, it is possible to highlight the following profitability ratings in Table 1:

- the analysis of profitability indicators shows a significant representation of companies with worse values of the indicated indicators than the desired norms,
- only IM Matijević-Novu Sad and ZZ Trlič-Ub during the entire period have above-average values of the ROA indicator, while the values fluctuate for other precincts;
- further analysis shows a certain dynamics of profitability improvement, except for Mitros Fleischwaren-S.Mitrovica, which gives a somewhat better picture of the generally insufficient profitability of the company in the analyzed sample, and in the observed period.

Table 3. Overview of the value of the indicator “Current liquidity” in the meat processing industry

“Current liquidity”	2018	2019	2020	2021	2022
Carnex d.o.o. IM Vrbas	4.42	4.77	3.54	2.05	2.11
IM Matijević, d.o.o.,Novi Sad	1.46	1.44	1.48	1.61	2.30
Mitros Fleischwaren d.o.o., S.Mitrovica	1.18	0.90	0.65	0.66	0.62
Neoplanata, do.o., IM Novi Sad	1.91	2.41	1.79	1.68	1.69
Vindija, d.o.o., Lajkovac	1.32	1.39	1.52	1.59	2.14
Yuhor, a.d., Jagodina	0.65	0.60	0.63	0.64	0.74
Zlatiborac, d.o.o., Beograd	1.03	0.99	0.96	1.05	1.07
ZZ Trlič, Ub	2.06	1.90	1.75	1.69	1.28
Mean value	1.75	1.80	1.54	1.37	1.49

Source: Authors' calculations

Table 4. Overview of the value of the indicator “Solvency - dynamic ratio” in the meat processing industry

“Solvency - dynamic ratio”	2018	2019	2020	2021	2022
Carnex d.o.o. IM Vrbas	19.48	24.81	8.59	12.62	10.11
IM Matijević, d.o.o.,Novi Sad	188.74	173.25	2,789.89	135.23	590.14
Mitros Fleischwaren d.o.o., S.Mitrovica	0.00	2.06	0.00	1.67	0.00
Neoplanata, do.o., IM Novi Sad	12.19	3.42	0.00	20.86	19.13
Vindija, d.o.o., Lajkovac	5.52	18.22	20.69	7.01	46.09
Yuhor, a.d., Jagodina	1.61	1.75	4.91	5.38	6.21
Zlatiborac, d.o.o., Beograd	5.70	2.61	4.40	3.73	6.90
ZZ Trlič, Ub	227.17	131.20	90.78	89.66	84.82
Mean value	57.55	44.66	364.91	34.52	95.42

Source: Authors’ calculations

Table 5. Overview of the value of the “Assets” indicator in the meat processing industry

“Assets”	2018	2019	2020	2021	2022
Carnex d.o.o. IM Vrbas	15,173,338.00	16,242,649.00	14,999,039.00	13,918,594.00	16,530,916.00
IM Matijević, d.o.o.,Novi Sad	22,407,327.00	22,206,687.00	24,263,772.00	28,400,793.00	27,840,240.00
Mitros Fleischwaren d.o.o., S.Mitrovica	4,954,852.00	5,597,137.00	4,683,897.00	4,822,211.00	4,972,824.00
Neoplanata, do.o., IM Novi Sad	5,911,614.00	5,033,951.00	5,305,730.00	5,527,787.00	6,581,223.00
Vindija, d.o.o., Lajkovac	3,112,171.00	3,121,604.00	3,085,132.00	2,995,851.00	3,214,882.00
Yuhor, a.d., Jagodina	4,135,741.00	4,442,159.00	4,624,762.00	5,087,724.00	6,626,940.00
Zlatiborac, d.o.o., Beograd	4,910,187.00	5,320,256.00	5,031,516.00	5,020,046.00	5,601,654.00
ZZ Trlič, Ub	2,094,976.00	2,268,616.00	1,991,235.00	2,241,484.00	2,346,854.00
Mean value	7,837,525.75	8,029,132.38	7,998,135.38	8,501,811.25	9,214,441.63

Source: Authors’ calculations

Table 6. Overview of the value of the “Net cash flow” indicator in the meat processing industry

“Net cash flow”	2018	2019	2020	2021	2022
Carnex d.o.o. IM Vrbas	1,913,767.00	3,405,011.00	-2,117,362.00	-1,097,486.00	-498,482.00
IM Matijević, d.o.o., Novi Sad	2,262,186.00	-1,414,950.00	1,072,647.00	627,506.00	1,304,565.00
Mitros Fleischwaren d.o.o., S.Mitrovica	163,083.00	102,179.00	356,435.00	103,454.00	243,669.00
Neoplanata, do.o., IM Novi Sad	-36,313.00	129,664.00	41,293.00	282,876.00	381,904.00
Vindija, d.o.o., Lajkovac	40,872.00	99,830.00	131,884.00	84,776.00	362,123.00
Yuhor, a.d., Jagodina	140,069.00	134,951.00	149,316.00	233,414.00	309,035.00
Zlatiborac, d.o.o., Beograd	69,249.00	151,518.00	223,034.00	170,377.00	352,129.00
ZZ Trlič, Ub	169,874.00	31,353.00	19,054.00	247,439.00	332,270.00
Mean value	590,348.38	329,944.50	-15,462.38	81,544.50	348,401.63

Source: Authors’ calculations

By analyzing the obtained results, it is possible to highlight the following ratings of the financial or cash position (liquidity and solvency) in Tables 2, 3, 4, 5 and 6, namely:

- the values of the liquidity indicators for Mitros Fleischwaren-S.Mitrovica, Yuhor-Jagodina and Zlatiborac-Beograd during the entire period are below the average value of the branch and the desired theoretical norms, while for the other companies, except for Carnex, there are companies with worse values of the indicated indicators than the desired theoretical norms, which further implies a relatively unfavorable rating liquidity and solvency of the company.
- given an unfavorable assessment of the company’s liquidity and solvency, the realized dynamics of the net cash flow and the dynamics of asset growth improve financial health;
- the values of the nominal solvency of the coverage of interest costs show significant differences in financial power, i.e. the degree of generating operating cash for the payment of interest on loans, at Mitros during the entire period they are below the average value of the branch and the desired theoretical norms, while in other companies, except for Yuhor-Jagodina and Zlatiborac-Beograd, there is a favorable assessment of financial strength.

Table 7. Overview of the value of the indicator “Solvency-Altman ems score” in the meat processing industry

“Solvency- Altman ems score”	2018	2019	2020	2021	2022
Carnex d.o.o. IM Vrbas	11.83	9.50	8.84	7.16	6.95
IM Matijević, d.o.o.,Novi Sad	9.48	7.75	7.83	7.85	9.99
Mitros Fleischwaren d.o.o., S.Mitrovica	3.18	2.39	1.19	1.00	0.19
Neoplanata, do.o., IM Novi Sad	8.69	10.76	8.40	8.05	7.92
Vindija, d.o.o., Lajkovac	6.51	6.58	7.05	7.21	8.86
Yuhor, a.d., Jagodina	2.17	2.07	2.20	2.31	2.74
Zlatiborac, d.o.o., Beograd	5.46	4.90	5.27	5.64	6.01
ZZ Trlič, Ub	9.12	8.95	8.91	9.24	7.76
Mean value	7.06	6.61	6.21	6.06	6.30

Source: Authors’ calculations

By analyzing the obtained results, it is possible to highlight the following solvency ratings in terms of the risk of bankruptcy in Table 7, namely:

- the Altman Z Score values of Mitros Fleischwaren-S.Mitrovica and Yuhor-Jagodina show worse values than the average and desired theoretical norms, and for the rest of the listed companies, a favorable assessment of the financial stability of the meat processing industry can be given.

- the representation of companies whose value of the Altman Z score indicator is above the value of the desired theoretical norms is significant, which implies a favorable assessment of the solvency of the analyzed companies.

Therefore, the further subject of the research focuses on the analysis of interdependence and the impact of Net cash flow, Current Liquidity Ratio, ROA, Solvency Ratio, Total assets on the Altman Z score.

Table 8. Overview of the model summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.841	.707	.663	1.752056734866454

Source: Authors’ calculations

The Table 8 above shows that the coefficient of determination that shows the value of the R-square of 0.707. This means that 70% variation in Altman Z score can be explained significantly by variations in the given predictors: Net cash flow, Current Liquidity Ratio, ROA, Solvency Ratio, Total assets.

Table 9. Overview of the ANOVA results

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	251.252	5	50.250	16.370	.000
	Residual	104.370	34	3.070		
	Total	355.622	39			

Source: Authors' calculations

Based on the data above (Table 9), a significant value of 0.000 is obtained. Because the significance is less than 0.05 or 5% then H_0 is rejected and H_a is accepted, so it can be concluded together net cash flow, current liquidity ratio, ROA, solvency ratio, total assets affect Altman Z score.

Table 10. Overview of the coefficients

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.893	.595		3.182	.003
	ROA	23.061	6.496	.343	3.550	.001
	Current Liquidity Ratio	2.425	.343	.750	7.075	.000
	Solvency Ratio	.001	.001	.156	1.449	.156
	Total assets	-2.201E-008	.000	-.055	-.474	.638
	Cash flow	-3.976E-007	.000	-.115	-1.145	.260

Source: Authors' calculations

From the above test results (Table 10), it can be concluded as follows:

1. ROA has a positive influence on the Altman Z score.
2. Current Liquidity Ratio has a positive influence on the Altman Z score.
3. Solvency Ratio has no influence on the Altman Z score.
4. Total assets has no influence on the Altman Z score.
5. Net Cash flow has no influence on the Altman Z score.

It was found that [predictor variable 1 - ROA] significantly predicted [Altman Z score] ($\beta = [.343]$, $p = [.001]$).

It was found that [predictor variable 2 - Current Liquidity Ratio] significantly predicted [Altman Z score] ($\beta = [.750]$, $p = [.000]$).

The findings show that there is a significant and direct influence of ROA profitability indicators and “Current liquidity” on the Altman Z score predictor of solvency. In other words, increasing the value of ROA increases the value of Altman Z score, that is, increasing the value of “Current liquidity” increases the value of Altman Z score, and a higher value of Altman Z score means a lower risk of bankruptcy. On the other hand, the results of the analysis show that indicators of dynamic solvency, size of assets and net cash flow have no effect on the Altman Z Score, so starting from the prevailing theoretical views, it is advisable to expand the research to other branches and sectors from the domestic and global market.

Conclusions

The risk of bankruptcy of a company is influenced by numerous factors, and among other things, it is important to shed light on the influence of certain indicators of profitability, liquidity and solvency. Previous research has shown the connection between these categories in various economic activities. Analysis of meat processing activity in the Republic of Serbia in the period 2018-2022 gives an unfavorable assessment of the financial position, and a slightly more favorable assessment of the profit position.

The findings of the conducted regression analysis show a statistically significant and positive influence of the ROA and current liquidity indicators on the Altman Z score.

The obtained results justify the analytical approach to create a platform for rational management of the company’s financial health.

The further course of research on the issue of factors affecting the risk of bankruptcy should be focused on other activities and types of companies on the one hand, and on the other hand on a wider range of indicators of the company’s financial and profit position.

Conflict of interests

The authors declare no conflict of interest.

References

1. Agencija za privredne registre (APR). Preuzeto 23.09.2023. sa <http://www.apr.gov.rs>[in English: Serbian Business Registers Agency (APR). Retrieved on 09/23/2023. from <http://www.apr.gov.rs>]
2. Agarwal, V., & Taffler, R. (2006). Comparing the performance of market-based and accounting-based bankruptcy prediction models, *Journal of Banking and Finance*, 32, 1-37.
3. Altman, E. (1968). Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy, *Journal of Finance*, 23, 589-609.
4. Aziz A., Emanuel D.C., Lawson G.H., (1988). Bankruptcy prediction – an investigation of cash flow based models. *J. Manag. Stud.* 25(5), 419–437.

5. Bernardin, D. E. Y., & Tifani, T. (2019). Financial Distress Predicted By Cash Flow and Leverage with Capital Intensity as Moderating. *Jurnal Apresiasi Ekonomi*, 7(1), 18–29. <https://doi.org/10.31846/jae.v7i1.188>
6. Beaver, W.H. (1968). Market Prices, Financial Ratios, and the Prediction of Failure, *Journal of Accounting Research*, 6(2), 179-92.
7. Chen, K.H. and Shimerda, T.A. (1981) An Empirical Analysis of Useful Financial Ratios. *Financial Management*, 10, 51-60.
8. Čavlin, M., Đokić, A., & Miletić, V. (2022). Influence of liquidity and solvency on profitability of agro industrial companies in the conditions of COVID-19, *Economics of Agriculture*, 69(2), 441-453.
9. Čavlin, M., Vapa Tankosić, J., & Mirković, Z. (2022). Analysis of factors of financial and profit position as a method of integrated risk management in the mining sector, *Ekonomija: teorija i praksa*, 15(3), 56-73. <https://doi.org/10.5937/etp2203056C>
10. Čavlin, M., Vapa Tankosić, J., Miletić, V., Ivaniš, M. (2021). Analysis of the impact of liquidity on the profitability of assets of medium and large enterprises in the meat production activity of the Republic of Serbia, *Economics of Agriculture*, 68, (3), pp. 789-803. ISSN 2334-8453.
11. Čavlin, M., & Tepavac, R. (2020). Mogućnost primene klasičnih bilansnih modela za prognozi solventnosti – primer MSP u ruralnim područjima Republike Srbije. U: *Turizam i ruralni razvoj* (str. 506-523). Univerzitet Kragujevac, Vrnjačka Banja. [in English: 11. Čavlin, M., & Tepavac, R. (2020). The possibility of applying classic balance models for solvency forecasts - an example of SMEs in rural areas of the Republic of Serbia. In: *Tourism and Rural Development* (pp. 506-523). University of Kragujevac, Vrnjačka Banja]
12. Dašić, M. (2022). The influence of the quality of logistics services on user satisfaction in Serbia. *Oditor*, 8(2), 109-138. <https://doi.org/10.5937/Oditor2202108D>
13. Dirman, A. (2020). Financial distress: the impacts of profitability, liquidity, leverage, firm size, and free cash flow. *International Journal of Business, Economics and Law*, 22(1), 17-25.
14. Dmitrović, V. (2015). *Intelektualni kapital kao strateška performansa organizacije*. FON Univerzitet u Beogradu, doktorska disertacija. [in English: 13. Dmitrović, V. (2015). *Intellectual capital as a strategic performance of the organization*. FON University in Belgrade, doctoral dissertation]
15. Dončić, S., Pantić, N., Lakićević, M., & Radivojević, N. (2022). Expected shortfall model based on a neural network. *Journal of Risk Model Validation*, 16(2), <https://doi.org/10.21314/JRMV.2022.016>
16. Ezzamel M., Mar-Molinero C., Beecher A., (1987). On the distributional properties of financial ratios., *J. Bus. Financ. Account.* 14(4), 463–481.

17. Hillegeist, S. A., Keating, E. K., Cram, D. P., & Lundstedt, K. G. (2004). *Assessing the probability of bankruptcy*, Review of Accounting Studies, 9, 5-34.
18. Gupta M.C., Huefner R.J., (1972). A cluster analysis study of financial ratios and industry characteristics, *J. Account. Res.* 10(1), 77–95.
19. Johnson W.B., (1979). The cross sectional stability of financial ratio patterns, *J. Financ. Quant. Anal.* 14(5), 1035–1048.
20. Koh H.C., (1992). The sensitivity of optimal cutoff points to misclassification costs of type I and type II errors in the going-concern prediction context, *J. Bus. Financ. Account.* 19(2), 187–197.
21. Li, J., & Du, W. (2011). An empirical study on the corporate financial distress prediction based on logistic model: Evidence from China's manufacturing Industry. *International Journal of Digital Content Technology and Its Applications*, 5(6), 368–379. <https://doi.org/10.4156/jdcta.vol5.issue6.44>
22. Malešević, Đ., & Čavlin, M., (2020). *Poslovna analiza*. FIMEK, Novi Sad. [in English: 20. Malešević, Đ., & Čavlin, M., (2020). Business analysis. FIMEK, Novi Sad]
23. Mossman C.E., Bell G.G., Swartz L.M., Turtle H., (1998). An empirical comparison of bankruptcy models. *Financ. Rev.* 33(2), 35–54.
24. Ohlson, J. A. (1980). Financial ratios and the probabilistic prediction of bankruptcy, *Journal of Accounting Research*, 18, 109-131.
25. Pavlicko, M., Marek D., and J. Mazanec (2021). Ensemble Model of the Financial Distress Prediction in Visegrad Group Countries, *Mathematics* 9 (16), 1886. <https://doi.org/10.3390/math9161886>
26. Pinches G.E., Mingo K.A., Caruthers J.K., (1973). The stability of financial patterns in industrial organizations, *J. Financ.* 28(2), 389–396.
27. Pohlman R.A., Hollinger R.D., (1981). Information redundancy in sets of financial ratios. *J. Bus. Financ. Account.* 8(4), 511–528.
28. Putri H.R. and A. Dhini, (2019) “Prediction of Financial Distress: Analyzing the Industry Performance in Stock Exchange Market using Data Mining,” *16th International Conference on Service Systems and Service Management (ICSSSM)*, Shenzhen, China, pp. 1-5, doi: 10.1109/ICSSSM.2019.8887824.
29. Radović-Marković, M., & Hanić, H. (2018). *Metodologija istraživanja u ekonomskim naukama*. Beogradska bankarska akademija, Fakultet za bankarstvo, osiguranje i finansije, Institut ekonomskih nauka, Beograd. ISBN 978-86-7852-038-9 [in English: Radović-Marković, M., & Hanić, H. (2018). *Research methodology in economic sciences*. Belgrade Banking Academy, Faculty of Banking, Insurance and Finance, Institute of Economic Sciences, Belgrade. ISBN 978-86-7852-038-9]
30. Roumani, Y.F., Nwankpa, J.K. & Tanniru, M. Predicting firm failure in the software industry. *Artif Intell Rev* 53, 4161–4182 (2020). <https://doi.org/10.1007/s10462-019-09789-2>

31. Rosner, B. (2011). *Fundamentals of Biostatistics*, 7th Edition. Brooks/Cole, Boston.
32. Savić, B., & Milojević, I. (2022). Challenges of targeted formation of financial reports in modern business conditions. *Oditor*, 8(2), 30-53. <https://doi.org/10.5937/Oditor2202030S>
33. Sayari, N., & Mugan, C. S. (2017). Industry specific financial distress modeling. *BRQ Business Research Quarterly*, 20(1), 45–62. <https://doi.org/10.1016/j.brq.2016.03.003>
34. Srhoj, S. (2022). Omega Score model for predicting firm default: Application in the Republic of Croatia, *Poslovna izvrsnost*, 16(2), 53-73.
35. Taffler R.J., (1983). The assessment of company solvency and performance using a statistical model, *Account. Bus. Res.* 13(52), 295–308.
36. Todorović, M., & Čupić, M. (2016). *Merenje performansi u lean poslovnom okruženju*. XXI Internacionalni naučni skup SM 2016, Strategijski menadžment i sistemi podrške odlučivanju u strategijskom menadžmentu, 1203-1211. [in English: 33. Todorović, M., & Čupić, M. (2016). *Performance measurement in a lean business environment*. XXI International Scientific Conference SM 2016, Strategic Management and Decision Support Systems in Strategic Management, 1203-1211.]
37. Wu, Y., Gaunt, C., & Gray, S. (2010). A comparison of alternative bankruptcy prediction models, *Journal of Contemporary Accounting & Economics*, 6, pp 34-45.
38. Yazdanfar, D. and Öhman, P. (2020). Financial distress determinants among SMEs: empirical evidence from Sweden, *Journal of Economic Studies*, 47 (3), 547-560. <https://doi.org/10.1108/JES-01-2019-003>
39. Zmijewski, M., E. (1984). Methodological Issues Related to the Estimation of Financial Distress Prediction Models, *Journal of Accounting Research*, 22, 59-82.

ANALYSIS OF INFECTIOUS MEDICAL WASTE MANAGEMENT IMPLICATION ON SUSTAINABLE AGRICULTURE DURING THE COVID-19 PANDEMIC - CASE STUDY OF ŠUMADIJA DISTRICT (REPUBLIC OF SERBIA)

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ABSTRACT

Agriculture is the world's most important industry. According to the structure, Šumadija district is mainly composed of arable land and gardens, which make up 69%. The increased amount of COVID-19 waste generated from medical activities in rural areas needs to be properly handled due to its contagious, even lethal properties. The aim of this study is an analysis of two drivers through the generation of COVID-19 waste, Central and local treatment site, proposed transport routes, and total cost in Šumadija district. Results showed the economic costs of transportation increased 2.5 times compared to before and after the emergence of the COVID-19 pandemic. Also, the increase in health risk was correlated to the increase in the per capita cost of transportation along the transportation routes. Analyses of human health risks and detailed financial calculations gave a clear insight in infectious waste management possible influence on agriculture.

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Introduction

The development of sustainable agriculture depends on knowledge, as a base for understanding how and why there is a need to conserve natural resources, which in developing countries are converted into agricultural land. Also, by protecting the environment, the value of arable land is maintained. This includes the economic factor one of the most important in sustainable agriculture, and its influence on markets and incentives for organic production (Stojić, Dimitrijević, 2020). Therefore, well well-being of inhabitants must be a prerequisite for success in any activity. We witness the emergence of SARS-CoV-2 in late 2019 and its epidemic potential. The rapid spread of this virus across the world in only 2 months highlights the necessity to strengthen infectious waste management in every healthcare institution (Weston, Frieman, 2020). The practice around the world is that medical waste and other forms of clinical waste are disposed of adequately and according to regulations in a sanitary landfill or burned as waste to obtain energy. In EU countries, the United Nations Basel Convention on the Transboundary Movement of Hazardous Wastes and their Disposal has provided instructions and guidelines on waste management amid the COVID-19 pandemic as an urgent and essential public service aimed at protecting human health and the environment (Sing et al., 2020a). However, developing countries are not able to implement this practice, so medical waste, together with solid municipal waste, is disposed of in badly managed landfills in the places of greatest infection (Nzediegwu, Chang, 2020). A good example is provided by China, which since 2003, following the outbreak of severe acute respiratory syndrome (SARS) in the region, has enacted, and is implementing more than 30 legal and emergency management orders on the environmentally sound management of medical waste. Therefore, carefully observing and applying this practice can contribute to the greater safety of people, and animals, and the preservation of the environment (Singh et al., 2020b). Medical waste disposal is a global issue since it is costly. This is supported by the fact that 3.5 million tones of medical waste per year generated in the USA, are disposed of at the cost of \$790 per tone (Windfeld, Brooks, 2015). Although we are faced with a pandemic and the creation of infectious waste in all healthcare units, infectious medical waste is still being transported in Serbia. Health systems need to address the problem of pandemic mismanagement (Yusefi et al., 2022). In most medical institutions in Serbia, there is no possibility of sterilizing used syringes and needles, swabs, bandages, and other infectious waste. Therefore, the set is transported to nearby regional centers, and health facilities equipped with autoclaves for sterilization and shredders. Unfortunately, Serbia still does not have modern facilities for the treatment of infectious medical waste (IMW), especially incinerators, which are necessary today. For these reasons, the COVID-19 pandemic affects the quality of life of people living in rural areas, where agriculture is the primary industry. This practice is particularly dangerous for the part of the population that lives on the infectious transport routes of this type of waste (Babae Tirkolae, Aydın, 2021; Behera, 2021). Also, the lack of financial support harms the effective management of medical waste in hospitals where there is a lack of medical

waste technologies and its neutralization at the source. That refers to vehicle routing problems and transportation planning problems (Thakur, 2021; Stanojevic et al., 2022). In general, during the great pandemic, apart from public health, the waste sector was the most affected because of the role he then assumed (Barua and Hossain, 2021). That is to say, the increased amount of infectious medical waste contaminated with COVID-19 increased the risk of spreading without neutralization on site. Serbia is a developing country whose waste management practices during COVID-19 failed in many aspects (Cao et al., 2023). There are justified reasons for concern, being predominantly a rural country, rich in arable land, and unique rural tourism households (Dimitrijevic et al., 2022). The Šumadia region is synonymous with the fertile land of Serbia. According to the structure, it is mainly composed of arable land and gardens, which make up 69%. The area under cereals occupies 40.8% and orchards 9.2% of the total agricultural area of the region. Also, 64,062 inhabitants live in this part of Serbia, two-thirds of whom are actively engaged in agriculture. If we look at statistical data on the activities of the Republic of Serbia, the active agricultural population makes up 64.8% (Stojić, Dimitrijević, 2020).

This study aimed to show how bad infectious medical waste management can be improved from the learnings of COVID-19 (Jayasinghe et al., 2023). The main goal of this paper is: to provide information on the amount of COVID-19 infectious medical waste generated during the COVID-19 pandemic; to identify existing routes of transportation through densely populated agricultural areas as gaps in existing infectious medical waste management practices; and to indicate problems and solutions to prevent potential infection: to protect farmers, agricultural land and products to the greatest extent. Therefore, the calculation of the amount of COVID-19 infectious waste as well as the cost of transportation with the number of people affected by this practice, presents opportunities for improvement in post-pandemic waste infrastructure. Insufficient COVID-19 infectious waste management affects agriculture and food systems in multiple ways. This unique opportunity to address these challenges can accelerate the transition to a more sustainable food system (Rasul, 2021).

Materials and methods

This study presents an analysis of Infectious waste management during the COVID-19 pandemic and how Serbia can change and support a novel approach to sustainable management. When it comes to agriculture, there are several concerns and considerations regarding the handling of COVID-19 waste. Contamination of Agricultural Land: Improper disposal of infectious waste in or near agricultural areas can lead to soil and water contamination. This can potentially affect the quality and safety of crops and livestock. (Devi et al., 2019); Risk to Farm Workers: Farm workers may be at risk of exposure to infectious COVID-19 if it is not managed safely. Inadequate disposal practices can lead to accidents or direct contact with contaminated materials (Elbadri, 2021). Biosecurity Measures: Agricultural operations should implement biosecurity measures to prevent the spread of diseases, including those that might be associated

with improper handling of infectious COVID-19 waste (Galanakis,2020; Fan et al., 2021; Obykhod et al., 2020)

Developing countries have poor infectious waste management, which directly increases the ratio of contaminated items to non-infectious fraction of medical waste. The average for developing countries is about 0.2 kg of infectious waste generated per day. During the COVID-19 pandemic, the assessment of healthcare waste can be conducted only by considering all medical waste generated within healthcare facilities as infectious. For this study, we use Mihai's (2020) formula for the calculation of COVID-19 waste in healthcare facilities in Šumadija district :

(At the national level)

$Mw = \text{Number of active cases of COVID-19 per day} \times Mwgr \text{ (kg} \cdot \text{bed} \cdot \text{day}^{-1}\text{)},$

where $Mwgr = \text{medical waste generation rate} — 1 \text{ kg} \cdot \text{bed} \cdot \text{day}^{-1}$

number of active cases is available at <https://www.worldometers.info/coronavirus/#countries> at the national level.

(At the subnational level)

$Mw = \text{confirmed cases of COVID-19 per day} \times Mwgr \text{ (kg} \cdot \text{bed} \cdot \text{day}^{-1}\text{)}.$

Therefore we calculated the amount of infectious COVID-19 waste by multiplying the number of active cases with the amount of infectious medical waste. The data used in this research was collected from the Institute of Public Health of Serbia “Dr. Milan JovanovićBatut”(Batut, 2023). The results are presented in Table 1.

Analytical Framework

Developing countries such as Serbia struggle with reliable public data on the amount of medical infectious waste during the COVID-19 pandemic. However, data collected worldwide indicate infectious waste generation in developing countries is 2.3 times higher than in the period before the pandemic crisis. Also, the starting point for any calculation is the city of Wuhan in China where citizens generated nearly 247 tons of medical waste per day at the height of the pandemic, about six times more with only infectious waste two times more than before the pandemic (Hossain et al., 2011; Sing, Ogunseitan, 2020a). The amount of infectious waste in China during the pandemic increased 12 times (Chen et al., 2021). There are many new methodologies developed to define influential medical indicators that reflect the effects of transporting infectious medical waste (Pažun et al., 2022; Valizadeh, Mozafari, 2021; Wei, 2020). Drivers for integrated waste management are helpful tools when conducting analysis and guaranteed improvement of waste management (Ilić, Nikolić, 2016). The analytical framework is built around two waste drivers, human health and financial stability. Research conducted in China during the pandemic showed that the impact of COVID-19 on China's agricultural economy was reflected in crop production and livestock production, employment of farmers, and the overall development of agriculture. (Pan et al., 2020).

Therefore, the driver analysis provided guidelines for preventing infectious waste from reaching arable land and farmers in Šumadija district. Both drivers were analyzed through collected data to identify the amount of COVID-19 infectious medical waste and transportation routes in km and the number of inhabitants on route for COVID-19 transport through agricultural land.

Also, apart from analyses of drivers, it was found that one of the key directions to solving the problem of COVID-19 infectious medical waste transport is to establish values between 1 and 6, indicators of risk from COVID-19 spread (Nikolic et al., 2022). In a study conducted by Nikolic et al. (2022) values of waste are calculated as the quantity of waste being transferred per one route per week/number of citizens living along this route. As 5,3 times increased amount of COVID-19, IW is defined as value 6 for the highest health risk and value 1,3 for financial collapse. These values applied along with the data collected and calculated by Mihai (2020) give a clear picture of IMWS in the Šumadia district presented below.

The population living near the routes used to transport infectious waste is linked with a driver of the importance of human health. Highly infectious COVID-19 medical waste presents a direct threat to human health if not properly handled (Adyel, 2020; Borrelle et al., 2020). The value of this driver is in the amount of generated waste transferred per route in liters per week per the number of citizens living along this route. The range of numerically expressed significance is a value between 1 and 6 (the amount of waste in Wuhan increased 5.3 times). This indicator expresses the degree of threat to human health. Nikolic et al. (2022) defined that values from 1 to 2 are less good, values < 2 and > 3 mean very high risk values > 3 and < 6 mean extremely high risk, and values > 5 mean the risk of shock to the health society (Nikolic et al., 2022).

Financial support reflects a high-level financial problem for society as a whole. About 70% of the costs of the waste management system are allocated to the transport of waste. The financial aspect of sustainable waste management must be one of the main drivers of a sustainable system (Erdem, 2022). This driver is numerically expressed through the transport cost of the generated waste per the transfer route / the number of citizens to whom the waste was transferred for this route. The driver of financial support is a number whose volume can be greater than 1. Nikolic et al. (2022) determined that values between 1 and 1.3 mean high risk, values > 1.3 to 1.6 mean very high risk, and values > 1.6 to 1.8 mean extremely high risk, while values $> 1,8$ mean the risk of a shock to the financial society (Nikolic et al., 2022) The initiatives are clearly defined to find an adequate solution for the transportation of highly hazardous waste and the impact of the covid-19 infection. This research aims to improve the medical waste management system in Serbia, through a rapid assessment of potentially infectious covid-19 medical waste generated in rural areas. The endangered health of residents is clearly shown through the financial analysis of which waste is transferred for each route and to present the amount of waste that is transferred, representing a high risk for citizens who live along the transfer routes, on the example of the Šumadija administrative district.

Results and Discussion

The issue of a new category of IMW (COVID-waste) mishandled is a rising concern to public health and environmental sustainability, no matter whether the pandemic is over (Ilyas et al.,2020). Three CTSs/LTSs (Central treatment site /local treatment site) have been established/planned in the Šumadija District.

1. CTS CHCKragujevac is in charge of eight additional places for waste collection.
2. CTS Central Clinic Kragujevac also includes the Institute of Public Health Kragujevac, the Institute for Emergency Medical Assistance, and the Institute for Dentistry.
3. In addition, an additional LTS was established in the Aranđelovac General Hospital with 130 beds. This treatment facility is responsible for the treatment of waste from the Aranđelovac Health Center.

The amounts of infectious medical waste in the Šumadija administrative district, by healthcare institutions of exemplary healthcare, are given in *Table 1*.

Table 1. Quantities of infectious waste generated in primary healthcare institutions

Collecting site (Municipality/Community Health Centers)	The population treated in CHC	Amount of infectious medical waste (kg/day)	Amount of infectious medical waste (l/day)	Amount of infectious medical waste (l/week)	Number of containers with a volume of 240 l per week
CHC Batočina	91659	3	30	210	1 x 240l (2x120l)
CHC Knić	102291	3	30	210	1x 240l (2x120l)
CHC Lapovo	58026	2	20	140	1x 240l (2x120l)
CHC Rača	152232	4	40	280	2x 240l
CHC Topola	250000	7	70	490	3 x 240l
Institute for Workers' Health Protection (IWHP)	291612	10	100	700	5 x 240l

Source: Author's calculations

Transportation of waste is always complex due to its hazardous nature, raising the question of how to tackle this issue the best way possible with the financial aspect taken into account (Fedotkina et al., 2019). An important role is also played by the distance (distance) of health institutions from the place for the treatment of infectious medical waste. Data on the distance are given in *Table 2*.

Table 2. Distance of medical institutions from the place of treatment (km)

Distance (km)	CTS (Central treatment site)	CHC Batočina	CHC Knić	CHC Lapovo	CHC Rača	CHC Topola	IWHP workers
CPT (central place for treatment)	0	27	17	16	19	40	3,5
CHC Batočina	27	0	50	4	17	67	30.5
CHC Knić	17	50	0	54	49	63	30
CHC Lapovo	16	4	54	0	19	47	19.5
CHC Rača	19	17	49	19	0	41	22.5
CHC Topola	40	67	63	47	41	0	43.5
IWHP	3.5	30.5	20.5	19.5	22.5	43.5	0

Source: Author's calculations

For the waste to reach the place of treatment, it takes a certain time, and the routes that the transport vehicle takes. Each country has its one regulations when it comes to infectious waste transportation. In Korea, medical waste is transported up to approximately 350 km, while in Germany and Japan hazardous waste(infectious and toxic) is transported up to approximately 100 km (Yoon et al., 2022). *Table 3.* shows the time required from the primary institution to CTS waste.

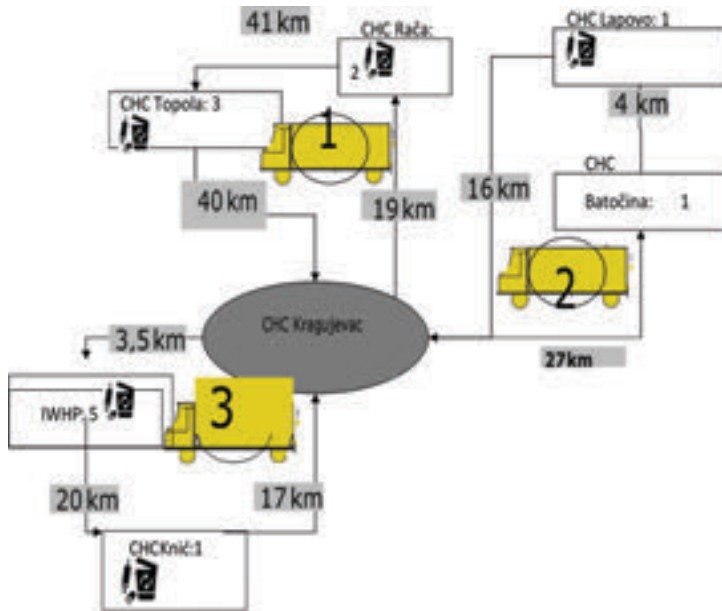
Table 3. Time required for transporting infectious waste to CTS

Transport time (min)	CPT	CHC Batočina	CHC Knić	CHC Lapovo	CHC Rača	CHC Topola	IWHP
CPT	0	40	26	25	30	60	10
CHC Batočina	40	0	70	10	30	80	40
CHC Knić	26	70	0	70	60	80	30
CHC Lapovo	25	10	70	0	30	65	31
CHC Rača	30	30	60	30	0	60	32
CHC Topola	60	80	80	65	60	0	60
IWHP	10	40	30	31	32	60	0

Source: Author's calculations

The movement of special vehicles is defined by the routes as well as the calculation of the time of transportation of infectious medical waste to the place of treatment. A schematic view is given in *Figure 1*. It is obvious that in the Šumadija district distance is approximately 80km, which follows developed country regulations.

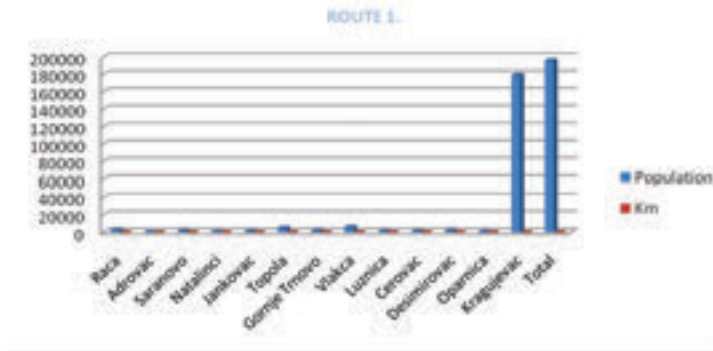
Figure 1. Proposed transport route in Šumadija district



Source: Author's analysis

Transport route 1 traces the path from CHC Rača via Topola to Kragujevac. On the given route, it passes through populated areas on the route. *Figure 2*. shows an overview of the populated places it passes through with the gravitating population and the total mileage of the route.

Figure 2. Number of citizens endangered by infectious waste from CHC Rača via Topola to Kragujevac



Source: Author's analysis

IMW transport route from Rača via Topola to Kragujevac with a length of 80.2 km.

The vehicle used to transport IMW is a Renault Kango with a cost price of 13,516 €.

Route: 160.4 km x 8 tours per month

1283.2 km x 5.2 l (average fuel consumption) – 66.73 l derivatives

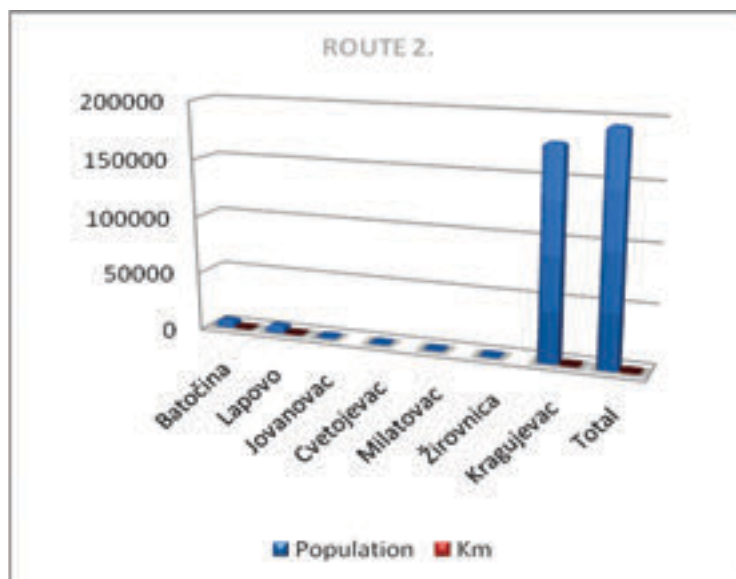
66.73 l x 129.9 din/l - 8668.00 din / 74.20 €

Need for oil and lubricant - 2580 din/ 22 €

Regular service and maintenance of vehicles without breakdowns, breakdowns, and accidents is for 6 months and amounts to a total of 17,050 din/ 145€.

In normal traffic conditions and road conditions concerning legal speed limits, the duration of the transport is 2 hours. Breakdowns, breakdowns, and accidents cannot be predicted. Transport route 2 traces the route from CHCBatočin via Lapovo to Kragujevac. On the given route, it passes through populated areas on the route. *Figure 3.* shows an overview of the populated places it passes through with the gravitating population and the total mileage of the route.

Figure 3. Number of citizens endangered by infectious waste from CHC Batočin via Lapovo to Kragujevac



Source: Author's analysis

IMW transport route from Batočina via Lapovo to Kragujevac with a length of 33.1 km.

The vehicle used to transport IMW is a Renault Panther with a cost price of 15,210 €.

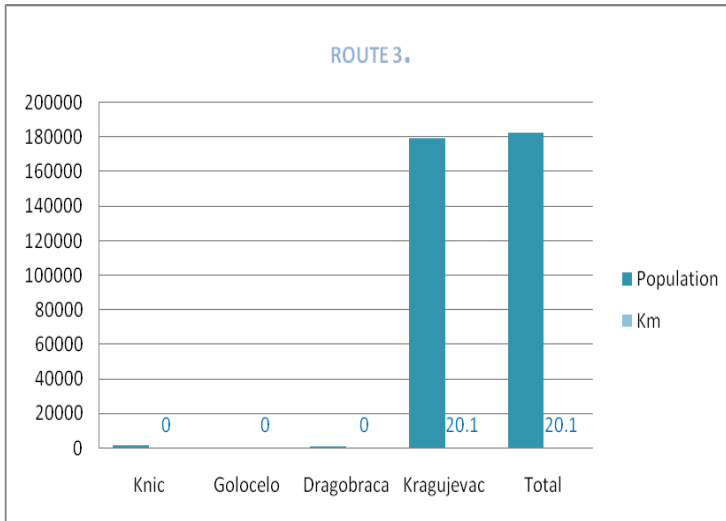
Route: 66.2 km x 8 tours per month

529.6 km x 6.5 l (average fuel consumption) – 34.5 l derivatives

34.5 l x 129.9 din/l - 4472.00 din / 38.20 €

Need for oil and lubricant - 4300 din/ 36.75 €

Figure 4. Number of citizens endangered by infectious waste from CHC Knić to Kragujevac



Source: Author's analysis

Regular service and maintenance of vehicles without breakdowns, breakdowns, and accidents is for 6 months and amounts to a total of 17,050 din/145€. In normal traffic conditions and road conditions, concerning legal speed limits, the duration of the transport is 1 hour. Breakdowns, breakdowns, and accidents cannot be predicted. Transport route 3 traces the route from CHC Knić to Kragujevac. On the given route, it passes through populated areas on the route. Figure 4. shows an overview of the populated places it passes through with the gravitating population and the total mileage of the route.

IMW transport route from Knić to Kragujevac with a length of 20.1 km. The vehicle used to transport IMW is a Renault Boxer with a cost price of 25,590 €.

Route: 40.2 km x 8 tours per month

321.6 km x 7.9 l (average fuel consumption) – 25.4 l derivatives

25.4 l x 129.9 din/l - 3300.00 din / 28.20 €

Need for oil and lubricant - 4300 din/ 36.75 €

Regular service and maintenance of vehicles without breakdowns, breakdowns, and accidents is for 6 months and amounts to a total of 19,656 din/ 168 €.

Under normal traffic conditions and road conditions, with compliance with legal speed

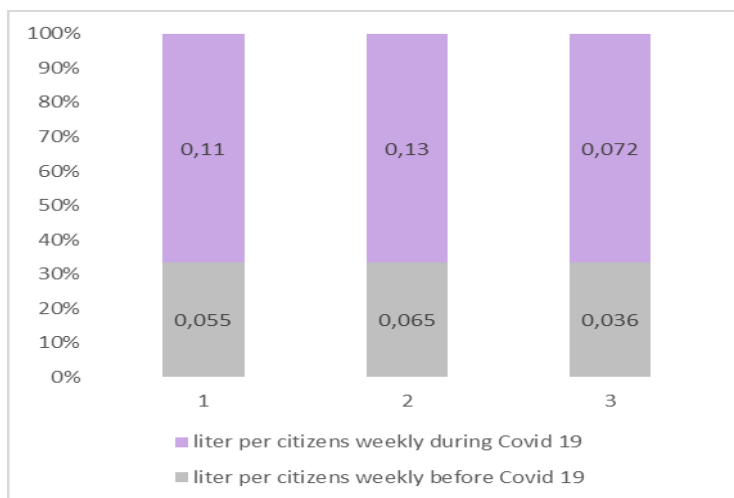
limits, the duration of the transport is 45 minutes. Breakdowns and accidents cannot be predicted. Transporting through urban areas, infectious pathways of medical waste affect residents and the environment along transport routes. According to the selected operational model, the institutions/places for the treatment of infectious medical waste (IMW) are divided into two categories:

(1) a central treatment site (CTS), which processes its waste, as well as waste from assigned health facilities;

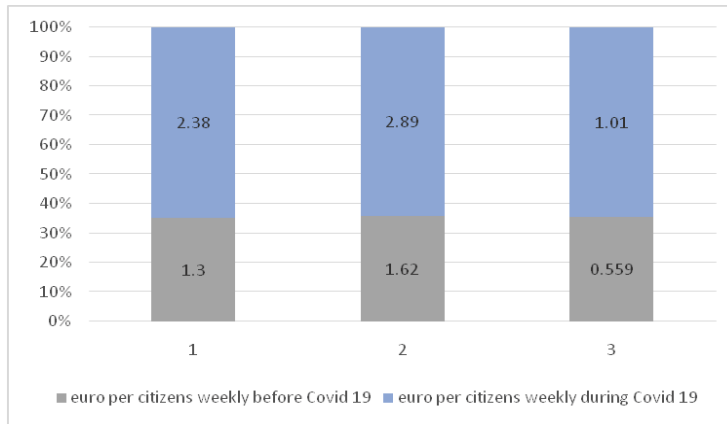
(2) a local treatment site (LTS), responsible for the safe treatment of one's waste. CTS / LTS institutions have also been tasked to collect waste from other health institutions in the district. Institutions whose infectious waste is taken for treatment are called MS institutions (institutions located at the place of origin and whose waste is transported to the place of treatment). Each administrative region has at least 1 CTS. It is usually a general hospital in the central town of the district. The exception is the districts where there are institutions of the new tertiary level of health care - clinical centers, where the CTS function is taken over by a health center or public health institute. The increased number of COVID-19 patients increases the amount of infectious waste.

We confidently claim that the transportation of medical waste covid 19 increases the risk of spreading the COVID-19 virus among the population in the Šumadija district. It is obvious that during the pandemic, health indicators, as well as infectious covid-waste, based on the calculation of health indicators for all three directions of the Šumadija region, doubled. Figure 5. clearly shows us the health risk index with a growing trend before and during the covid 19 pandemic.

Figure 5. Input values for calculation of health indicators before and during a Covid pandemic.



Source: Author's analysis

Figure 6.Analyses of economic indicators before and during a Covid pandemic.

Source: Author's analysis

As the health risk increases, so does the per capita cost of transportation along the transportation routes. Figure 6 shows an overview of financial risk per capita with cost prices before and during the COVID-19 pandemic.

Conclusions

This paper aims to show COVID-19 infectious medical waste mismanagement in the Šumadija district. The Covid-19 pandemic has led to an increase in infectious waste generation. As a result, the amount of infectious medical waste transported through populated areas and transport routes through the Šumadija administrative district increases. Through direct analysis, it was included that both health and financial risks are doubled. It has been found that there was a 2 to 3-fold increase in the amount of infectious medical waste before and after the emergence of the COVID-19 pandemic. Additionally, the costs of transporting the waste and the cost price of IMW transport have increased by 2.5 times compared to before the pandemic. This entails a doubled risk of accidental situations, thus doubling the risk of contamination of the environment. This can potentially affect the quality and safety of crops and risk to farm workers. Inadequate disposal practices can lead to accidents or direct contact with contaminated materials. Although the length of routes within the district is below the recommended km by developed countries, no more than 80km, about 197000 inhabitants were directly exposed to the virus. The projected growing amount of medical waste in the observed District requires an increase in existing treatment and neutralization capacities and the application of new sustainable solutions. In line with the fact that Šumadija district is rich with fields, orchards, vegetable beds, vineyards alternate..., waste management should be a priority. Overall, the management of infectious COVID-19 waste affects agriculture and it should prioritize the safety of farmers, the integrity of agricultural products, and compliance with relevant regulations to prevent environmental contamination and public health risks. Proper education and adherence to guidelines are critical to achieving these goals. Therefore, recommendations include:

-The capacity of installed autoclaves can be increased by increasing their working time, to avoid additional investments.

-By decentralizing the place for treatment at the local level, the spread of the Covid-19 virus will be prevented.

- Such a general epidemiological situation could not be predicted, and therefore the solvency of the healthcare institution was put in serious jeopardy due to the incurred costs, as they must be reimbursed from their funds because they are not contracted with the Republic Fund.

Based on the results of this research, the following recommendations can be considered for future research:

To prevent the occurrence of possible accidents on the route of transportation. An integrated model to evaluate COVID-19 medical waste transportation risk by integrating an extended type-2 fuzzy total interpretive structural model (TISM) with a Bayesian network (BN) can be taken into consideration (Tang et al., 2023)

To improve the medical waste management system, quantitative statistical analysis by using the method of peer-reviewed publications originating from different geographical areas can be taken into consideration (Achuthan et al., 2022; Visser et al., 2021).

Conflict of interests

The authors declare no conflict of interest.

References

1. Achuthan, K., Nair, V. K., Kowalski, R., Ramanathan, S., & Raman, R. (2023). Cyberbullying research—Alignment to sustainable development and impact of COVID-19: Bibliometrics and science mapping analysis. *Computers in Human Behavior*, *140*, 107566. <https://doi.org/10.1016/j.chb.2022.107566>
2. Adyel, T. M. (2020). Accumulation of plastic waste during COVID-19. *Science*, *369*(6509), 1314-1315. <https://doi.org/10.1126/science.abd9925>
3. Babae Tirkolae, E., & Aydın, N. S. (2021). A sustainable medical waste collection and transportation model for pandemics. *Waste Management & Research*, *39*(1_ suppl), 34-44. <https://doi.org/10.1177/0734242X211000437>
4. Barua, U., & Hossain, D. (2021). A review of the medical waste management system at Covid-19 situation in Bangladesh. *Journal of Material Cycles and Waste Management*, *23*(6), 2087-2100. <https://doi.org/10.1007/s10163-021-01291-8>
5. Batut, 2023. Institute of Public Health of Serbia “Dr. Milan Jovanović Batut”, Reports, (2020) COVID-19 statistic in Serbia,
6. Available from: <https://covid19.data.gov.rs/infectedhttps://data.gov.rs/sr/datasets/covid-19-dnevni-izveshtajinstituta-za-javno-zdravlje-srbije-ozarazhenim-litsimana-teritoriji-republikesrbije/> Access date: 16.02.2023.

7. Behera, B. C. (2021). Challenges in handling COVID-19 waste and its management mechanism: A Review. *Environmental nanotechnology, monitoring & management*, 15, 100432. <https://doi.org/10.1016/j.enmm.2021.100432>
8. Borrelle, S. B., Ringma, J., Law, K. L., Monnahan, C. C., Lebreton, L., McGivern, A., ... & Rochman, C. M. (2020). Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution. *Science*, 369(6510), 1515-1518. <https://doi.org/10.1126/science.aba3656>
9. Cao, C., Xie, Y., Liu, Y., Liu, J., & Zhang, F. (2023). Two-phase COVID-19 medical waste transport optimization considering sustainability and infection probability. *Journal of Cleaner Production*, 389, 135985. <https://doi.org/10.1016/j.jclepro.2023.135985>
10. Chen, C., Chen, J., Fang, R., Ye, F., Yang, Z., Wang, Z., ... & Tan, W. (2021). What medical waste management system may cope With COVID-19 pandemic: Lessons from Wuhan. *Resources, Conservation and Recycling*, 170, 105600. <https://doi.org/10.1016/j.resconrec.2021.105600>
11. Devi, A., Ravindra, K., Kaur, M., & Kumar, R. (2019). Evaluation of biomedical waste management practices in public and private sector of health care facilities in India. *Environmental Science and Pollution Research*, 26, 26082-26089. <http://dx.doi.org/10.1007/s11356-019-05785-9>
12. Dimitrijević, M., Ristić, L., & Bošković, N. (2022). Rural tourism is a driver of the economic and rural development in the Republic of Serbia. *Hotel and Tourism Management*, 10(1), 79-90. doi: 10.5937/menhottur2201079D
13. Elbadri, N. (2021). Developing a Risk Assessment Framework for Evaluating and Mitigating Occupational Exposure of Migrant Farmworkers to Enteric Pathogens in Canada's Seasonal Agricultural Worker Program (Master's thesis, University of Waterloo).
14. Erdem, M. (2022). Designing a sustainable logistics network for hazardous medical waste Collection a case study in the COVID-19 pandemic. *Journal of Cleaner Production*, 376, 134192. <https://doi.org/10.1016/j.jclepro.2022.134192>
15. Fan, S., Teng, P., Chew, P., Smith, G., & Copeland, L. (2021). Food system resilience and COVID-19—Lessons from the Asian experience. *Global Food Security*, 28, 100501 <https://doi.org/10.1016/j.gfs.2021.100501>
16. Fedotkina, O., Gorbashko, E., & Vatkina, N. (2019). Circular economy in Russia: Drivers and barriers for waste management development. *Sustainability*, 11(20), 5837. <https://doi.org/10.3390/su11205837>
17. Galanakis, C. M. (2020). The food systems in the era of the coronavirus (COVID-19) pandemic crisis. *Foods*, 9(4), 523. <http://dx.doi.org/10.3390/foods9040523>
18. Jayasinghe, P. A., Jalilzadeh, H., & Hettiaratchi, P. (2023). The Impact of COVID-19 on Waste Infrastructure: Lessons Learned and Opportunities for a Sustainable Future. *International Journal of Environmental Research and Public Health*, 20(5), 4310. <https://doi.org/10.3390/ijerph20054310>
19. Hossain, M. S., Santhanam, A., Norulaini, N. N., & Omar, A. M. (2011).

- Clinical solid waste management practices and its impact on human health and environment—A review. *Waste management*, 31(4), 754-766. <https://doi.org/10.1016/j.wasman.2010.11.008>
20. Ilić, M., & Nikolić, M. (2016). Drivers for development of circular economy—A case study of Serbia. *Habitat International*, 56, 191-200. <https://doi.org/10.1016/j.habitatint.2016.06.003>
 21. Ilyas, S., Srivastava, R. R., & Kim, H. (2020). Disinfection technology and strategies for COVID-19 hospital and bio-medical waste management. *Science of the Total Environment*, 749, 141652. doi: [10.1016/j.scitotenv.2020.141652](https://doi.org/10.1016/j.scitotenv.2020.141652)
 22. Mihai, F. C. (2020). Assessment of COVID-19 waste flows during the emergency state in Romania and related public health and environmental concerns. *International Journal of Environmental Research and Public Health*, 17(15), 5439. <https://doi.org/10.3390/ijerph17155439>
 23. Nikolic, M., Tomasevic, V., Kranjac, M., Pazun, B., & Ugrinov, D. (2022). GIS ANALYSIS OF SARS-CoV-2 SPREADING MINIMIZATION VIA INFECTIOUS MEDICAL WASTE TRANSPORTED THROUGH DENSELY POPULATED AREAS. *Fresenius Environmental Bulletin*, 31(4), 4525-4535. ISSN 1018-4619
 24. Nzediegwu, C., & Chang, S. X. (2020). Improper solid waste management increases potential for COVID-19 spread in developing countries. *Resources, conservation, and recycling*, 161, 104947. <https://doi.org/10.1016/j.resconrec.2020.104947>
 25. Obykhod, H., Khvesyk, Y., & Malkov, M. (2020). Impact of coronavirus on the state of food security and treatment of medical waste. Економіка природокористування і сталій розвиток. <http://dspace.nbuv.gov.ua/handle/123456789/183377>
 26. Pazun, B., Nikolić, M., Grujčić, Ž., Ugrinov, D., & Langović, Z. (2022). Optimization Model of Infectious Medical Waste Disposal Using It Tools Case of Serbia. *Fresenius Environmental Bulletin*. ISSN 1018-4619. http://www.prtparlar.de/download_feb_2022/
 27. Pan, D., Yang, J., Zhou, G., & Kong, F. (2020). The influence of COVID-19 on agricultural economy and emergency mitigation measures in China: A text mining analysis. *PloS one*, 15(10), e0241167. <https://doi.org/10.1371/journal.pone.0241167>
 28. Rasul, G. (2021). Twin challenges of COVID-19 pandemic and climate change for agriculture and food security in South Asia. *Environmental Challenges*, 2, 100027. <https://doi.org/10.1016/j.envc.2021.100027>
 29. Singh, N., Tang, Y., & Ogunseitan, O. A. (2020a). Environmentally sustainable management of used personal protective equipment. *Environmental science & technology*, 54(14), 8500-8502. <https://doi.org/10.1021/acs.est.0c03022>
 30. Singh, N., Tang, Y., Zhang, Z., & Zheng, C. (2020b). COVID-19 waste management: Effective and successful measures in Wuhan, China. *Resources, conservation, and recycling*, 163, 105071. <https://doi.org/10.1016/j.resconrec.2020.105071>
 31. Stanojević, K., Radovanović, G., Makajić-Nikolić, D., Savić, G., Simeunović, B., & Petrović, N. (2022). Selection of the optimal medical waste incineration

- facility location: A challenge of medical waste risk management. *Vojnosanitetski preglad*, 79(2), 125-132. <https://doi.org/10.2298/VSP200521072S>
32. Stojić, V., & Dimitrijević, M. (2020). Consumers' intentions to use of organically produced food in the sumadija region. *Економика пољопривреде*, 67(1), 253-267. doi:10.5937/ekoPolj2001253S
 33. Tang, J., Liu, X., & Wang, W. (2023). COVID-19 medical waste transportation risk evaluation integrating type-2 fuzzy total interpretive structural modeling and Bayesian network. *Expert Systems with Applications*, 213, 118885. <https://doi.org/10.1016/j.eswa.2022.118885>
 34. Thakur, V. (2021). Framework for PESTEL dimensions of sustainable healthcare waste management: Learnings from COVID-19 outbreak. *Journal of cleaner production*, 287, 125562. <https://doi.org/10.1016/j.jclepro.2020.125562>
 35. Valizadeh, J., & Mozafari, P. (2021). A novel cooperative model in the collection of infectious waste in COVID-19 pandemic. *Journal of Modelling in Management*, 17(1), 363-401. ISSN: 1746-5664
 36. Visser, M., Van Eck, N. J., & Waltman, L. (2021). Large-scale comparison of bibliographic data sources: Scopus, Web of Science, Dimensions, Crossref, and Microsoft Academic. *Quantitative science studies*, 2(1), 20-41. https://doi.org/10.1162/qss_a_00112
 37. Visser, M., Van Eck, N. J., & Waltman, L. (2021). Large-scale comparison of bibliographic data sources: Scopus, Web of Science, Dimensions, Crossref, and Microsoft Academic. *Quantitative science studies*, 2(1), 20-41. https://doi.org/10.1162/qss_a_00112
 38. Windfeld, E. S., & Brooks, M. S. L. (2015). Medical waste management—A review. *Journal of environmental management*, 163, 98-108. <https://doi.org/10.1016/j.jenvman.2015.08.013>
 39. Weston, S., & Frieman, M. B. (2020). COVID-19: knowns, unknowns, and questions. *Mosphere*, 5(2), 10-1128. <https://doi.org/10.1128/msphere.00203-20>
 40. Wei, G. (2020). Medical waste management experience and lessons in covid-19 outbreak in Wuhan." Chongqing: Gient Heating Industry Co.[Google Scholar]. Available from: <https://www.waste360.com/medicalwaste/medical-waste-management-experienceand-lessons-covid-19-outbreak-wuhan>
 41. Yoon, C. W., Kim, M. J., Park, Y. S., Jeon, T. W., & Lee, M. Y. (2022). A review of medical waste management systems in the Republic of Korea for hospital and medical waste generated from the COVID-19 pandemic. *Sustainability*, 14(6), 3678. <https://doi.org/10.3390/su14063678>
 42. Yusefi, A. R., Sharifi, M., Nasabi, N. S., Rezabeigi Davarani, E., & Bastani, P. (2022). Health human resources challenges during COVID-19 pandemic; evidence of a qualitative study in a developing country. *PloS one*, 17(1), e0262887. <https://doi.org/10.1371/journal.pone.0262887>

SELECTION OF THE LOCATION OF THE DISTRIBUTION CENTER FOR AGRICULTURAL PRODUCTS

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ABSTRACT

The aim of the study was to use a multi-criteria decision-making method to make a rational choice for a new location for the distribution centre of agricultural products in the northeastern part of Bosnia and Herzegovina, specifically in five populated areas. The required criteria were selected based on experiences from previous research in this field, and decision-makers involved in the selection were engineers and technologists from the company in question. The results indicate that the criteria of construction cost and market connectivity gained the greatest importance, and Brčko was chosen as the location for the future distribution centre among the five populated areas. Additionally, the successful application of the used multi-criteria decision-making method, in this case, the CoCoSo method, was demonstrated. This could lead to improvements in making future business decisions within this economic sector.

Introduction

The selection of a distribution centre location is a crucial strategic issue for every company, particularly for those involved in the distribution of agricultural products. The need for transporting various goods has, undoubtedly, significantly increased as urban areas have become denser, and consumer demand has sharply risen (Sopha et al., 2018). As highlighted by Stević et al. (2022), distribution centres, whether urban or regional, emerge as the most popular alternative among potential interventions for

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reducing and/or enhancing the efficiency of urban traffic. De Carvalho et al. (2020) define distribution centres as places where products are transshipped, deliveries are consolidated, and the distribution process is efficiently executed. According to Okatan et al. (2019), a distribution centre represents a specific and designated location near markets and transportation hubs, facilitating well-organized storage and distribution based on the type and durability of the products. Kuo (2011) concludes that companies strive to increase economies of scale and reduce transportation costs, choosing a location that best facilitates these goals. The decision on the choice of a distribution centre location is influenced by a large number of factors. Supporting this, Mihajlović et al. (2019) note that the location selection problem plays a crucial role in logistics, making it very important to find the most desirable distribution centre location. The choice of location for distribution centres can expedite sales and procurement while reducing logistics costs, providing economic benefits to both suppliers and customers (Yang, Song, 2022). In essence, the selection of a distribution centre is a crucial strategic decision for every company (Agrebi, Abed, 2021).

Problem becomes even more complex when dealing with sensitive products, such as agricultural products. Whether of plant or animal origin, these products have specific characteristics that must be taken into account in their storage and transportation, so this is one of the main reasons for this type of research. The strong development of modern logistics for agricultural products is of great importance for improving the efficiency of agricultural product distribution, reducing costs, effectively solving problems, improving the lives of farmers, increasing agricultural production, and promoting rural prosperity (Mihajlović et al., 2019). Li Ma (2021) further states that a reasonable location and layout of agricultural product distribution centres can not only efficiently improve logistics, reduce costs, loss rates, and waste but also optimize the entire supply chain system.

Daily changes in the market conditions of the economy imposed the obligation of a serious approach to planning and organization of all business segments in agriculture and agribusiness, and making a decision has become something that is of crucial importance for every manager or business organizer. (Nedeljković et al., 2017) In support of the above, the number of factors that must be considered, and criteria that must be met, before making a rational decision, is growing day by day. Successfully overcoming complex organizational problems and making rational business decisions in agribusiness offer us multi-criteria decision-making methods that have been confirmed through some earlier research by individual domestic and foreign authors (Puška et al., 2023; Nedeljković et al., 2020; Maksimović et al., 2018 ; Durkalić et al., 2019; Kozlovskiy et al., 2018; Badr et al., 2018 ect.)

The choice of location is usually influenced by various qualitative and quantitative criteria (Kieu et al., 2021). Therefore, the effective resolution of location selection and evaluation for the establishment of distribution centres is achieved through the use of multi-criteria decision-making (Kuo, 2011). Specific multi-criteria decision-making methods play a crucial role in the evaluation and selection of distribution

centre locations, varying in their approaches. Hence, the aim of this study is to apply one such multi-criteria decision-making method to choose an appropriate location for an agricultural product distribution centre that best satisfies all specified criteria. The research focuses on planned distribution centres for agricultural products, specifically crops and vegetables, in the region of Bosnia and Herzegovina, namely four populated areas (Bijeljina, Ugljevik, Brčko, Zvornik, and Janja).

Literature review

As a result of the significant importance of selecting locations for distribution centres, numerous multi-criteria methods have been developed to assist decision-makers (Agrebi et al., 2017). In their earlier research, some authors concluded that choosing an appropriate location for a distribution centre can significantly impact a company's competitiveness, profitability, and sustainability (Ozerova et al., 2019; Taghikhah et al., 2019; Ehtesham Rasi, Sohanian, 2020; Kieu et al., 2021; Pantović et al., 2023). Supporting these claims is the fact that choosing the location for agricultural product distribution centres has become an important area of research in recent times. During the selection process, multiple criteria can be considered, sometimes conflicting with each other. Some of these criteria include transportation costs (Li, Zhou, 2021; Teng et al., 2021; Yonathan, Pujawan, 2021), proximity to markets (Van Der Lee et al., 2020; Xiong et al., 2020; Suman et al., 2021), and resource availability (Monzón et al., 2020; Milojević et al., 2020; Stock et al., 2020; Ilić et al., 2022; Baker et al., 2022).

Some of the earlier research has focused on the selection of locations for agricultural product distribution centres, utilizing multi-criteria analysis methods. For instance, Gergin et al. (2022) employed multi-criteria analysis methods to assess the location of oilseed warehouses in Turkey. They used a combined approach with AHP, TOPSIS, and the Delphi decision-making method, along with panel data, resulting in a comprehensive integrated approach used as a model for location selection. The results, as the authors conclude, are significant for shaping future policies in this economic sector. Nong (2022) proposed an integrated approach based on AHP and TOPSIS methods for selecting the most suitable location for a distribution centre. The model was suggested for the Dong Nai province in Vietnam and is advantageous for use in various industrial sectors. Additionally, Puška et al. (2023a) focused their research on the significance of location in establishing distribution centres. For their study conducted in the Brčko district, they employed multi-criteria decision-making methods, namely fuzzy set SWARA and CRADIS methods. Based on their research, they confirmed the hypothesis that this method can be successfully used for selecting the location of a future distribution centre. The aim of the study was to use a multi-criteria decision-making method to make a rational choice for a new location for the distribution centre of agricultural products in the northeastern part of Bosnia and Herzegovina.

Methodology

A multi-criteria decision-making model called CoCoSO (*Combined Compromise Solution*) has been proposed for the selection of distribution centre locations. Multi-criteria methods, including the CoCoSo method, have their strengths and weaknesses. Some authors argue that the choice of method depends on the decision-maker's preferences (Jansen et al., 2022; Schmitt et al., 2022), the characteristics of the problem (Mihajlović et al., 2019; Aytekin, 2021), and the availability of data (Kadoić et al., 2021; Mugiyo et al., 2021). The CoCoSo multi-criteria decision-making method has a wide range of applications. One reason for using this method in the study is its infrequent application by domestic authors, and this serves to popularize it. Essentially, the method is based on integrating simple weight additive and exponential weight product models (Lukić, 2021).

Yazdani (2019) outlines the following steps of this method:

1. *The determination of the initial decision matrix is carried out by the following statement:*

$$x_{ij} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix}; i = 1, 2, \dots, m; j = 1, 2, \dots, n.$$

where m represents the number of alternatives, and n represents the number of specified criteria.

2. *Normalization of the initial decision matrix is achieved through the following equations:*

$$r_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}}; \text{ (when it comes to benefit criteria),}$$

$$r_{ij} = \frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}}; \text{ (when it comes to cost criteria).}$$

3. *Establishing the sums of weighted comparable sequences () and the strengths of weighted comparable sequences () for each set alternative is based on the following formulas:*

$$S_i = \sum_{j=1}^n (w_j r_{ij})$$

$$P_i = \sum_{j=1}^n (r_{ij})^{w_j}$$

4. *Calculating the relative weights of alternatives with strategy aggregation is obtained using the following formulas:*

$$k_{ia} = \frac{P_i + S_i}{\sum_{i=1}^m (P_i + S_i)}$$

$$k_{ib} = \frac{S_i}{\min_i S_i} + \frac{P_i}{\min_i P_i}$$

$$k_{ic} = \frac{\lambda(S_i) + (1-\lambda)(P_i)}{(\lambda \max_i S_i + (1-\lambda) \max_i P_i)}$$

5. Ranking alternatives based on k_i is obtained in the following way:

$$k_i = (k_{ia} k_{ib} k_{ic})^{\frac{1}{3}} + \frac{1}{3} (k_{ia} k_{ib} k_{ic})$$

To obtain the weighting coefficients, the well-known AHP (Analytic Hierarchy Process) method was used, and the research results are presented in tabular and graphical form in the following text.

Research Results and Discussion

Due to the significance of choosing the location for the distribution centre, the following Table 1 provides a brief description of the economic and social criteria that will be used for evaluation by the selected experts of the company. The company in question is engaged in the sale and distribution of agricultural products intended for customers both domestically and internationally. Therefore, the existence of such a centre plays a crucial role in their operations. The company falls into the category of small to medium-sized enterprises, depending on the engagement of seasonal labour, and its headquarters are located in the municipality of Belgrade. With the development of business in the regional countries, the company plans to expand its distribution network beyond the borders of Serbia. Consequently, the selection of the location for the distribution centre for their products, which primarily consist of crops and vegetables (such as wheat, barley, corn, sunflower, beans, lentils, etc.), as well as certain products resulting from their processing, becomes crucial. The company comprises graduate engineers and several food technologists, five of whom, in this case, are considered decision-makers and evaluators of specific criteria.

Table 1. Research criteria

Criterion label (C)	Criterion	Description	Criteria type
C1	Construction cost	By choosing the location, reduce construction costs to a reasonable, minimal level that does not compromise quality.	Minimum
C2	Location accessibility	Choose a location that provides a place that is maximally available for further work activities.	Maximum
C3	Logistics costs	Reduce costs to a reasonable and minimal level.	Minimum
C4	Safety	By choosing a location, ensure reliability in every segment of functioning.	Maximum
C5	Market connection	Maximize connection with the main market entities.	Maximum

Criterion label (C)	Criterion	Description	Criteria type
C6	Distance from customers	By choosing a location, reduce the distance from potential customers to a minimum.	Minimum
C7	Distance from supplier	By choosing a location, reduce the distance from potential suppliers to a minimum.	Minimum
C8	Impact on the environment	By choosing the location, minimize the environmental impact through its operational activities.	Minimum

Source: Authors

As mentioned earlier, for alternatives, or potential locations of the distribution centre, five populated areas in Bosnia and Herzegovina were considered in the following regions: Bijeljina, Brčko, Zvornik, Ugljevik, Janja, and their brief descriptions can be seen in the following Table 2.

Table 2. Potential locations of the distribution centre

Alternative label (A)	Location	Short description
A1	Bijeljina	It occupies the northeastern part of Bosnia and Herzegovina; Proximity to the borders with Serbia and Croatia; Proximity to major transportation routes; Proximity to larger watercourses; Good terrain configuration; Proximity to markets and potential major suppliers.
A2	Brčko	It occupies the northeastern part of Bosnia and Herzegovina; Proximity to the borders with Serbia and Croatia; Good connectivity with the interior of Bosnia and Herzegovina; Proximity to the highway (M75); Proximity to major navigable watercourses and possession of a river port; Good terrain configuration; Proximity to markets and potential major suppliers. Good infrastructure equipment.
A3	Zvornik	It occupies the eastern part of Bosnia and Herzegovina; Good connectivity with major highways; Proximity to river watercourses; Proximity to major market centres; Good geographical position; Proximity to border crossings; Good connectivity with large supplier centres.
A4	Ugljevik	It occupies the northeastern part of Bosnia and Herzegovina; Proximity to the borders with Serbia and Croatia; Good connectivity with the interior of Bosnia and Herzegovina; Good connectivity with large and small supplier centres in Bosnia and Herzegovina. Accessible and quality workforce
A5	Janja	It occupies the northeastern part of Bosnia and Herzegovina; Proximity to the border with Serbia; Good connectivity with other parts of Bosnia and Herzegovina; Good connectivity with all main and local roads in the region; Good connectivity with potential customers and suppliers from Bosnia and the region; Good infrastructure; Good terrain configuration; Accessible and quality workforce.

Source: Authors

After individually considering all the criteria and proposed alternatives, a joint expert assessment was given based on a formed linguistic scale, whose quantitative values can be seen in the following Table 3.

Table 3. Linguistic scale of values

Evaluation of criteria	Linguistic scale
1	VP-Very Poor
2	P-Poor
3	M-Medium
4	G-Good
5	VG-Very Good

Source: Đalić et al., 2020

After determining the type of criteria based on the previous Table 1 and proceeding according to decisions, weight values for individual criteria were obtained from experts, where we observe that the criteria ‘construction cost’ and ‘market connectivity’ have the highest values (Table 4). The assessment was carried out based on the Analytic Hierarchy Process (AHP) decision-making methodology, which in this case provides the most favourable solution. The reason for the obtained ratings of individual criteria, specifically the significance of construction cost, should be sought in the increasing costs involved in it, while market connectivity, as stated by Koohathongsumrit & Meethom (2021), is crucial due to the fact that transport has become a key factor in international and domestic distribution centres.

Table 4. Expert assessment of criteria

	C1	C2	C3	C4	C5	C6	C7	C8
A1	3	4	3	3	5	5	4	5
A2	2	3	3	4	4	5	4	5
A3	2	2	3	3	4	4	4	4
A4	4	3	4	4	3	3	4	3
A5	4	4	4	4	3	3	3	2
Max.	4	4	4	4	5	5	4	5
Min.	2	2	3	3	3	3	3	2
C/B	min.	max.	min.	max.	max.	min.	min.	min.
Weight	0,2	0,1	0,1	0,15	0,2	0,1	0,1	0,05

Source: Authors' calculation

After the formation of the initial decision-making matrix, in further steps it was normalized (table 5), as well as the determination of its weights (table 6).

Table 5. Normalized decision-making matrix

	C1	C2	C3	C4	C5	C6	C7	C8
A1	0,5	1	1	0	1	0	0	0
A2	1	0,5	1	1	0,5	0	0	0
A3	1	0	1	0	0,5	0,5	0	0,33
A4	0	0,5	0	1	0	1	0	0,66
A5	0	1	0	1	0	1	1	1

Source: Authors' calculation

Table 6. Weighted normalized decision-making matrix

	C1	C2	C3	C4	C5	C6	C7	C8
A1	0,1	0,1	0,1	0	0,2	0	0	0
A2	0,2	0,05	0,1	0,15	0,1	0	0	0
A3	0,2	0	0,1	0	0,1	0,05	0	0,0165
A4	0	0,05	0	0,15	0	0,1	0	0,033
A5	0	0,1	0	0,15	0	0,1	0,1	0,05

Source: Authors' calculation

Further calculation established the sum of weighted comparable sequences of strings () and the strength of weighted comparable sequences (). (Table 7)

Table 7. Weighted and exponential comparability of sequences i

A1	0,5	0,2942
A2	0,6	3,641
A3	0,4665	3,703
A4	0,333	3,13
A5	0,5	3,994
Sum	2,3995	17,41
Min.	0,333	2,942
Max.	0,6	3,994

Source: Authors' calculation

Table 8 gives us the calculated relative weights of the alternatives, i.e., its aggregation, as well as their ranking order. In the last column of table 8, we see the final ranking of the alternatives values.

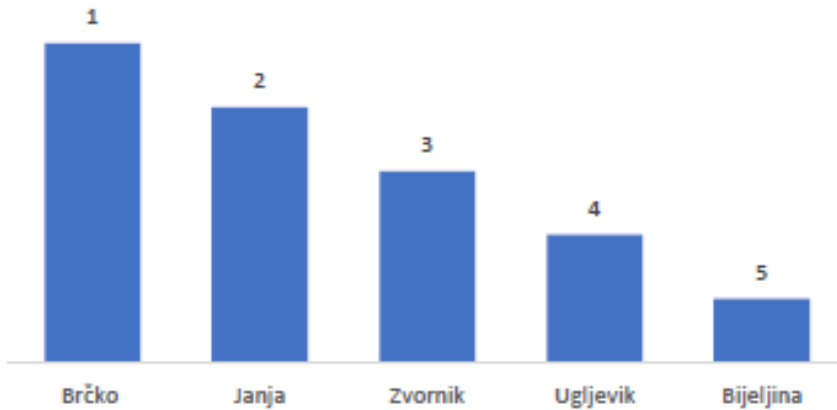
Table 8. Final aggregation and ranking

		Rank		Rank		Rank		Rank
A1	0,173755	5	2,501502	4	0,749238	5	1,13	5
A2	0,214089	2	3,039395	1	0,923161	2	2,22319	1
A3	0,21048	3	2,659568	3	0,907597	3	2,0457	3
A4	0,174815	4	2,063902	5	0,753809	4	1,6382	4
A5	0,226861	1	2,859081	2	0,978232	1	2,2015	2

Source: Authors' calculation

As seen in Figure 1, the chosen location for constructing the future distribution centre is Brčko, situated in the district of the same name in Bosnia and Herzegovina. Immediately following is the populated place Janja. Similar research results are found in the study by Puška et al. (2023), where the authors identify the settlement of Brčko as the optimal location for establishing a new distribution centre in their study. Advanced multi-criteria decision-making methods were also applied for this purpose.

Figure 1. Ranking of distribution centres



Source: Edited by the author

Conclusion

The selection of the distribution centre location represents a complex business decision-making problem in any company, especially one involved in the distribution of agricultural products. To address this, a multi-criteria decision-making method was employed, where experts, based on given economic and social criteria, identified the most favourable location from five proposed sites for distribution centres. The optimal location was determined to be the populated place Brčko, located in the Brčko District in Bosnia and Herzegovina. The undeniable significance of the location selection in this case is attributed to the use of the CoCoSo multi-criteria decision-making method, providing impetus for refining the research methodology in future studies. Future research should focus on further developing methods that assist in making rational decisions regarding the selection of locations for these centres, especially in the context of agriculture and agribusiness.

Conflict of interests

The authors declare no conflict of interest.

References

1. Agrebi, M., & Abed, M. (2021). Decision-making from multiple uncertain experts: case of distribution center location selection. *Soft Computing*, 25(6), 4525–4544. <https://doi.org/10.1007/s00500-020-05461-y>
2. Agrebi, M., Abed, M., & Omri, M. N. (2017). ELECTRE I based relevance decision-makers feedback to the location selection of distribution centers. *Journal of Advanced Transportation*, Article ID 7131094. <https://doi.org/10.1155/2017/7131094>
3. Aytekin, A. H. (2021). Comparative Analysis of the Normalization Techniques in the Context of MCDM Problems. *Decision Making*, 4(2), 1–25. <https://doi.org/10.31181/dmame210402001a>
4. Badr, G., Hoogenboom, G., Moyer, M., Keller, M., Rupp, R., & Davenport, J. (2018). Spatial suitability assessment for vineyard site selection based on fuzzy logic. *Precis. Agric.* 19, 1027–1048. <https://doi.org/10.1007/s11119-018-9572-7>
5. Baker, T., Moore, K., Lim, J., Papanastasiou, C., McCarthy, S., Schreve, F., Lawson, M., & Versace, V. (2022). Rural emergency care facilities may be adapting to their context: A population-level study of resources and workforce. *Australian Journal of Rural Health*, 30(3), 393-401. <https://doi.org/10.1111/ajr.12846>
6. de Carvalho, N.L., Vieira, J.G.V., da Fonseca, P.N., & Dulebenets, M.A. (2020). A Multi-Criteria Structure for Sustainable Implementation of Urban Distribution Centers in Historical Cities. *Sustainability*, 12, 5538. <https://doi.org/10.3390/su12145538>
7. Durkalić, D., Furtula, S., Borisavljević, K. (2019), Ranking tourism market performance in EMU countries: results of PROMETHEE - GAIA approach, *Hotel and Tourism Management*, 7(2), 67-76, doi: 10.5937/menhottur1902067D,
8. Đalić, I., Stević, Ž., Erceg, Ž., Macura, P., Terzić, S. (2020). Selection of a Distribution channel using the Integrated FUCOM-MARCOS model. *International Review*, 3-4:80-96.
9. Ehtesham Rasi, R., & Sohanian, M. (2020). A multi-objective optimization model for sustainable supply chain network with using genetic algorithm. *Journal of Modelling in Management*, 16(2), 714–727. <https://doi.org/10.1108/jm2-06-2020-0150>
10. Gergin, R. E., Peker, I., Baki, B., Tuzkaya, U. R., & Tanyas, M. (2022). Oilseed warehouse location selection with an integrated approach: a case of Turkey. *Kybernetes*. <https://doi.org/10.1108/k-10-2021-1072>
11. Ilić, V., Mihajlović, M., & Knežević, M. (2022). The role of social entrepreneurship in modern business conditions. *Oditor*, 8(2), 75-90. <https://doi.org/10.5937/Oditor2202074I>
12. Jansen, C., Blocher, H., Augustin, T., & Schollmeyer, G. (2022). Information efficient learning of complexly structured preferences: Elicitation procedures and their application to decision making under uncertainty. *International Journal of Approximate Reasoning*, 144, 69–91. <https://doi.org/10.1016/j.ijar.2022.01.016>

13. Kadoić, N., Šimić, D., Mesarić, J., & Begičević Redep, N. (2021). Measuring Quality of Public Hospitals in Croatia Using a Multi-Criteria Approach. *International Journal of Environmental Research and Public Health*, 18(19), 9984. <https://doi.org/10.3390/ijerph18199984>
14. Kieu, P.T., Nguyen, V.T., Nguyen, V.T., & Ho, T.P. (2021). A Spherical Fuzzy Analytic Hierarchy Process (SF-AHP) and Combined Compromise Solution (CoCoSo) Algorithm in Distribution Center Location Selection: A Case Study in Agricultural Supply Chain. *Axioms*, 10, 53. <https://doi.org/10.3390/axioms10020053>
15. Koothongsumrit, N., & Meethom, W. (2021). An integrated approach of fuzzy risk assessment model and data envelopment analysis for route selection in multimodal transportation networks. *Expert Systems with Applications*, 171(114342), 114342. <https://doi.org/10.1016/j.eswa.2020.114342>
16. Kozlovskiy, S., Mazur, H., Vdovenko, N., Shepel, T., Kozlovskiy, V. (2018). Modeling and Forecasting the Level of State Stimulation of Agricultural Production in Ukraine Based on the Theory of Fuzzy Logic. *Montenegrin J. Econ.*, 14, 37–53. <https://doi.org/10.14254/1800-5845/2018.14-3.3>
17. Kuo, M.-S. (2011). Optimal location selection for an international distribution center by using a new hybrid method. *Expert Systems with Applications*, 38(6), 7208–7221. <https://doi.org/10.1016/j.eswa.2010.12.002>
18. Li Ma (2021). Research on Location Selection of Agricultural Products Logistics Distribution Center Based on Two-stage Combination Optimization Algorithm, The 2nd International Conference on Computing and Data Science (CONF-CDS 2021), IOP Publishing, 1881. <https://doi.org/10.1088/1742-6596/1881/4/042085>
19. Li, X., & Zhou, K. (2021). Multi-objective cold chain logistic distribution center location based on carbon emission. *Environmental Science and Pollution Research*, 28(25), 32396–32404. <https://doi.org/10.1007/s11356-021-12992-w>
20. Lukić, R. (2021). Analiza efikasnosti osiguravajućih kompanija po vrstama osiguranja u Srbiji na bazi CoCoSo metode, *Tokovi osiguranja*, (2), str. 9-23. <https://doi.org/10.5937/TokOsig2102009L>
21. Maksimović, A., Grgić, Z., Puška, A., Bobić, B., Čejvanović, F. (2018). Primjena višekriterijskog odlučivanja za izbor optimalne sorte jabuke za sjeverozapadnu regiju BiH. *J. Cent. Eur. Agric.* 19, 740–759. <https://doi.org/10.5513/JCEA01/19.3.2062>
22. Mihajlović, J., Rajković, P. M., Petrović, G. M., & Ciric, D. (2019). The selection of the logistics distribution fruit center location based on MCDM methodology in southern and eastern region in Serbia. *Operational Research in Engineering Sciences: Theory and Applications*, 2(2). <https://doi.org/10.31181/oresta190247m>
23. Milojević, I., Mihajlović, M., & Pantić, N. (2020). Collection and documentation of audit evidence. *Oditor*, 6(2), 77-90. <https://doi.org/10.5937/Oditor2002077M>

24. Monzón, J., Liberatore, F., & Vitoriano, B. (2020). A Mathematical Pre-Disaster Model with Uncertainty and Multiple Criteria for Facility Location and Network Fortification. *Mathematics*, 8(4), 529. <https://doi.org/10.3390/math8040529>
25. Mugiyo, H., Chimonyo, V. G. P., Sibanda, M., Kunz, R., Masemola, C. R., Modi, A. T., & Mabhaudhi, T. (2021). Evaluation of Land Suitability Methods with Reference to Neglected and Underutilised Crop Species: *A Scoping Review*. *Land*, 10(2), 125. <https://doi.org/10.3390/land10020125>
26. Nedeljković, M., Puška, A., & Krstić, S. (2022). Multicriteria Approach to Rural Tourism Development in Republic of Srpska, *Economics of Agriculture*, 69(1), 13-26. <https://doi.org/10.5937/ekoPolj2201013N>
27. Nedeljković, M., Zoranović, T., Vukoje, V. & Plavšić, M. (2017). Poslovno odlučivanje u poljoprivredi i agrobiznisu, *Agroekonomika*, 46(76), Departman za ekonomiku poljoprivrede i sociologiju sela, Poljoprivredni fakultet Novi Sad, str. 55-65.
28. Nong, T. N. M. (2022). A hybrid model for distribution center location selection. *The Asian Journal of Shipping and Logistics*, 38(1), 40–49. <https://doi.org/10.1016/j.ajsl.2021.10.003>
29. Okatan, B.S., Peker, I., & Baki, B. (2019). An Integrated DEMATEL-ANP-VIKOR Approach for Food Distribution Center Site Selection: A Case Study of Georgia. *Pressacademia*, 6, 10–20. <https://doi.org/10.17261/Pressacademia.2019.1030>
30. Ozerova, M. G., Sharopatova, A. V., & Olentsova, J. (2019). Improving the competitiveness of agricultural products as a basis for solving import replacement issues. IOP Conference Series. <https://doi.org/10.1088/1755-1315/315/2/022026>
31. Pantović, D., Seočanac, M., Đorđević, N. (2023). Cultural values, tourism valorization and authenticity: the case of Vrnjačka Banja, *The European Journal of Applied Economics*, 20(1), 93-106. <https://doi.org/10.5937/ejae20-42657>,
32. Puška, A., Nedeljković, M., Stojanović, I., & Božanić, D. (2023). Application of Fuzzy TRUST CRADIS Method for Selection of Sustainable Suppliers in Agribusiness, *Sustainability*, 15(3), <https://doi.org/10.3390/su15032578>
33. Puška, A., Štilić, A., & Stević, Ž. (2023a). A Comprehensive Decision Framework for Selecting Distribution Center Locations: A Hybrid Improved Fuzzy SWARA and Fuzzy CRADIS Approach, *Computation* 11(73), <https://doi.org/10.3390/computation11040073>
34. Schmitt, T., Hoffmann, M., Rodemann, T., & Adamy, J. (2022). Incorporating Human Preferences in Decision Making for Dynamic Multi-Objective Optimization in Model Predictive Control. *Inventions*, 7(3), 46. <https://doi.org/10.3390/inventions7030046>
35. Sopha, B.M., Asih, A.M.S., & Nursitasari, P. D. (2018). Location Planning of Urban Distribution Center under Uncertainty: A Case Study of Yogyakarta Special Region Province, Indonesia. *J. Ind. Eng. Manag.* 11, 542. <http://dx.doi.org/10.3926/jiem.2581>

36. Stević, Ž., Miškić, S., Vojinović, D., Huskanović, E., Stanković, M., & Pamučar, D. (2022). Development of a Model for Evaluating the Efficiency of Transport Companies: PCA–DEA–MCDM Model. *Axioms*, 11, 140. <https://doi.org/10.3390/axioms11030140>
37. Stock, P. G., Wall, A., Gardner, J., Domínguez-Gil, B., Chadban, S., Muller, E., Dittmer, I., & Tullius, S. G. (2020). Ethical Issues in the COVID Era: Doing the Right Thing Depends on Location, Resources, and Disease Burden. *Transplantation*, 104(7), 1316–1320. <https://doi.org/10.1097/tp.0000000000003291>
38. Suman, M. N. H., MD Sarfaraj, N., Chyon, F. A., & Fahim, M. R. I. (2021). Facility location selection for the furniture industry of Bangladesh: Comparative AHP and FAHP analysis. *International Journal of Engineering Business Management*, 13, 184797902110308. <https://doi.org/10.1177/18479790211030851>
39. Taghikhah, F., Voinov, A., & Shukla, N. (2019). Extending the supply chain to address sustainability. *Journal of Cleaner Production*, 229, 652–666. <https://doi.org/10.1016/j.jclepro.2019.05.051>
40. Teng, F., Xinxin, W., Jiajia, B., & Peng, W. (2021). Research on Ant Colony Algorithm for Location Planning of Distribution Center. *Journal of Physics: Conference Series*, 1920(1), 012099. <https://doi.org/10.1088/1742-6596/1920/1/012099>
41. Van Der Lee, J., Oosting, S., Klerkx, L., Opinya, F., & Bebe, B. O. (2020). Effects of proximity to markets on dairy farming intensity and market participation in Kenya and Ethiopia. *Agricultural Systems*, 184, 102891. <https://doi.org/10.1016/j.agsy.2020.102891>
42. Xiong, Y., Okorie, C., & Ezeoke, G. (2020). Enhancing distribution network performance: a quantitative approach to developing a distribution strategy model. *Pressacademia*, 7(4), 160–182. <https://doi.org/10.17261/pressacademia.2020.1331>
43. Yang, L., & Song, X. (2022). High-performance computing analysis and location selection of logistics distribution center space based on whale optimization algorithm. *Computational Intelligence and Neuroscience*, 2055241. <https://doi.org/10.1155/2022/2055241>
44. Yazdani, M., Zarate, P., Zavadskas, E. K., & Turskis, Z. (2019). A combined compromise solution (COCOSO) method for multi-criteria decision-making problems. *Management Decision*, 57(9), 2501–2519. <https://doi.org/10.1108/MD05-2017-0458>
45. Yonathan, M., & Pujawan, I. N. (2021). Distribution Network Configuration of Drilling Material to Reduce Transportation Cost. *IPTEK Journal of Proceedings Series*, 0(3), 168. <https://doi.org/10.12962/j23546026.y2020i3.11198>

SOCIALLY RESPONSIBLE BUSINESS WITH REFERENCE TO AGRICULTURAL FARMS

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ABSTRACT

The aim of this paper is to show that business entities that apply ethical principles in their business, gain a good reputation on the market and trust in the quality of their product. Thus, it is known that the business entity is responsible, which enables it to fulfill the basic goal of business, which is to make a profit. The subject of research in this paper is the impact of socially responsible business on the market position of business entities. The authors specifically investigated the application and impact of socially responsible business rules on the position of agricultural farms in the territory of the municipality of Ruma. The instruments used in this research are a survey of farm owners and other stakeholders, an extensive literature review and a method of comparative analysis. The results of the research show that compliance with the rules of business ethics, in the long term, brings more profit to the business entity, so compliance with those standards is becoming more and more universal. That is why agricultural producers follow the rules of socially responsible business. The authors concluded that the social responsibility of business entities is an ethical demand that society places on them, a correlation with two demands that they are already faced with: economic - gaining profit and legal.

Introduction and literature review

In this paper, the authors point out the importance of corporate social responsibility (CSR) of business entities (companies, agricultural farms) not only because of the

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benefits that the business entity provides to the community, but also to ensure the sustainability of its own business for a long period of time and to achieve the main goal of business and that is making a profit.

Through socially responsible operations, business entities can significantly help the development of the local community in which they operate. That is why it is important that they recognize in time how important it is to improve business processes, business methods and ways of generating profit, first taking care of their internal environment (their employees), then the environment of the task (customers, suppliers, competitors, the labor market) and recognizing opportunities, but and threats from the external environment.

The idea and principles of socially responsible business were first created in the German legal system in 1937, with the adoption of the Law on Joint Stock Companies. If we bear in mind that Germany is the creator of the rule of law, it is understandable that this concept was found first of all, precisely in German law. Based on the concept of „special interest of the company as a legal entity”, this law incorporates the interest of the state in joint stock companies. The law provided for the formation of a supervisory board with the aim of taking care of the special interests of the company (the interest of the company), which is different from the interests of other persons interested in the company’s operations (Kuntz, 2017).

This is the first time that the state has been nominated as one of the persons interested in the company’s operations (constituent). Otherwise, until then, and in many countries of the world, the issue of social responsibility of companies, first of all from a theoretical point of view and only later, from an institutional point of view, started to be discussed (Vives, A. 2008) only with the emergence of the stock market crisis and major stock market scandals. Only then it was recognized that the company still has a significant influence on the state through its influence on the environment, public revenues of the state, politics, economy, consumers, etc.

In this way, the correctness of the American position, which advocates the exclusivity of the interests of capital owners in the company, was called into question. Facing major systemic crises on a global level, the question arose whether a company is an institution of private law only, which only has the function of realizing the interests of its owners, or is it also an institution that has a general social function, which also has specific public law functions of satisfying the interests of others persons, some of which are private interests and some public interests (Hamers, J. et al 2005; Gill, A. 2008)?

Consideration of this important issue also raised the phenomenon of the company’s social responsibility. The beginning of the new century became the century of full affirmation of the system of social responsibility of companies. Otherwise, many people equate the concept of social responsibility with philanthropy. Also, the terms „social” and „responsibility” have long been incorrectly interpreted in practice. In the context of corporate social responsibility, the term „social” does not mean that which is the domain of the government, but represents the company’s relationship with society, including the environment. This concept primarily refers to the protection of human rights, corporate governance, environmental protection and the protection and promotion of the rights of workers and the state in a sociological sense.

In order to promote this institute, Great Britain introduced the function of minister for socially responsible business. The Danish government has developed a social index to measure a company's level of commitment to social responsibility. The European Parliament advocates for the creation of mechanisms to enforce the rules of social responsibility of companies and recommends the Commission of the European Union to consider the advantages of legally binding standards on the implementation of socially responsible business (Davidsson, P. A. 2002).

On the formal level, the Republic of Serbia is not far behind the countries of the European Union. The Government of Serbia adopted certain regulations, which provided for measures and activities for the promotion of socially responsible business in Serbia. A significant contribution to this goal is also expected from the implementation of the current national strategy of sustainable development of the Republic of Serbia (International Finance Corporation (IFC), 2011).

There is no doubt that the main interest of a business entity is the provision of profit, which, however, in most of the world in the last few decades has been limited by moral principles. Therefore, it can be concluded that "the interest of the company is the totality of all individual interests of all constituents." In this totality, the interest of the shareholders, that is, the owner of the capital, is primary, therefore only in the first place, but in any case it is not the only interest. In addition to the above, the management of the company is the bearer of a special interest of its own ("interest of the management"), because it brings its specific organizational human capital into the company. Bearing in mind the management's duty to work in the best interest of the company, in the event of a conflict between its own interest and the company's interest, the management is obliged to be loyal to the company it manages (fiduciary duty).

At first glance, the company is a compact, legal entity with one interest, the owner's interest. However, the company is also internally full of conflicts and contradictions (Tabaroši, S. 2005), and therefore also towards the outside world. The company is characterized by multiple layers of different interests and risks that exist in every company, both internal constituents and external constituents, consumers and others (Corbett, A. 2008). In addition to the above, the company itself has its own interest, so one can talk about the interest of the company as well as the interest of the state in the sociological sense of the word. In this way, it can talk about multiple interests:

- interest of capital owners,
- interest of creditors,
- interest of employees,
- interest of the director (management) i
- the interest of society
- the interest of the state (Brian, R. 2004).

The interests of the mentioned persons are often contradictory to each other and always dynamic, which makes the company a conflicted and not at all idyllic subject (Tabaroši, S. 2005). Due to the existence of different interests, the legislator has a special, not at all easy, role to maximally harmonize and harmonize these interests with regulations (Rilka, D. et al 2000).

The question arises, where is the position of the state and society in the sociological sense of the word? The state is also interestingly integrated into the operations of the company as well as employees and management, creditors, consumers and users of services (products), which in turn presupposes its duties, but also the duties of the management of that company (state affiliation of the company, environmental protection, property registers and capital, tax aspects, criminal liability, financial reports, business transparency and the like) (Vasiljević, M. 2013).

The system of social responsibility of companies in the European Union (EU) is today integrated into several segments:

- environmental protection and sustainable development,
- protection of workers' rights,
- protection of consumer interests,
- social issues and employment,
- public procurement,
- human rights policy, where it is a particularly open question whether a subsidiary company founded in another country should respect the standards of these rights that exist in the country of its headquarters or such standards of the country of the controlling company as the founder (Vasiljević, M. 2011) and
- external relations and, at the same time, company policy towards internal and external stakeholders (Corporate Governance Code of the Republic of Serbia, 2012).

In this paper, the application of CSR rules at agricultural farms engaged in plant production was investigated. The reason for analysis the business of these entities is multiple: the Republic of Serbia is an agricultural country, agriculture significantly affects the environment and people's health, the effects of product quality can be seen in the short term, etc.

Because, agriculture faces twofold requirements: it needs to find a way to produce quality food for the population, at the same time to take care of environmental protection, so these requirements of socially responsible business are assumed for the observed agricultural farms.

The basic principles on which agricultural production is based according to the generally accepted CSR principles are as follows:

- the principle of health - agriculture should maintain and increase the health of soil, plants, animals, people and the planet as a whole,

- the principle of ecology - agriculture should be based on living eco-systems and cycles, to support them and help maintain them,
- the principle of fairness - agriculture should be based on honest and fair relations towards the general environment, nature and life,
- the principle of nurturing and caring - agriculture should be managed in a careful and responsible manner in order to preserve the health and well-being of current and future generations and ecosystems.

Materials and methods

For the purposes of this paper, the authors conducted research by interviewing the representatives of the agricultural farms and other stakeholders in Serbia: 50 capital owners; 20 managers and 20 creditors (banks and suppliers), was performed, in the period from 2019 to 2022. The observed agricultural holdings are engaged in plant production in the territory of the municipality of Ruma. All of them have been engaged in plant production for at least ten years. All persons regularly monitor innovations in the field they are dealing with. The research was conducted over a period of three years, from 2020 to 2022. In the observed period, all persons had a successful and long business, regularly paid their obligations to all persons, the state, employees, benefactors, gained the trust of customers and operate transparently.

In order to research the mentioned topic, it was necessary to determine the basic attributes of socially responsible business and the results of agricultural business operations.

The respondents were asked the following questions: whether the owners are making a profit; do they follow the rules; whether they are competitive in the market; whether they have regular customers of the product; do they pay their debts regularly, is the business transparent?

The respondent's statement was as follows: all capital owners, all creditors and 90% of managers declared that it is necessary to protect the interests of the majority owner relative to other interest groups, while 10% of managers declared that priority should be given to the interests of the company.

For the purposes of the research, an extensive literature review was conducted and the method of comparative analysis was applied.

The paper presents two research hypotheses:

Hypothesis 1: The primary goal of organizing and operating a company is to make a profit, in order to protect the interests of the majority owner.

Hypothesis 2: The company should follow the generally known rules of corporate social responsibility in order to achieve its objective.

Results and discussion

Based on the results of the research, bearing in mind that the motive of the capital owner is to invest in order to return the funds and obtain a return on the invested funds, as well as the fact that he bears the greatest risk of the company's business, the author concluded that the regulations and business practices should be set in such a way as to prioritize protection interests of capital owners. By applying good corporate social responsibility, it is possible to organize the company in such a way that, with mutual respect for the interests of all constituents, the goal of the company's operations can be achieved - profit, which is a condition for satisfying the interests of all persons interested in the company's operations.

Agricultural farms whose operations have been the subject of research for years voluntarily apply ethical principles in their business practices, which directly positively affected their working conditions, employees, local community and the environment. In this way they form reliable and responsible business entities that generate profits and orderly operate in the market.

Table 1. Presentation of the application of CSR principles and business effects

No.	Elements of business	Period of research			Are the effects of CSR positive?		
		2020	2021	2022	2020.	2021	2022
1.	Making a profit	Yes	Yes	Yes	Yes	Yes	Yes
2.	Compliance with regulations	Yes	Yes	Yes	Yes	Yes	Yes
3.	Competitiveness in the market	Yes	Yes	Yes	Yes	Yes	Yes
4.	Customer satisfaction	Yes	Yes	Yes	Yes	Yes	Yes
5.	Payment of obligations	Yes	Yes	Yes	Yes	Yes	Yes
6.	Is the business transparent?	Yes	Yes	Yes	Yes	Yes	Yes

Source: Research of Authors

The research determined that the entrepreneurs whose business was the subject of the research comply with the rules of the CSR. They believe that they benefit economically from an ethical attitude towards all constituents, which is evident by retaining and increasing the number of satisfied customers, regular debt payments and transparent business practices. That is why they enjoy the trust of other stakeholders. From time to time they receive subsidies from the state and are able to acquire new knowledge from their activities. The operation of the observed agricultural holdings is sustainable, which fulfills the goal of the owners of the agricultural holdings, which is reflected in the acquisition of profit.

In their operations, companies are traditionally faced with the obligation to fulfill two goals: economic, making a profit, and legal, compliance with the legal regulations of

the country of operation and beyond (Code of Corporate Governance of the Republic of Serbia, 2012), but also the application of the so-called soft rules in business, in the last few decades, such as various internationally recognized standards, codes, including socially responsible business (Vasiljević, M. 2013).

The main business objectives of today's company and its management are:

- stable and growing return on investment (return),
- constant inflow of cash (cash flows) i
- increased earnings;
- high management income with the possibility of receiving valuable annual bonuses;
- growth and expansion in order to expand activities and markets;
- good competitive position on the market (Rajnović, Lj. et al 2019).

These goals are in a cause-and-effect relationship and, logically speaking, the experiential matrix of every corporate administration. This is how we arrive at the imperative activity of the company and its management towards constantly increasing profits, because this is how the safe life of the corporation is maintained (Rajnović, Lj. et al 2019). Profit is a means to distribute periodic and annual corporate profits to shareholders through earnings, rewards to management, and to a large extent accumulated for new projects, or saved in case of aleatory or occasional cyclical economic events in the world. Profit is a means that a company needs to live (Arsić, Z. 2005).

After several decades of applying CSR rules, it can say that it is a socially responsible company is one that is legally responsible, respects the legitimate national legal system, including human rights standards in the country of performance and the rights of other constituents interested in the company's operations (Begović, B. et al 2003; Vasiljević, M. 2013). The obligation of the company to act according to additional, higher standards of civil rights remains a moral, not a legal obligation. Local legislation determines the lower threshold of the company's obligations, and their realistic range above that threshold is determined solely by moral requirements (Tabaroši, S. 2005). logical conclusion that the social responsibility of companies is primarily a moral requirement that society places on companies as a correlate to the above two requirements, economic and legal, with the fact that the mentioned moral i.e. non-profit effects of the company become an important criterion for evaluating its success and responsibility in business (Tabaroši, S. 2005).

The question, whether there is a place for moral principles in the business operations of companies is not without importance, because it is increasingly considered that compliance with the standards of business ethics, in the long term, brings more profit to the company (Koevski, G. 2007). Respect for moral standards in business decision-making is becoming more and more universal, so that the social responsibility of the

company is determined not only by legal standards, but also by moral ones, which constitute specific standards of business ethics (Vasiljević, M. 2013).

If the question arises of how to proceed in the event of a conflict of interest between profit maximization and social responsibility of the company, the theory of social responsibility provides arguments in favor of social responsibility (Koevski, G. 2005). In theory and practice, the elements of socially responsible business have been elaborated and shown through the pyramid, namely:

- the economic responsibility of the company - to make a profit, without which the company cannot survive (Koevski, G., 2007),
- legal responsibility - obligation to comply with legal regulations,
- ethical responsibility - the obligation of moral business,
- philanthropic responsibility – which means being a good corporate business entity (Caroll, A. 1996).

If the responsibilities of the company were presented in the form of a pyramid, the broadest base and power would be 1) economic responsibility, then 2) legal responsibility of the company, while after that would come 3) moral responsibility and at the top, as the least in terms of power and commitment of the company, would come bi 3) charitable or philanthropic responsibilities, which reflect even the smallest part of the company's social responsibility. Ethical and charitable responsibilities are undertaken if it increases the company's profit (Nehme, M. 2008).

The application of socially responsible business rules is indicated by reasons of ethics and marketing, but both have their economic expression in increasing profits (Savković, V. 2009). It is considered that doing socially responsible business is a kind of investment, not an expense for the company (Bukvić, R. 2019). It is a real condition without which there is no sustainable development of the company in the long term, as well as the development and stability of the environment and the country in which the company operates.

Socially responsible business has more favorable effects for all constituents:

- leads to improvement of the economic efficiency of the company,
- enables access to domestic and foreign capital markets,
- leads to more stable sources of financing and lower cost of capital,
- ensures the reputation of the company, management and other managers (Besmer, V. 2006).

Companies with socially responsible business respect and reward their employees more, because they understand the value of the human factor and their contribution to business (Herrmann, K. K. 2004). The application of high standards of socially responsible business ensures the inflow of fresh capital, which in the long term contributes to greater competitiveness of companies; reduces the risks related to investments in the

company, because a socially responsible company is one that the public trusts; trust between all groups involved in business activities (IFC, 2011).

Companies that respect social responsibility contribute more to the economy of the company's country of nationality and to the wider community. Such companies base their business on sound foundations and can provide greater profits to shareholders, employees and all other external (IFC, 2011) and internal interest groups, contribute to a better company reputation, which has become a key element of a company's goodwill. Such companies gain public trust and goodwill, which leads to greater confidence in their products and services and increased business profitability.

The rules of social responsibility are evolutionary and adapt to the conditions of the market where companies operate. Reporting to the public (primarily public opinion) is the most effective coercive mechanism for companies to submit to voluntary codes of socially responsible behavior. On the other hand, the legal system of countries is usually the most effective method for applying and introducing new standards of corporate social responsibility policy (Tipurić, D. 2008).

Reporting on corporate social responsibility and economic sustainability is increasingly becoming a common practice of reputable companies. Companies usually make their activities in that part of the business available to the general public as part of their annual reporting or as independent voluntary reporting. This ensures the company's openness and communication with the public. Reporting helps the company to clearly and precisely set goals, to measure the performance and success of implemented changes, and from the obtained results data on the impact of the company on the environment, society and economy can be seen.

One of the most common ways to report is the G4 Guidelines (Global Reporting Initiative Sustainability Reporting Guidelines). The GRI project was created in 2000. The aforementioned framework was developed over time and adapted to new trends, so G4 represents the fourth generation of guidelines intended for all business entities, regardless of size, sector or market in which they operate. For now, the guidelines represent a comprehensive framework for stakeholder reporting.

Conclusion

The agricultural holdings whose operations are considered in this article have sustainable operations, make a profit and operate in accordance with legal regulations. This achieved the two goals faced by every company, because investors would not invest their funds if they do not have a return on investment. At the same time, agricultural farms have a quality product, take care of environmental protection, pay debts on time, are able to retain customers and acquire new ones, receive subsidies from the state. Based on the above, it can be concluded that agricultural farms respect ethical principles, which is why they have a good reputation among stakeholders, including the state.

Although CSR represents the voluntary application of ethical principles, i.e., “soft rules”, in business, they have a direct positive impact on working conditions, employees, the local community and the environment and thus forms a reliable and responsible company that makes a profit. The goal of socially responsible business is to contribute to the fact that business entities (small and large) can be profitable and successful, and at the same time responsible and sustainable.

Positive and proactive actions of companies above the levels prescribed by law in various business processes, such as investing in the social community, etc. it has become an indispensable practice in the modern world. Over time, it has been shown that such a practice has multiple benefits for the company and society as a whole.

Interest in society and the environment in which a company operates is increasingly influencing the corporate strategy of all economic entities, regardless of size. A characteristic of responsible companies is their focus on strategic, long-term oriented goals and activities that contribute to their achievement. Managing socially responsible activities involves working with others (interest-influential groups), and not in isolation. Measuring business performance not only by financial, but also environmental and social performance has entered into common use in management and can most often be found under the term triple balance or 3 P (profile, people, planet).

Respecting the interests of constituents has become a constant that will be judged by the public. It will be the same in the future. If a company proves unable to work for the good of others, sooner or later it will fail. Competition, as the highest controller of market power and an instrument of expropriation, will also take care of that.

The application of socially responsible business rules significantly contributes to the country’s economy and the company’s better reputation. Such companies become recognizable on the market, gain the trust of the environment and beyond, and goodwill, which significantly affects the business results of companies and thus the economic environment in the country as a whole.

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Conflict of interests

The authors declare no conflict of interests.

References

1. Arsić, Z., (2005), Code od conduct (corporate governance code), Law and economy, *Association of Lawyers in the Economy of Serbia*, Belgrade, p. 551.
2. Besmer, V., (2006), The Legal Character of Private Codes of Conduct: More than Just a Pseudo- Formal Gloss on Corporate Social Responsibility, *Hasting Business*

- Law Journal* 2/2006, San Farnscisco, pp. 290-292.
3. Bukvić, R., Rajnović, Lj., (2019), Should companies be managed in the interests of shareholders, Chapter in teh monograf „Corporate Governance in Serbia,, *Faculty of Economics in Belgrade*, Belgrade, p. 168-169.
 4. Begović, B., Bukvić, R., Mijatović, B., Živković, B., Hiber, D., (2003), Advancing Corporate Governance, *Center for Liberal Studies*, Belgrade.
 5. Brian R. Cheffins, (2004), *Company Law – Theory, Structure and Operation*, Oxford 2004, 47-125; J. Hamers, K. Schwarz, B. Steins Bisschop, pp.300.CISG: (1980) United Nations Convention on Contracts for the International Sale of Goods, *Official Gazette of the SFRY - International Agreements* No 10/1.
 6. Caroll, A., (1996), *Business and Society: Ethics and Stakeholder Management*, Cincinnati Ohio: *South-Western College Publishing*.
 7. Corbett, A., (2008), Corporate Social Responsibility – Do We Have Good Cause to be Sceptical About it?, *Griffith Law Review* 17: 1/2008, p. 418 - 419.
 8. Davidsson, P., A., (2002), Legal Enforcement of Corporate Social Responsibility within the EU, *Columbia Law Journal of European Law* 8/2002, p. 541-542.
 9. Gill, A., (2008), Corporate Governance as Social Responsibility: A Research Agenda, *Berkeley Journal of International Law* 26/2008, p. 461-465 i 473-474.
 10. Global Reporting Initiative, (2000).
 11. Hamers, J., Schwarz, K., Bisschop, B., S., (2005), Corporate Social Responsibility Trends in the Netherlands and Europe, *Stellenbosch Law Review* 16/2005, p.299.
 12. Herrmann, K., K., (2004), Corporate Social Responsibility and Sustainable Development: The European Union Initiative as a Case Study, *Indiana Journal of Global Legal Studies* 11(2): pp. 205-232.
 13. Koevski, G., (2007), Comparative Corporate Governance, *Faculty of Law Justinijan First*, Skoplje.
 14. Koevski, G., (2005), Social responsibility of large joint stock companies, *Pravni život, Association of Lawyers in the Economy of Serbia*, Belgrade, p.11-13.
 15. Code of Corporate Governance of the Republic of Serbia, Official Gazette of the RS no. 99/2012.
 16. Kuntz, T., (2017), German Corporate Law in 20th Century, *Hendbook on the history of the Corporate and Compnay Law*, Edward Elger, p. 205-243).
 17. International Finance Corporation (IFC), (2011), *Corporate Governance Manual*, Belgrade.
 18. Nehme, M., Koon,C., Ghee,W., (2008), Tracing the Historical Development of Corporate Social Responsibility and Corporate Social Reporting“, *James Cook U. L.* p. 134-135.
 19. OECD Principles of Corporate Governance (1999, 2004), *OECD Publications Service*, Paris, Cedex 16, France.

20. Rilka Dragneva, William Simons, (2000), Can the Stakeholder Paradigm Provide a Way Out of 'Vulture' Capitalism in Eastern Europe?, International Conference on Corporate Governance and Company Law, Ohrid 2000.
21. Rajnović, Lj., Cico, S., Eremić – Đorđić, J., (2019), Sustainable operations as a strategy of a management of companies, with review in the field of agriculture, *Agricultural Economics*, Publishers: Scientific Society of Agrarian Economists of the Balkans, Belgrade, Institute of Agricultural Economics, Belgrade, Academy of Economic Sciences, Bucharest, Romania, 2019, p. 601-617, VOL LXVI, No 2, p. 333-660.
22. Rajnović, Lj., Mihailović, N., Cico S., (2023), Responsibility for material deficiencies of goods, with reference to organic product, *Agricultural Economics*, Publishers: Scientific Society of Agrarian Economists of the Balkans, Belgrade, Institute of Agricultural Economics, Belgrade, Academy of Economic Sciences, Bucharest, Romania, UDEC 338.43:63, ISSN 0352-3462; Vol LXX, No 1 (1-344); DOI: 10.59267/ekoPolj230113R; UDC 658.62:631.47; str. 13-27.
23. Savković, V., (2009) Corporate social responsibility – from moral to legal obligation, *Pravni život, Association of Lawyers in the Economy of Serbia*, 12, pp. 425-436.
24. Tabaroši, S., (2005) Corporate Social Responsibility, *Faculty of Law*, University of Belgrade, Belgrade.
25. Tipurić, D., (2008), Corporate Governance, *Synergija nakladištvo d.o.o* Zagreb.
26. Vasiljević, M., (2011), Guide for the application of the Law on Business Companies, *Faculty of Law*, University of Belgrade.
27. Vasiljević, M., (2013), Corporate Governance, *Faculty of Law*, University of Belgrade.
28. Vives, A., (2008), Corporate Social Responsibility: The Role of Law and Markets and the Case of Developing Countries, Chicago – *Kent Law Review*, 83:1/2008, p. 20-21.
29. Law on Business Companies (Official Gazette of the RS, No.36/11, 99/2011, 83/2014 – other law and 5/2015, 4/2018, 95/2018, 91/2019 and 109/2021).

A CONTEMPORARY BIBLIOMETRIC ANALYSIS OF CULINARY TOURISM LITERATURE

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ABSTRACT

Culinary tourism is recognized in academic literature as an initiator of cultural revitalization, social and economic development, as well as a source of recreation, entertainment, socializing and learning. Due to the increasing interest of the academic community in this topic, this paper refers to an evaluative bibliometric analysis of the contemporary culinary tourism literature published in the WoS category: Hospitality Leisure Sport Tourism. The aim of the paper is to provide an insight into the current state and dynamics of the development of this field through a detailed analysis of the intellectual structure of culinary tourism, the predominant research topics, the applied research methodology and the most influential articles, authors and academic journals. A critical review of the literature published in the previous decade will enable to identify research gaps as well as to suggest directions for future research whose implementation would bring the field of culinary tourism closer to the stage of maturity and roundness of scientific thought. The sublimation of the culinary tourism literature published in the most prestigious academic journals over the past decade should provide the basis for further research efforts and discussions by the academic community.

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Introduction

Culinary tourism is a multidimensional concept and encompasses the processes of producing, preparing and consuming food (Batat, 2020), which is often the most important factor when choosing a destination (Agyeiwaah et al., 2018). This interpretation is also indicated by the Latin etymological origin of the word “culinary” with its root in the word “culīna”, which could be interpreted as a visitor’s activity inspired by food out of the residence place (Wondirad et al., 2021). Although it is not a new activity, culinary tourism has experienced significant growth in recent years due to the growing number of tourists whose primary travel motive is to taste unique and authentic culinary products (Ottenbacher & Harrington, 2013). Culinary tourism is becoming increasingly influential, not only in creating tourists’ experiences, but also in providing significant socio-cultural and economic benefits since it impacts on economic and social development through employment growth, resource efficiency, reduction of social disparities, etc. (UNWTO, 2017). For these reasons, culinary tourism is becoming an increasingly important area of interest and research of the academic community.

However, the relevant literature does not provide a unified stance that refers to clearly defined boundaries between culinary tourism and other types of tourism such as food and gastronomy tourism. Some authors, such as Stone et al. (2018), even argue that culinary tourism and food tourism are not separate forms of tourism, but synonyms. The same authors also identified gastronomy tourism with culinary and food tourism in a later study (Stone et al., 2021). Updahay and Sharma (2014) and Lenglet and Giannelloni (2015), on the other hand, take the more general view that food tourism is the broader concept and includes gastronomy tourism and culinary tourism. According to Okumus et al. (2021), food tourism differs from all other forms of tourism since the primary goal is not the desire to visit a specific destination, but rather the desire to consume authentic food. This need has its origins in the experiences and pleasures of tourists who have already had the opportunity to consume this type of food. Martin et al. (2021) gave a similar definition of food tourism and emphasized that it includes visiting primary and secondary food producers, food festivals and restaurants as the main motive of the visit. Gastronomy tourism can be defined as traveling in order to search for authentic food and drink experiences (Božić & Milošević, 2021; Đurović & Božić, 2022). The difference between food tourism and gastronomy tourism is reflected in the primary motive, which in the case of gastronomy tourism does not include recommendations in the form of lived experiences (Prayag et al., 2020). In addition, gastronomy tourism can also be linked to the desire to experience more than just food, especially local cultural and historical heritage (Lee et al., 2018). Finally, culinary tourism is the narrowest term that encompasses travel with the goal of tasting unique culinary products (Ottenbacher & Harrington, 2013). However, to limit the concept of culinary tourism exclusively to the consumption of already prepared culinary products would be too narrow and a simplistic interpretation, as, besides stated, it also includes a variety of specialized formats and services, such as meetings with local producers, weekends on farms, private social dining, culinary trails, food tours, iconic food, cookbooks, cooking classes,

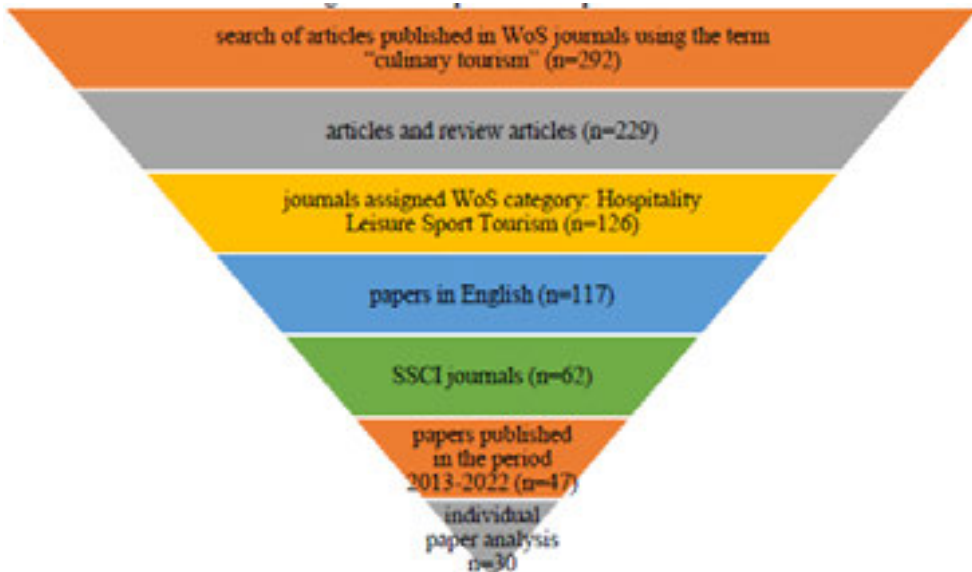
wine and cheese routes, market visits. All mentioned formats can be considered as the segments of culinary tourism that are adequately positioned in developed countries (Lenglet & Giannelloni, 2016; Chang et al., 2020; Yang et al., 2020).

Therefore, through a critical review and an evaluative bibliometric analysis of the contemporary literature on culinary tourism, the paper aims to: 1) provide an insight into the intellectual structure of the researched discipline and the main streams of culinary tourism scholarly knowledge, 2) identify research gaps and underexplored niches, and 3) suggest directions for future research that would contribute to the scientific maturation and circling of the culinary tourism field.

Research methodology

In order to achieve the paper goals, a search for titles, abstracts and keywords of articles published in WoS journals using the term “culinary tourism” was conducted, resulting in an initial sample of 292 articles. This sample was then filtered by considering only: 1) articles and review articles (proceeding papers, book reviews and editorial materials were excluded), 2) articles published in academic journals assigned the WoS category: Hospitality Leisure Sport Tourism, 3) articles written in English, 4) articles published in SSCI journals, and 5) articles published in the ten-year period (2013-2022). The application of the listed criteria resulted in a sample of 47 articles, whereupon the individual articles were downloaded and examined in detail, with the aim of excluding those articles where culinary tourism was not the focus of the research. In this way, the final sample of 30 articles was formed (Figure 1).

Figure 1. Sample creation procedure



Source: Authors

The studied ten-year period (2013-2022) was divided into two five-year periods in order to follow the dynamics of the development of culinary tourism literature and to perform a comparative analysis of 9 articles published in the first sub-period (2013-2017) and 21 articles published in the second sub-period (2018-2022). The presentation of the results of the search for contemporary culinary tourism literature was followed by a critical review of the literature with the aim of identifying dominant and under-researched topics, the most frequently used methodological approaches and dominant theoretical frameworks. Since the literature review contains elements of subjectivism (Dimitrovski et al., 2019) and cannot be completely objective and without the influence of the author's knowledge, scientific interests and cognitive biases, an evaluative bibliometric analysis followed to ensure the necessary objectivity. In this analysis, following Benckendorff and Zehrer (2013), Hall (2011), Zhang et al. (2015), the dynamics of article publication, the distribution of articles across journals, the analysis of author affiliation, the keyword analysis and the citation analysis of individual articles and journals were presented. The combination of evaluative bibliometric analysis and critical literature review thus provided a comprehensive overview of researched topic.

Results and discussion

Search results and culinary tourism literature review

The search for culinary tourism literature published in the WoS category: Hospitality Leisure Sport Tourism in the period 2013-2017 resulted in a selection of 9 articles published in seven academic journals. Ottenbacher and Harrington (2013) recognized the importance of the concept of culinary tourism for the promotion of destinations and identified six key elements for its development, noting that their standardization is not possible because the development of culinary tourism depends on local and regional cultural and historical heritage. For the same reason, there is no way to establish a general framework for the development of culinary tourism promotion strategies and, for this reason, each of them must be created in accordance with the specificities of the observed area, incorporating the experiences and satisfaction of tourists and tourism stakeholders. Sotiriadis (2015) points out the importance of strategic planning and proposes an adequate conceptual framework that can be used for the development of culinary tourism and the improvement of the destination's competitiveness.

Culinary tourism could be an important source of revenue for the destination (Tsai, 2016), and its development should be the method that differentiates one destination from another (Sotiriadis, 2015). According to Tsai (2016), local food and cuisine reflect local culture and customs and "can provide tourists with unforgettable experiences" (p. 546). Terroir products, as authentic local culinary products produced in small quantities, have a particularly important role in attracting tourists and providing a memorable tourism experience. One of the additional characteristics of terroir products, such as authentic French cheeses, is that they are mainly consumed in the production area and cannot be produced in other destinations (Lenglet and Giannelloni, 2016).

A prerequisite for the development of culinary tourism and all other forms of tourism is active marketing, with branding and brand management playing an important role in positioning a destination on the culinary tourism map (Jiang et al., 2017). Some authors such as Spilková and Fialová (2013) emphasized the need for regional branding and pointed out the positive influence of regional brands and culinary tourism on the development of rural areas. Studies on the culinary preferences of tourists are of particular importance when developing marketing strategies and plans to attract tourists. One such study was conducted by Updhyay and Sharma (2014), where they distinguished three groups of tourists: “taste seekers, localization seekers and experience seekers” (p. 33).

Unfortunately, many destinations do not adequately promote their rich and authentic culinary offer. Okumus et al. (2013) examined the use of local cuisine in the promotion of four small Caribbean islands and found that all four destinations “gave very limited or superficial description about local and regional cuisine” (p. 424). Silkes et al. (2013) agreed with this assessment, pointing out that most local communities did not adequately and strategically include the culinary offer in their promotional materials. Based on all these facts, it is not difficult to conclude that there are numerous challenges for the development of culinary tourism that tourism service providers and tourism policy makers must face in the future by following global trends and considering the comparative advantages of a particular destination.

Table 1. Culinary tourism literature published in WoS category: Hospitality Leisure Sport Tourism in the period 2013-2017

Author(s)	Title	Journal	Region	Method(s)
Ottenbacher, M.C., & Harrington, R.J. (2013)	“A case study of a culinary tourism campaign in Germany: Implications for strategy making and successful implementation”	<i>Journal of Hospitality & Tourism Research</i>	Germany	Questionnaire techniques
Sotiriadis, M.D. (2015)	“Culinary tourism assets and events: Suggesting a strategic planning tool”	<i>International Journal of Contemporary Hospitality Management</i>	/	Leiper’s method
Jiang, W.H., Li, Y.Q., Liu, C.H., & Chang, Y.P. (2017)	“Validating a multidimensional perspective of brand equity on motivation, expectation, and behavioural intention: A practical examination of culinary tourism”	<i>Asia Pacific Journal of Tourism Research</i>	Taiwan	Questionnaire techniques
Spilková, J., & Fialová, D. (2013)	“Culinary tourism packages and regional brands in Czechia”	<i>Tourism Geographies</i>	Czechia	Questionnaire techniques

Author(s)	Title	Journal	Region	Method(s)
Lenglet, F., & Giannelloni, J.L. (2016)	“Does a <i>terroir</i> product tell the same story to tourists, day-trippers and local consumers? The moderating role of variety-seeking tendency and perceived authenticity”	<i>International Journal of Tourism Research</i>	/	ANOVA
Updhyay, Y., & Sharma, D. (2014)	“Culinary preferences of foreign tourists in India”	<i>Journal of Vacation Marketing</i>	India	Factor analyses
Silkes, C.A., Cai, L.P.A., & Lehto, X.Y. (2013)	“Marketing to the culinary tourist”	<i>Journal of Travel & Tourism Marketing</i>	USA (Indiana)	Qualitative content analysis
Okumus, F., Kock, G., Scantlebury, M.M.G., & Okumus, B. (2013)	“Using local cuisines when promoting small Caribbean island destinations”	<i>Journal of Travel & Tourism Marketing</i>	Caribbean	Qualitative content analysis
Tsai, C.T. (2016)	“Memorable tourist experiences and place attachment when consuming local food”	<i>International Journal of Tourism Research</i>	Taiwan	Questionnaire techniques

Source: Authors

The search for literature on culinary tourism published in the WoS category: Hospitality Leisure Sport Tourism in the second sub-period (2018-2022) identified 21 articles published in eight academic journals. A study by Wondirad et al. (2021) demonstrated the positive impact of culinary tourism on the development and socio-cultural revitalization of destinations in developing countries, as well as on the length of tourists' stay. According to Batat (2020), Michelin-starred luxury restaurants, which “operate as ambassadors of a local food culture and culinary traditions” (p. 160), have a particularly important role in the development and “gastronomisation” of rural and urban destinations and in improving their image and attractiveness. Restaurants are the key stakeholders in ensuring the sustainable culinary tourism development (Alonso et al., 2018).

The most important factor for branding culinary destinations is tourists' satisfaction with the food at gastronomic festivals (Yang et al., 2020). Satisfaction and loyalty are more pronounced among those tourists who have consumed local, especially iconic food. Martin et al. (2021) found that tourists' experience gained by consuming iconic food encourage them to revisit the destination, while consuming local food and the associated experiences motivate tourists to recommend the destination to others. According to Stone et al. (2017), tourism stakeholders and policy makers are not sufficiently aware of the fact that memorable culinary tourism experiences are the most important factor of loyalty and destination revisits. Tourism stakeholders should also develop concepts such as “cooking holiday” (Chang et al., 2020) and “cooking for fun” (Luoh et al., 2020), that would create a stronger connection between tourists and destinations. Agyeiwaah et al.

(2018) have analyzed the satisfaction, loyalty, experience and motivation of culinary tourists who have attended cooking schools and found a high level of satisfaction and a large number of repeated visits of tourists who have practiced this type of vacation. According to Prayag et al. (2020), cooking classes offer tourists the “opportunities to learn about local foods alongside peers in an interactive setting” (p. 2453). Stone et al. (2021b) point out the importance of developing a culinary tourism education strategy that aims to educate young residents about local culinary products in order to preserve local traditions and customs and generate benefits for the tourism industry. Di-Clemente et al. (2019) emphasized the importance of tourists’ involvement and memorable culinary tourism experiences in creating long-lasting loyalty, while Qian et al. (2020) examined “tourists’ experience at private social dining” (p. 784). According to Stone et al. (2021a), food experiences are more memorable than other travel experiences (p. 801), and food neophilia, i.e. the passion for trying new food, as well as food neophobia, i.e. the fear of trying new food, may have a particular influence on tourists’ acceptance of local culinary products (Baah et al., 2019; Okumus et al., 2021). An important part of the culinary tourism experience is the organization of endemic attractions and innovations that allow tourists to actively observe and participate in the processes of local food preparation. According to Lee et al. (2018, p. 110), a major tourist attraction is experiencing a different culture, such as Hakka food culture and cuisine, or Halal food culture and cuisine (Yousaf & Xiucheng, 2018). The fact that innovations do not have an exclusively positive impact on the tourist’ experience should not be ignored. Global practice shows the great importance of local food and culinary tourism, but also the lack of proactivity on the part of tourism operators and managers.

In order to successfully promote traditional cuisine and destinations, managers should actively participate in and interpret local culture and customs. According to Okumus et al. (2018), it is crucial for the development of culinary tourism that local cuisines “become integrated into destination marketing efforts” (p. 586). Yousaf and Xiucheng (2018) pointed out that active marketing primarily affects the initial tourist visit and that internet marketing plays an important role in the development of culinary tourism due to its reliance on the visual manifestation of culinary products. A good marketing strategy has a positive impact on positioning the destination on the culinary tourism map and leads to an increase in tourist numbers (Forgas-Serra et al., 2019), with electronic word of mouth (e-WOM) playing a particularly important role in marketing efforts (Lai et al., 2021). In addition to active marketing, culinary tourism stakeholders must be aware of the fact that enhancing the tourist experience is the most important long-term marketing strategy.

Finally, the literature review in the second sub-period (2018-2022) identified the application of various theoretical frameworks within the culinary tourism discipline, such as: Porter’s value chain theory (Wondirad et al., 2021), stakeholder theory (Alonso et al., 2018; Stone et al., 2021), experience economy theory (Lai et al., 2021), social practice theory (Alonso et al., 2018), perceived value theory (Lai et al., 2021), indicating a good theoretical foundation and relevance of the conducted research. Stakeholder theory is the most commonly used theoretical framework among the listed theories.

Table 2. Culinary tourism literature published in WoS category: Hospitality Leisure Sport Tourism in the period 2018-2022

Author(s)	Title	Journal	Region	Method(s)
Wondirad, A., Kebete, Y., & Li, Y. (2021)	“Culinary tourism as a driver of regional economic development and socio-cultural revitalization: Evidence from Amhara National Regional State, Ethiopia”	<i>Journal of Destination Marketing & Management</i>	Ethiopia	Qualitative content analysis
Alonso, A.D., Kok, S., & O’Brien, S. (2018)	“Sustainable culinary tourism and Cevicherias: A stakeholder and social practice approach”	<i>Journal of Sustainable Tourism</i>	Peru	Qualitative content analysis
Stone, M.J., Soulard, J., Migacz, S., & Wolf, E. (2017)	“Elements of memorable food, drink, and culinary tourism experiences”	<i>Journal of Travel Research</i>	Australia, Irealnd, UK, USA	Questionnaire techniques
Prayag, G., Gannon, M.J., Muskat, B., & Taheri, B. (2020)	“A serious leisure perspective of culinary tourism co-creation: The influence of prior knowledge, physical environment and service quality”	<i>International Journal of Contemporary Hospitality Management</i>	Iran	PLS-SEM
Yousaf, S., & Xiucheng, F. (2018)	“Halal culinary and tourism marketing strategies on government websites: A preliminary analysis”	<i>Tourism Management</i>	China, Japan, Thailand, South Korea	Qualitative content analysis
Stone, M.J., Migacz, S., & Wolf, E. (2021b)	“Learning through culinary tourism and developing a culinary tourism education strategy”	<i>Journal of Tourism and Cultural Change</i>	/	Qualitative content analysis
Qian, J.W., Law, R., & Fan, D.X.F. (2020)	“Exploring tourists’ experience at private social dining: Dimensionality and satisfaction”	<i>International Journal of Tourism Research</i>	France, USA, UK	Tourist Experience Scale (TES)
Stone, M.J., Migacz, S., & Sthapit, E. (2021a)	“Connections between culinary tourism experiences and memory”	<i>Journal of Hospitality & Tourism Research</i>	USA	Tourist Experience Scale (TES)
Yang, F.X., Wong, I.A., Tan, X.S., & Wu, D.C.W. (2020)	“The role of food festivals in branding culinary destinations”	<i>Tourism Management Perspectives</i>	/	Hierarchical moderated regression
Luoh, H.F., Tsaur, S.H., & Lo, P.C. (2020)	“Cooking for fun: The sources of fun in cooking learning tourism”	<i>Journal of Destination Marketing & Management</i>	Taiwan	FCLT scale
Forgas-Serra, S., Fernandez, J.M., & Cerdan, L.M. (2019)	“The value of popular cuisine in tourism: A Costa Brava case study”	<i>Journal of Tourism and Cultural Change</i>	Spain (Costa Brava)	Case study

Author(s)	Title	Journal	Region	Method(s)
Lai, I.K.W., Liu, Y.D., & Lu, D. (2021)	“The effects of tourists’ destination culinary experience on electronic word-of-mouth generation intention: The experience economy theory”	<i>Asia Pacific Journal of Tourism Research</i>	China	Covariance-based structural equation modelling (CBSEM)
Batat, W. (2020)	“The role of luxury gastronomy in culinary tourism: An ethnographic study of Michelin-Starred restaurants in France”	<i>International Journal of Tourism Research</i>	France	Qualitative mixed-method
Chang, J., Okumus, B., Wang, C.H., & Chiu, C.Y. (2020)	“Food tourism: cooking holiday experiences in East Asia”	<i>Tourism Review</i>	Taiwan	Delphi method and the analytic hierarchy process (AHP)
Okumus, B., Dedeoglu, B.B., & Shi, F.F. (2021)	“Gender and generation as antecedents of food neophobia and food neophilia”	<i>Tourism Management Perspectives</i>	China	Factor analyses
Baah, N.G., Bondzi-Simpson, A., & Ayeah, J.K. (2019)	“How neophilia drives international tourists’ acceptance of local cuisine”	<i>Current Issues in Tourism</i>	Ghana	Qualitative content analysis
Martin, C.A., Izquierdo, C.C., & Laguna-Garcia, M. (2021)	“Culinary tourism experiences: The effect of iconic food on tourist intentions”	<i>Tourism Management Perspectives</i>	Spain	Questionnaire techniques
Agyeiwaah, E., Otoo, F.E., Sontikul, W., & Huang, W.J. (2018)	“Understanding culinary tourist motivation, experience, satisfaction, and loyalty using a structural approach”	<i>Journal of Travel & Tourism Marketing</i>	Thailand (Chiang Mai)	PLS-SEM
Di-Clemente, E., Hernández-Mogollón, J.M., & Campón-Cerro, A.M. (2019)	“Tourists’ involvement and memorable food-based experiences as new determinants of behavioural intentions towards typical products”	<i>Current Issues in Tourism</i>	USA, Italy, Spain, UK	PLS-SEM
Okumus, B., Xiang, Y.X., & Hutchinson, J. (2018)	“Local cuisines and destination marketing: Cases of three cities in Shandong, China”	<i>Asia Pacific Journal of Tourism Research</i>	China (Shandong)	Case study
Lee, T.H., Chao, W.H., & Lin, H.Y. (2018)	“Cultural inheritance of Hakka cuisine: A perspective from tourists’ experiences”	<i>Journal of Destination Marketing & Management</i>	Taiwan	Zaltman Metaphor Elicitation Technique (ZMET)

Source: Authors

Overall, the research focus in the first sub-period (2013-2017) is on topics such as strategic planning, culinary preferences and experiences of tourists, importance of active marketing and branding, inadequate promotion of the culinary offer. The predominant themes of the second research period (2018-2022) are satisfaction, loyalty and memorable experiences of culinary tourists, culinary tourism education (learning), active marketing, endemic attractions and innovation. In this sub-period, the researchers have referred to the different theoretical approaches and frameworks that provide a more solid scientific basis for the studies.

It should be emphasized that there is a lack of research focusing on green practices and environmental protection in both sub-periods. This research would be of great importance since food waste leads to a worrying emission of greenhouse gasses and culinary tourists are no less polluters than tourists who prefer other forms of tourism. There is also a lack of research on molecular cuisine, fusion cuisine, neurocuisine and haute cuisine as new trends and prospective niches of culinary tourism. In the future, the aforementioned research gaps should be closed by conducting appropriate qualitative and quantitative research and publishing scientific articles in reputable academic journals.

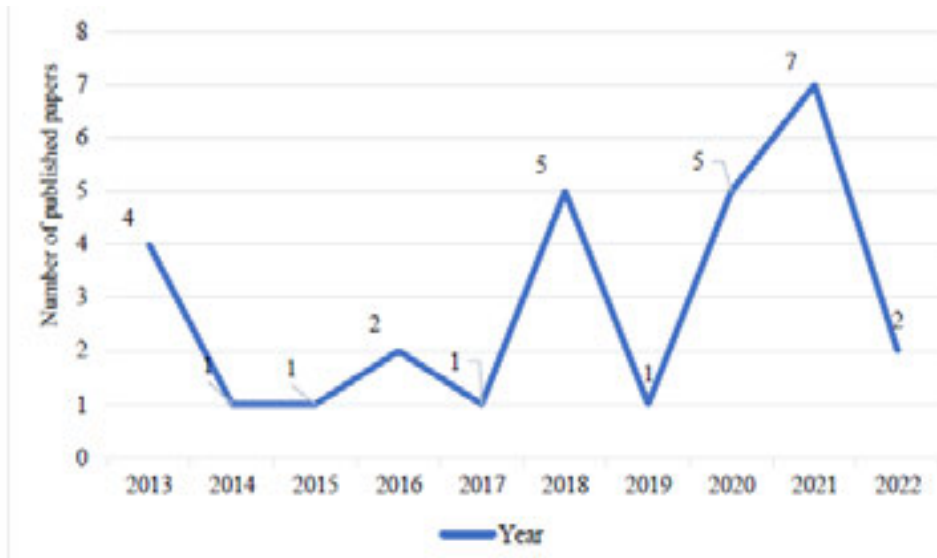
It is not possible to determine the predominant geographical area of research from Table 1, since that almost all surveys are territorially separated, with the exception of Taiwan, where two studies were conducted. In the following sub-period, shown in Table 2, most surveys were conducted in the USA and China (four surveys each). Spain, Taiwan and the United Kingdom stand out with three surveys each, while two surveys were conducted each in France and Thailand. There are also surveys in Africa (Ethiopia and Ghana) and South America (Peru), making culinary tourism a global phenomenon with global significance. Surveys from Australia, Iran, Ireland, China, Japan and South Korea contribute to this conclusion.

Finally, the questionnaire technique as a research method had a dominant participation of 45% in the first sub-period (Table 1). In addition, the qualitative content analysis method was used in 22% of the surveys, while the Leiper method, ANOVA and factor analysis were used in 11% of the studies. In the second sub-period, the structure of the methods used was more diverse (Table 2). Qualitative content analysis was the predominant research method with a frequency of 24%, followed by partial least squares – structural equation modeling (PLS-SEM) technique with a frequency of 14%. Questionnaire techniques and the Tourist Experience Scale (TES) have a participation rate of 10%. All other methods participate with a rate of 5%. Overall, qualitative content analysis is the most frequently used research method, which indicates that the field of culinary tourism has not yet reached the stage of maturity, since, according to Lima-Carlos Filho (2019), quantitative rather than qualitative research dominates in the maturity phase of the scientific discipline.

Results of the evaluative bibliometric analysis

The evaluative bibliometric analysis primarily presented the dynamics of article publication, which shows a strong fluctuation and accelerated production of scientific articles on culinary tourism, since their number more than doubled in the second sub-period (2018-2022) compared to the first (2013-2017). However, despite the increase in the number of articles, the dynamics do not indicate a constant growth of scientific production over time and therefore do not confirm the validity of Price's bibliometric law (Price, 1963), which states that the "growth of scientific production over time follows an exponential function" (Guilera et al., 2013, p. 946). These findings are consistent with the research findings from the field of tourism psychology by Barrios et al. (2008) and the research findings from the field of economic impact of sporting events by Dimitrovski et al. (2021).

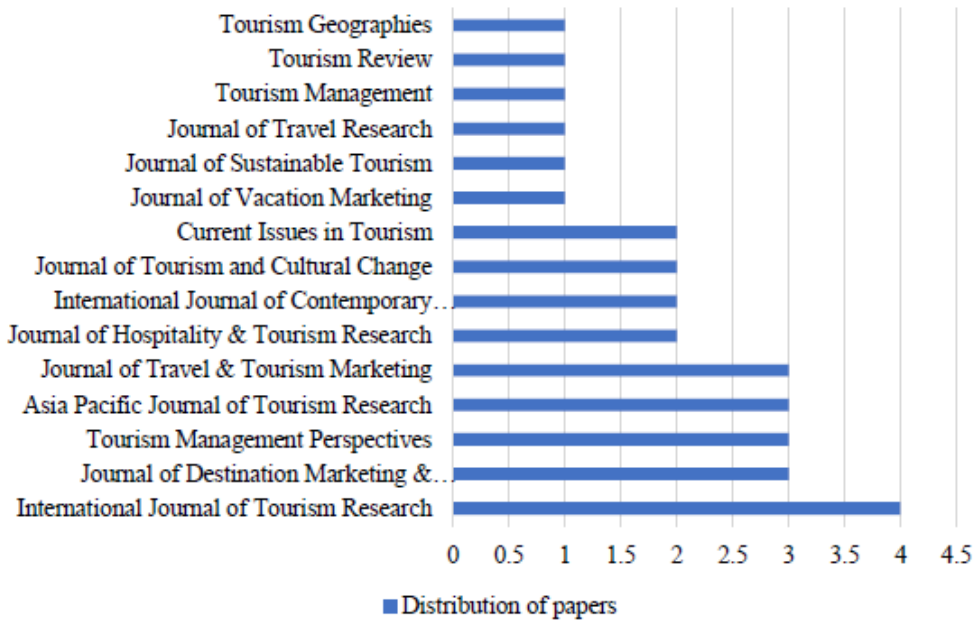
Figure 2. Dynamics of article publishing



Source: Authors

The distribution of articles among journals was then determined in order to confirm or reject the validity of Bradford's bibliometric law (Bradford, 1934), which "describes how the articles in a specific area are scattered across journals" (Guilera et al., 2013, p. 946). Since the vast majority of articles are not concentrated in one or a few core journals, i.e. the difference in the distribution of articles across journals is not significant, the validity of Bradford's law cannot be confirmed. This finding contradicts the results of similar bibliometric studies by Barrios et al. (2008) and Dimitrovski et al. (2021). The most productive journal in the context of culinary tourism literature is the International Journal of Tourism Research, which is represented in the selected sample with 13.3% (Table 3).

Figure 3. The distribution of the articles across the journals



Source: Authors

The affiliation of authors of articles published in both sub-periods was analysed in a next step in order to identify the countries whose authors are leaders in the field. The results are presented in Table 3 and Table 4.

Table 3. Country of authors' affiliation (2013-2017)

Author(s)	Country of the first author's affiliation	Country of the second author's affiliation	Country of the third author's affiliation	Country of the fourth author's affiliation
Ottenbacher, M.C., & Harrington, R.J. (2013)	Germany	USA		
Sotiriadis, M.D. (2015)	South Africa			
Jiang, W.H., Li, Y.Q., Liu, C.H., & Chang, Y.P. (2017)	China	China	Taiwan	Taiwan
Spilková, J., & Fialová, D. (2013)	Czech Republic	Czech Republic		
Lenglet, F., & Giannelloni, J.L. (2016)	France	France		
Updhyay, Y., & Sharma, D. (2014)	India	India		
Silkes, C.A., Cai, L.P.A., & Lehto, X.Y. (2013)	USA	USA	USA	
Okumus, F., Kock, G., Scantlebury, M.M.G., & Okumus, B. (2013)	USA	USA	USA	USA
Tsai, C.T. (2016)	Taiwan			

Source: Authors

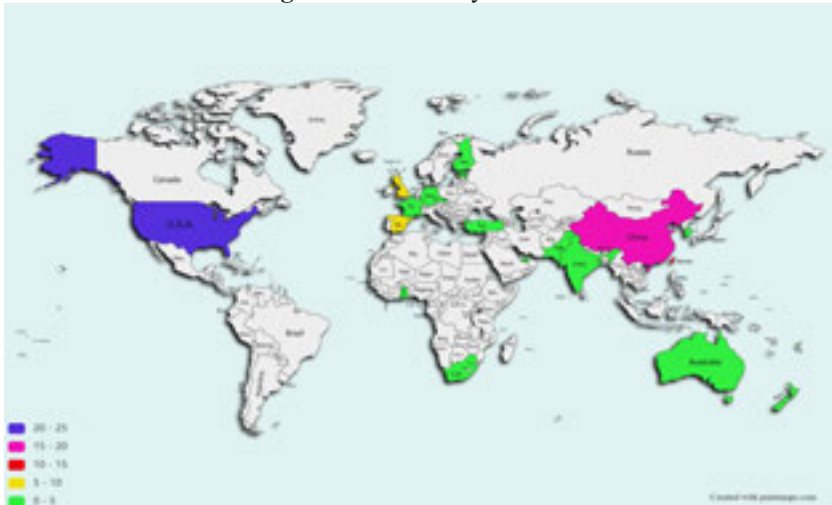
Table 4. Country of authors' affiliation (2018-2022)

Author(s)	Country of the first author's affiliation	Country of the second author's affiliation	Country of the third author's affiliation	Country of the fourth author's affiliation
Wondirad, A., Kebete, Y., & Li, Y. (2021)	Fiji and Ethiopia	Ethiopia	China and South Korea	
Alonso, A.D., Kok, S., & O'Brien, S. (2018)	UK and Australia	UK	UK	
Stone, M.J., Soulard, J., Migacz, S., & Wolf, E. (2017)	USA	USA	USA	USA
Prayag, G., Gannon, M.J., Muskat, B., & Taheri, B. (2020)	New Zealand	UK	Australia	UK
Yousaf, S., & Xiucheng, F. (2018)	China and Pakistan	China		
Stone, M.J., Migacz, S., & Wolf, E. (2021b)	USA	USA	USA	
Qian, J.W., Law, R., & Fan, D.X.F. (2020)	China	China	UK	
Stone, M.J., Migacz, S., & Sthapit, E. (2021a)	USA	USA	Finland	
Yang, F.X., Wong, I.A., Tan, X.S., & Wu, D.C.W. (2020)	China	China	China	China
Luoh, H.F., Tsaur, S.H., & Lo, P.C. (2020)	Taiwan	Taiwan	Taiwan	
Forgas-Serra, S., Fernandez, J.M., & Cerdan, L.M. (2019)	Spain	Spain	Spain	
Lai, I.K.W., Liu, Y.D., & Lu, D. (2021)	China	China	China	
Batat, W. (2020)	France			
Chang, J., Okumus, B., Wang, C.H., & Chiu, C.Y. (2020)	Taiwan	USA	Taiwan	Taiwan
Okumus, B., Dedeoglu, B.B., & Shi, F.F. (2021)	USA	Turkey	China	
Baah, N.G., Bondzi-Simpson, A., & Ayeh, J.K. (2019)	Ghana	Ghana	UAE	
Martin, C.A., Izquierdo, C.C., & Laguna-Garcia, M. (2021)	Spain	Spain	Spain	
Agyeiwaah, E., Otoo, F.E., Suntikul, W., & Huang, W.J. (2018)	China	China	China	China
Okumus, B., Xiang, Y.X., & Hutchinson, J. (2018)	USA	China	USA	
Lee, T.H., Chao, W.H., & Lin, H.Y. (2018)	Taiwan	Taiwan	Taiwan	

Source: Authors

In the first sub-period (2013-2017), 38.1% of the authors of the papers on the topic of culinary tourism were from the USA, while in the following sub-period (2018-2022) authors from China and Taiwan took over the primacy, with a combined share of 43.5%. Thus, a gradual shift of scientific interest from the West to the East can be seen, whereby the USA continues to occupy the first position with 21 authors, China the second with 20, Taiwan the third with 12, etc., when looking the entire ten-year period. (Figure 4). Half of the total number of authors (81) were from the USA or China (41), although it should be noted that authors with two affiliations were treated as authors from both countries (Papić et al., 2023). In the second sub-period, the first appearance of authors from scientifically recognised European countries such as the United Kingdom (6 authors with 3 articles) and Spain (6 authors with 2 articles) was observed. Finally, the analysis provides a conclusion about the high level of collaboration between authors on the topic of culinary tourism, as only 3 articles are single-authored and the average number of authors per co-authored article is 2.9.

Figure 4. Authors by countries



Source: Authors

In order to identify the predominant niches of authors' interest, the analysis of keywords was conducted, whereby, in addition to a tabular presentation containing keywords used three or more times (Table 5), a corresponding graphical presentation was also prepared (Figure 5).

Table 5. The most commonly used keywords within the sample

Keyword	Number of repetitions	2013-2017	2018-2022
culinary tourism	24	9	15
food tourism	8	2	6
memorable tourism experiences	5	1	4
culinary experience	4	1	3
cooking classes	4	0	4
gastronomy	4	1	3
tourism	4	3	1
food	4	2	2
satisfaction	3	0	3
stakeholder theory	3	1	2
motivation	3	1	2
marketing	3	2	1

Source: Authors

The analysis of 173 selected keywords has shown that besides the expected investigation of gastronomy, food, tourism and the link between food and tourism manifested in food tourism, the author's interest is also focused on topics such as tourist and culinary experience, acquisition of culinary knowledge, satisfaction, motivation, marketing and finally the theoretical framework reflected mainly in stakeholder theory. The difference between the two sub-periods can be seen in the keywords "cooking classes" and "satisfaction", which do not appear in the first sub-period but play a major role in the second sub-period. This indicates a shift in the author's interest towards culinary learning and tourist satisfaction.

Figure 5. Keyword cloud

Source: Authors

The last element of the evaluative bibliometric analysis is the citation analysis implemented both, for the individual articles (Table 6) and for the journals in which the articles were published (Table 7). The subject of the analysis are the WoS Core Collection and Scopus citations, since WoS and Scopus are the most recognized index databases and "remain today the main sources for citation data" (Mongeon & Paul-Hus, 2016, p. 214).

Table 6. Article distribution of WoS Core Collection and Scopus citations

Articles/Authors	WoS Core Collection citations			Scopus citations		
	Total	per author	per year	Total	per author	per year
Ottenbacher, M.C., & Harrington, R.J. (2013)	50	25	5	73	36.5	7.3
Sotiriadis, M.D. (2015)	27	27	3.4	37	37	4.6
Jiang, W.H., Li, Y.Q., Liu, C.H., & Chang, Y.P. (2017)	22	5.5	3.7	25	6.3	4.2
Spilková, J., & Fialová, D. (2013)	29	14.5	2.9	34	17	3.4
Lenglet, F., & Giannelloni, J.L. (2016)	8	4	1.1	9	4.5	1.3
Updhyay, Y., & Sharma, D. (2014)	25	12.5	2.8	34	17	3.8
Silkes, C.A., Cai, L.P.A., & Lehto, X.Y. (2013)	52	13	5.2	58	19.3	5.8
Okumus, F., Kock, G., Scantlebury, M.M.G., & Okumus, B. (2013)	70	17.5	7	70	17.5	7
Tsai, C.T. (2016)	214	214	30.6	254	254	36.3
Wondirad, A., Kebete, Y., & Li, Y (2021)	32	10.7	16	45	15	22.5
Alonso, A.D., Kok, S., & O'Brien, S. (2018)	14	4.7	2.8	21	7	4.2
Stone, M.J., Soulard, J., Migacz, S., & Wolf, E. (2017)	121	30.3	20.2	139	34.8	23.2
Prayag, G., Gannon, M.J., Muskat, B., & Taheri, B. (2020)	57	14.3	19	67	16.8	22.3
Yousaf, S., & Xiucheng, F. (2018)	77	38.5	15.4	96	48	19.2
Stone, M.J., Migacz, S., & Wolf, E. (2021b)	5	1.7	2.5	7	2.3	3.5
Qian, J.W., Law, R., & Fan, D.X.F. (2020)	9	3	3	11	3.7	3.7
Stone, M.J., Migacz, S., & Sthapit, E. (2021a)	33	11	16.5	35	11.7	17.5
Yang, F.X., Wong, I.A., Tan, X.S., & Wu, D.C.W. (2020)	33	8.3	11	44	11	14.7
Luoh, H.F., Tsaur, S.H., & Lo, P.C. (2020)	20	6.7	6.7	21	7	7
Forgas-Serra, S., Fernandez, J.M., & Cerdan, L.M. (2019)	3	1	0.75	2	0.7	0.5
Lai, I.K.W., Liu, Y.D., & Lu, D. (2021)	18	6	9	22	7.3	11
Batat, W. (2020)	35	35	11.7	50	50	16.7
Chang, J., Okumus, B., Wang, C.H., & Chiu, C.Y. (2020)	18	4.5	6	20	5	6.7
Okumus, B., Dedeoglu, B.B., & Shi, F.F. (2021)	27	9	13.5	28	9.3	14
Baah, N.G., Bondzi-Simpson, A., & Ayeh, J.K. (2019)	23	7.7	5.8	21	7	5.3
Martin, C.A., Izquierdo, C.C., & Laguna-Garcia, M. (2021)	9	3	4.5	11	3.7	5.5

Articles/Authors	WoS Core Collection citations			Scopus citations		
	Total	per author	per year	Total	per author	per year
Agyeiwaah, E., Otoo, F.E., Sontikul, W., & Huang, W.J. (2018)	103	25.8	20.6	123	30.8	24.6
Di-Clemente, E., Hernández-Mogollón, J.M., & Campón-Cerro, A.M. (2019)	36	9	9	42	10.5	10.5
Okumus, B., Xiang, Y.X., & Hutchinson, J. (2018)	20	6.7	4	22	7.3	4.4
Lee, T.H., Chao, W.H., & Lin, H.Y. (2018)	14	4.7	2.8	13	4.3	2.6

Source: Authors

The articles Tsai (2016), Stone et al. (2017) and Agyeiwaah et al. (2018) achieved the largest number of WoS Core Collection and Scopus citations. Tsai (2016) is by far the most cited and influential article in the field of culinary tourism with 214 citations in WoS and 254 citations in Scopus. Since this article is a single-authored, it has received the most citations per author as well as the most citations per year, indicating its dominant influence in shaping scholarly thought in the field of culinary tourism. Yousaf and Xiucheng (2018) and Batat (2020) also achieved a significant number of citations per author.

Among the individual authors, Professor Bendegül Okumus from the University of Central Florida (USA) is the most productive with 4 published articles and 37.7 citations per author. She is followed by Professor Matthew J. Stone from California State University (USA) and Professor Steve Migacz from Roosevelt University (USA) with 3 co-authored articles and 43 citations per author. The most cited author is Professor Chen-Tsang (Simon) Tsai from Tainan University of Technology (Taiwan). These authors had the strongest influence on the scientific modelling of the researched field.

Table 7. Journals distribution of WoS Core Collection and Scopus citations

Journal	WoS Core Collection citations		Scopus citations	
	Total	per article	Total	per article
International Journal of Tourism Research	266	66.5	324	81
Journal of Destination Marketing & Management	66	22	79	26.3
Tourism Management Perspectives	69	23	83	27.7
Asia Pacific Journal of Tourism Research	60	20	69	23
Journal of Travel & Tourism Marketing	225	75	251	83.7
Journal of Hospitality & Tourism Research	55	27.5	80	40
International Journal of Contemporary Hospitality Management	84	42	104	52
Journal of Tourism and Cultural Change	8	4	9	4.5
Current Issues in Tourism	59	29.5	63	31.5
Journal of Vacation Marketing	25	25	34	34

Journal of Sustainable Tourism	14	14	21	21
Journal of Travel Research	121	121	139	139
Tourism Management	77	77	96	96
Tourism Review	18	18	20	20
Tourism Geographies	29	29	34	34

Source: Authors

Finally, with regard to the distribution of WoS Core Collection and Scopus citations across the individual journals, the International Journal of Tourism Research, as the most productive journal in the field of culinary tourism, achieved the most citations. The Journal of Travel & Tourism Marketing is in the second place in terms of the number of articles published and citations achieved, while the Journal of Travel Research achieved the highest number of citations per article. It is expected that the above-mentioned journals will continue to make a dominant contribution to the development of the analysed discipline in the future.

Conclusions

The sublimation of the literature on culinary tourism published in the most renowned WoS journals over the past decade provides an insight into the current state and development dynamics of this field. The evaluative bibliometric analysis revealed a predominance of authors from the USA and China, while the validity of Price and Bradford's bibliometric law was not confirmed. The author of the most cited article is from Taiwan. The International Journal of Tourism Research provided the strongest support for the study of culinary tourism. The most commonly used research method is a qualitative content analysis, while stakeholder theory is the most commonly used theoretical framework.

A critical review of the literature has identified under-researched niches (green practices, environmental protection, fusion cuisine, molecular cuisine, neurocuisine, haute cuisine) whose study would correspond to current trends and contribute to the maturation and circling the scientific thought of the analyzed discipline. In this way, a theoretical contribution of the paper is ensured, which, according to the author's knowledge, represents the first bibliometric study of the discipline of culinary tourism and should be the starting point for further research, discussions in the academic community and the development of the analyzed field in general. On the other hand, the practical implications of the paper are reflected in the identification of special formats or segments of culinary tourism (meetings with local producers, weekends on farms, private social dining, culinary trails, food tours, iconic food, cookbooks, cooking classes, wine and cheese routes, market visits), whose establishment, promotion and development could improve offer of the service providers in less developed countries and their results. This would further influence the perception of culinary tourism as a type of educational initiative that would channel curiosity about food into a comprehensive learning about the culture of food preparation.

Closing the research gaps identified by a critical literature review is a proposal for future research, where at least one of future studies should be related to relational bibliometric analysis whose absence is the main limitation of this paper. The relational bibliometric analysis would reveal the relationships and degree of collaboration between members of the culinary tourism academic community, thus providing a more complete insight into the intellectual structure of the researched discipline.

Conflict of interests

The authors declare no conflict of interest.

References

1. Agyeiwaah, E., Otoo, F.E., Suntikul, W., & Huang, W.J. (2018). Understanding culinary tourist motivation, experience, satisfaction, and loyalty using a structural approach. *Journal of Travel & Tourism Marketing*, 36(3), 295–313. <https://doi.org/10.1080/10548408.2018.1541775>
2. Alonso, A. D., Kok, S., & O'Brien, S. (2018). Sustainable culinary tourism and Cevicherías: A stakeholder and social practice approach. *Journal of Sustainable Tourism*, 26(5), 812–831. <https://doi.org/10.1080/09669582.2017.1414224>
3. Baah, N.G., Bondzi-Simpson, A., & Aye, J.K. (2019). How neophilia drives international tourists' acceptance of local cuisine. *Current Issues in Tourism*, 23(18), 2302–2318. <https://doi.org/10.1080/13683500.2019.1619676>
4. Barrios, M., Borrego, A., Vilagínés, A., Ollé, C., & Somoza, M. (2008). A bibliometric study of psychological research on tourism. *Scientometrics*, 77(3), 453–467. <https://doi.org/10.1007/s11192-007-1952-0>
5. Batat, W. (2020). The role of luxury gastronomy in culinary tourism: An ethnographic study of Michelin Starred restaurants in France. *International Journal of Tourism Research*, 23(2), 150–163. <https://doi.org/10.1002/jtr.2372>
6. Benckendorff, P., & Zehrer, A. (2013). A network analysis of tourism research. *Annals of Tourism Research*, 43, 121–149. <https://doi.org/10.1016/j.annals.2013.04.005>
7. Božić, A., & Milošević, S. (2021). Critical success factors for new dishes in gastronomic offer of Belgrade restaurants. *Menadžment u Hotelijerstvu i Turizmu*, 9(2), 51–62. <https://doi.org/10.5937/menhottur2102051b>
8. Bradford, S.C. (1934). Sources of information on specific subjects. *Engineering*, 23(3), 85–88.
9. Chang, J., Okumus, B., Wang, C.H., & Chiu, C.Y. (2020). Food tourism: Cooking holiday experiences in East Asia. *Tourism Review*, 76(5), 1067–1083. <https://doi.org/10.1108/tr-09-2019-0399>

10. Di-Clemente, E., Hernández-Mogollón, J.M., & Campón-Cerro, A.M. (2019). Tourists' involvement and memorable food-based experiences as new determinants of behavioural intentions towards typical products. *Current Issues in Tourism*, 23(18), 2319–2332. <https://doi.org/10.1080/13683500.2019.1631265>
11. Dimitrovski, D., Leković, M., & Đurađević, M. (2021). Economic impact of the sporting events as tourism niche product: A contemporary bibliometric analysis. *Ekonomika Preduzeća*, 69(7–8), 422–437. <https://doi.org/10.5937/ekopre2108422d>
12. Dimitrovski, D., Leković, M., & Joukes, V. (2019). A bibliometric analysis of Crossref agritourism literature indexed in Web of Science. *Menadzment u Hotelijerstvu i Turizmu*, 7(2), 25–37. <https://doi.org/10.5937/menhottur1902025d>
13. Đurović, M., & Božić, A. (2022). Attributes of service quality: A report from Belgrade restaurants. *Menadzment u Hotelijerstvu i Turizmu*, 10(2), 105–119. <https://doi.org/10.5937/menhottur2202105d>
14. Forgas-Serra, S., Majó Fernandez, J., & Mundet Cerdan, L. (2019). The value of popular cuisine in tourism: A Costa Brava case study. *Journal of Tourism and Cultural Change*, 19(2), 216–229. <https://doi.org/10.1080/14766825.2019.1617722>
15. Guilera, G., Barrios, M., & Gómez-Benito, J. (2013). Metaanalysis in psychology: A bibliometric study. *Scientometrics*, 94(3), 943–954. <https://doi.org/10.1007/s11192-012-0761-2>
16. Hall, M. C. (2011). Publish and perish? Bibliometric analysis, journal ranking and the assessment of research quality in tourism. *Tourism Management*, 32(1), 16–27. <https://doi.org/10.1016/j.tourman.2010.07.001>
17. Jiang, W.H., Li, Y.Q., Liu, C.H., & Chang, Y.P. (2017). Validating a multidimensional perspective of brand equity on motivation, expectation, and behavioural intention: A practical examination of culinary tourism. *Asia Pacific Journal of Tourism Research*, 22(5), 524–539. <https://doi.org/10.1080/10941665.2017.1287106>
18. Lai, I.K. W., Liu, Y., & Lu, D. (2021). The effects of tourists' destination culinary experience on electronic word-of-mouth generation intention: The experience economy theory. *Asia Pacific Journal of Tourism Research*, 26(3), 231–244. <https://doi.org/10.1080/10941665.2020.1851273>
19. Lee, T.H., Chao, W.H., & Lin, H.Y. (2018). Cultural inheritance of Hakka cuisine: A perspective from tourists' experiences. *Journal of Destination Marketing & Management*, 7, 101–111. <https://doi.org/10.1016/j.jdmm.2016.09.006>
20. Lenglet, F., & Giannelloni, J.L. (2016). Does a *terroir* product tell the same story to tourists, day-trippers and local consumers? the moderating role of variety-seeking tendency and perceived authenticity. *International Journal of Tourism Research*, 18(5), 494–505. <https://doi.org/10.1002/jtr.2067>
21. Lima, S. - Carlos Filho, F. de A. (2019). Bibliometric analysis of scientific production on sharing economy. *Revista de Gestão*, 26(3), 237–255. <https://doi.org/10.1108/rege-01-2019-0018>

22. Luoh, H.F., Tsaur, S.H., & Lo, P.C. (2020). Cooking for fun: The sources of fun in cooking learning tourism. *Journal of Destination Marketing & Management*, 17, 100442. <https://doi.org/10.1016/j.jdmm.2020.100442>
23. Martin, C.A., Izquierdo, C.C., & Laguna-Garcia, M. (2021). Culinary tourism experiences: The effect of iconic food on tourist intentions. *Tourism Management Perspectives*, 40, 100911. <https://doi.org/10.1016/j.tmp.2021.100911>
24. Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics*, 106(1), 213–228. <http://doi.org/10.1007/s11192-015-1765-5>
25. Okumus, B., Dedeoğlu, B.B., & Shi, F. (2021). Gender and generation as antecedents of food neophobia and food neophilia. *Tourism Management Perspectives*, 37, 100773. <https://doi.org/10.1016/j.tmp.2020.100773>
26. Okumus, B., Xiang, Y., & Hutchinson, J. (2018). Local cuisines and destination marketing: Cases of three cities in Shandong, China. *Asia Pacific Journal of Tourism Research*, 23(6), 584–599. <https://doi.org/10.1080/10941665.2018.1469521>
27. Okumus, F., Kock, G., Scantlebury, M.M.G., & Okumus, B. (2013). Using local cuisines when promoting small Caribbean island destinations. *Journal of Travel & Tourism Marketing*, 30(4), 410–429. <https://doi.org/10.1080/10548408.2013.784161>
28. Ottenbacher, M.C., & Harrington, R.J. (2013). A Case Study of a Culinary Tourism Campaign in Germany. *Journal of Hospitality & Tourism Research*, 37(1), 3–28. <https://doi.org/10.1177/1096348011413593>
29. Papić, M., Garabinović, D., Blagojević, M., Leković, M., Kostić, M., & Dimitrovski, D. (2023). Multi-criteria Decision-making in the tourism domain: The past, present and future of the research field (2023). *Journal of Scientific & Industrial Research*, 82(7), 721–735. <https://doi.org/10.56042/jsir.v82i07.1968>
30. Prayag, G., Gannon, M.J., Muskat, B., & Taheri, B. (2020). A serious leisure perspective of culinary tourism co-creation: The influence of prior knowledge, physical environment and service quality. *International Journal of Contemporary Hospitality Management*, 32(7), 2453-2472. <https://doi.org/10.1108/ijchm-10-2019-0897>
31. Price, D. J. de Solla (1963). *Little science, big science*. New York: Columbia University Press.
32. Qian, J., Law, R., & Fan, D.X.F. (2020). Exploring tourists' experience at private social dining: Dimensionality and satisfaction. *International Journal of Tourism Research*, 22(6), 776–787. <https://doi.org/10.1002/jtr.2379>
33. Silkes, C. A., Cai, L. A., & Lehto, X. Y. (2013). Marketing to the culinary tourist. *Journal of Travel & Tourism Marketing*, 30(4), 335–349. <https://doi.org/10.1080/10548408.2013.784151>

34. Sotiriadis, M.D. (2015). Culinary tourism assets and events: Suggesting a strategic planning tool. *International Journal of Contemporary Hospitality Management*, 27(6), 1214–1232. <https://doi.org/10.1108/ijchm-11-2013-0519>
35. Spilková, J., & Fialová, D. (2013). Culinary tourism packages and regional brands in Czechia. *Tourism Geographies*, 15(2), 177–197. <https://doi.org/10.1080/14616688.2012.726268>
36. Stone, M.J., Migacz, S., & Sthapit, E. (2021a). Connections between culinary tourism experiences and memory. *Journal of Hospitality & Tourism Research*, 46(4), 797–807. <https://doi.org/10.1177/1096348021994171>
37. Stone, M.J., Migacz, S., & Wolf, E. (2021b). Learning through culinary tourism and developing a culinary tourism education strategy. *Journal of Tourism and Cultural Change*, 20(1–2), 177–195. <https://doi.org/10.1080/14766825.2021.1876078>
38. Stone, M.J., Soulard, J., Migacz, S., & Wolf, E. (2017). Elements of memorable food, drink, and culinary tourism experiences. *Journal of Travel Research*, 57(8), 1121–1132. <https://doi.org/10.1177/0047287517729758>
39. Tsai, C.T. (2016). Memorable tourist experiences and place attachment when consuming local food. *International Journal of Tourism Research*, 18(6), 536–548. <https://doi.org/10.1002/jtr.2070>
40. UNWTO (2017). *Second Global Report on Gastronomy Tourism*. Retrieved from <https://www.unwto.org/archive/global/press-release/2017-05-17/2nd-unwto-report-gastronomy-tourism-sustainability-and-gastronomy> (October 22, 2023).
41. Updhyay, Y., & Sharma, D. (2014). Culinary preferences of foreign tourists in India. *Journal of Vacation Marketing*, 20(1), 29–39. <https://doi.org/10.1177/1356766713486143>
42. Wondirad, A., Kebete, Y., & Li, Y. (2021). Culinary tourism as a driver of regional economic development and socio-cultural revitalization: Evidence from Amhara National Regional State, Ethiopia. *Journal of Destination Marketing & Management*, 19, 100482. <https://doi.org/10.1016/j.jdmm.2020.100482>
43. Yang, F.X., Wong, I.A., Tan, X.S., & Wu, D.C.W. (2020). The role of food festivals in branding culinary destinations. *Tourism Management Perspectives*, 34, 100671. <https://doi.org/10.1016/j.tmp.2020.100671>
44. Yousaf, S., & Xiucheng, F. (2018). Halal culinary and tourism marketing strategies on government websites: A preliminary analysis. *Tourism Management*, 68, 423–443. <https://doi.org/10.1016/j.tourman.2018.04.006>
45. Zhang, S., Lyu, P., & Yan, Y. (2015). Global geographical and scientometric analysis of tourism-themed research. *Scientometrics*, 105(1), 385–401. <https://doi.org/10.1007/s11192-015-1678-3>

ESTIMATION OF PREVALENCE, EFFECT AND COST OF MASTITIS ON SIMMENTAL DAIRY FARMS OF DIFFERENT SIZES

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ABSTRACT

Mastitis, a production disease highly prevalent in dairy farming, poses a significant challenge to farmers. It is responsible for decreased milk production, reduced milk quality, and increased treatment costs. Thus, early detection and prompt treatment are essential to prevent the infection and minimize the mastitis impact. This study aimed to determine how farm size affects the prevalence, effect, and cost of mastitis. Therefore, a total of 4,922,751 test-day records for dairy Simmental cows collected in the period 2005-2022 were analysed. Results showed that mastitis was most prevalent among small farms, which also exhibited a lower total increase in milk production. In contrast, the highest prevalence of healthy cows was observed at large farms, with the highest total increase in milk production.

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These findings suggest that mastitis prevalence and recovery potential in cows are highly variable and significantly impacted by the farm size. Larger farms exhibit better management practices related to microclimate conditions, feeding, and higher genetic potential of animals. These conditions ensure a lower frequency of mastitis-related problems and higher chances of animal recovery and restoration of production, in line with the genetic potential of animals.

Introduction

Production diseases are a class of diseases that are primarily caused by management practices, such as metabolic disorders. Among dairy cows, production diseases are pre-dominantly related to inadequate feeding or handling practices. The term has been expanded to include a range of other disorders, such as infertility, mastitis, and laminitis, which may involve infectious agents but are largely exacerbated by nutritional or management factors (Nir, 2003). While infectious diseases can result in significant economic losses during outbreaks and receive greater public attention, production diseases continue to be of paramount economic importance for the overall efficiency of animal production. According to Hogeveen et al. (2019), the economic impact of production diseases is several times greater than that of epidemic infectious diseases. Furthermore, it is vital to acknowledge the significance of production diseases which are a critical factor in animal production, particularly in the dairy industry. By addressing the underlying causes of production diseases, such as poor feeding or handling practices, we can enhance the overall health and well-being of the animals while simultaneously improving the eco-nomic efficiency of animal production.

Mastitis is the most widespread production disease that affects dairy cattle (Seegers et al., 2003). It is the inflammation of the parenchyma, or functional tissue, of the mammary gland. This inflammation can be caused by various factors, but intramammary infection (IMI) is the most common cause, usually resulting from the presence of infectious pathogens such as bacteria in the udder. Mastitis is a complex disease that results in physical, chemical, and usually bacteriological changes in milk and pathological changes in the gland tissue. The inflammation can be in an acute or chronic stage, and depending on the signs of inflammation, mastitis in dairy cows is divided into clinical and subclinical categories. Clinical mastitis is characterized by visible changes in milk, mammary gland, or even at the level of the entire organism. These changes can include clots, discoloration, and a decrease in the milk production. The affected cow may also have a fever, decreased appetite, and show signs of pain and discomfort. Subclinical mastitis, on the other hand, is not visible and does not show any physical symptoms. It is usually diagnosed by the somatic cell count (SCC) testing of milk, which measures the number of white blood cells in milk. Elevated SCCs indicate the presence of an immune response to an intramammary infection, even in the absence of visible signs of inflammation. Adkins and Middleton (2018) have classified clinical

mastitis based on its severity as mild, moderate, and severe. In mild cases, changes in milk are evident, such as clots, scales, and alterations in colour and consistency of milk secretion. In moderate cases, changes are observed in both milk and the mammary gland. Inflammation in the tissue results in redness, heat, pain, and swelling. In severe cases, changes are evident in milk, mammary gland, and symptoms of systemic disease such as changes in body temperature, rumination rate, appetite, hydration status, and behaviour. Narváez-Semanate et al. (2022) have reported that the incidence of mild cases of clinical mastitis is the highest, followed by moderate cases. On the other hand, severe cases are relatively less common. Overall, mastitis is a significant concern for dairy farmers as it can result in the decreased milk production, decreased milk quality, and increased treatment costs. Therefore, early detection and prompt treatment are necessary in order to prevent the spread of infection and to minimize the impact of mastitis on dairy production.

The mastitis diagnosis is typically predicated on clinical observations or measurements of the inflammatory response to infection. Conversely, identifying the causative agent of infection is essential for diagnosing IMI. Detecting subclinical mastitis in dairy cattle is a challenging task due to its potential to cause more harm than clinical mastitis and the significant risk it poses. Even minor productivity changes can lead to prolonged losses in production. Hence, it is imperative to monitor and detect mastitis early to minimize the negative impact on dairy production. Regrettably, preventative measures against mastitis in cows are only implemented after their milk yield has significantly declined. Subclinical mastitis is more frequent than clinical mastitis and can account for up to 80% of milk production losses. Moreover, affected udder quarters can completely dry out, which can lead to death or culling from the herd. Halasa et al. (2007) assert that mastitis, regardless of the type, can have unfavourable consequences for the dairy industry, including the decreased milk production and quality. Furthermore, Özkan Gülzari et al. (2018) illuminated that mastitis's prevalence can contribute adversely to greenhouse gas emissions. Farmers can minimize milk losses, optimize culling rates, and reduce variable costs by preventing and managing subclinical mastitis. This can reduce the amount of emissions per kilogram of milk produced, ultimately increasing profits. Argaw (2016) stated that the early diagnosis of mastitis is crucial since changes in the udder tissue occur before they become visible. Early detection enables early treatment that minimizes or eliminates the need for antibiotics and maintains production continuity. This benefits the sick cow by decreasing the duration of the infection, leading to less damage to the udder. However, if the duration of mastitis infection, especially contagious mastitis, is prolonged, the possibility of infection spreading to other cows in the herd increases. Kamal et al. (2014) emphasized that the early diagnosis of mastitis also has economic implications, as it allows for the reduction of milk production losses and the increased chances of recovery.

Keeping track of somatic cell count (SCC) as a crucial piece of information from milk recording as it can indicate intramammary infections and help monitor milk quality at individual, herd, and population levels (Schukken et al., 2003). By tracking SCC

for each animal in the herd, farmers can gain insights into the health of their udders. Elevated SCC usually signifies a more severe infection, making this metric a valuable tool for evaluating udder health. The number of somatic cells (SCC) is associated with inflammatory processes, making it a useful diagnostic method for assessing udder health (Ivanov et al., 2016). The invasion of the mammary gland tissue by pathogens promotes the trafficking of various immune cells to the inflammation site, leading to an increase in the number of somatic cells in the secreted milk (Alhussien and Dang, 2018). Notably, an increase in SCC during successive lactations was associated only with an increase in the number of polymorphonuclear leukocytes (PMN). However, an increase in SCC during any lactation was associated with an increase in both PMN and other milk somatic cells (Blackburn, 1966). When testing milk, an udder is considered healthy if the count of somatic cells is less than 100,000 cells/ml milk (Smith et al., 2001). Mikó et al. (2016) stated that the healthy milk should contain from 20,000 to 100,000 SCC/ml. However, an increase in somatic cells can result in a loss of milk production, leading to economic losses for dairy farmers (Hadrich et al., 2018). The total milk losses in the herd depend on the distribution of SCC at the cow level and parity within the herd (Chen et al., 2021). According to Mikó et al. (2016), a decrease in milk yield has been observed in cows with elevated somatic cell counts (SCC). The extent of the decline in milk production was directly associated with the degree of SCC, with cows having SCC levels from 50,000 to 100,000 cells/ml exhibiting a loss greater than 8%, while those with average SCC levels from 100,000 to 250,000 cells/ml displaying a decrease in milk production by more than 15%, and even up to 18% (Pfützner and Ózsvári, 2016). Furthermore, the impact of heat stress on somatic cell count (SCC) in Holstein cows has been the subject of study by Gantner et al. (2011, 2017). The study has identified variations in SCC depending on the temperature-humidity index value, daily production level, breed, and parity.

The increasing significance of preventing disorders and diseases in dairy cattle has led to research aimed at determining the prevalence of mastitis and its consequent impact and costs in the population of dairy Simmental cows in Croatia, while considering farm size.

Materials and methods

The statistical analysis was conducted using the milk recording database of cows that are being selected in Croatia. The data was obtained from the Croatian Agency for Agriculture and Food (HAPIH). In Croatia, milk recording is carried out following the AT4/BT4 method, which involves measuring the amount of milk and sampling milk from each lactating cow during morning/evening milking every four weeks. The collected milk samples are analysed in the Central Laboratory for Milk Quality Control (SLKM) of HAPIH. The International Committee for Animal Recording (ICAR, 2017) has defined the procedure for taking milk samples during milk recording, as well as laboratory testing of samples. Milk samples undergo chemical composition testing to determine the content of milk fat, protein, lactose, dry matter, dry matter without fat, urea, and freezing point. Additionally, the content of casein, free fatty

acids, pH value, and ketone bodies are tested. The accredited laboratory uses infrared spectrophotometry to analyse the proportion of milk fat, proteins, lactose, and urea. The fluoro-opto-electronic method is used to count somatic cells. The chemical quality of milk is determined by MilkoScan analyzers, while Fossomatic analyzers are used for somatic cell count.

As part of the logical data control process, test-day records that had individual traits falling outside of the following ranges were deleted from the database: daily milk yield less than 3 kg or greater than 100 kg, daily milk fat content less than 1.5% or greater than 9%, daily protein content less than 1% or greater than 7%, and daily lactose content less than 3% or greater than 6%. Additionally, test-day records with missing or illogical values for lactation stage (less than 5 days or greater than 400 days), parity (less than 1 or greater than 10), age at first calving (less than 21 or greater than 36 months), calving date, milk recording date, and herd code were also deleted from the database. After the logical data control process, the database contained a total of 4,922,751 test-day records for dairy Simmental cows, covering the milk recording period from January 1st, 2005 to December 31st, 2022.

The cows were divided into four different classes based on their parity: 1, 2, 3, and 4 or more. Depending on the size of the herd, five classes were formed ranging from less than 5 cows to 200 - 500 cows. The test-day records were also grouped into four seasons based on the month of milk recording: winter (December, January, and February), spring (March, April, May), summer (June, July, August), and autumn (September, October, November). To evaluate the prevalence of mastitis, the daily somatic cell count (SCC) of the cows was analysed. Cows with an SCC below 200,000/ml were considered healthy, while cows with an SCC ranging from 200,000/ml to 400,000/ml were considered at risk of mastitis. An SCC exceeding 400,000/ml was indicative of the presence of mastitis in cows.

The prevalence of mastitis among Simmental cows refers to the percentage of cows in a specific mastitis class, based on the number of somatic cells produced per day, out of the total number of animals. Additionally, the prevalence rate was calculated separately for each herd size class. To analyse the impact of mastitis prevalence on production indicators, only cows with a confirmed mastitis (SCC > 400,000/ml) were included in the study. The reference point for daily milk yield was set to the date of mastitis prevalence determination. The mastitis index was determined based on the number of days after the mastitis diagnosis, with D-0 being the test-day record on the day of diagnosis, A-1 within 35 days, A-2 between 36 and 70 days, A-3 between 71 and 105 days, and A-4 more than 105 days. The effect of the mastitis index on daily milk production (milk, fat, and protein yield) was analysed separately by herd size class. This was done using a specific statistical model:

$$y_{ijklmn} = \mu + b_1(d_i/305) + b_2(d_i/305)^2 + b_3 \ln(305/d_i) + b_4 \ln^2(305/d_i) + A_j + P_k + S_l + M_m + e_{ijklmn} \quad (1)$$

The given equation estimates the daily milk, fat, and protein yield of a cow. The variables used in the equation are as follows: y_{ijklm} represents the estimated milk

production trait, μ is the intercept, b_1, b_2, b_3, b_4 are regression coefficients, and d_i is the stage of lactation (i ranging from 6 to 400 days). A_j represents the fixed effect of age at first calving (j ranging from 21 to 36 months) but is only applicable for the first parity, while P_k represents the fixed effect of parity (k ranging from 1, 2, 3, to ≥ 4). S_l represents the fixed effect of recording season (l ranging from spring to winter) and M_m represents the fixed effect of mastitis index (m ranging from D-0, A-1, A-2, A-3, to A-4). Finally, e_{ijklm} represents the residual. The statistical significance of differences between estimated LsMeans was evaluated by means of Scheffe's method of multiple comparisons, implemented via the MIXED procedure of the SAS software package (SAS Institute Inc., 2019). The estimated differences in daily yields of milk, fat, and protein for each of the analysed milk recordings, namely D-0, A-1, A-2, A-3, and A-4, were presented separately based on herd size.

After the diagnosis of mastitis, the total difference in milk yield for four successive milk recordings (from D-0 to A-4) was calculated using the equation below:

$$Y = D_{A1-D0} * I_{D0-A1} + D_{A2-A1} * I_{A1-A2} + D_{A3-A2} * I_{A2-A3} + D_{A4-A3} * I_{A3-A4} \quad (2)$$

where:

Y = estimated milk yield (kg);

D_{A1-D0} – the difference between the estimated daily milk yield at the first successive milk recording and the daily milk yield determined at the reference milk recording;

I_{D0-A1} – the interval between the reference recording and the first successive milk recording;

D_{A2-A1} – the difference between the estimated daily milk yield at the second and first successive milk recordings;

I_{A1-A2} – the interval between the first and second successive milk recordings;

D_{A3-A2} – the difference between the estimated daily milk yield at the third and second successive milk recordings;

I_{A2-A3} – the interval between the second and third successive milk recordings;

D_{A4-A3} – the difference between the estimated daily milk yield at the fourth and third successive milk recordings;

I_{A3-A4} – the interval between the third and fourth successive milk recordings.

The total difference in milk production in quantity (kg) and value (euro, (Jurinić Kojić et al., 2023)) was presented separately for herd size class.

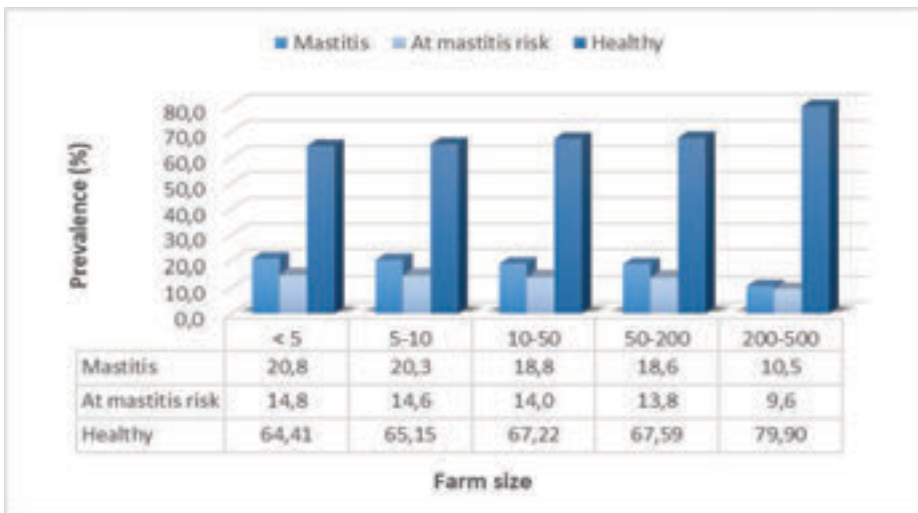
Results

The present study aimed to examine the prevalence of healthy cows, cows at mastitis risk, and cows with mastitis in response to the number of animals in lactation (farm size). The analysis revealed that there was a significant variation in the prevalence of

mastitis, ranging between 10.5% and 20.8% (Figure 1). Similarly, the prevalence of cows at mastitis risk varied from 9.6% to 14.8%. The percentage of healthy cows varied between 64.41% and 79.90%. The observed differences in animal health status were largely attributable to the milk recording season. Notably, the highest prevalence of mastitis was identified in small-scale farms with less than 5 cows, which accounted for 20.0% of the total population. Conversely, the lowest mastitis prevalence was observed in large-scale farms with 200-500 cows, which registered a prevalence rate of 10.5%. Additionally, the percentage of healthy cows was highest in the largest farms (79.90%).

This study underscores the need for careful and regular monitoring of cow health status, with particular attention to the prevalence of mastitis in small-scale farms. Such monitoring can help to reduce the incidence of animal disease, optimize milk production, and promote animal welfare.

Figure 1. The prevalence of healthy, cows at mastitis risk, and cows with mastitis regarding the herd size class.



Source: Authors' calculations

The results of the statistical analysis indicated that all independent variables, including lactation stage, age at first calving, parity, recording season, and breeding region, as well as mastitis index (D-0, A-1, A-2, A-3, A-4), had a statistically significant effect ($p < 0.001$) on daily milk yield in both breeds and across all farms, regardless of size.

The mastitis index (D-0, A-1, A-2, A-3, A-4) has a significant effect on daily milk, fat, and protein yield, as confirmed by statistical analysis. This effect is present across all farm sizes, suggesting that mastitis has a similar impact on milk production regardless of the size of the farm. The data in Table 1 shows that LsMeans of daily milk yield varied from 13.924 kg/day at D-0 to 14.404 kg/day at A-4 at the smallest farms; from 14.078 kg/day at D-0 to 14.836 kg/day at A-3 at farms with 50 - 10 cows; from 14.932 kg/day at D-0 to 15.923 kg/day at A-2 at farms with 10 - 50 cows; from 16.896 kg/day

at D-0 to 17.768 kg/day at A-3 at medium farms with 50 - 200 cows; and from 16.422 kg/day at D-0 to 19.094 kg/day at A-3 at the largest farms with 200 - 500 cows. The lowest daily milk yield was determined at D-0, which is the test-day record when the mastitis prevalence was determined. This finding is consistent across all farm sizes. In contrast, an increase in daily milk yield was observed at successive milk recordings. However, the degree of increase varied depending on the farm size, with the largest farms showing the most significant increase in daily milk yield.

The variability in daily fat yield showed a different pattern with the highest values determined at D-0 (0.630 kg/day at the smallest farms; and 0.811 kg/day at the largest farms) followed by a drop at successive milk recordings. This pattern was also observed across all farm sizes. The LsMeans for daily protein yield showed similar variability to daily milk yield, with the lowest values determined at D-0 milk recording (from 0.495 kg/day at farms with less than 5 cows to 0.619 kg/day at farms with more than 200 cows) followed by an increase in value at successive milk recordings. This detailed analysis suggests that the mastitis index has a significant impact on milk production, regardless of the size of the farm. The data also highlights the importance of regular milk recordings in detecting changes in milk yield caused by mastitis.

Table 1. LsMeans of daily yields (milk, fat, and protein) at analysed milk recordings (D-0, A-1, A-2, A-3, A-4) regarding the herd size class

Herd size	MR	Daily milk yield (kg)			Daily fat yield (kg)			Daily protein yield (kg)		
		Estim	StdEr	P	Estim	StdEr	P	Estim	StdEr	P
< 5 cowS	D-0	13.924	0.055	< 0.0001	0.630	0.003	< 0.0001	0.495	0.002	< 0.0001
	A-1	14.385	0.060	< 0.0001	0.592	0.003	< 0.0001	0.498	0.002	< 0.0001
	A-2	14.394	0.061	< 0.0001	0.597	0.003	< 0.0001	0.498	0.002	< 0.0001
	A-3	14.338	0.064	< 0.0001	0.591	0.003	< 0.0001	0.497	0.002	< 0.0001
	A-4	14.404	0.053	< 0.0001	0.597	0.003	< 0.0001	0.498	0.002	< 0.0001
5 – 10 cows	D-0	14.078	0.082	< 0.0001	0.623	0.004	< 0.0001	0.504	0.003	< 0.0001
	A-1	14.736	0.087	< 0.0001	0.603	0.004	< 0.0001	0.515	0.003	< 0.0001
	A-2	14.684	0.087	< 0.0001	0.601	0.004	< 0.0001	0.511	0.003	< 0.0001
	A-3	14.836	0.090	< 0.0001	0.607	0.005	< 0.0001	0.517	0.003	< 0.0001
	A-4	14.824	0.080	< 0.0001	0.608	0.004	< 0.0001	0.516	0.003	< 0.0001
10 – 50 cows	D-0	14.932	0.107	< 0.0001	0.652	0.005	< 0.0001	0.542	0.004	< 0.0001
	A-1	15.923	0.112	< 0.0001	0.641	0.006	< 0.0001	0.564	0.004	< 0.0001
	A-2	15.823	0.113	< 0.0001	0.643	0.006	< 0.0001	0.560	0.004	< 0.0001
	A-3	15.834	0.115	< 0.0001	0.642	0.006	< 0.0001	0.560	0.004	< 0.0001
	A-4	15.913	0.104	< 0.0001	0.646	0.005	< 0.0001	0.562	0.004	< 0.0001
50 – 200 cows	D-0	16.896	0.556	< 0.0001	0.725	0.028	< 0.0001	0.618	0.020	< 0.0001
	A-1	17.635	0.561	< 0.0001	0.708	0.029	< 0.0001	0.630	0.021	< 0.0001
	A-2	17.626	0.560	< 0.0001	0.715	0.029	< 0.0001	0.629	0.021	< 0.0001
	A-3	17.768	0.564	< 0.0001	0.716	0.029	< 0.0001	0.633	0.021	< 0.0001
	A-4	17.524	0.555	< 0.0001	0.710	0.028	< 0.0001	0.624	0.020	< 0.0001

Herd size	MR	Daily milk yield (kg)			Daily fat yield (kg)			Daily protein yield (kg)		
		Estim	StdEr	P	Estim	StdEr	P	Estim	StdEr	P
200 – 500 cows	D-0	16.422	1.394	< 0.0001	0.811	0.067	< 0.0001	0.619	0.050	< 0.0001
	A-1	17.928	1.374	< 0.0001	0.793	0.066	< 0.0001	0.656	0.050	< 0.0001
	A-2	19.094	1.334	< 0.0001	0.804	0.064	< 0.0001	0.681	0.048	< 0.0001
	A-3	18.809	1.528	< 0.0001	0.766	0.073	< 0.0001	0.680	0.055	< 0.0001
	A-4	19.047	1.039	< 0.0001	0.775	0.050	< 0.0001	0.680	0.038	< 0.0001

*MR – milk recording; D-0 – milk recording when the mastitis prevalence was determined; A-1, A-2, A-3, A-4 – successive milk recordings; Estim – estimate; StdEr – standard error of estimate. *Source:* Authors' calculations

The estimated variations in daily milk production between the D-0 and A-1 milk recordings were found to differ based on the size of the farm. The highest increase was observed in the largest farms, reaching up to 1.51 kg/day (equivalent to 45.20 kg/month), while the lowest increase was seen in the smallest farms with less than 5 cows, where it was limited to 0.46 kg/day (equivalent to 13.86 kg/month). A range of differences, from a decrease of 0.01 kg/day to an increase of 1.17 kg/day, were observed in the other analysed milk recordings (A-1&A-2, A-2&A-3, and A-3&A-4), and these variations were dependent on the number of milk recordings and the size of the farm.

The daily fat yield decreased between the D-0 and A-1 milk recordings, ranging from -3.81 kg*10⁻²/day (for farms with less than 5 cows) to -1.06 kg*10⁻²/day (for farms with 10 - 50 cows). On the other hand, the daily protein yield increased from 0.33 kg*10⁻²/day (for farms with less than 5 cows) to 3.68 kg*10⁻²/day (for farms with 200 - 500 cows). The variations in daily fat and protein yield between the other analysed milk recordings (A-1&A-2, A-2&A-3, and A-3&A-4) ranged from 0.09 kg*10⁻²/day to 3.82 kg*10⁻²/day for fat and from 0.02 kg*10⁻²/day to 2.56 kg*10⁻²/day for protein, and they were found to be dependent on the number of milk recordings and the size of the farm.

Table 2. Estimated differences in daily milk, fat, and protein yield between the analysed milk recordings (D-0, A-1, A-2, A-3, A-4) regarding the herd size class

Herd size (N cows)	I. MR	II. MR	Daily milk yield (kg)				Daily fat yield (kg*10 ⁻²)				Daily protein yield (kg*10 ⁻²)			
			Est	SE	P	Mdif	Est	SE	P	Mdif	Est	SE	P	Mdif
< 5	D-0	A-1	0,46	0,05	***	13,86	-3,81	0,30	***	-114,36	0,33	0,20	n.s.	10,04
	A-1	A-2	0,01	-0,06	n.s.	0,25	0,52	-0,33	n.s.	15,61	-0,02	-0,22	n.s.	-0,58
	A-2	A-3	-0,06	-0,06	n.s.	-1,69	-0,64	-0,35	n.s.	-19,15	-0,13	-0,23	n.s.	-4,04
	A-3	A-4	0,07	-0,06	n.s.	2,00	0,61	-0,31	n.s.	18,28	0,17	-0,21	n.s.	5,21
5 – 10	D-0	A-1	0,66	0,07	***	19,76	-1,98	0,34	***	-59,46	1,07	-0,25	***	32,02
	A-1	A-2	-0,05	-0,07	n.s.	-1,56	-0,18	-0,37	n.s.	-5,36	-0,39	0,27	n.s.	-11,80
	A-2	A-3	0,15	-0,08	n.s.	4,56	0,59	-0,39	n.s.	17,82	0,65	-0,29	n.s.	19,57
	A-3	A-4	-0,01	-0,07	n.s.	-0,36	0,11	-0,35	n.s.	3,22	-0,11	-0,25	n.s.	-3,38

Herd size (N cows)	I. MR	II. MR	Daily milk yield (kg)				Daily fat yield (kg*10 ⁻²)				Daily protein yield (kg*10 ⁻²)			
			Est	SE	P	Mdif	Est	SE	P	Mdif	Est	SE	P	Mdif
10 – 50	D-0	A-1	0,99	0,08	***	29,75	-1,06	0,39	n.s.	-31,85	2,15	0,28	***	64,55
	A-1	A-2	-0,10	-0,09	n.s.	-3,00	0,21	-0,43	n.s.	6,22	-0,40	-0,31	n.s.	-11,88
	A-2	A-3	0,01	-0,09	n.s.	0,32	-0,14	-0,45	n.s.	-4,31	0,00	-0,33	n.s.	-0,10
	A-3	A-4	0,08	-0,08	n.s.	2,38	0,45	-0,40	n.s.	13,55	0,26	-0,29	n.s.	7,79
50 – 200	D-0	A-1	0,74	0,17	***	22,18	-1,72	0,85	n.s.	-51,71	1,24	0,61	n.s.	37,23
	A-1	A-2	-0,01	-0,18	n.s.	-0,28	0,74	-0,93	n.s.	22,17	-0,14	-0,67	n.s.	-4,21
	A-2	A-3	0,14	-0,19	n.s.	4,25	0,09	-0,98	n.s.	2,66	0,45	-0,70	n.s.	13,51
	A-3	A-4	-0,24	-0,17	n.s.	-7,31	-0,64	-0,86	n.s.	-19,14	-0,93	-0,62	n.s.	-27,84
200 – 500	D-0	A-1	1,51	1,45	n.s.	45,20	-1,77	6,95	n.s.	-53,00	3,68	5,23	n.s.	110,47
	A-1	A-2	1,17	-1,43	n.s.	34,97	1,06	-6,87	n.s.	31,71	2,56	-5,16	n.s.	76,77
	A-2	A-3	-0,29	-1,58	n.s.	-8,56	-3,82	-7,61	n.s.	-114,54	-0,10	-5,72	n.s.	-3,04
	A-3	A-4	0,24	-1,46	n.s.	7,15	0,93	-6,99	n.s.	27,77	-0,02	-5,26	n.s.	-0,58

* D-0 – milk recording when the mastitis prevalence was determined; A-1, A-2, A-3, A-4 – successive milk recordings; Est – estimated difference, Mdif – estimated monthly difference (Est*interval between the successive milk recordings). *Source:* Authors' calculations

Table 3 presents the differences in milk production in both quantity (kg) and value (euro) during the analysed period from D-0 to A-4 milk recording, with respect to farm size. Cows raised on the smallest farms with fewer than 5 lactating animals showed the lowest increase in daily milk production during the first milk recording (A-1), amounting to 13.857 kg/month (7.21 euro/month), and the lowest total increase of 14.422 kg (7.50 euro)/month. In contrast, the farms with more than 200 cows showed the highest increase in milk production during the first milk recording and the entire analysed period, with 45.195 kg (23.50 euro)/month and 78.757 kg (40.95 euro)/month, respectively.

Table 3. Estimated differences in daily milk, fat, and protein yield between the analysed milk recordings (D-0, A-1, A-2, A-3, A-4) regarding the herd size class

Herd size (N cows)	A-1		A-2		A-3		A-4		Total difference	
	kg	euro	kg	euro	kg	euro	kg	euro	kg	euro
< 5	13.857	7.21	0.251	0.13	-1.685	-0.88	1.999	1.04	14.422	7.50
5 – 10	19.760	10.28	-1.560	-0.81	4.559	2.37	-0.359	-0.19	22.400	11.65
10 – 50	29.749	15.47	-3.003	-1.56	0.319	0.17	2.377	1.24	29.442	15.31
50 – 200	22.181	11.53	-0.280	-0.15	4.255	2.21	-7.314	-3.80	18.842	9.80
200 – 500	45.195	23.50	34.969	18.18	-8.556	-4.45	7.149	3.72	78.757	40.95

Source: Authors' calculations

These results demonstrate that the potential for an animal's recovery and restoration of production is largely variable and significantly influenced by farm management and genetic potential. The animal's genetic potential offers the highest possibility of recovery and restoration of production at the largest farms with better management strategies.

Discussions

This study analysed the prevalence of mastitis, cows at risk of mastitis, and healthy cows based on farm size. Mastitis prevalence varied between 10.5% and 20.8%, while healthy cow proportion ranged from 64.41% to 79.90%. Small-scale farms had the highest mastitis prevalence (20.0%), and large-scale farms had the lowest (10.5%) with the highest percentage of healthy cows (79.90%).

Mastitis is a common infectious disease that affects dairy cows and has a significant impact on milk production and quality. Several factors can influence the occurrence and incidence rate of clinical mastitis cases in dairy herds, as reported by Tomazi et al. (2018). These factors include the season, production system, cow's production level, herd size, and somatic cells in milk. High temperatures and humidity during the summer period create a favourable environment for heat stress in dairy cows, increasing the risk of intra-mammary infections, especially those caused by environmental pathogens. According to Gantner et al. (2011), changes in environmental conditions during the summer period can significantly affect the quantity and quality of milk, somatic cell counts, and mastitis prevalence. Nobrega and Langoni (2011) found that the level of lactose in cows during the dry season was higher, indicating a higher prevalence of mastitis during that period. Similarly, Sharma et al. (2018) reported that mastitis cases are most common during the early autumn or winter, and there is an increased risk of mastitis during winter calving. The authors explain that free and open housing on farms increases the risk of infectious agents in the cows' bedding, which contributes to mastitis-related problems. Weber et al. (2020), in a study on the Holstein breed in Brazil, found that the season significantly affected the composition and quality of milk. Milk was of higher quality during the winter and spring seasons, while in the hotter months of summer and autumn, the quality and availability of forage, and the frequency of mastitis (increased somatic cell counts) negatively affected milk quality. According to Haygert-Velho et al. (2018), heat stress affects lactating cows in summer and autumn, leading to variation in monthly milk production and quality. Antanaitis et al. (2021) state that summer is the most crucial time for the appearance of the causative agent of subclinical mastitis in milk. However, mastitis can also be related to management systems, nutrition, and housing in different seasons. During the outdoor season, milk is more likely to contain higher proportions of environmental bacteria. Furthermore, the micro(climate) of a farm and its management practices can significantly impact animal performance, particularly in relation to mastitis. Notably, larger farms tend to exhibit better management practices and environmental conditions, leading to a lower incidence of mastitis. This conclusion is supported by a study conducted by Fesseha et al. (2021), which found that herd size is strongly correlated ($p < 0.05$) with mastitis prevalence. Specifically, the study reported that farms with fewer than 10 cows had the highest prevalence of mastitis (over 77%), while the lowest prevalence was observed at the largest farms. According to a study conducted by Shuiyun et al. in 2023, the prevalence of clinical mastitis in Chinese dairy cows varied depending on the region. The study also identified parity, age, season, and lactation as the potential risk factors for

mastitis. The authors recommended that practitioners improve management strategies to develop appropriate prevention and control programmes for the disease.

This research showed that the mastitis index (D-0 to A-4) significantly affected daily milk, fat, and protein yield, regardless of farm size. The lowest daily milk yield was recorded at D-0 across all farm sizes. Successive milk recordings showed an increase in daily milk yield, with the largest farms showing the most significant increase. Furthermore, daily fat yield varied across all farm sizes with the highest values recorded on the first day, followed by a decline in subsequent milk recordings. On the other hand, daily protein yield showed similar variability like daily milk yield.

Furthermore, the milk production differences between D-0 and A-1 varied based on the farm size. Largest farms saw a 1.51 kg/day increase, while the smallest had only a 0.46 kg/day increase. Other recordings showed a range of differences, from a decrease of 0.01 kg/day to an increase of 1.17 kg/day, dependent on the number of recordings and farm size. During the period between the first and second milk recordings (D-0 and A-1), the daily fat yield decreased for all farms. The decrease ranged from -3.81 kg*10⁻²/day for farms with less than 5 cows to -1.06 kg*10⁻²/day for farms with 10 - 50 cows. Conversely, the daily protein yield increased during this period. It ranged from 0.33 kg*10⁻²/day for farms with less than 5 cows to 3.68 kg*10⁻²/day for farms with 200 - 500 cows. The changes in daily fat and protein yield between subsequent milk recordings (A-1&A-2, A-2&A-3, and A-3&A-4) varied depending on the number of milk recordings and the size of the farm. The variations ranged from 0.09 kg*10⁻²/day to 3.82 kg*10⁻²/day for fat, and from 0.02 kg*10⁻²/day to 2.56 kg*10⁻²/day for protein.

The differences observed in this research regarding the increase of daily milk yield after the diagnosis of mastitis on different farms can be attributed to variations in feeding and microclimatic conditions within the production facilities. Simmental cows appear to recover more efficiently in farms with better management practices, including superior feeding options, microclimatic conditions, and animals with greater genetic potential, as indicated by the highest increase in daily milk yield on the largest farms. Research by Antanaitis et al. (2021) suggested that these differences in milk yield are linked to differences in management systems, feeding practices, and seasonal conditions. Wani et al. (2022) found that the highest milk loss during mastitis occurred in spring, followed by summer and autumn. Additionally, Yang et al. (2013) discovered that milk yield, composition, and related measures were influenced by parity and season. Chen et al. (2023) noted that the impact of season on mastitis occurrence varied across regions, likely due to diverse climate conditions. Furthermore, Harjanti and Sambodho (2020) reported a statistically significant negative correlation ($P < 0.0001$) between mammary inflammation and milk production ($r = -0.59$), milk protein ($r = -0.55$), lactose ($r = -0.51$), and fat content ($r = -0.46$). They concluded that an increase in mammary infection in cows leads to a decrease in milk production and milk components.

The analysis of the differences in milk production (quantity in kg and value in euros) during the analysed period from D-0 to A-4 milk recording reveals that farm size plays

an important role. Cows bred on farms with fewer than 5 lactating animals had the lowest increase in daily milk production during the first milk recording (A-1), which amounted to 13.857 kg/month (7.21 euro/month), and the lowest total increase of 14.422 kg (7.50 euro)/month. On the other hand, farms with more than 200 cows showed the highest increase in milk production during both the first milk recording and the entire analysed period, with 45.195 kg (23.50 euro)/month and 78.757 kg (40.95 euro)/month, respectively. These results demonstrate that the potential for an animal's recovery and restoration of production is largely variable and significantly influenced by farm management and genetic potential. The animal's genetic potential offers the highest possibility of recovery and restoration of production at the largest farms with better management strategies. According to Huijps et al. (2008), the economic losses of a clinical case of mastitis in a default scenario was found to be €210 on average, ranging from €164 to €235, depending on the month of lactation. The total economic losses of mastitis, including subclinical and clinical cases, per cow present in a default scenario varied between €65 and €182 per year, depending on the bulk tank somatic cell count. The study also found that over 7% of farmers expected their economic losses to be lower, averaging €78 per cow per year, but there was a large variation in this estimate ranging from €17 to €198 per cow per year. Same authors concluded that underestimating the economic losses of mastitis could be a general problem in the dairy sector, which can result in inadequate investment in prevention and control measures. Therefore, it is crucial to accurately estimate the financial impact of mastitis to encourage farmers to adopt effective measures to reduce the incidence of the disease. The findings of this research highlight the importance of effective management practices and suitable environmental conditions in mitigating mastitis prevalence on farms as well as the necessity of developing adequate strategies to control and prevent the disease in dairy herds. Furthermore, in small farms, where technological advancements are limited, and cattle with lower genetic potential are present, the prevention of mastitis becomes even more crucial. Due to the lack of knowledge and optimal management practices, small farms often face significant challenges in reducing mastitis infections. This results in lower milk production and lower profitability. Therefore, it is imperative to provide education and training to all farmers, particularly the ones with smaller farms. With proper education and training, farmers can learn how to prevent mastitis infections and implement best practices to increase milk production and profitability. By reducing mastitis infections, farmers can achieve higher milk quality, lower treatment costs, and increased sales revenue. This, in turn, will lead to higher profitability of small farms.

Conclusions

The study aimed to determine how different farm management practices related to the farm size affected the prevalence, the impact and the cost of mastitis. The results showed that mastitis was most prevalent at the smallest farms, with a lower total increase in milk production. Conversely, the highest prevalence of healthy cows was observed at the largest farms, with the highest total increase in milk production after the mastitis occurrence. These findings indicate that mastitis prevalence and recovery potential in

cows are highly variable and significantly impacted by the farm size. Larger farms imply better management practices related to microclimate conditions, feeding as well as higher genetic potential of animals. These conditions ensure a lower frequency of problems and a higher chance of animal recovery as well as the restoration of production, in line with the genetic potential of animals, and finally lower total direct costs.

In conclusion, preventing and managing subclinical/clinical mastitis is essential for the dairy industry. The early diagnosis of mastitis is crucial since it allows for early treatment, which minimizes the need for antibiotics and maintains production continuity. This not only benefits the sick cow by reducing the duration of the infection, but it also re-duces the possibility of infection spreading to other cows in the herd. Early diagnosis of mastitis has economic implications, as it allows for the reduction of milk production losses and increased chances of recovery. By minimizing milk losses, optimizing culling rates, and reducing variable costs, farmers can reduce the amount of emissions per kilo-gram of milk produced, ultimately increasing profits and decreasing environmental foot-print.

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Conflict of interests

The authors declare no conflict of interest.

References

1. Adkins, P.R., & Middleton, J.R. (2018): Methods for diagnosing mastitis. *Veterinary Clinics: Food Animal Practice*, 34.3, 479-491.
2. Antanaitis, R., Juozaitienė, V., Jonike, V., Baumgartner, W., & Paulauskas, A. (2021). Milk lactose as a biomarker of subclinical mastitis in dairy cows. *Animals*, 11.6, 1736.
3. Argaw, A. (2016). Review on epidemiology of clinical and subclinical mastitis on dairy cows. *Food Sci Qual Manag*, 52,6, 56-65.
4. Blackburn, P.S. (1966). The variation in the cell count of cow's milk throughout lactation and from one lactation to the next. *J. Dairy Res.*, 33.2, 193-198.
5. Chen, S., Zhang, H., Zhai, J., Wang, H., Chen, X., & Qi, Y. (2023). Prevalence of clinical mastitis and its associated risk factors among dairy cattle in mainland China during 1982–2022: a systematic review and meta-analysis. *Front. vet. sci.*, 10, 1185995.
6. Fesseha, H., Mathewos, M., Aliye, S., & Wolde, A. (2021). Study on prevalence of bovine mastitis and associated risk factors in dairy farms of Modjo town and suburbs, central Oromia, Ethiopia. *Veterinary Medicine: Research and Reports*, 271-283.

7. Gantner, V., Bobic, T., Gantner, R., Gregic, M., Kuterovac, K., Novakovic, J., & Potocnik, K. (2017). Differences in response to heat stress due to production level and breed of dairy cows. *Int. J. Biometeorol.*, 61, 1675-1685.
8. Gantner, V., Mijić, P., Kuterovac, K., Solić, D., & Gantner, R. (2011). Temperature-humidity index values and their significance on the daily production of dairy cattle. *Mljekarstvo*, 61(1), 56-63.
9. Hadrich, J.C., Wolf, C.A., Lombard, J., & Dolak, T.M. (2018). Estimating milk yield and value losses from increased somatic cell count on US dairy farms. *J. Dairy Sci.*, 101(4), 3588-3596.
10. Halasa, T., Huijps, K., Østerås, O., & Hogeveen, H. (2007). Economic effects of bovine mastitis and mastitis management: A review. *Veterinary Quarterly*, 29 (1), 18-31.
11. Harjanti, D.W., & Sambodho, P. (2020). Effects of mastitis on milk production and composition in dairy cows. In: *IOP Conference Series: Earth and Environmental Science*. IOP Publishing, 012032.
12. Haygert-Velho, I.M.P., da Conceição, G. M., Cosmam, L. C., Alessio, D. R. M., Busanello, M., Sippert, M. R., Damiani, C., Almeida, A.P.A., & Velho, J.P. (2018). Multivariate analysis relating milk production, milk composition, and seasons of the year. *An. Acad. Bras. Cienc.*, 90(4), 3839-3852.
13. Hogeveen, H., Steeneveld, W., & Wolf, C. A. (2019). Production Diseases Reduce the Efficiency of Dairy Production: A Review of the Results, Methods, and Approaches Regarding the Economics of Mastitis. *Annu. Rev. Resour. Econ.*, 11, 289-312.
14. Huijps, K., Lam, T. J., & Hogeveen, H. Henk. (2008). Costs of mastitis: facts and perception. *J. Dairy Res.*, 75,1, 113-120.
15. ICAR, International Committee for Animal Recording (2017). Guidelines for Dairy Cattle Milk Recording, *Guidelines*.
16. Ivanov, G.Y., Bilgucu, E., Ivanova, I.V., Uzatici, A., & Balabanova, T.B. (2016). Monitoring of the Somatic Cells Count for Improving Milk and Dairy Products Quality. *Sci. works Univ. Food Technol.*, 63(1), 90-97.
17. Jurinić Kojić, M., & Mišević, Z. (2023). Sirovo mlijeko i mliječni proizvodi.
18. Kamal, R.M., Bayoumi, M.A., & Abd El Aal, S.F.A. (2014). Correlation between some direct and indirect tests for screen detection of subclinical mastitis. *Int. Food Res. J.*, 21(3), 1249-1254.
19. Mikó, E., Atasever, S., Gráff, M., & Erdem, H. (2016). Influence of Somatic Cell Count on Daily Milk Yield and Milk Production Losses in Primiparous Hungarian Holstein Cows. In *Memoriam Ferenc Kovács International Congress on Veterinary and Animal Science*.
20. Narváez-Semanate, J.L., Daza-Bolaños, C.A., Valencia-Hoyos, C.E., Hurtado-Garzón, D.T., & Acosta-Jurado, D.C. (2022). Diagnostic methods of subclinical mastitis in bovine milk: an overview. *Rev Fac Nac Agron Medellin*, 75(3), 10077-10088.

21. Nir, O. (2003). What are production diseases, and how do we manage them? *Acta Vet. Scand.*, Supplement, 98, 21–32.
22. Nóbrega, D.B., & Langoni, H. (2011). Breed and season influence on milk quality parameters and in mastitis occurrence. *Pesqui. Vet. Bras.*, 31 (12), 1045–1052.
23. Özkan Gülzari, Ş., Vosough Ahmadi, B., & Stott, A.W. (2018). Impact of subclinical mastitis on greenhouse gas emissions intensity and profitability of dairy cows in Norway. *Prev. Vet. Med.*, 150, 19–29.
24. Pfützner, M., & Ózsvári, L. (2016). The Economic Impact of Decreased Milk Production Due to Subclinical Mastitis in East German Dairy Herds. *World Buiatrics Congress*,
25. SAS Institute Inc. (2019). SAS User's Guide, Version 9.4. SAS Institute Inc. Cary, NC.
26. Schukken, Y.H., Wilson, D.J., Welcome, F., Garrison-Tikofsky, L., Gonzalez, R.N. (2003). Monitoring udder health and milk quality using somatic cell counts. *Vet. Res.*, 34(5), 579–596.
27. Seegers, H., Fourichon, C., & Beaudeau, F. (2003). Production effects related to mastitis and mastitis economics in dairy cattle herds. *Vet. Res.*, 34 5, 475–491.
28. Sharma, N., Gurdeep Singh, S., Sharma, S., Misri, J., Gupta, S., & Hussain, K. (2018). Mastitis Occurrence Pattern in Dairy Cows and Importance of Related Risk Factors in the Occurrence of Mastitis. *J. Anim. Res.*, 2, 315–326.
29. Smith, K.L., Hillerton, J.E., & Harmon, R.J. (2001). Guidelines on normal and abnormal raw milk based on somatic cell counts and signs of clinical mastitis. *National Mastitis Council*, 9, 11–13.
30. Stocco, G., Cipolat-Gotet, C., Stefanon, B., Zeconi, A., Francescutti, M., Mountricha, M., & Summer, A. (2023). Herd and animal factors affect the variability of total and differential somatic cell count in bovine milk. *J. Anim. Sci.*, 101, 0–10.
31. Sumon, M.R., Parvin, S., Ehsan, A., & Islam, T. (2020). Dynamics of somatic cell count and intramammary infection in lactating dairy cows. *J. Adv. Vet. Anim. Res.*, 7(2), 314–319.

32. Tomazi, T., Ferreira, G.C., Orsi, A.M., Gonçalves, J.L., Ospina, P.A., Nydam, D.V., Moroni, P., & Dos Santos, M.V. (2018). Association of herd-level risk factors and incidence rate of clinical mastitis in 20 Brazilian dairy herds. *Prev. Vet. Med.*, 161, 9–18.
33. Wani, S.A., Haq, R.I.U., Parray, O.R., Nazir, Q.U.A., Mushtaq, M., Bhat, R.A., Parrah, J.U., Chakraborty, S., Dhama, K., & Yattoo, M.I.A. (2022). Brief Analysis of Economic Losses Due to Mastitis in Dairy Cattle. *Indian Vet. J.*, 99(2), 27–31.
34. Weber, C.T., Corrêa Schneider, C.L., Busanello, M., Bandeira Calgareo, J.L., Fioresi, J., Gehrke, C.R., Da Conceição, J.M., & Haygert-Velho, I.M.P. (2020). Season effects on the composition of milk produced by a Holstein herd managed under semi-confinement followed by compost bedded dairy barn management. *Semina: Cienc. Agrar.*, 41(5), 1667–1678.
35. Yang, L., Yang, Q., Yi, M., Pang, Z.H., & Xiong, B.H. (2013). Effects of seasonal change and parity on raw milk composition and related indices in Chinese Holstein cows in northern China. *J. Dairy Sci.*, 96(11), 6863–6869.

AGRARIAN DISTRESS: A CASE STUDY OF INDEBTEDNESS AMONGST FARMERS IN HARYANA STATE

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ABSTRACT

This study addresses the critical issue of farmer indebtedness as the primary cause of agrarian distress in Haryana, India. The pervasive challenge of debt negatively impacts farmers' livelihoods and agricultural sustainability, creating a cycle that hampers investment in modern farming technologies and sustainable practices. The study highlights the disproportionate access to credit, with institutional lenders favoring semi-medium, medium, and larger farmers, while small and marginalized farmers resort to non-institutional sources with higher interest rates. This unequal access perpetuates financial strain on the latter group. The findings emphasize the urgent need for government intervention and institutional support to assist marginalized and small farmers. The study advocates for comprehensive measures, including risk mitigation strategies, enhanced credit access, minimum support prices, and sustainable agricultural policies, to break the cycle of farmer debt and ensure the well-being of those crucial to our food systems.

Introduction

Farmers⁴ in the Indian state of Haryana have been struggling with debt because they have been taking on debt year after year in order to meet their needs. They are unable to pay

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4 A farmer is a cultivator, someone who rears animals (fish or cattle) or cultivates land or crops.
<http://ea.bg.ac.rs>

off their loan in the amount of time that the lending company has specified. For marginal⁵ and small⁶ farmers, this means that their land holdings are small enough to support their agricultural output, which makes it impossible for them to repay the loan on time. Thus, borrowing money to produce agricultural goods is not a bad thing. The taking out of loans for farming purposes is necessary to keep farming running smoothly. In developed nations as well, farmers borrow money for farming. Repayment of their loan will come from the money made from farming operations. But for Indian farmers, repaying the loan on schedule is a difficult undertaking (Dandekar & Bhattacharya, 2017).

In India, the majority of farmers are deeply indebted. Farmers' debt was not the result of a single factor, but rather a variety of factors. Low prices for their agricultural output, crop failure, high input costs (machinery, high yield variety seeds, fertilizers, pesticides, etc.), high interest rates from non-institutional sources, small landholdings, irresponsible loan use, and old or inherited debt were the main causes they cited (Jakhar et al., 2022a). A farmer finds it extremely difficult to escape the debt spiral once they are caught by the combined effects of all these factors. Farmers took out loans also to cover their consumption needs, build a new home, and celebrate social events like weddings and anniversaries and sometimes take out new loans in order to pay off old debt, which adds to their overall debt load (Jakhar et al., 2023). Farmers are ensnared in debt as a result of the yearly rise in these debts. Under these conditions, they are unable to escape the debt cycle. Farmers' suicide caused by indebtedness is another big issue in India (Grover et al.; Kaur et al.; & Sonawane, 2016).

The decline and uncertainty in agricultural earnings, as well as increased reliance on purchased inputs, stimulate higher borrowing from institutional and non-institutional sources at higher interest rates. Consequently, they faced problems in repayments, which added to the agrarian (or farmer) distress (Patil, 2008). Because the cost of agricultural inputs has been rising faster than the return on their produce, farming is no longer a lucrative career. The majority of farmers work directly in the traditional crop cultivation sector. The primary obstacle to their adoption of modern production techniques is their small landholdings. Horticultural crops could not be substituted for traditional crops. The Indian government responded to this problem by launching the Kisan Credit Card Scheme (KCC) in 1998–1999, which encouraged the development of an inventive credit facility that would enable farmers to obtain the credit quickly and easily they need. The issue of farmer debt remains a challenge for policymakers and the government, though. Joel Salatin stated that know your food, know your farmers, and know your kitchen. Thus, agriculture is the root of all economic activities of this world.

Materials and Methods

The Indian state of Haryana served as the study's location. The state is close to Delhi, the capital of India, and is situated in the country's northwest. The state makes up 1.34

5 A cultivator with lands up to one hectare in size is referred to as a marginal farmer.

6 A cultivator with landholdings between 1.01 and 2.00 hectares is referred to as a small farmer.

percent of the country's total area with its 44 212 square kilometers. There are 22 districts in the state. According to the 2011 census, 25 351 462 people are living in the state, with 13 494 734 men and 11 856 728 women. Of the total population of the state, 8 842 103 (34.88 percent) lives in urban areas and 16 509 359 (65.12 percent) lives in rural areas. The state's net sown area is 3,601 thousand hectares. The state's land holdings average 2.22 hectares in size. The state of Haryana has a gross state domestic product (GSDP) of 780 612 crore rupees and a per capita income of 247 628 rupees. At constant prices, the agricultural and related sectors comprise 18.9% of the GSDP. Industry and services account for 30.2% and 50.9% of the GSDP, respectively (GoH, 2021; 2020).

Primary and secondary data served as the foundation for this investigation. Primary data have been gathered according to carefully thought-out timetables. Secondary data on farmer indebtedness have been taken from various reports published by the Reserve Bank of India (RBI) and the National Sample Survey Organization (NSSO). Based on cropping patterns and ecology, the state of Haryana has been divided into three agricultural zones (GoH, 2013). Furthermore, a purposeful selection was made for Haryana's second zone, which included the districts of Sirsa, Fatehabad, Hisar, Jind, Rohtak, Faridabad, and Palwal and covered 39% of the state's area. The state's second zone is a representation of its dry and wet regions. The principal crops grown in this zone are cotton, rice, and wheat. Moreover, the districts of Faridabad, Jind, and Sirsa have been chosen, respectively, based on the highest percentage of land covered by the crops of wheat, rice, and cotton. Two hundred responders were chosen using a proportionate sampling technique. Of the chosen farmers, 106, 48, and 46 were chosen to represent farmers growing wheat, rice, and cotton, respectively, from the districts of Faridabad, Jind, and Sirsa. The corresponding author has personally organized (ordered) the fieldwork. The author has taken complete care of objectivity during the fieldwork. With assistance from the Sarpanch, Panchayat members, and other well-known village residents, a list of farmers who are in debt has been created. For data analysis, average (or mean values) and percentage approaches have been employed. The responses provided by a sample of 200 respondents served as the basis for this study's findings. Diagrams and tables are created for the findings to be presented in an efficient manner.

Results and Discussion

The study's findings are broken down into two sections: section I and section II. The results based on NSSO reports are shown in the first section. A field survey has been carried out in the study's second section to illustrate the actual situation about farmer indebtedness. The study emphasized the amount of debt, the sources of the loan, the length of the loan, the goals of the loan, and the interest rates assessed by various lending organizations. On the problems of farmers' indebtedness large number of studies were conducted in Punjab state of India (neighboring state of Haryana) by Gill (2014), Singh (2006), Singh et al. (2008; 2012; 2014), Singh & Bhogal (2014), Singh & Tiwan (2016). One of the main issues facing Punjab and Haryana, two states in India, is farmer debt. The following are the study's findings:

Section-I: Indebtedness of agricultural households in Haryana and India

National sample survey organisation (NSSO) estimates income, expenditure, productive assets, and indebtedness of agricultural households (farmers) at the national (or state) level with the interval of ten years. Sahu (2018) and Padmaja & Ali (2018) also conducted a study on NSO data sets for India. Their findings supported this study. The last report was published in the year 2012-13. On behalf of published previous reports, the extent of indebtedness of agricultural households (farmers) in India and Haryana (state) is depicted as follows:

Table 1. Incidence of indebtedness amongst agricultural households

State	Percentage of indebted agricultural households					
	1971	1981	1992	2003	2013	2019
India	44.30	21.69	25.90	48.6	51.9	50.02
Haryana	34.90	11.61	28.40	53.1	42.30	47.50

Source: NSO reports (1976, 1986, 1996, 2005, 2013, 2019)

The incidence of indebted agricultural households in Haryana and India is depicted in table 1. In the Haryana state, 34.90 per cent of agricultural households were estimated as indebted agricultural households in 1971, followed by 11.16, 28.40, 53.1, 42.30, and 47.50 per cent in 1981, 1992, 2003, 2013, and 2019 respectively. The extent of indebted agricultural households had continuously been increased in the four decades, i.e., 1981, 1992, 2003, and 2019 but a 10.8 per cent decrement was reported between 2003 to 2013. At national level, 44.30 per cent of agricultural households were estimated as indebted agricultural households in 1971, followed by 21.69, 25.90, 48.6, 51.9, and 50.02 per cent in 1981, 1992, 2003, 2013, and 2019 respectively. The percentage of indebted agricultural households has continuously been increased since 1981 in India. Thus, overall, the extent of indebted agricultural households has been continuously increasing in Haryana. It indicates agrarian distress amongst the farmers or agricultural households. Hence, today farmer indebtedness is a crucial and sentimental political issue in India.

Table 2 shows the proportion of indebted agricultural households in India and Haryana as well as the average amount of outstanding loans per agricultural household. In India and Haryana, the percentage of agricultural households with debt was 50.02 and 47.50 percent, respectively. The average amount of outstanding debt per agricultural household in India was 74 121, while in Haryana it was 182 922. Between 2013 and 2019, the average amount of debt (in absolute terms) increased in India by 57.70 and in Haryana by 131.54%, respectively. As a result, the debt load keeps rising every year. Therefore, there is a pressing need to address farmer indebtedness in India as it is a significant problem.

Table 2. Indebted agricultural households and the average amount of outstanding loans per agricultural household

(Amount of debt in INR)

Farm-size categories (in hectares)		India				Haryana			
		Average amount of outstanding loan per agricultural household		Percentage of indebted agricultural households		Average amount of outstanding loan per agricultural household		Percentage of indebted agricultural households	
Year		2013	2019	2013	2019	2013	2019	2013	2019
Marginal farmers	<0.01	31 100	26 883	41.9	38.5	9 500	39 682	25.2	27.8
	0.01-0.40	23 900	33 220	47.3	40.8	19 200	61 567	33.0	35.8
	0.41-1.00	35 400	51 933	48.3	48.4	73 700	134 215	53.2	37.0
Small farmers	1.01-2.00	54 800	94 498	55.7	57.4	90 000	170 614	40.0	58.5
Semi- medium farmers	2.01-4.00	94 900	175 009	66.5	69.7	157 300	362 121	50.7	69.3
Medium farmers	4.01-10.00	182 700	326 766	76.3	79.3	116 200	716 519	39.7	78.6
Large farmers	10+	290 300	791 132	78.7	81.4	468 100	1 018 854	74.3	93.8
All Size		47 000	74 121	51.9	50.0	79 000	182 922	42.3	47.5

Source: NSS report No.576 and 587

As farms pivot from marginal to large farmer⁷, the amount of debt owed by agricultural households showed a consistent upward trend. Thus, in India, the amount of debt in percentage form increases with farm size by ownership. The average amount of outstanding debt per household in India's agricultural sector rose as well, from rupees 26 883 for marginal farmers to rupees 791 132 for large farmers. As a result, the large farm category was where the highest outstanding debt was reported. The state of Haryana in India presents a similar picture of farmer indebtedness. According to reports, the percentage of debt was highest in the large farm size category (93.8%) and lowest in the marginal farm size category (27.8%), respectively. In the large (or marginal) farm size category in Haryana, the highest (or lowest) average amount of debt per agricultural household was reported to be rupees 1 018 854 (or 39 682). All things considered; Haryana had a high average amount of outstanding debt per agricultural household. As such, it is an important and delicate matter in Haryana. Approximately 50 per cent of farmers are burdened by debt, and every other farmer faces difficulties related to debt. When it comes to employment, India's economy is based mostly on agriculture. Significant investments in rural areas can break the vicious cycle of debt by generating jobs in the economy's hinterland.

⁷ A large farmer is a cultivator who owns more than 10 hectares of land.

Section-II: A case study of indebtedness amongst farmers in Haryana state

The amount and burden of debt borne by farmers in Haryana have been quantified through a case study. Farmers in India have historically been heavily indebted, so this is not a recent issue (Siwach et al., 2022). The case study's conclusions are shown here in the following manner:

Extent of debt (Measurement of debt burden)

The amount of debt has been divided into three categories, namely the average debt per sampled farmer, owned acre, and operated acre. Table 3 shows the amount of debt owed by farmers in relation to various farm size categories. The average outstanding debt for each farmer in the sample, each owned acre, and each operated acre was 603 830, 85 226, and 69 048 rupees, respectively. The medium⁸ and marginal farm-size categories revealed the maximum and minimum extent of debt, or the average amount of debt per sampled farmer, respectively. The real debt burden on farmers is measured by the average amount of outstanding debt per owned acre. The real burden of debt on farmers increases with the average debt load per acre of land owned. For farm sizes classified as marginal, small, semi-medium⁹, medium, and large, the average amount of outstanding debt per owned acre is 76 110, 95 780, 154 420, 77 882, and 19 524 rupees, respectively. Farmers in the semi-medium category bear the brunt of persistent debt. Approximately thirty percent of the farmers (semi-medium and medium) surveyed obtained sixty-nine percent of the total amount of outstanding loans. On the other hand, only 27 per cent of the loan amount was obtained (struggling with) by roughly 67 per cent of the surveyed marginal and small farmers. Small and marginal farmers require funding, but they are unable to obtain the desired level of credit due to their small landholdings. They deserve more recognition for diversifying their revenue streams. However, semi-medium and medium-sized farmers have a greater potential for debt accumulation and have taken out a greater number of loans from various sources. However, they are also caught in a never-ending cycle of debt due to their inefficient use of the loan amount. Large amounts of debt are directly used in non-productive activities by semi-medium and medium-sized farmers; of the total loan amount, 49.07 and 37.27 per cent share are directly used in non-productive activities by semi-medium and medium-sized farmers (Jakhar et al., 2023).

8 A cultivator with landholdings ranging from 4.01 hectares to 10.00 hectares is classified as a medium farmer.

9 A cultivator with landholdings between 2.01 and 4.00 hectares is classified as a semi-medium farmer.

Table 3. Extent of debt amongst the farmers: category-wise*(Amount of debt in INR)*

Sr. No.	Farm-size categories	Landholdings in hectares by ownership of farmers	No. of sampled farmers	Total amount of debt	Average amount of debt		
					Per sampled farmer	Per owned acre	Per operated acre
1.	Marginal farmers	Up to 1.00	96 (48.00)	18 038 000 (14.94)	187 896	76 110	27 880
2.	Small farmers	1.01 to 2.00	38 (19.00)	14 367 000 (11.90)	378 079	95 780	53 809
4.	Semi-medium farmers	2.01 to 4.00	36 (18.00)	45 863 000 (37.97)	1 273 972	154 420	128 828
4.	Medium farmers	4.01 to 10.00	24 (12.00)	37 617 000 (31.15)	1 567 375	778 82	100 045
5	Large farmers	Above 10.00	06 (3.00)	4 881 000 (4.04)	813 500	19 524	47 388
6.	All sampled farmers	-----	200 (100.00)	120 766 000 (100.00)	603 830	85 226	69 048

Source: Primary data

Small and marginal farmers' stories are similar to those of semi-medium farmers. Their ownership of small landholdings prevents them from being able to pay off their loan on time. Large and medium-sized farmers are also in debt, but because they own substantial amounts of land, they can afford to repay the loan on schedule. For large farmers, the average amount of outstanding debt per owned acre is sufficiently low to be paid off promptly through agricultural output. In general, debt is a trap for farmers across all farm size categories. Marginal, small, and semi-medium farmers in particular are heavily indebted. Farmers' debt suggests that farming is not an economically viable sector in Haryana. The main factor contributing to farmer debt is small land holdings (Darling, 1925). Nonetheless, 2.25 hectares is the average size of land holdings in the state of Haryana (GoH, 2021). Sharma (2018) claimed that marginal and small farmers in Punjab were caught in a never-ending cycle of debt. However, large, and medium-sized farmers are also caught in a debt spiral. It happened in Haryana as a result of rising input costs, low harvest season prices, and inefficient use of the loan amount (Jakhar et al., 2022a).

Sources of debt

Debt is incurred from two different sources: institutional and non-institutional. Among institutional sources, commercial and cooperative banks are the two main ones. However, the main non-institutional sources of debt are relatives and friends,

commission agents¹⁰, or arhtiyas, and professional money lenders¹¹ (Yadav, 2017). Table 4 shows the average debt incurred from various sources for the various farm-size categories. Of the total debt, 66.71 per cent came from institutional sources, while the remaining 33.29 per cent came from non-institutional sources for all of the farmers in the sample. Moreover, commercial banks have incurred 51.38 and 15.33 per cent of the institutional debt, respectively, out of the total of 66.71 per cent. In comparison to commercial banks, the share of cooperative banks in Haryana is very low. Because, the lack of adequate funds and poor loan recovery is main constraint in the proper functioning of co-operative banks/ societies (Singh et al., 2022).

The loan disbursement share of cooperative banks and societies was raised in prior years, according to Singh et al. (2021). However, of the 33.29 shares of non-institutional debt, commission agents or arhtiyas, professional money lenders, and friends and family accounted for 20.80, 11.27, and 1.22 per cent of the total debt, respectively. In his research, Duggal (2017) found that 52.6 per cent of the debt was obtained from non-institutional sources of credit and 47.4% came from institutional sources in the Sonapat district of Haryana. This study was supported by his findings.

Table 4. Debt incurred from different loan sources: category-wise

(Mean values in INR)

Sr. No.	Sources of debt	Marginal farmers	Small farmers	Semi-medium farmers	Medium farmers	Large farmers	All sampled farmers
A.	Institutional sources						
1.	Commercial Banks	84 125 (44.77)	174 579 (46.17)	584 722 (45.9)	982 250 (62.67)	452 667 (55.64)	310 250 (51.38)
2.	Co-operative Banks/ societies	21 260 (11.31)	84 711 (22.41)	238 056 (18.68)	151 000 (9.63)	177 500 (21.82)	92 595 (15.33)
	Sub-total	105 385 (56.09)	259 290 (68.58)	822 778 (64.58)	1 133 250 (72.3)	630 167 (77.46)	402 845 (66.71)
B.	Non-institutional sources						
1.	Commission agents or arhtiyas	63 875 (34)	71 447 (18.9)	199 500 (15.66)	343 125 (21.9)	141 667 (17.42)	125 570 (20.80)
2.	Professional money lenders	14 469 (7.7)	42 710 (11.30)	242 389 (19.03)	78 042 (4.98)	00	68 055 (11.27)
3.	Relatives & friends	4 167 (2.21)	4 632 (1.22)	9 305 (0.73)	12 958 (0.82)	41 666 (5.12)	7 360 (1.22)
	Sub-total	82 511 (43.91)	118 789 (31.42)	451 194 (35.42)	434 125 (27.7)	183 333 (22.54)	200 985 (33.29)
	Total	187 896 (100)	378 079 (100)	127 3972 (100)	1 567 375 (100)	813 500 (100)	603 830 (100)

Source: Primary data (Figures in the parentheses represent percentages)

10 Commission agents, a link between farmers and buyers of crops on the market. They arrange for the auction and delivery of harvested crop to the buyers. They are also working as moneylenders.

11 A person who lends money in exchange for someone's valuables.

In the state of Haryana, commission agents, or arhtiyas, are the primary providers of non-institutional debt, while commercial banks are the primary providers of institutional debt. The results of this investigation are corroborated by Singh et al. (2008). They found that when farm size (measured by landholdings) shifted from marginal to large farmers, the amount of debt per sampled farmer increased in the Indian state of Punjab. The same findings were reported in the Indian state of Haryana by this study. The study discovered that the amount of outstanding debt (in percentage form) incurred from institutional sources has increased and decreased among non-institutional sources as farm-size categories varied from marginal to small, semi-medium to medium, and medium to large.

Small and marginal farmers thus rely more on non-institutional lending sources than do medium-sized and large farmers. Due to their small landholdings under ownership, their agricultural production is likewise quite low. In order to meet their financial needs, they must borrow money at a higher interest rate from non-institutional sources. As a result, the Indian state of Haryana has been actively financing agriculture through non-institutional lending sources. Farmers continue to be responsible for about one-third of the debt, which comes from non-institutional sources. This does not bode well. When it comes to institutional loans, medium-sized and larger farmers have easier access than marginal or small farmers. Azam et al., (2021) also reported that educated, large scale and financially sound farmers more benefited from institutional sources. For increasing the share of institutional loan, government should provide hassles free loan to farmers. No loan without surety, complicated and time-consuming process of granting loans, bank officials are not cooperative in advancing loans, bribes, and ambiguous terms and conditions are the main constraints in seeking loans from institutional sources in Haryana (Jakhar et al., 2022b).

Tenure of debt/loan

There are three different types of debt/loan tenure: short-term¹², medium-term¹³, and long-term¹⁴. In Table 5, it is shown. Short-term, medium-term, and long-term loans account for 46.14, 39.48, and 13.88 per cent of the total amount of outstanding debt, respectively. The percentage of short-term debt incurred by marginal, small, and medium-sized farmers is higher than that of medium- and long-term loans.

12 A short-term loan is one that is taken out for a maximum of fifteen months to cover an immediate need for a farmer, such as buying seeds, fertilizer, and pesticides.

13 This type of loan is taken out for a period of fifteen months to five years in order to buy a tractor, farm equipment, dig a borewell, etc.

14 A long-term loan is one that is taken out for a period longer than five years, usually to finance cropping pattern modifications and land reforms.

Table 5. Tenure of Debt amongst the Farmers: Category-wise*(Mean values in INR)*

Sr. No.	Farm-size Categories	Short-term Loan	Medium-term Loan	Long-term Loan	Total
1.	Marginal Farmers	90 865 (48.36)	61 937 (32.96)	35 094 (18.68)	187 896 (100)
2.	Small Farmers	216 605 (57.29)	138 316 (36.59)	23 158 (6.12)	378 079 (100)
4.	Semi-medium Farmers	377 444 (29.63)	734 417 (57.65)	162 111 (12.72)	1 273 972 (100)
4.	Medium Farmers	1 057 500 (67.47)	376 750 (24.03)	133 125 (8.50)	1 567 375 (100)
5.	Large Farmers	66 667 (8.20)	166 667 (20.49)	580 166 (71.31)	813 500 (100)
6.	All Sampled Farmers	281 610 (46.64)	238 415 (39.48)	83 805 (13.88)	603 830 (100)

Source: Primary data (Figures in the parentheses represent percentages)

Moreover, large farmers incur a higher percentage of debt over the long term compared to the medium and short terms. Semi-medium farmers have racked up the most debt under the category of medium-term loans. As a result, rather than taking out long-term loans or debt, most farmers have taken out short- and medium-term ones. The greatest amount of outstanding debt was discovered to be rupees 1 057 500 (67.47 per cent by medium farmers), 734 417 (57.65 per cent by semi-medium farmers), and 580166 (71.31 per cent by large farmers) under the categories of short-term, medium-term, and long-term loans. About 50 per cent of the total debt has been incurred as a short-term loan to cover farmers' immediate needs, such as buying fertilizer, seeds, insecticides, and manure. Additionally, a portion of this loan amount is utilized for non-productive endeavours that do not add anything to the overall production of agriculture. Farmers become trapped in a vicious cycle of debt as a result of these unproductive loans and debts. Once they were caught in this spiral, there was no way out. Investment in the state's hinterland can give rural households access to additional revenue streams. However, with careful planning, farmers' reliance on formation can be decreased. This is the final answer to the issue at hand.

Types of Debt/Loan

Three categories have been established for debt/loan types: inherited¹⁵, cash¹⁶, and kind¹⁷. Table 6 shows the numbers (mean values) associated with debt. According to the study, 74.49 per cent of debt was incurred as a cash loan, 16.42 per cent as a kind loan, and the remaining 9.09 per cent was incurred as inherited debt among farmers.

15 The total amount of loans that a son inherited from his father following his passing.

16 A cash loan is one in which the loanee, a farmer, receives the entire loan amount upfront.

17 It is a type of loan in which the loanee farmer receives agricultural inputs like seeds, fertilizers, pesticides, insecticides, etc., for the smooth operation of farming.

The average debt held by each farmer in the sample is Rs. 54 845, 449 800, and 99 145 in the form of kind, cash, and hereditary loans, respectively. The investigation revealed that small farmers (rupees 102 631) and marginal farmers (rupees 25740) received the highest and lowest average amounts of hereditary loans. The average loan amount for small farmers (rupees 40 474) and semi-medium farmers (rupees 268 833) has been determined, as well as the minimum and maximum amounts. For medium farmers (rupees 1 320 500) and marginal farmers (rupees 121 427), the maximum and minimum cash loan amounts have been determined. Therefore, of the debt among the farm-size categories, about 75 per cent has been paid for with cash, and only 9.09 per cent is inherited or ancestor debt. Farmers in Haryana are not particularly fond of this type of loan. A lot of farmers obtained loans in cash.

Table 6. Types of Loans amongst the Farmers: Category-wise

(Mean values in INR)

Sr. No.	Farm-size categories	Hereditary loan	Loan contracted in cash	Loan contracted in kind	Total
1.	Marginal farmers	25 740 (13.70)	121 427 (64.62)	40 729 (21.68)	187 896 (100)
2.	Small farmers	102 631 (27.15)	234 974 (62.15)	40 474 (10.70)	378 079 (100)
4.	Semi-medium farmers	60 333 (4.74)	944 806 (74.16)	268 833 (21.10)	1 273 972 (100)
4.	Medium farmers	83 917 (5.35)	1 320 500 (84.25)	162 958 (10.40)	1 567 375 (100)
5.	Large farmers	70 000 (8.60)	611 500 (75.17)	132 000 (16.23)	813 500 (100)
6.	All sampled farmers	54 885 (9.09)	449 800 (74.49)	99 145 (16.42)	603 830 (100)

Source: Primary data (Figures in the parentheses represent percentages)

Purposes of Loan

Loan purposes fall into two categories: productive purposes and non-productive purposes. Table 7 shows the average debt/loan amount for each category (for various purposes). 36.45 per cent of the total debt was incurred for non-productive reasons, while 63.55 per cent of the debt was incurred for productive purposes. The large farm-size category (98.03%) and marginal farm-size category (55.36%) have been found to have the highest and lowest percentages of debt (in terms of dollars) incurred for productive purposes.

Table 7. Debt Incurred for Different Purposes: Category-wise*(Mean values in INR)*

Sr. No.	Farm-size categories	Productive purpose	Non-productive purpose	Total
1.	Marginal farmers	104 021 (55.36)	83 875 (44.64)	187 896 (100)
2.	Small farmers	275 526 (72.87)	102 553 (27.13)	378 079 (100)
3.	Semi-medium farmers	733 333 (57.56)	540 639 (42.44)	1 273 972 (100)
4.	Medium farmers	1 046 250 (66.75)	521 125 (33.25)	1 567 375 (100)
5.	Large farmers	797 500 (98.03)	16 000 (1.97)	813 500 (100)
6.	All sampled farmers	383 755 (63.55)	220 075 (36.45)	603 830 (100)

Source: Primary data (Figures in the parentheses represent percentages)

Conversely, the categories of marginal farm size (44.64%) and large farm size (1.97%) have been found to have the highest and lowest amounts of debt incurred for non-productive purposes, respectively.

Thus, to install new tube wells, buy heavy machinery, and implement fruitful land reforms, the majority of large farmers took out loans. Conversely, marginal, small, semi-medium, and medium-sized farmers borrowed money for both beneficial and detrimental reasons. Their surplus, if any, is likewise minimal because they (primarily marginal and small farmers) have small landholdings and low agricultural production. While it is not morally wrong to accumulate debt for non-productive uses, farmers are burdened with debt because of these non-productive expenses. According to Singh's (2006) research, Punjabi farmers in India spend an excessive amount of their loans and debts on what are non-productive (consumption) purposes. Thus, the main reason behind agrarian distress in India, especially in Haryana, is debt or loans used for non-productive purposes.

Rate of Interests

Three categories have been established for the interest rate: 0 to 15, 16 to 24, and 25 to 36. Table 8 shows debt according to annual interest rate. According to the study, the total amount of debt incurred by all of the sampled farmers was 67.63, 22.42, and 9.95 per cent, or 0–15 percent, 16–24 percent, and 25–36 percent annually, respectively. No debt has been taken on that carries an interest rate higher than 36% annually. Due to their small landholdings, which they must mortgage against the loan, marginal farmers must incur debt or loans at higher interest rates to meet their basic needs.

Table 8. Debt According to Rate of Interests: Category-wise*(Mean values in INR)*

Sr. No.	Interest rate (percent, per annum)	Marginal farmers	Small farmers	Semi-medium farmers	Medium farmers	Large farmers	All sampled farmers
1.	0-15	107 990 (57.47)	263 000 (69.56)	827 222 (64.93)	1 146 208 (73.13)	671 833 (82.59)	408 405 (67.63)
2.	16-24	58 667 (31.22)	79 342 (20.99)	252 361 (19.81)	353 750 (22.57)	141 667 (17.41)	135 360 (22.42)
3.	25-36	21 239 (11.31)	35 737 (9.45)	194 389 (15.26)	67 417 (4.30)	00	60 065 (9.95)
	Total	187 896 (100)	378 079 (100)	1 273 972 (100)	1 567 375 (100)	813 500 (100)	603 830 (100)

Source: Primary data (Figures in the parentheses represent percentages)

Conversely, because the average amount of debt held by semi-medium farmers is high, these farmers have incurred loans and debt at higher interest rates. As a result, they must obtain a loan at a higher annual interest rate from non-institutional sources. Furthermore, the extent (amount) of debt incurred up to 15% of the annual rate of interest has increased (in percentage terms) from 57.47 to 69.56, 64.93, 73.13, and 82.59, respectively, as farm sizes have varied from marginal to small, semi-medium, medium, and large farmers. Conversely, as farm sizes shifted from marginal to large, the amount of debt taken on at interest rates ranging from 16 to 24 percent annually decreased. As a result, it showed that the amount of debt taken on at a low-interest rate increased with farm size and vice versa. Interest-free loan options may lessen the need for debt relief programs (Jain & Raju, 2011). Such a policy could break the cycle of indebtedness and lessen the burden of debt on farmers.

Conclusions and Suggestions

Farmer indebtedness is not a new concept, it has had a long history. Indian farmers were born in debt, lived in debt, and died in debt (Darling, 1925). The current study demonstrated that the amount of debt is rising annually. Throughout time, the amount of debt has been steadily rising. For policymakers, skewed debt access is another significant obstacle. Government policies should assist marginalized and small farmers in their efforts to improve their lot in life. Significant investment in the state's hinterland could lessen farmers' reliance on agriculture. Their income should be boosted through new job opportunities in rural areas. The study also discovered that the main factors contributing to agrarian distress, especially for marginal and small farmers, are the size of debt incurred from non-institutional sources and the higher interest rate on that debt. The amount spent on non-productive expenses directly increases the amount of debt held by each sampled farmer; the lower the socioeconomic standing of farmers, the higher the amount of debt per owned acre. Farmers are therefore ensnared in debt. To minimize the amount of money lent out for unproductive purposes, the government and social institutions ought to organize awareness campaigns.

Farmers in Haryana and throughout India no longer find farming to be an economically viable occupation because of the ongoing strain that population growth is having on the agricultural sector. India's farm households have very low marginal physical productivity. One of the most effective ways to solve the debt issue is to shift the population's reliance from agriculture to other economic sectors. The main factor leading to debt is low agricultural income. Therefore, in order to lower farmer debt in the state of Haryana, the government should encourage and support non-agricultural activities.

Conflict of interests

The authors declare no conflict of interest.

References

1. Azam, Md. S., Tiwari, S. C., & Pathak, H. R., (2021). Do financial constraints matter in accessing agricultural loan? Organic Vs. conventional farmers. *The IPU Journal of Accounting Research and Audit Practice*, 20(4), 205-223.
2. Dandekar, A., & Bhattacharya, S. (2017). Lives in debt narratives of agrarian distress and farmer suicides. *Economic and Political Weekly*, LII (20), 77-84.
3. Darling, Melcolm. (1925). *The Punjab Peasants in Prosperity and Debt*. London: Oxford University Press.
4. Duggal, H. (2017). Composition of indebtedness among marginal farmers in Sonapat district of Haryana: a household level analysis. *Global Journal for Research Analysis*, 6(5), 492-496.
5. Gill, A. (2014). *Agriculture credit in Punjab: have policy initiatives made a dent in informal credit market?* (Discussion paper No. 07).
6. GoH (Government of Haryana). (2013). Working Group Report on Productivity Enhancement of Crops in Haryana. Haryana Kisan Ayog, 1-3.
7. GoH (Government of Haryana). (2020): Statistical Abstract of Haryana-2018-19. Department of Economic and Statistical Analysis, Haryana, 11-67 and 375-425.
8. GoH (Government of Haryana). (2021). Economic Survey of Haryana- 2020-21. Department of Economic and Statistical Analysis, Haryana, 1-13 and 32-67.
9. Grover, D. K., Kumar, S., Singh, J., & Singh, J. M. (2016). *Farmer suicide in Punjab: causes and suggestions*. (ARCE study No. 40.) Agro-economic Research Centre, Department of Economics, Punjab Agricultural University, Ludhiana.
10. Gupta, R. V. (1997). R. V. Gupta Committee Report for Agricultural Loan. Reserve Bank of India.
11. Jain, R., & Raju, S. S., (2011). Credit overdue and farmers' perception on agricultural debt waiver and debt relief scheme. *Journal of Agricultural Development & Policy*, 21(2), 73-86.
12. Jakhar, B., kait, R., Kumar, V. (2023). Loan utilisation and repayment behaviour: evidence from farmers of Haryana. *Economic and Regional Studies*, 16(2), 286-316. <https://doi.org/10.2478/ers-2023-0019>

13. Jakhar, B., Kait, R., & Kumar, V., (2022b). Borrowing and repayment hardships: evidences from farmers in Haryana. *Economic and Regional Studies*, 15(4), 562-580. <https://doi.org/10.2478/ers-2022-0038>
14. Jakhar, B., Kait, R., Kumar, V. (2022a). Farmers' perception of causes and consequences of their indebtedness in Haryana, India. *Economic and Regional Studies*, 15(1), 56-73. <https://doi.org/10.2478/ers-2022-0005>
15. Jakhar, B., Siwach, M., & Kait, R. (2022c). Indebtedness: field notes on farmers from Haryana, India. *Problems of Agricultural Economics*, 373(4), 121–139. <https://doi.org/10.30858/zer/156651>
16. Kaur, L., Sharma, P., & Garg, L. (2016). Causes and cure of farmer's suicide. *Indian Journal of Economics and Development*, 12(1a), 305-310.
17. NSSO. (2013). Income, Expenditure, Productive Assets, and Indebtedness of Agricultural Households in India. National Sample Survey Organisation, 13-86.
18. Padmaja, S. S., & Ali, J. (2018). Indebtedness of agricultural household in rural India: magnitude and determinants. *Research Gate*, <https://www.researchgate.net/publication/327012027>.
19. Patil, Balasaheb Vikhe. (2008). Agricultural Indebtedness: Crisis and Revival. *Economic & Political Weekly*, 43(5), 47-52.
20. RBI (Reserve Bank of India). (2019). *Credit Reach*. Report of the Internal Working Group to Review Agricultural Credit, Reserve Bank of India, 1-15.
21. Sahu, R. K. (2018). Dynamics of rural indebtedness in India. *International Journal of Advanced Engineering and Research Development*, 5(4), 2485-2493.
22. Sharma, R. (2018). Indebtedness among small and marginal farmers in Patiala district of Punjab: an analysis. *International Journal of Research in Social Sciences*, 8(5), 732-739.
23. Singh, M., Sidhu, M. S., & Bhullar, A. S. (2012). An economic analysis of indebtedness of marginal and small farmers in Punjab. *International Research Journal of Agricultural Economics and Statistics*, 3(2), 235-239.
24. Singh, S. (2006). Credit, indebtedness and farmer suicides in Punjab. *Economic & Political Weekly*, 41(30), 3330-3331.
25. Singh, S., & Bhogal, S. (2014). Depeasantization in Punjab: status of farmers who left farming. *Current Science*, 106(10), 1364-1368.
26. Singh, S., Bhogal, S., & Singh, R. (2014). Magnitude and determinants of indebtedness among farmers in Punjab. *Indian Journal of Agricultural Economics*, 69(2), 242-256.
27. Singh, S., Singh, A. & Malik, K. (2021). Performance of primary agricultural cooperative societies in Haryana. *Agricultural Situation in India*, LXXVIII (06), 24-31.
28. Singh, S., Singh, A., & Lal, Ch., (2022). Constraints in the functioning of Primary Agricultural Cooperative Societies in Haryana state, India. *Economic and Regional Studies*, 15(4) 509-518. <https://doi.org/10.2478/ers-2022-0034>
29. Singh, S., Toor, J. S., & Tiwana. B. S. (2016). *Rural indebtedness in Punjab: an empirical analysis*. [Doctoral thesis, Department of Economics, Punjabi University Patiala]. Sodhganga a reservoir of Indian theses.

30. Singh, Sukhpal. (2006). Credit, Indebtedness and Farmer Suicides in Punjab. *Economic & Political Weekly*, 41(30), 3330-3331.
31. Singh, Sukhpal., Kaur, Manjeet and Kingra, H. S. (2008). Indebtedness among Farmers in Punjab. *Economic & Political Weekly*, 43(26-27), 130-136.
32. Siwach, M., Bharat., & Jakhar, B. (2022). [Review of the Book *Chains of Servitude: Bondage and Slavery in India*, by Patnaik, U. & Dingwaney, M.]. *CASTE / A Global Journal on Social Exclusion*, 3(2), 458-462. <https://doi.org/10.26812/caste.v3i2.435>.
33. Sonawane, S. T. (2016). Critical study of farmers suicide in Maharashtra- causes and remedies. *International Journal of Innovative Research in Science, Engineering and Technology*, 5(11), 20150-20155.
34. Yadav, S. S. (2017). Sources of agricultural credit in India: a conceptual study of Indian agricultural credit. *Shodh Drishti*, 8(3), 161-166.

MITIGATING SPATIAL DISPROPORTIONS IN AGRICULTURE THROUGH REVEALING COMPETITIVE ADVANTAGES

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ABSTRACT

Spatial development of agriculture has always been among the core agendas of food security. Amid the increased volatility of food markets globally, low diversification of agricultural production depresses competitiveness and flexibility of farmers. To narrow spatial development gaps, the study presents the five-stage approach to revealing territory-specific competitive advantages in producing nine categories of agricultural products. The data is collected across all administrative territories of Russia categorized according to the cadastral value of farmland. The revealed mismatches between the parameters of food self-sufficiency, productivity of crops, and profitability of farmers show that agricultural policy should aim at stimulating production of competitive products with due account to the spatial features of agriculture to ensure the highest return per unit of inputs along with adequate accessibility of staples for consumers. Determining proportions in which agricultural facilities should be allocated across territories would allow governments to tailor the resource provision programs, including subsidies to territories, agricultural sectors, and individual producers.

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Introduction

Food security reflects certain conditions of a food market under which all consumers at any time have full physical, social, and economic access to sufficient, safe, and nutritious food (Food and Agriculture Organization of the United Nations, 2009). Since recently, many of the conventional threats to food security in Russia, such as environmental and economic aspects of agricultural production, have been aggravating under the pressure of economic sanctions on the country (Samygin, Kudryavtsev, 2018). Against the background of new challenges to food security, there are arising problems of dependence on imports across a variety of food sectors, low self-sufficiency of the country on certain agricultural products, increasing costs in agriculture, and deteriorating accessibility of staples due to degrading real incomes spurred by food inflation (Kuznetsov, 2022; Loginova, 2022).

Zakshevskii et al. (2019), Erokhin et al. (2022), and Kumar (2022) recognize the potential of developing existing competitive advantages, as well as revealing the new ones as most promising ways of adaptation to the contemporary challenges to the agricultural sector. Carbone and Rivers (2017) and Donaldson (2019) demonstrate the importance of promoting competitiveness of local farmers for achieving the food security and food self-sufficiency goals. Promoting competitive advantages allows agricultural producers to raise the quality of their products, reduce prices, increase efficiency, and thus improve the parameters of physical availability and economic accessibility of food (Mahajan, Tomar, 2021). According to Addai et al. (2023), an important issue in the transformation of approaches to strategic planning in agriculture is the convergence of the spatial development tasks with those of agricultural production and sustainable rural development. This approach makes it possible to identify the features of spatial development of various types of territories, identify their strengths and weaknesses, and determine the individual set of spatial development tools (Harbiankova, Gertsberg, 2022). As demonstrated by Li et al. (2022) and Shi et al. (2023), sustainable development of rural areas is facilitated by spatial development mechanisms, including attraction of resources from periphery territories to centers of agricultural and economic development (the agglomeration effect) and the spread of innovations from the center to the periphery areas. The resource allocation processes ultimately aggravate uneven development and concentration of economic activity in more developed territories (Mishchenko, 2012). Liu et al. (2022) and Widomski and Musz-Pomorska (2023) advocate a need for using an integrated approach in the “competitiveness - spatial development - sustainable rural development” paradigm to ensure a more efficient and rational use of scarce natural, labor, and financial resources in agriculture.

In addition to the external pressures on the competitiveness of Russian farmers, one of the most significant internal constraints is the spatial disproportions of agricultural production. In Soviet times, command allocation of production forces considered natural conditions of individual territories, but it still contributed to emerging over-specialization of particular areas on farming particular crops (Erokhin et al., 2020b). Low

spatial diversification of agricultural production depressed both the competitiveness positions and flexibility of farmers in addressing challenges to food security, such as degradation of agricultural lands, climate change effects on productivity of crops and agricultural animals, and social stratification issues in rural areas (Wegren, Elvestad, 2018). Spatial disproportions aggravate inter- and intra-regional differentiation, thereby threatening competitiveness in agriculture (Zakshevskii et al., 2019). Significant natural and economic differences between territories in Russia stipulate the need for regional specialization in the cultivation of the most suitable crops (Samygin et al., 2019; Erokhin et al., 2020a).

Taking into account the load of challenges to competitiveness of agricultural producers in Russia, as well as the fact that not all national food security tasks have been solved, the revision of approaches to strategic planning in agriculture is required. The research hypothesis is that in order to secure domestic supply of food at the adequate consumption threshold, the government needs to mitigate spatial disproportions of agricultural production and employ all of the available agricultural capacities across the country. The research question is whether the purely market concept of competitive advantage could be converged with the government's intervention into adjusting spatial development processes in agriculture. It is assumed that the latter allows for focusing agricultural producers on achieving strategic development goals from the perspective of rational use of natural, economic, and social potential of a territory. Therefore, it is important to focus research on investigating spatial development patterns beneficial for both producers and consumers. Addressing the relevance of bridging spatial development gaps in allocation of production forces in agriculture, this study aims at elaborating and testing of the approach to revealing competitive advantages across agricultural sectors in diverse territories of Russia.

The rest of the paper is organized as follows. The Materials and Methods section explains the research framework used to assess competitive advantages of territories, as well as overviews the set of variables along the stages of the study. The Results section reports major findings. In the Discussion, the authors discuss the findings and point out the potential contributions of the study to the literature. Conclusion summarizes authors' findings and outlines their implications.

Materials and methods

Common criteria used in the assessment of competitive advantages of territories include gross output and yield per unit of land area, cost intensity and labor intensity of production, cost per unit of inputs, average producer price and export price, share of exports in the volume of production and that of imports in the domestic supply, transportation and logistics costs, and the volume of government support of domestic farmers. None of the methods of assessing competitive advantages is free from limitations (Table 1). As argued by Sachitra (2016), the comprehensive assessment of competitive advantage should take proper account of not only producer-specific, but also territory-specific features of agricultural production, as well as it should expand

the scope of analysis from merely physical parameters of availability of food supplies to wider dimensions of food security. Among the approaches to assessing advantages, the OECD methodology of comparative analysis of state support for agricultural production most comprehensively reflects spatial features of competitive advantages (Fukasaku, 1992). In Russia, the methodology was adjusted by the Gaidar Institute for Economic Policy to measure the productivity of crops and agricultural animals, cost of production, and protection and support of producers (Serova et al., 2003).

Table 1. Major approaches to assessing competitive advantages of territories in spatial development of agricultural production

Approach	Sources	Essence	Limitations
Comparative analysis of government support for agricultural production	Fukasaku (1992), Serova et al. (2003), Aliyeva et al. (2019)	The approach aims at determining the degree of dependence of markets on import tariffs and state support, identifying comparative advantages of a territory, and quantifying the level of government support	The method is applicable to the assessment of agrarian policies. The parameters fail to capture competitive advantages of territories in ensuring accessibility of staples
Strategic spatial distribution of crop production	Feng et al. (2014), Siptitz et al. (2016), Pei et al. (2021)	The distribution scheme is based on the biological and climatic potential of territories. The formulation of the optimization problem is reduced to maximizing the net economic result of the agricultural sector.	The optimal sectoral structure of agriculture ensures the promotion of higher profitable activities while restraining the development of lower-performing sectors
Composite assessment of competitive advantages	Bogoviz et al. (2016), Maslova et al. (2019), Warlina et al. (2023)	Territories for favorable crop production are identified based on the use of a cumulative score and an composite index based on productivity, cost, and labor intensity indexes. Assessment is based on an integrated indicator	A limited set of crops/products and parameters used to assess competitive advantages. The method allows for assessing the competitiveness of products, but not to identify competitive advantages
Business and financial performance of agricultural producers	Romantseva (2010), Kuzmenkova (2013), Hayat et al. (2020)	Parameters characterize the level and size of agricultural production, the development of agriculture in a territory, and the use of production potential	The indicators show the efficiency, but not advantages of territories, which does not allow assessing advantages by product type
The conventional - green nexus of spatial development	Hussain et al. (2019), Akram et al. (2020), Wang et al. (2022)	The patterns of spatial distribution of agricultural production are determined by the transformation of conventional sectors and the development of organic agriculture and the green economy	The approach overemphasizes the role of environmental parameters of agricultural production in determining competitiveness of agricultural produces

Approach	Sources	Essence	Limitations
Behavioral aspects of allocation of production forces	Small et al. (2016), Gao et al. (2018), Raza et al. (2023)	Spatial distribution of productive forces are influenced by the behavioral paradigms in rural communities such as coping strategies, financial literacy of farmers, and sustainable development awareness	The competitive advantages nexus shifts from spatial development issues to community-specific issues of economic and social parameters of rural communities

Source: Authors' development

For the purpose of this study, the OECD-Gaidar set of parameters was supplemented by twelve authors' variables to better capture the aspects of physical availability and economic accessibility of agricultural products. The calculation algorithm was built along five stages (Table 2).

Table 2. Variables per stages

Stages	Variables	Indexes	Specification
Stage 1	Share in total	S	Contribution of the output of product i to the total agricultural output of a territory
	Productivity	$Prod$	Output of product i per unit of land or unit of input
	Cost	C	Cost of production per unit of product i
	Profitability*	$Prof$	Cost-price ratio for a unit of product i
	Self-sufficiency	S_s	Output-consumption ratio of product i per capita
	Availability*	A_v	Ratio of the output of product i per capita to the standards of rational and adequate consumption of this product
	Accessibility*	A_c	Ratio of the consumption of product i per capita to the standards of rational and adequate consumption of this product
Stage 2	Localization index	I_L	Ratio of the share of output of product i in the total agricultural output of a territory to the share of output of product i in the total agricultural output of a country
	Productivity index	I_{prod}	Ratio of the yield (productivity) of product i in a territory to the yield (productivity) of product i in a country
	Cost index	I_c	Ratio of the cost of product i in a country to that in a territory
	Consumer protection index	I_{CP}	Ratio of the price of product i in a country to the price of product i in a territory
	Self-sufficiency index*	I_{SS}	Ratio of the level of self-sufficiency of a territory in product i to the level of self-sufficiency of a country in product i
	Availability index*	I_{AV}	Ratio of physical availability of product i in a territory to the level of physical availability of product i in a country
	Accessibility index*	I_{AC}	Ratio of economic accessibility of product i in a territory to the level of economic accessibility of product i in a country
	Product quality index*	I_{PQ}	Ratio of the quality parameter of product i in a territory to the quality parameter of product i in a country
	Profitability index*	I_{prof}	Ratio of the profitability of product i in a territory to the profitability of product i in a country
Stage 3	Composite index of competitive advantage*	I_{CA}	Geometric mean index per agricultural products

Stages	Variables	Indexes	Specification
Stage 4	Conditional output, territory*	O_T	Product of the gross output of product i in a territory and the composite index of competitive advantage of a territory
	Conditional output, country*	O_C	Sum of conditional outputs of territories under study
Stage 5	Weighted contribution coefficient*	C_{CW}	Ratio of the conditional output of product i in a territory to the conditional output of product i in a country

Note: * = introduced by authors. Source: Authors' development

Stage 1 captures availability and accessibility of staples at the regional and national levels. At Stage 2, indexes of comparative advantages are calculated on the basis of the obtained per-territory values. Localization index is the critical parameter to reveal areas of specialization, where $I_L > 1$ shows competitive advantage of a territory in production of product i . Therefore, in this study, specialization is interpreted as a consequence of components of competitive advantages (yield, cost, profitability, etc.) of a territory. Agrarian policy is considered rational if both the localization index and the related component-specific indexes of competitive advantages exceed one. Based on the Stage 2 indexes, the study proceeds with calculating the composite index of competitive advantage (Stage 3) and parameters of conditional output at the territorial and national levels (Stage 4) and concludes with finding the weighted contribution coefficient at Stage 5. The study is based on the data for 2017-2019 collected across territories of Russia grouped according to the cadastral value of farmland (from the lowest in Type I territories to the highest in Type V territories).

Results

Spatial patterns of agricultural production in Russia do not entirely reflect competitive advantages of respective territories. In contradiction to the specialization principle, for certain products, prices and costs are higher in territories majoring in producing them ($I_L > 1$) than those in territories where $I_L \leq 1$. Thus, for grain, sunflower, sugar beet, potatoes, vegetables, and meat, lower I_L values are associated with higher production costs I_C (Table 3). Similar patterns are observed for the localization-productivity ratio for dairy and meat and the localization-profitability ratio for potatoes, vegetables, sunflower, milk, and eggs. The paradox is that in territories specializing in the production of the above products, profitability of those products is lower than that in non-specializing territories.

Table 3. Parameters of competitive advantages of territories

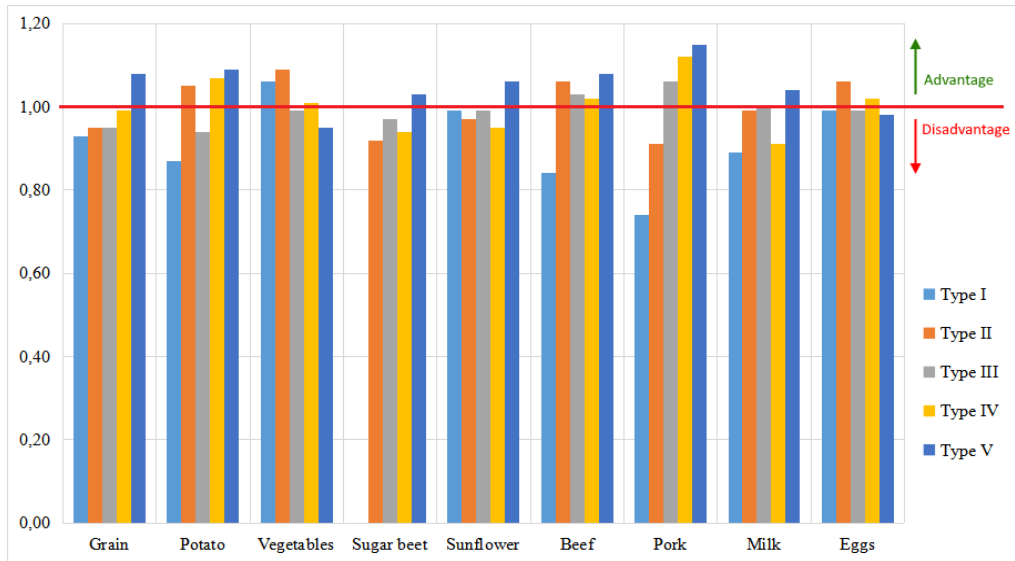
Products	Territories on I_L	Indexes								
		I_L	S	I_{prod}	I_C	I_{CP}	I_{SS}	I_{AV}	I_{AC}	I_{prof}
Grain	≤ 1	0.51	28.00	0.92	1.05	1.09	0.50	0.51	1.01	0.97
	> 1	1.59	72.00	1.03	0.98	0.97	2.37	2.46	1.04	1.01

Products	Territories on I_L	Indexes								
		I_L	S	I_{prod}	I_C	I_{CP}	I_{SS}	I_{AV}	I_{AC}	I_{prof}
Potatoes	≤ 1	0.52	33.00	0.92	1.22	1.16	0.88	0.90	1.02	1.05
	> 1	1.57	67.00	1.04	0.92	0.94	1.25	1.34	1.07	0.98
Vegetables	≤ 1	0.60	43.00	0.92	1.26	1.20	0.75	0.73	0.97	1.05
	> 1	1.60	57.00	1.00	0.87	0.89	1.58	1.83	1.16	0.97
Sugar beet	≤ 1	0.58	13.00	0.79	1.02	1.11	0.47	0.49	1.01	0.92
	> 1	2.65	87.00	1.04	1.00	0.99	2.31	2.34	1.03	1.00
Sunflower	≤ 1	0.37	9.00	0.80	1.15	1.01	0.41	0.42	1.00	1.13
	> 1	2.17	91.00	1.06	0.99	0.99	2.52	2.55	1.02	1.00
Beef	≤ 1	0.63	52.00	1.04	0.82	1.01	1.21	1.24	1.02	0.81
	> 1	1.73	48.00	0.94	1.32	0.92	0.97	0.90	0.93	1.44
Milk	≤ 1	0.61	31.00	1.16	1.01	0.98	1.09	0.98	0.90	1.03
	> 1	1.42	69.00	0.94	1.00	1.01	1.15	1.23	1.07	0.99
Eggs	≤ 1	0.57	34.00	0.94	1.18	0.99	0.73	0.72	0.99	1.19
	> 1	1.83	66.00	1.02	0.83	1.05	1.57	1.63	1.04	0.79

Source: Authors' development

Based on the Stage 2 data, there were calculated quotas for production of selected agricultural products at Stages 3-5 across five types of territories (Figure 1). Type V territories are the most suitable locations for the majority of staples (six products out the nine included in the study). Respectively, Type I territories demonstrated competitive advantage ($I_{ca} > 1$) in vegetable growing only.

Figure 1. Composite indexes of competitive advantages of types of territories



Source: Authors' development

When allocating quotas, the authors considered earlier findings of Sachitra (2016) and Erokhin et al. (2020b), who recommended taking into account returns per unit of agricultural resources, the availability of food for consumers, and the efficiency of agricultural production for farmers. The above approach highlights the relevance of parameters of yield and productivity ($Prod$ and I_{prod}), cost (C and I_C), profitability ($Prof$ and I_{profit}), and consumer protection (I_{CP} and I_{PQ}). Focusing on the geometric mean of I_{prod} , I_C , I_{profit} , and I_{CP} , the study resulted in revealing competitive advantages in producing selected staples across five types of territories (Figure 1). In these territories, the corresponding products occupy a significant share of production, as well as they are most affordable for consumers and most profitable for producers.

Discussions

Since the early 2000s, Russia's agrarian policy has been prioritizing self-sufficiency in basic foodstuffs (Wegren, Elvestad, 2018). This study's findings show that the parameters of self-sufficiency, availability, and accessibility of selected items (except meat) are higher in those territories, which specialize in producing those products. Nevertheless, while meeting national food self-sufficiency targets in quantitative terms, domestic producers fail to secure the domestic supply in accordance with international standards of adequate access to healthy nutrition for all. As demonstrated by the revealed relationships between the localization of production (sugar beet, potatoes, vegetables, meat), on the one hand, and cost and productivity indexes, on the other, prioritizing self-sufficiency in all categories of staples in all types of territories may turn into a detriment to local consumers. In case of the localization-productivity and the localization-profitability mismatches (meat and dairy and potatoes, vegetables, sunflower, milk, and eggs, respectively), agrarian policy is carried out to the detriment of farmers. In other territories, similar categories of agricultural products are either more affordable for consumer or more cost-effective for producers. Therefore, the spatial allocation of production forces should be optimized from the standpoint of both availability and accessibility of staples.

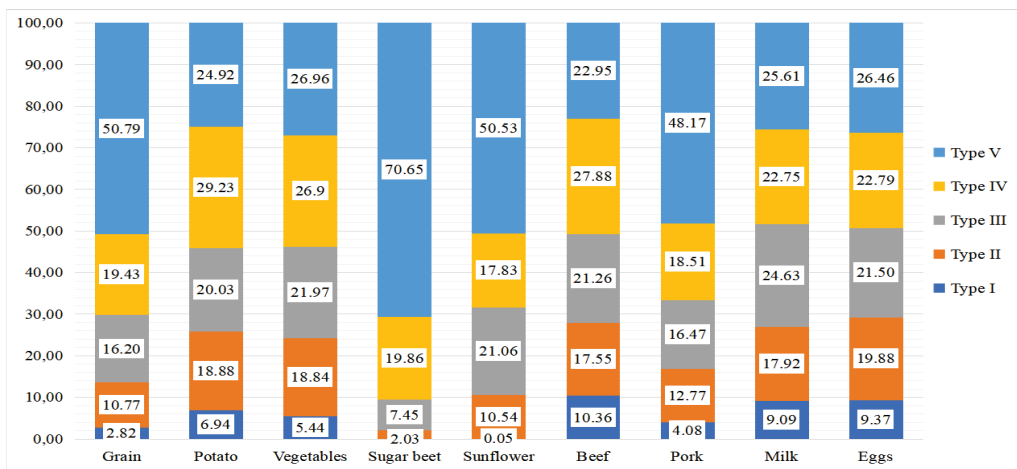
Fertő and Hubbard (2003) showed that the pursuance of self-sufficiency in all foods could result in the misallocation of scarce resources across territories. Asadullah and Savoia (2018) and Al-Abdelmalek et al. (2023) have been advocating higher thresholds of overall self-sufficiency due to the increased volatility of food markets and prices and disruption of food supply chains. However, as evidenced by Carbone and Rivers (2017) and Erokhin et al. (2020b), for lower-diversified agricultural sectors, self-sufficiency policy could hardly promote competitiveness across all sectors as it diverts resources to products with lower values of I_{prod} and it thus triggers underutilization of competitive advantages. The mismatches between the parameters of localization, productivity, and profitability show that agricultural policy should aim at stimulating production of competitive products ($I_{CA} > 1$) with due account to the spatial features of production in

order to ensure the highest return per unit of resources along with adequate accessibility and profitability of a product.

Advantages of only Type V territories could not be enough to ensure self-sufficiency in staples at the national level. Mishchenko (2012) and Li et al. (2021) show that the availability of high-productive arable land and pastures is one of the key determinants of competitive advantages of a territory, but they are not enough to ensure sustainable development of rural areas. Economic factors, such as the proximity of rural areas to product sales markets or centers of alternative non-agricultural employment of rural dwellers, are particularly significant in the development of rural areas in Russia. The stability of territorial systems depends on the concentration of economic activity in those places that have comparative advantages. The first-tier advantages include natural resources, climate, and geographical location (Krugman, 1991). They little depend on the efforts of local government or businesses. At the territorial level, governments may only affect second-tier factors, such as institutional environment, human capital, or agglomeration effect. According to Zubarevitch (2010), in Russia, conventional factors of competitive advantages, such as labor and capital, determine spatial development of rural areas by only 30%, while the remaining 70% of variables can be neither predicted nor assessed. Therefore, allocating production facilities in certain proportions across all types of territories is critical to mitigating spatial disproportions between first-tier and second-tier factors and encouraging the use of advantages (Figure 2).

Optimization of the structure of agricultural production could not only improve availability of staples on the market. It could also release misallocated resources and engage them in boosting the output of competitive products. Once the allocation of production facilities is adjusted, one can expect both accessibility of foods for consumers and the return on inputs for producers to go up.

Figure 2. Distribution of quotas for the production of staples across types of territories, %



Source: Author's development

By using advantages of a territory in crop yields (productivity of animals), it is possible to increase the total output (consequently, food availability). By using advantages in prices, it is possible to increase the total volume of food consumption in a territory (food availability). Also, by using advantages in cost and profitability of agricultural products, it is possible to improve the performance of farmers. As a result, the approach tested in this study could provide a tool for supporting strategic decisions on mitigating spatial disproportions in agriculture. It could be used to identify the optimal size of quotas for production of certain products in certain territories. Matching self-sufficiency targets with the localization parameters of advantages would allow governments to tailor the resource provision programs.

Conclusions

Contemporary challenges to establishing food security degrade the effectiveness of many conventional approaches to strategic planning in agriculture. A more flexible approach is needed to implement existing advantages and generate new ones at the regional level. Amid the new rise in food trade protectionism and increasing volatility of food supply chains, the implementation of competitive advantages should be focused on the improvement of availability and accessibility of food on domestic markets. The study demonstrated that an approach to revealing competitive advantages of territories should escape from overemphasizing efficiency and over-concentrating on measuring returns on inputs. The assessment framework should capture the parameters of availability and accessibility of food products. Localization and self-sufficiency targets should be flexible to reflect individual sets of advantages of individual territories. They should be measured against the parameters of productivity and profitability to narrow the gaps between self-sufficiency thresholds at the national level and varying agricultural production capacities of territories. The integration of composite indexes to the assessment framework allows for determining proportions in which production facilities should be allocated across types of territories. At the national level, these distribution patterns could be linked to both food self-sufficiency targets and rational consumption standards by categories of food products. Quotas at the national and regional levels act as a quantitative expression of the strategic goals of spatial development. The approach becomes an effective means of supporting strategic decision-making on spatial planning in agriculture.

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Conflict of interests

The authors declare no conflict of interest.

References

1. Addai, G., Abunyewah, M., Erdiaw-Kwasie, M.O., Okyere, S.A., Gyensare, M.A., & Guodaar, L. (2023). Application of the Rural Web Framework within the Context of Sustainable Development: A Systematic Literature Review. *Sustainability*, 15, 4239. <https://doi.org/10.3390/su15054239>.
2. Akram, M.W., Akram, N., Wang, H., Andleeb, S., Ur Rehman, K., Kashif, U., & Hassan, S.F. (2020). Socioeconomics Determinants to Adopt Agricultural Machinery for Sustainable Organic Farming in Pakistan: A Multinomial Probit Model. *Sustainability*, 12, 9806. <https://doi.org/10.3390/su12239806>.
3. Al-Abdelmalek, N., Kucukvar, M., Onat, N.C., Fares, E., Ayad H., Bulak, M.E., Ekren, B.Y., Kazancoglu, Y., & Ertogral, K. (2023). Transforming Challenges into Opportunities for Qatar's Food Industry: Self-Sufficiency, Sustainability, and Global Food Trade Diversification. *Sustainability*, 15, 5755. <https://doi.org/10.3390/su15075755>.
4. Aliyeva, L., Huseynova, S., Babayeva, S., Huseynova, V., Nasirova, O., & Hasanzade, F. (2019). Food Security and Optimal Government Intervention Level in Agriculture (Comparative Analysis). *Bulgarian Journal of Agricultural Science*, 25, 12-20.
5. Asadullah, M.N., & Savoia, A. (2018). Poverty Reduction during 1990–2013: Did Millennium Development Goals Adoption and State Capacity Matter? *World Development*, 105, 70-82. <https://doi.org/10.1016/j.worlddev.2017.12.010>.
6. Bogoviz, A., Vorobev, S., & Vorobeva, V. (2016). Economic Efficiency of Specialization of the Agricultural Organizations of Grain Type. *Economics of Agriculture of Russia*, 9, 43-49.
7. Carbone, J., & Rivers, N. (2017). The Impacts of Unilateral Climate Policy on Competitiveness: Evidence from Computable General Equilibrium Models. *Review of Environmental Economics and Policy*, 11, 24-42. <https://doi.org/10.1093/reep/rew025>.
8. Donaldson, D. (2019). Comparative Advantage and Agricultural Trade. *Agricultural Economics*, 50, 29-40. <https://doi.org/10.1111/agec.12529>.
9. Erokhin, V., Gao, T., Chivu, L., & Andrei, J.V. (2022). Food Security in a Food Self-Sufficient Economy: A Review of China's Ongoing Transition to a Zero Hunger State. *Agricultural Economics – Czech*, 68(12), 476-487. <https://doi.org/10.17221/278/2022-AGRICECON>.
10. Erokhin, V., Gao, T., & Ivolga A. (2020a). Structural Variations in the Composition of Land Funds at Regional Scales across Russia. *Land*, 9, 201. <https://doi.org/10.3390/land9060201>.
11. Erokhin, V., Li, D., & Du, P. (2020b). Sustainability-Related Implications of Competitive Advantages in Agricultural Value Chains: Evidence from Central Asia – China Trade and Investment. *Sustainability*, 12, 1117. <https://doi.org/10.3390/su12031117>.

12. Feng, Z., Yang, L., & Yang, Y. (2014). Temporal and Spatial Distribution Patterns of Grain Crops in the West Liaohe River Basin. *Journal of Resources and Ecology*, 5, 244-252. <https://doi.org/10.5814/j.issn.1674-764X.2014.03.007>.
13. Fertő, I., & Hubbard, L.J. (2003). Revealed Comparative Advantage and Competitiveness in Hungarian Agri-Food Sectors. *World Economy*, 26, 247-259. <https://doi.org/10.1111/1467-9701.00520>.
14. Food and Agriculture Organization of the United Nations. (2009). *Declaration of the World Summit on Food Security*. Retrieved from <https://www.fao.org/3/k6050e/k6050e.pdf> (September 29, 2023).
15. Fukasaku, K. (1992). *Economic Regionalisation and Intra-Industry Trade: Pacific-Asian Perspectives*. OECD, Paris.
16. Gao, T., Ivolga, A., & Erokhin, V. (2018). Sustainable Rural Development in Northern China: Caught in a Vice Between Poverty, Urban Attractions, and Migration. *Sustainability*, 10, 1467. <https://doi.org/10.3390/su10051467>.
17. Harbiantkova, A., & Gertsberg, L. (2022). Information Model for Sustainable Rural Development. *Energies*, 15, 4009. <https://doi.org/10.3390/en15114009>.
18. Hayat, N., Al Mamun, A., Nasir, N.A.M., Selvachandran, G., Nawi, N.B.C., & Gai, Q.S. (2020). Predicting Sustainable Farm Performance—Using Hybrid Structural Equation Modelling with an Artificial Neural Network Approach. *Land*, 9, 289. <https://doi.org/10.3390/land9090289>.
19. Hussain, M., Butt, A.R., Uzma, F., Ahmed, R., Islam, T., & Yousaf, B. (2019). A Comprehensive Review of Sectorial Contribution Towards Greenhouse Gas Emissions and Progress in Carbon Capture and Storage in Pakistan. *Greenhouse Gases: Science and Technology*, 9, 617-636. <https://doi.org/10.1002/ghg.1890>.
20. Krugman, P. (1991). *Geography and Trade*. MIT Press, Cambridge.
21. Kumar, K.N.R. (2022). Competitiveness of Indian Agricultural Exports: A Constant Market Share Analysis. *Research on World Agricultural Economy*, 3, 25-38. <https://doi.org/10.36956/rwae.v3i2.514>.
22. Kuzmenkova, V. (2013). Forecasting of Territorial and Sectoral Structure of Agricultural Production. *Economics of Agriculture of Russia*, 9, 57-62.
23. Kuznetsov, Y. (2022). Developing the Agro-Industrial Complex of Russia and Ensuring the Food Security of the Country under Sanctions. *Economic Analysis: Theory and Practice*, 21, 1390-1419. <https://doi.org/10.24891/ea.21.8.1390>.
24. Loginova, D. (2022). Assessing the Short-term Effect of Exchange Rate Liberalisation on Food Import Prices: The Regression Discontinuity in Time Employed for Russian Food Markets in 2014. *Research on World Agricultural Economy*, 3(3), 52-67. <https://doi.org/10.36956/rwae.v3i3.612>.
25. Li, H., He, H., & Zhang, J. (2022). Study on Rural Development Evaluation and Drivers of Sustainable Development: Evidence from the Beijing-Tianjin-Hebei Region of China. *Sustainability*, 14, 9570. <https://doi.org/10.3390/su14159570>.

26. Li, J., Liu, Y., Yang, Y., & Jiang, N. (2021). County-Rural Revitalization Spatial Differences and Model Optimization in Miyun District of Beijing-Tianjin-Hebei Region. *Journal of Rural Studies*, 86, 724-734. <https://doi.org/10.1016/j.jrurstud.2019.10.012>.
27. Liu, C.-C., Lee, C.-T., Guo, Y.-F., Chiu, K.-N., & Wang, T.-Y. (2022). The Study of Sustainable Rural Development in Taiwan - A Perspective of Causality Relationship. *Agriculture*, 12, 252. <https://doi.org/10.3390/agriculture12020252>.
28. Mahajan, K., & Tomar, S. (2021). COVID-19 and Supply Chain Disruption: Evidence from Food Markets in India. *American Journal of Agricultural Economics*, 103, 35-52. <https://doi.org/10.1111/ajae.12158>.
29. Maslova, V., Zaruk, N., Fuchs, C., & Avdeev, M. (2019). Competitiveness of Agricultural Products in the Eurasian Economic Union. *Agriculture*, 9, 61. <https://doi.org/10.3390/agriculture9030061>.
30. Mishchenko, I. (2012). Spatial Aspects of Sustainable Rural Territories Development. *Tomsk State University Journal of Economics*, 19, 95-102.
31. Pei, W., Guo, X., Ren, Y., & Liu, H. (2021). Study on the Optimization of Staple Crops Spatial Distribution in China under the Influence of Natural Disasters. *Journal of Cleaner Production*, 278, 123548. <https://doi.org/10.1016/j.jclepro.2020.123548>.
32. Raza, A., Tong, G., Erokhin, V., Bobryshev, A., Chaykovskaya, L., & Malinovskaya, N. (2023). Sustaining Performance of Wheat-Rice Farms in Pakistan: The Effects of Financial Literacy and Financial Inclusion. *Sustainability*, 15, 7045. <https://doi.org/10.3390/su15097045>.
33. Romantseva, Y. (2010). *Location of Agricultural Production by Territory and Categories of Farms in the Russian Federation (Economic and Statistical Analysis)*. Russian State Agrarian University, Moscow.
34. Sachitra, V. (2016). Review of Competitive Advantage Measurements: Reference on Agribusiness Sector. *Journal of Scientific Research and Reports*, 12, 1-11. <https://doi.org/10.9734/JSRR/2016/30850>.
35. Samygin, D., Baryshnikov, N., & Mizjurkina, L. (2019). Models of Scenario Forecasting of the Region's Agriculture Development. *Economy of Regions*, 15, 865-879. <https://doi.org/10.17059/2019-3-18>.
36. Samygin, D., & Kudryavtsev, A. (2018). Strategic Instruments of State Support Distribution in the Agrarian Sector. *Ekonomicheskaya Politika*, 13, 156-175. <https://doi.org/10.18288/1994-5124-2018-5-156-175>.
37. Serova, E., Karlova, N., Tikhonova, T., Khramova, I., & Shik, O. (2003). *Review of Budget Expenditures for Agriculture (Regional Aspect)*. Gaidar Institute for Economic Policy, Moscow.
38. Shi, Q., Li, Z., Xu, Y., Yan, T., & Chen, M. (2023). Dynamic Scenario Simulations of Sustainable Rural and Towns Development in China: The Case of Wujiang District. *Sustainability*, 15, 8200. <https://doi.org/10.3390/su15108200>.

39. Siptitz, S., Romanenko, I., Evdokimova, N., Rybakova, R., & Egorova, O. (2016). *Methodology for the Development of Strategic Directions for the Placement of Crop Production*. ERD, Moscow.
40. Small, B., Brown, P., & Montes de Oca Munguia, O. (2016). Values, Trust, and Management in New Zealand Agriculture. *International Journal of Agricultural Sustainability*, 14, 282-306. <https://doi.org/10.1080/14735903.2015.1111571>.
41. Wang, Y., Zuo, L., & Qian, S. (2022). Green-Biased Technical Change and Its Influencing Factors of Agriculture Industry: Empirical Evidence at the Provincial Level in China. *International Journal of Environmental Research and Public Health*, 19, 16369. <https://doi.org/10.3390/ijerph192316369>.
42. Warlina, L., Soegoto, E.S., Supatmi, S., Oktafiani, D., & Jatnika, R. (2023). Regional Competitive Advantage of Agriculture as the Leading Sector in Garut Regency, West Java Province, Indonesia. *Journal of Eastern European and Central Asian Research*, 10, 74-84. <https://doi.org/10.15549/jeecar.v10i1.1084>.
43. Wegren, S.K., & Elvestad, C. (2018). Russia's Food Self-Sufficiency and Food Security: An Assessment. *Post-Communist Economies*, 30, 565-587. <https://doi.org/10.1080/14631377.2018.1470854>.
44. Widomski, M.K., & Musz-Pomorska, A. (2023). Sustainable Development of Rural Areas in Poland since 2004 in the Light of Sustainability Indicators. *Land*, 12, 508. <https://doi.org/10.3390/land12020508>.
45. Zakshevskii, V., Merenkova, I., Novikova, I., & Kusmagambetova, E. (2019). Methodological Toolkit for Diagnosing Diversification of Rural Economy. *Economy of Regions*, 15, 520-533. <https://doi.org/10.17059/2019-2-16>.
46. Zubarevitch, N. (2010). Regional Development and Regional Institutions in Russia. *Regional Studies*, 28, 3-14.

POLICY INSTRUMENTS FOR THE DEVELOPMENT OF RURAL TOURISM IN THE LEAST DEVELOPED AREAS OF SERBIA: THE EXAMPLE OF THE MUNICIPALITY OF MEDVEĐA

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ABSTRACT

The paper analyzes the instruments of rural tourism development policy in the least developed areas of the Republic of Serbia on the example of the Municipality of Medveđa. It is based on the hypothesis that economic policy makers, with new legal solutions, have made it possible for agricultural households engaged in rural tourism to apply for IPARD incentives on an equal basis with other agricultural households. Using the semi-structured interview technique, research was conducted on the importance of IPARD incentives for the development of rural tourism in the least developed areas of Serbia on the example of the Municipality of Medveđa as well on the significance of the synergistic effect of the development of rural and spa tourism in this local community.

Introduction

Agricultural holdings, in accordance with the new legal solutions of the Republic of Serbia, can also engage in rural tourism, which is achieved through the use of IPARD incentives. The use of incentives leads to the development of undeveloped areas that have tourism as an unused potential. The synergetic effect of agriculture and tourism can best be shown through the development of rural tourism, that is, by enabling agricultural farms to engage in rural tourism in addition to agriculture, through which they can, among other things, market their agricultural products.

The first part of the paper explains the incentives for the development of tourism in rural areas, which are available based on new legal solutions. The policy of balanced regional development of the Republic of Serbia is implemented by achieving investments in devastated areas. Investors are allowed to use the IPARD incentive programs, as well

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as incentives for direct investment in spa areas. The Municipality of Medveđa has unused economic potentials for the development of rural tourism and tourism in the area of the spa Sijarinska Banja, which is located on the territory of this municipality. In the second part of the paper, data on the resources and level of development of the Municipality of Medveđa are given, as an example of a local administrative unit (LAU) that is classified by level of development into devastated areas. The third part of the paper presents the research conducted using the semi-structured interview technique on the importance of IPARD incentives for the development of rural tourism in the Municipality of Medveđa.

Incentives for the development of tourism in rural areas

The Law on Amendments and Supplements to the Law on Agriculture and Rural Development (“Official Gazette of the Republic of Serbia”, No. 114/2021) stipulates in Article 2, Point 4 that an agricultural holding is “a production unit where a business company, agricultural cooperative, institution or other legal person, entrepreneur or natural person - farmer performs agricultural production, i.e. performs processing of agricultural products, i.e. performs other non-agricultural activities (rural tourism, old crafts, etc.)”. By amending the aforementioned article, the legislator recognized for the first time as agricultural holdings those engaged in rural tourism. This is an important fact because the activities of rural tourism (and other non-agricultural activities in the countryside) have become equal to agricultural activities when applying for IPARD project subsidies.

The financial instrument of the European Union to help rural development is IPARD. IPARD programs are adopted by the Government, in accordance with Article 7a of the Law on Agriculture and Rural Development, and they are financed from the pre-accession assistance funds of the European Union and the budget of the Republic of Serbia. The Republic of Serbia moderates its rural development policy, among other things, towards the goal of improving the quality of life in rural areas and reducing poverty. In fact, the implementation of the IPARD program is one of the instruments of the agricultural policy and rural development policy of the Republic of Serbia.

Pre-accession assistance instruments (IPA), as one of the European Union’s support to candidate countries, is available in the Republic of Serbia (Glušćević et al., 2017; Luković et al, 2023; Šobić et al., 2023). IPARD represents part of IPA support intended for rural development. IPARD aims, among other things, to develop rural communities and improve the quality of life of the people who live in them.

Four IPARD measures are currently accredited in the Republic of Serbia (Ministry of Agriculture, Forestry and Water Management, Directorate for Agrarian Payments, IPARD EU4Rural Areas, 2021):

“Measure 1 - Investments in physical assets of agricultural holdings for investments in the sector of primary agricultural production;

Measure 3 - *Investments in physical assets related to the processing and marketing of agricultural products and fishery products for investments in the sector of processing agricultural products and fishery products;*

Measure 7 – *Diversification of agricultural holdings and business development for investments in the development of non-agricultural economic activities and improvement of the quality of life in rural areas;*

Measure 9 - *Technical assistance to support the IPARD Governing Body in the implementation of the IPARD II program”.*

Measure 7 aims to support the development of rural areas that are highly dependent on agriculture and the use of natural resources. Measure 7 includes: rural tourism and recreational activities (establishment of “tourist households and recreational zones, modernization of existing tourist facilities, facilities and equipment for recreational fishing, hunting and horse riding, development of tourist catering, equipment for recreational activities”) and renewable energy resources (equipment for facilities, construction and/or reconstruction of facilities). Investments contribute to the development of the rural area, which will lead to new employment and an increase in household income, which will lead to a reduction in the depopulation of these areas. Measure 7 allows “potential users to obtain support for a wide range of investments, such as the construction and reconstruction of accommodation facilities, landscaping, recreational activities, areas for tasting and selling food and beverages, creating a website, purchasing equipment for the production of energy from renewable sources and others” (Ministry of Agriculture, Forestry and Water Management, IPARD Program Management Department, IPARD Management Body, IPARD EU4Rural Areas, 2023).

The Republic of Serbia has great untapped economic potential for the development of rural tourism, which is encouraged precisely by Measure 7 of the IPARD program. Users of this measure can get a return of up to 65% (Ministry of Agriculture, Forestry and Water Management, Administration for Agrarian Payments, IPARD EU4Rural Areas, 2021) of the invested money if they opt for one of the listed investments.

The Annual Report of the Ministry of Agriculture, Forestry and Water Management on the implementation of the IPARD II program for 2022 (2023) confirms that there is a great interest in using incentives that include the establishment of tourist households and recreational zones within the Rural Tourism and Recreational Activities Sector within Measure 7, which in the total number of requests submitted under Measure 7, they have a share of 97.7% with 591 requests submitted. The largest number of requests for using the IPARD program under Measure 7 were submitted for investments to establish tourist households and recreational zones. Eighty-two requests were submitted for the modernization of existing tourist facilities. The largest number of approved requests, according to the aforementioned report, within the Sector of Rural Tourism and Recreational Activities refers to the establishment of tourist households and recreational zones. The value of submitted requests is 17.7 million euros of approved public support, and 34 requests in the amount of 3.2 million euros were approved for

investments in the modernization of existing tourist facilities. The average amount of approved public support for investments for the establishment of tourist households and recreational zones is 175,439 euros, while the lowest average amount of 37,043 euros was achieved per request for investments in equipment for recreational activities.

It is important to note that, in addition to the IPARD program, the state also awards incentives for investment in spa areas that represent untapped economic potential for the development of rural areas, with larger amounts of incentive funds being awarded to investors who are distinguished for investing in less developed areas where the areas of spas are located, and all in accordance with balanced regional development. Article 28 of the Law on Tourism (“Official Gazette of the Republic of Serbia”, No. 17/2019) prescribes incentive funds for the development of tourism that are allocated from the budget of the Republic of Serbia, among other things, for participation in financing projects for the development and improvement of rural tourism and catering. Also, Article 2 of the Law on Investments (“Official Gazette of the Republic of Serbia”, no. 89/2015 and 95/2018) defines the goals of this law, namely “improving the investment environment in the Republic of Serbia and encouraging direct investments in order to strengthen the economic and development, and employment growth”. On the basis of this law, in 2018, the Regulation on conditions and methods of attracting direct investments has been adopted (“Official Gazette of the Republic of Serbia”, No. 18/2018) whose article 4, paragraph 2, stipulates that incentive funds can also be used for “financing investment projects in the sector of hotel accommodation services on the territory of the local self-government unit where the area of the spa was established”. On the basis of this regulation, for the first time, policy makers of attracting direct investments included areas of spas as places where investors can receive incentives from the state for their investments. Already in the following year, 2019, a special Regulation was adopted on determining the criteria for awarding incentives to attract direct investments in the hotel accommodation services sector (“Official Gazette of the Republic of Serbia”, no. 33/2019 and 42/2019). Namely, Article 1 of the said regulation stipulates that “the criteria, conditions and method of attracting direct investments in the sector of hotel accommodation services in spa and climatic zones are regulated more closely”. With the adoption of this regulation, the economic-system framework of the policy of attracting direct investments for investments in the hotel accommodation service sector has been enriched, and potential investors have been offered, in addition to spa areas, a list of climatic zones by investing in which they can obtain incentives from the budget of the Republic of Serbia. Some areas of spas and climatic zones are located in rural areas by entering into which investors would receive higher amounts of incentives (Ljubisavljević, Gnjatović, 2020). Investment incentives can be granted for investment projects in the hotel accommodation services sector with a minimum value of 2,000,000 euros and which ensure the employment of at least 70 new employees for an indefinite period associated with the investment project.

The aforementioned incentive measures, i.e. the IPARD program and incentives granted by the state to investors for investments in spa and climatic zones can have a positive effect on the development of tourism in rural areas.

Resources and level of development of the municipality of Medveđa

The classification of LAU according to the degree of development is prescribed by the Law on Regional Development (“Official Gazette of the Republic of Serbia”, no. 51/2009, 30/2010 and 89/2015 - other law). The degree of development of LAU is compared with the national GDP average. Namely, in accordance with the aforementioned law, there are four groups of LAU according to the level of development. The first group consists of LAU whose level of development is above the national average and they are considered developed. The LAU belonging to the second group have a level of development ranging from 80% to 100% of the national average and they can be said to be at the level of the national average. Furthermore, LAU classified into the third group are underdeveloped and their degree of development is in the range of 80% to 100% of the national average, while the fourth group consists of LAU whose level of development is below 60% of the national average and they are extremely underdeveloped. It is important to note that the fourth group of LAU in terms of development also includes those units whose level of development is below 50% of the national average. This subgroup of the fourth group is considered devastated areas. In 2014, in accordance with the Law on Development, the Regulation was adopted on establishing a unique list of the development of regions and LAU for the year 2014 (“Official Gazette of the Republic of Serbia”, No. 104/2014). LAU has been classified into the first, second, third and fourth groups, as well as the group of devastated areas. The Municipality of Medveđa is in accordance with the aforementioned regulation has been classified into a subgroup of the fourth group, i.e. into devastated areas.

Corrective macroeconomic indicators of the level of development of LAU, in accordance with the aforementioned regulation, are the decrease or increase in the number of inhabitants, i.e. demographic decline or growth, unemployment rate and population density. Demographic growth or decline, in accordance with Article 3 of the aforementioned regulation, is “an indicator of demographic changes and depopulation in the territory of a LAU, measured by the growth rate of the total number of residents of the LAU in the observed year in relation to the Census data from 1971”. A change in the number of inhabitants can be caused by various factors. Some of them are birth rate, mortality, immigration and emigration (Mladenović et al., 2003; Stanciu et al., 2019; Popescu et al., 2017; Popescu et al., 2018) or departure from underdeveloped rural regions to developed ones.

The average rate of demographic decline in the municipality of Medveđa, which is shown in Table 1, was based on the data obtained from the Statistical Office of Serbia (1975, 2022), that is, the number of inhabitants of the municipality of Medveđa from the Census of 1971 and the estimate of the number of inhabitants for the year 2021 and according to the pattern (Mladenović et al., 2003):

$$r = \sqrt[t-1]{\frac{P_i}{P_{i-1}}} - 1$$

where:

r - is an average rate of demographic growth or decline,

P_i - is number of inhabitants in the observed period (estimates of the number of inhabitants for the year 2021),

P_{i-1} - is number of inhabitants in the base period (number of inhabitants from the 1971 Census),

t - the time that passed between the Census in the base period and the observed period.

Population density represents, in addition to the average rate of demographic growth/decline and the unemployment rate, a corrective macroeconomic indicator of the level of development of the LAU. Population density is calculated as the ratio between the total number of inhabitants and the surface area expressed in km². The population density was obtained based on the data of the Statistical Office of Serbia (2022).

The third selected corrective macroeconomic indicator on the basis of which the position of the Municipality of Medveđa in relation to the level of development of the Republic of Serbia can be seen is the unemployment rate. The unemployment rate tells about the living standard of the population. Namely, higher unemployment rates show that the quality of life is worse, and that the population does not have available funds for consumption and the purchase of goods and services.

The unemployment rate, according to Gnjatović and Leković (2019, 72), represents the ratio between the number of unemployed persons and the active population and is calculated as follows:

$$n_a = \frac{N_a}{P_a} \times 100$$

where:

n_a - is an unemployment rate,

N_a - is number of unemployed persons,

P_a - active population (the active population or labor force is the sum of unemployed and employed persons).

The average rate of demographic decline, population density and unemployment rate are shown in Table 1 for the Republic of Serbia and the Municipality of Medveđa in order to show the indicators on the basis of which the Municipality of Medveđa is classified as devastated areas.

Table 1. Average rate of demographic growth or decline, population density and unemployment rate in the Republic of Serbia and the Municipality of Medveđa

Indicators	Total
The average rate of demographic growth or decline based on the number of inhabitants according to the 1971 Census and the estimate of the number of inhabitants for the year 2021	
Republic of Serbia	-0,43
Municipality of Medveđa	-2,46
Population Density	
Republic of Serbia	77
Municipality of Medveđa	12
Unemployment rate	
Republic of Serbia	17,36
Municipality of Medveđa	35,21

Source: Statistical Office of Serbia (1975, 2022)

Analyzing the average rate of demographic decline, it is noticeable that an intensive process of depopulation is present in the Municipality of Medveđa, that is, a decrease in the number of inhabitants. The decrease in the number of inhabitants negatively affects the development of the economy. On the one hand, the labor force is an economic resource that is becoming limited, while on the other hand, the population is a consumer of goods and services, and the decrease in demand for goods and services leads to less consumption and production of the same. With the arrival of investors and the realization of investments, the existing regional differences would be mitigated (Stamenković et al., 2017), the existing population would be retained and new ones would be attracted, and finally a larger labor market and greater consumption of goods and services would be ensured, which further leads to the increase in the production of goods and services and increase in the standard of living of the population.

The Municipality of Medveđa has a very low population density compared to the national average. By connecting the population density with the average rate of demographic decline recorded, it can be concluded that the demographic depletion in this Municipality is very intense and that due to the low population density, i.e. the large dispersion of the population, the problem is both on the supply side and on the demand side. Namely, for the development of tourism as a labor-intensive branch, a population is needed that will participate in the creation of the offer of tourist services, but on the other hand, will also be able to be a user of them on the demand side.

The unemployment rate of the Municipality of Medveđa is 35.21 and it significantly exceeds the national average. It is important to point out that the Regulation on conditions and methods of attracting direct investments from 2018 and the Regulation on determining the criteria for awarding incentives for attracting direct investments in the hotel accommodation services sector from 2019 stipulate that one of the conditions for awarding incentives for investments is that in the area of spas, the employment of at

least 70 new employees, that is, the creation of 70 new jobs. This condition imposes the conclusion that any new investment in rural areas leads to new employment (Gnjatović, 2016) and to a decrease in the unemployment rate. Given that the aforementioned legal solutions were adopted a few years ago, it is expected that the effects of encouraging direct investments will be visible in the coming period, i.e. that new investments in rural tourism in the Municipality of Medveđa will induce the creation of new jobs, increasing employment opportunities and reducing the unemployment rate.

The Municipality of Medveđa has unused natural resources and assets that, if used for the purpose of tourism, can represent the development potential of this municipality. With the development of tourism in the territory of the Municipality of Medveđa, there would be a decrease in unemployment, a decrease in the departure of young people, and there would be a return of the population that had migrated. In this way, the population density would also increase, so all corrective macroeconomic indicators would show relatively more favourable values and the Municipality of Medveđa would be classified as a LAU that is at a higher level of development. Realization of investments with the help of incentives that are determined for the arrival of investors would lead to more even regional development, as a long-term goal (Aničić et al., 2011).

On the territory of the Municipality of Medveđa, the Sijarinska Banja area is also located. In 2006, the Government of the Republic of Serbia determined the cadastral parcels that make up the area of Sijarinska Banja in the Decision on determining the area of “Sijarinska Banja” (“Official Gazette of the Republic of Serbia”, no. 88/06). Based on this decision and the Regulation on conditions and methods of attracting direct investments from 2018, the area of Sijarinska Banja has been designated as one of the potential places for investments in the construction of new or revitalization of existing accommodation facilities for which investors can receive investment incentives from the state. Using these investment incentives, in accordance with the regulation, along with the investments new employment is required. Given that the Municipality of Medveđa is located in a devastated area, if investors decide to invest in the zone of Sijarinska Banja, the state will give them a greater amount of incentives than if they decided to invest in LAU classified into more developed groups. Sijarinska Banja represents the untapped economic potential of the Municipality of Medveđa.

The special rehabilitation hospital “Geyzer” is a health institution in Sijarinska Banja that specializes in rehabilitation, in accordance with Article 30, paragraph 2 of the Regulation on the plan of the network of health institutions (“Official Gazette of the Republic of Serbia”, No. 5/2020, 11/ 2020, 52/2020, 88/2020, 62/2021, 69/2021, 74/2021 and 95/2021). This specialized hospital is on the list of the Ministry of Economy (2015) as one of the 11 special hospitals for rehabilitation that have been put forward for privatization. This specialized hospital operates successfully, and in addition to its main activity, which is the provision of extended rehabilitation services, it also deals with catering (Special Hospital for Rehabilitation Geyzer Sijarinska Banja, 2022). In Sijarinska Banja, in addition to the specialized hospital, there are also private accommodation facilities, which in most cases are located in family households (Tourist

organization Medveđa, 2023). These households, if they are registered as agricultural holdings, can apply for IPARD project subsidies and thus improve their activities in the field of tourism.

Materials and methods

The subject of the research was to explore the effects of the implementation of new legal solutions that enable agricultural households engaged in rural tourism to apply for IPARD incentives on an equal basis with other agricultural households. The aim of the research was to explain the importance of IPARD incentives for the development of rural tourism in the Municipality of Medveđa, which belongs to the least developed areas of Serbia.

Based on the subject and goal of the research, a general hypothesis was defined which reads:

X0 - The least developed areas in the Republic of Serbia offer a number of opportunities for the development of rural tourism.

Specific hypotheses were set on the basis of the general one and they read:

X1 - Economically systemic solutions related to the allocation of IPARD incentives have a positive effect on the development of tourism in rural areas.

X2 - Economic systemic solutions that regulate the allocation of investment incentives have a positive effect on the development of rural areas.

In order to be as objective as possible in proving the set hypotheses, and due to the lack of quantitative data, empirical research was conducted using a qualitative method, using the semi-structured in-depth interview technique. Interviews that were used for research on the views of representatives of relevant institutions and organizations were based on the methodology applied by Johnson, Crooks and Ormond (2015) in a scientific paper on the health system of Jamaica. The respondents' answers were saved in the audio recording and the examiner's notes. All audio recordings have been typed, with the names of the persons who represented the selected institutions and organizations, their functions in the institutions and organizations, with the date and time of each interview. The respondents' statements were grammatically corrected, without changing their meaning.

Representatives of the following organizations responded to the invitation to interview: Tourist Organization of the Municipality of Medveđa and a representative of the Special Hospital for Rehabilitation "Geyzer" in Sijarinska Banja, as well as a representative of an institution: a representative of the Municipality of Medveđa.

Selected respondents were asked questions, grouped into three thematic units: What are the unused economic potentials of the Municipality of Medveđa? How much encouraging the development of agricultural households engaged in rural tourism would contribute to its development as well as the development of spa tourism and

vice versa? What is the role of the Municipality of Medveđa in creating a positive environment for attracting investments?

Results and discussions

By answering the first group of questions, the respondents explained the economic specificities of their LAU, especially from the aspect of tourism development. Both the representatives the aforementioned institution and organizations spoke about the key unused economic potentials of the Municipality of Medveđa.

Through the analysis of the conducted interviews, it was determined that the key economic potential of the Municipality of Medveđa is tourism, that is, the development of the Sijarinska Banja area, which is located on the territory of this LAU. The development of tourism is possible, among other things, thanks to the untouched nature, which is suitable for the development of agriculture and organic production and the marketing of these products through tourism. According to the representatives of the Municipality of Medveđa, natural resources can be used for the development of animal husbandry, wood industry and mines (Pantović et al., 2022). In the vicinity of the Sijarinska Banja, there is Caričin Grad, which, due to its historical importance and archaeological sites, represents a tourist potential, as stated by the representative of the Municipality of Medveđa.

The representative of the Tourism Organization of the Municipality of Medveđa stated that the Special Rehabilitation Hospital “Geyser” was created in the 1990s using the accommodation facilities of a hotel that could not survive by dealing exclusively with commercial services in tourism. He explained that Sijarinska Banja had a lot of unused potential that would be better utilized by building at least two more hotels, but that would require the arrival of investors. Also, as the respondent from the Tourism Organization of the Municipality of Medveđa stated, “for the construction of the hotel, there would have to be an investment in the sense of arranging the spa and improving the superstructure at the destination itself.” The representative of the Special Rehabilitation Hospital “Geyser” pointed out that there is also a water polo pool in Sijarinska Banja, but that it is necessary to invest in covering and heating it in the winter months in order to extend the tourist season to the whole year. The specificity of this spa is the existence of a geyser, which is a source of thermo-mineral water with a temperature of 71 degrees, in the vicinity of which there are pools, which also represent economic potential.

As stated by the representative of the Tourism Organization of the Municipality of Medveđa, the Sijarinska Banja reached its peak in 1978, when the largest number of guests was recorded, which at that time was around 18,000. Respondents from aforementioned institution and organizations pointed out that there is only the Geyser Hotel in Sijarinska Banja. Namely, the representative of the Tourism Organization of the Municipality of Medveđa stated, among other things, that “in 1954, the first hotel with 120 beds, called Belgrade was built, and that in 1974 it was adapted and expanded into a hotel with 267 beds. Since then, the name of the hotel has been changed to Hotel

“Geyser”. The representative of the Municipality of Medveđa pointed out that in 2010 there was a plan to build a new hotel whose investors would be from Russia, but that this investment was not realized.

The representative of the Municipality of Medveđa stated, among other things, that that local government has started to invest in Sijarinska Banja, but that it is necessary to invest in the development of agricultural households in order to increase their accommodation capacity and engage in rural tourism.

All respondents agreed that there is room for better utilization of the healing factor. According to the respondents from the Tourism Organization of the Municipality of Medveđa, the potential of the healing factor in Sijarinska Banja is huge. In the 1990s, research was carried out and a well was made, from which a stream of water was obtained at 85 degrees. The thermal energy of this water is currently used only for heating a specialized hospital, but with investments, it could be used for heating other facilities on the territory of the Municipality.

Also, according to the representative of the Geyser Special Rehabilitation Hospital, the construction of a wellness and spa center in Sijarinska Banja and the completion of the restoration of the Roman bath belonging to the specialized hospital are planned. Then, the representative of the Municipality of Medveđa pointed out that it is planned to build a factory for bottling sour water on a plot of 3 ha in front of the entrance to Sijarinska Banja. With this investment, water utilization would be higher.

The second group of questions posed to respondents was related to encouraging the development of agricultural households engaged in rural tourism, that is, how much encouraging the development of agricultural households would contribute to the development of rural tourism as well as the development of spa tourism and vice versa.

The analysis determined that there were no realized investments in the territory of the municipality of Medveđa with the help of the IPARD project, and there were no investment incentives in the area of Sijarinska Banja.

Representatives of the aforementioned institution and organizations claimed that it would be good if some of the investors recognized the potential of rural tourism in the Municipality of Medveđa, as well as in Sijarinska Banja as a potential for investment, and that the level of incentives they receive for investing in devastated area would help a lot in that process. Respondents explained that there are no private investors, but the state invested in the development of health tourism. Namely, the representative of the Municipality of Medveđa stated that with the help of the state, the following investments have been realized or are in the process of being realized. First, the Ministry of Economy financed 40 million dinars for the reconstruction of a bathroom, while the Ministry of Tourism approved funds for the construction of a wellness and spa center, the construction of which is expected in the coming period. According to the representative of the Tourism Organization of the Municipality of Medveđa, the position of the Sijarinska Banja in the devastated area is also recognized in the subsidies

that the state gives for the use of vouchers for accommodation facilities in Sijarinska Banja,. Namely, there are no luxury resorts in Sijarinska Banja, the guests have a lower paying capacity, so the state subsidy in the form of a voucher of 5,000 dinars increases the number of overnight stays.

All respondents from the aforementioned institution and organizations were aware of the positive impact of IPARD and investment incentives on the development of rural tourism in agricultural households and the area of Sijarinska Banja. They all agreed that IPARD and government incentives are a necessary condition for attracting direct investments in the Municipality of Medveđa. They particularly pointed out to the problem of emigration of young people from their homeland hoping that investments in rural tourism could stop this negative trend.

The third group of questions related to the activities that the municipality of Medveđa carries out in order to create the best possible environment for attracting direct investments. The municipality of Medveđa is a scattered municipality with a large area, but with small budgets, according to the words of all the representatives of the examined institutions and organizations. The representative of the municipality points out that small funds are invested in improving the business environment to attract direct investments and that higher levels of government help them to make investments in road and communal infrastructure. The representative of the municipality of Medveđa, among other things, stated that they are ready to speed up the process of granting the necessary permits if an investor decides to invest in tourism in their municipality. engaged in the development of a project that would apply to the relevant ministries for the allocation of funds for the realization of the necessary investments in, for example, pool covering, water heating and construction of additional sports and recreational facilities. Also, the distance of the municipality from the highway is another obstacle for creating a favorable business environment.

The analysis of the answers of the respondents has shown that the specific hypotheses X1 (Economically systemic solutions related to the allocation of IPARD incentives have a positive effect on the development of tourism in rural areas) and X2 (Economically systemic solutions that regulate the allocation of investment incentives have a positive effect on the development of rural areas) have been proved. Namely, by using IPARD incentives and government incentives granted for investments in spa areas would increase the number of accommodation capacities in rural areas. This would increase the number of tourists, create new jobs and reduce unemployment, increase the income of households engaged in tourism, and lead to the development of the entire rural area in which the Municipality of Medveđa is located.

Conclusions

The conducted research proved the general hypothesis X0 - The least developed areas in the Republic of Serbia offer a number of opportunities for the development of rural tourism. Namely, the example of the Municipality of Medveđa shows the great

unused economic potential of the devastated areas. In addition to untouched nature, this Municipality has natural healing factor - water, which can be better used by investing in accommodation facilities in the area of Sijarinska Banja with the help of incentives. Also, rural tourism can be developed by using IPARD incentives that have a positive effect on the development of tourism in households that, in addition to carrying out agricultural activities, can dare to market their agricultural products to tourists staying in their households. The new legal solutions related to the IPARD project and incentives for spa areas show that the Republic of Serbia wants to support the development of tourism in rural areas. Positive effects of these economic systemic solutions will be visible in the coming period. With their application, balanced regional development goals could be carried out. The research showed that while new legal solutions represent an incentive for investments in rural and spa tourism, the Municipality of Medveđa needs the help of the state to create a favorable business environment for their realization.

Conflict of interests

The authors declare no conflict of interest.

References

1. Aničić, J., Laketa, M. & Vukotić, S. (2011). Investiciona politika i regionalni razvoj Srbije u tranzicionom periodu. *Zbornik radova Geografskog instituta "Jovan Cvijić" SANU*, 61(3), 47-61. [in English: Aničić, J., Laketa, M. & Vukotić, S. (2011). Investment Policy and Regional Development of Serbia in the Transition Period, *Collection of Papers of the Institute of Geography "Jovan Cvijić" SANU*, 61(3), 47-61].
2. Gnjatović, D. & Leković, M. (2019). *Nacionalna ekonomija*. Fakultet za hotelijerstvo i turizam u Vrnjačkoj Banji. [in English: Gnjatović, D. & Leković, M. (2019). *National Economy*, Faculty of Hotel Management and Tourism in Vrnjačka Banja].
3. Gnjatović, D. (2016). Državni podsticaji stranim direktnim investicijama kao instrument politike javnih rashoda u Republici Srbiji. R. Kovačević i M. Gligorić, urednici: *Strane direktne investicije i privredni rast u Srbiji*. Ekonomski fakultet u Beogradu, 131-139. [in English: Gnjatović, D. (2016). State Incentives for Foreign Direct Investments as an Instrument of the Public Expenditure Policy in the Republic of Serbia. R. Kovačević & M. Gligorić, editors: *Foreign Direct Investments and Economic Growth*, Faculty of Economics in Belgrade, 131-139.].
4. Gluščević, S., Maksimović, S., Pejanović, R., & Simeunovic, T. (2017), Possibility of rural sector development in Serbia using IPARD program, *Economics of Agriculture*, 2017(2), 753-767.
5. Johnston, R., Crooks, V.A. & Ormond, M. (2015). Policy implications of medical tourism development in destination countries: revisiting and revising an existing framework by examining the case of Jamaica. *Globalization and Health*, 11(29), 1-13. doi:10.1186/s12992-015-0113-0

6. Luković, M., Pantović, D., Kostić, M., Veljović, S., Bugarčić, J. (2023), Food plant diversity in cultural ecosystem services perspective: edible plants as a driver for improving the offer of gastro-tourism, *Ecologica*, 30 (110), 201-208, <https://doi.org/10.18485/ecologica.2023.30.110.5>
7. Ljubisavljević, T., & Gnjatović, D. (2020). Direct Investments in Spa Tourism of Undeveloped Rural Regions: Case Study of the Municipality of Kuršumljia. *Economics of Agriculture*, 67(1), 207-222. doi:10.5937/ekoPolj2001207L
8. Ministarstvo poljoprivrede, šumarstva i vodoprivrede, Uprava za agrarna plaćanja, IPARD EU4Rural Areas (2021). *Vodič za korisnike IPARD II programa za Meru 7 diversifikacija poljoprivrednih gazdinstava i razvoj poslovanja*, Retrieved from <http://www.minpolj.gov.rs/download/vodic-m7-septembar-2021.pdf?script=lat> (September 5, 2023) [*in English*: Ministry of Agriculture, Forestry and Water, Department for Agrarian Finances, IPARD EU4Rural Areas (2021). *Guide for the users of IPARD II program for the Measure 7 Diversification of agricultural statehoods and business development*, Retrieved from <http://www.minpolj.gov.rs/download/vodic-m7-septembar-2021.pdf?script=lat> (September 5, 2023)].
9. Ministarstvo poljoprivrede, šumarstva i vodoprivrede, Odeljenje za upravljanje IPARD programom, IPARD Upravljačko telo, IPARD EU4Rural Areas (2023). *Godišnji izveštaj o sprovođenju IPARD II programa za 2022. godinu*, Retrieved from <http://www.minpolj.gov.rs/download/Godisnji-izvestaj-o-sprovođenju-IPARD-II-programa-za-2022.-godinu.pdf?script=lat> (September 7, 2023) [*in English*: Ministry of Agriculture, Forestry and Water, Department for Agrarian Finances, IPARD Program Management Department, IPARD Management Body, IPARD EU4Rural Areas (2023). *Annual Report on the Implementation of IPARD II program for 2022*, Retrieved from <http://www.minpolj.gov.rs/download/Godisnji-izvestaj-o-sprovođenju-IPARD-II-programa-za-2022.-godinu.pdf?script=lat> (September 7, 2023)].
10. Mladenović, D., Đolević, V. & Šoškić, D. (2003). *Ekonomska statistika (sedmo izmenjeno i dopunjeno izdanje)*. Ekonomski fakultet, Beograd. [*in English*: Mladenović, D., Đolević, V. & Šoškić, D. (2003). *Economic Statistics (seventh revised edition)*. Faculty of Economics, Belgrade].
11. Ministarstvo privrede (2015). Banje i specijalne bolnice iz portfolija Agencije za privatizaciju Republike Srbije. Retrieved from http://www.priv.rs/upload/document/banje_portfolio_ap_2015-04-23_060138.pdf (October 5, 2023) [*in English*: Ministry of Agriculture (2015) Spas and Special Hospitals in the Portfolio of the Privatization Agency of the Republic of Serbia. Retrieved from http://www.priv.rs/upload/document/banje_portfolio_ap_2015-04-23_060138.pdf (October 5, 2023)].
12. Odluka o utvrđivanju područja “Sijarinska Banja” (“Službeni glasnik Republike Srbije”, br. 88/06) [*in English*: Decision on determining the area “Sijarinska Banja” (“Official Gazette of the Republic of Serbia”, no. 88/06)].

13. Pantović, D., Bošković, N., & Petrović, T. (2022). Measuring Convergence in Tourism Competitiveness of Natural and Cultural Resources: A Case of the Balkans and Eastern Europe. *Ekonomický časopis*, 910 (70/2022), 703 – 722. Doi: <https://doi.org/10.31577/ekoncas.2022.09-10.02>,
14. Popescu, G. H., Sima, V., Nica, E., & Gheorghe, I. G. (2017). Measuring sustainable competitiveness in contemporary economies—Insights from European economy. *Sustainability*, 9(7), 1230.
15. Popescu, G. H., Davidescu, A. A. M., & Huidumac, C. (2018). Researching the main causes of the Romanian shadow economy at the micro and macro levels: Implications for sustainable development. *Sustainability*, 10(10), 3518.
16. Republički zavod za statistiku (1975). *Opštine u SR Srbiji (1974)*, Retrieved from <https://publikacije.stat.gov.rs/G1975/Pdf/G19752002.pdf> (September 25, 2023) [*in English*: Statistical Office of Serbia (1975). *Municipalities in SR Serbia (1974)*, Retrieved from <https://publikacije.stat.gov.rs/G1975/Pdf/G19752002.pdf> (September 25, 2023)].
17. Republički zavod za statistiku (2022). *Opštine i regioni u Republici Srbiji (2021)*, Retrieved from <https://publikacije.stat.gov.rs/G2022/pdf/G202213049.pdf> (September 25, 2023) [*in English*: Statistical Office of Serbia (2022). *Municipalities and Regions in the Republic of Serbia (2021)*, Retrieved from <https://publikacije.stat.gov.rs/G2022/pdf/G202213049.pdf> (September 25, 2023)].
18. Specijalna bolnica za rehabilitaciju Gejzer Sijarinska Banja. (2022). Naslovna strana. Retrieved from <https://gejzer.rs/> (September 30, 2023) [*in English*: Special Hospital for Rehabilitation Gejzer Sijarinska Spa. (2022). Title page. Retrieved from <https://gejzer.rs/> (September 30, 2023)].
19. Stamenković, M., Veselinović, P., & Milanović, M. (2017). Demografski resursi okruga u Republici Srbiji: analiza grupisanja. *Teme*, 41(4), 873-897. doi: 10.22190/TEME1704873S [*in English*: Stamenković, M., Veselinović, P., & Milanović, M. (2017). Demographic Resources of the Regions in the Republic of Serbia: Grouping Analysis. *Themes*, 41(4), 873-897. doi: 10.22190/TEME1704873S].
20. Stanciu, S., Zlati, M. L., Antohi, V. M., & Bichescu, C. I. (2019). The Development Analysis of the Romanian Traditional Product Market Based on the Performance Model for Sustainable Economic Development. *Sustainability*, 11(4), 1123.
21. Šobić, Lj., Bošković, N., Pantović, D. (2023). Entrepreneurial elements in rural tourism - findings from PLS-SEM. *Economics of Agriculture*, 70(2), 521–535. <https://doi.org/10.59267/ekoPolj2302521S>
22. Turistička organizacija Medveđa (2023), Smeštaj, Retrieved from <https://www.tomedvedja.org.rs/index.php/smestaj/privatni-smestaj> (October 4, 2023) [*in English*: Tourist Organization Medveđa (2023), Accommodation Retrieved from <https://www.tomedvedja.org.rs/index.php/smestaj/privatni-smestaj> (October 4, 2023)].

23. Uredba o uslovima i načinu privlačenja direktnih investicija (“Službeni glasnik Republike Srbije”, br. 18/2018) [*in English*: Regulation on conditions and methods of attracting direct investments (“Official Gazette of the Republic of Serbia”, No. 18/2018)].
24. Uredba o određivanju kriterijuma za dodelu podsticaja radi privlačenja direktnih ulaganja u sektoru usluga hotelskog smeštaja (“Službeni glasnik Republike Srbije”, br. 33/2019 i 42/2019) [*in English*: Decree on determining the criteria for awarding incentives to attract direct investments in the hotel accommodation services sector (“Official Gazette of the Republic of Serbia”, no. 33/2019 and 42/2019)].
25. Uredba o utvrđivanju jedinstvene liste razvijenosti regiona i jedinica lokalne samouprave za 2014. godinu (“Službeni glasnik Republike Srbije”, br. 104/2014) [*in English*: Decree on establishing a unified list of development of regions and local self-government units for 2014 (“Official Gazette of the Republic of Serbia”, No. 104/2014)].
26. Uredba o planu mreže zdravstvenih ustanova (“Službeni glasnik Republike Srbije”, br. 5/2020, 11/2020, 52/2020, 88/2020, 62/2021, 69/2021, 74/2021 i 95/2021) [*in English*: Regulation on the plan of the network of health institutions (“Official Gazette of the Republic of Serbia”, no. 5/2020, 11/2020, 52/2020, 88/2020, 62/2021, 69/2021, 74/2021 and 95/2021)].
27. Zakon o izmenama i dopunama Zakona o poljoprivredi i ruralnom razvoju (“Službeni glasnik Republike Srbije”, br. 114/2021) [*in English*: Law on Amendments to the Law on Agriculture and Rural Development (“Official Gazette of the Republic of Serbia”, No. 114/2021)].
28. Zakon o turizmu (“Službeni glasnik Republike Srbije”, br. 17/2019) [*in English*: Law on Tourism (“Official Gazette of the Republic of Serbia”, No. 17/2019)].
29. Zakon o ulaganjima (“Službeni glasnik Republike Srbije”, br. 89/2015 i 95/2018) [*in English*: Law on Investments (“Official Gazette of the Republic of Serbia”, no. 89/2015 and 95/2018)].
30. Zakon o regionalnom razvoju (“Službeni glasnik Republike Srbije”, br. 51/2009, 30/2010 i 89/2015 – dr. zakon) [*in English*: Law on Regional Development (“Official Gazette of the Republic of Serbia”, no. 51/2009, 30/2010 and 89/2015 - other laws)].

DIGITAL MARKETING - MARKETING OPPORTUNITIES AND THE POWER OF DIGITAL CONSUMERS

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ABSTRACT

The article contrasts digital and conventional marketing while also examining the fundamentals of the idea of digital marketing, as well as its structure and characteristics in contemporary corporate environments. This study tries to pinpoint the key strategies for attracting and keeping people while utilizing digital marketing. The primary digital marketing tools are examined, and it is emphasized that there are no general answers for tool selection; rather, each tool must be chosen for a particular business. Digital marketing is the practice of promoting goods or services via the use of digital technology, mostly the Internet but also mobile devices, display advertisements, and other digital media. Digital marketing efforts are becoming more common and effective as digital platforms are integrated into daily life and marketing strategies and as more consumers use digital devices than physical stores. This essay largely focuses on conceptualizing digital marketing and how it benefits modern businesses.

Introduction

In today's fast-paced business world, new technologies are constantly emerging, providing innovative solutions that enhance productivity and efficiency. These advancements have revolutionized the way companies operate and interact with customers and have become an indispensable tool for success. One prominent example is cloud computing, which allows businesses to store and access data and resources

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remotely, reducing costs and increasing flexibility. Additionally, the rise of artificial intelligence and machine learning has enabled businesses to automate processes, analyze vast amounts of data, and gain valuable insights to make informed decisions. These new technologies have undoubtedly reshaped the business landscape and opened up endless possibilities for growth and development.

New technologies have become a game-changer in the field of agribusiness, transforming the way agricultural activities are conducted. These advancements have resulted in increased productivity, improved efficiency, and sustainable practices. One notable technology revolutionizing agro-business is precision agriculture, which involves the use of satellites, drones, and sensors for monitoring crop health, soil conditions, and irrigation needs. These data-driven solutions enable farmers to make informed decisions, optimize resource utilization, and minimize environmental impact.

A more modern marketing paradigm known as “new media marketing” or “consumer generated media” has replaced classic marketing principles as a result of recent technical advancements in communication. This modern phenomena, known as “Social Media,” expands on the fundamental ideas of traditional marketing concepts to create message that is more participatory, customer-focused, and electronically driven. The quality of the material is crucial for success with this kind of positive interaction and is a prerequisite for success discussed later. These new communication concepts have expanded around the world, and as media continues to be digitalized, more varied and endless marketing strategies have been developed. As a consequence, businesses have seen “improved marketing efficiency” (Knoblich, et al., 2017; Tiwari, 2018; Nica et al., 2023)

Another significant technological development in agro-business is genetic engineering. Scientists have been able to improve crop characteristics, such as disease resistance, yield potential, and nutritional value through genetic modification. This has paved the way for genetically modified organisms (GMOs), which have sparked debates about their potential risks and benefits. While some argue that GMOs can help address global food security concerns and reduce the reliance on pesticides, others are concerned about their long-term effects on human health and biodiversity. Nevertheless, it is evident that genetic engineering has the potential to revolutionize crop production and shape the future of agro-business.

From a conventional foundation, several writers have created various tactics that have progressed from traditional marketing to digital marketing (Lopez garcia, et al., 2019). Institutions need to anticipate impending disruptions and adjust their actions accordingly. Generally speaking, they have to communicate and interact with the intended audience. Numerous topics were examined, including the impacts of social media usage on B2B customer loyalty and the influence of users’ favorable attitudes about social networking sites on the development of positive attitudes toward social networking ads. Digital advertising and marketing have become indispensable tools in today’s business landscape, revolutionizing the way companies promote their products and engage with their target audience.

Literature review

In order for digital marketing to be successful for businesses, the key characteristics of digital content are usability, navigation, and speed. (Kanttila, 2004). Use of word-of-mouth WOM on social media and for popularizing the site are additional tried-and-true methods for succeeding with digital marketing. (Trusov, et al., 2009, Tavana, 2022). Nowadays, digital marketing has taken the role of tedious advertising and marketing techniques. Furthermore, due to its enormous capacity, it has the ability to significantly increase government efficiency and aid in the recovery of the economy.

A sophisticated kind of Internet marketing, digital marketing enables users to engage with offline clients and tailor their needs in addition to utilizing online technology. In addition to receiving current information on the required resource, the end user may also provide feedback through the interactive form and a range of tools, which helps to increase the number of interested parties (Serohina, et al., 2019). A large number of companies have recognized the importance of digital marketing during the pandemic.

COVID-19 By encouraging individuals to use social media and other web apps for their pleasure, socializing, shopping, and keeping up with the news, among other things, Pandemic served as an enabler. Looking specifically at marketing, Pandemic has prioritized mobile and social media marketing. (Dašić, et al., 2020; Mason et al., 2021). The figures are undisputed: Around four billion of the world's population are active social media users, and 98.8% of them access social media networks via mobile devices. In comparison to marketers with less expertise, those who have been using social media for at least a year had much higher success in terms of driving visitors. But physical purchasing intentions continue to outpace internet ones. (Dubbelink et al., 2021; 2021; Patil et al., 2021; Dašić, 2023).

The ongoing objective of marketing activity is the development of favorable customer-business relationships that result in value creation for both parties. To do this, it's crucial to focus on the right market segment, understand customer desires and expectations, and place a significant emphasis on establishing a base of dedicated customers. All of the aforementioned are still true in the field of digital marketing, which has introduced certain unique traits and requirements. (Wibowo et al., 2021). Digital marketing strategies include social networking, mobile apps, Internet advertising, viral content, contextual advertising, targeted advertising, native advertising, and content marketing, to name just a few. (Dašić, et al., 2023).

One of the most significant digital marketing channels, mobile marketing, enables customers to easily access a range of goods and services and to purchase and sell practically anywhere and at any time. Mobile marketing is a collection of tactics used by organizations to connect and communicate with customers in a vivid and engaging way, influencing their purchasing decisions. (Babu, Ramamoorthy, 2020; Dwivedi, et al., 2021; Nabieva, 2021).

Social media marketing is the practice of using websites and social media platforms to advertise goods and/or services. Social media significantly altered the dynamic between businesses offering goods and services and their customers. (Dašić, Jeličić, 2016). Consumers who spend a lot of time on social media nowadays use it as their primary source of information on goods and services since it has evolved into a major platform for communication and socializing, particularly among young people. Because of the convenience, self-organization, self-education, wealth of information, alternative possibilities, decreased cost, and time, social media users feel empowered and have more opportunities to participate online, which is greatly welcomed. (Babu, Ramamoorthy, 2020; Dubbelink et al., 2021; Labrovic et al., 2021).

Businesses have the opportunity to increase customer engagement through interactions beyond purchases, including customer idea generation, learning about customer preferences and other characteristics, leveraging positive Word of Mouth (WoM), and buzz marketing, by establishing brand presence on social media, especially on social networking sites. Gaining a competitive edge for a business through this specific digital channel implies improving brand recognition and image, which results in higher brand loyalty, which improves the effectiveness and efficiency of the company's entire marketing plan. (Babu, Ramamoorthy, 2020).

The incorporation of a digital marketing strategy into an organization's overall marketing strategy appears to be an unavoidable organizational answer for long-term and successful business outcomes. (Malesev, Cherry, 2021; Santos, Pinto-e-Silva, 2021; Tairova, 2021).

Results of one study's (Kotane, et al., 2019), findings indicate that chatbots and virtual assistants, as well as artificial intelligence, augmented reality, and machine learning, will be the most widely utilized digital marketing tools in 2019. Businesses should embrace a new perspective and work with multiple stakeholders in order to give value to consumers in a sustainable fashion and secure a position in the market. Utilizing data science and technological advancements, they can efficiently use vast amounts of diverse consumer data, take advantage of data analytics, and accurately predict consumers' changing preferences in order to develop market-adaptive digital marketing and overall marketing strategies. (Yosep et al., 2021).

Some authors (Rakić, Rakić, 2019), claim that market power is being redirected from companies to digital consumers. The primary sources of power for digital consumers are their connections with other consumers, their access to more information and expertise, their mobility, and ultimately their control over communications and impact on businesses. A company's communications and activities are under the control of many, knowledgeable, mobile, and connected consumers. The key area in which artificial intelligence (AI) may have a big influence on content development and marketing is based on data collected from consumers. Like AI, augmented reality may be used to provide customers more ways to see an item before they buy it (Han et al., 2021; Hassan, 2021). Digital consumers have power and this should not be seen

as a threat, but as an opportunity. Consumers in today's digital marketplace expect to be assisted, not sold to, when making selections about what to buy. Because of this, content marketing, customization, and interactive content are crucial for piquing customer interest, guiding users along the buyer's journey, and improving corporate results. It is anticipated that dynamic and engaging information would become more crucial for capturing consumers' attention and improving their overall experience. Although the expectations and aspirations of consumers drive the evolution of digital marketing, these advancements signify the beginning of new industry transformations (Slijepčević, et al., 2020).

Digital marketing

The word "digital marketing" refers to the activity of promoting goods and services using digital channels, such as websites, mobile applications, social media networks, search engines, and other marketing platforms. When the internet first went online in the 1990s, digital marketing started to gain popularity. Businesses commonly blend traditional and digital marketing techniques in their strategy and campaigns. Traditional and digital marketing concepts are similar and are generally viewed as a new way for businesses to engage with consumers and better understand their behavior (Mohamud, Alkhayat, 2022).

Table 1. Comparison of digital and traditional marketing

Traditional marketing	Digital marketing
Includes telephone, broadcasting, printing, and direct mail	Includes collaborations, search engine optimization, emails, social networks, and text messaging.
Time-consuming and expensive procedure	Quite a quick and inexpensive method to advertise
Long periods of time are spent planning advertising strategies.	Short-term plans are made for advertising campaigns.
The outcomes are simple to quantify.	The outcomes are mostly simple to quantify.
Reducing consumer audience reach because of fewer chances	Greater audience reach made possible by a variety of technologies and possibilities
There is no dialogue with the audience.	Interaction with the audience occurs
The link is just one-way	The link is reciprocal.
Only when working are answers possible to obtain.	The answer or feedback can appear at any time

Source: Authors

Organizations have plenty of time to observe the social environment and its behavior in a systematic and methodical manner before the Internet and social media. In the digital age, online advertising has evolved beyond simple banner ads and basic keyword searches. With the rise of technologies like artificial intelligence (AI) and machine learning, digital marketing has become more sophisticated, enabling businesses to create highly personalized and interactive campaigns. Through AI-powered algorithms, companies can analyze vast amounts of data to tailor their advertisements to individual users, creating a more engaging and relevant experience. Moreover, digital advertising

also allows for real-time feedback and adjustment, enabling companies to adapt their strategies on the fly and optimize their campaigns for maximum effectiveness.

In 2020, the market for digital advertising and marketing was valued at \$350 billion, and by 2026, it is expected to grow to \$786.2 billion. The market for digital marketing and advertising in the United States is presently valued at \$460 billion (Marino, 2023).

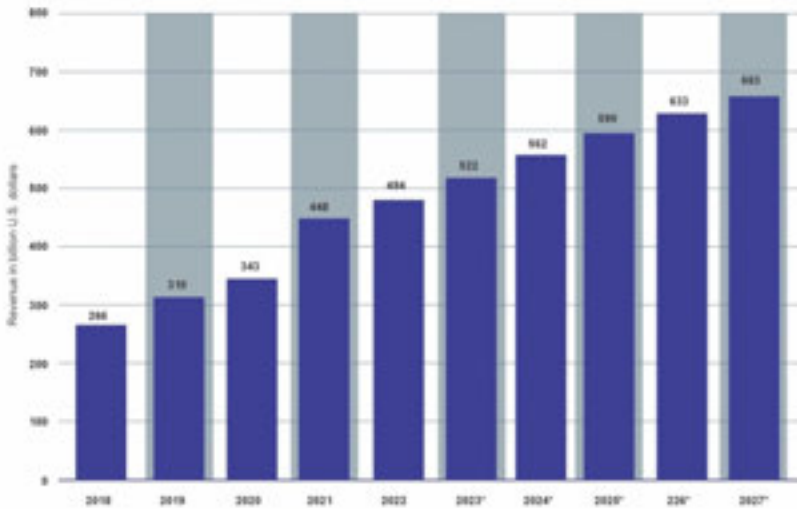
The digital advertising sector was exhibiting signs of strong development before the epidemic. However, the epidemic has hastened digital adoption, and the effect will last indefinitely. As a result, the market for digital advertising will develop more robustly in the years to come.

Digital advertising has become one of the most important tools for marketing on a global scale. A record-breaking 681 billion US dollars in global digital advertising spending was predicted to occur in 2023 as a consequence of rising internet penetration rates and the continuous demand for online content, particularly during the pandemic. When you consider that this figure accounts for more than 70% of all global advertising investments, it is even more astounding. However, despite the fact that this innovative and exciting type of advertising has seen significant growth in many regions of the world, the digital advertising market is getting more concentrated and aggressive every year. (Statista Research Department, 2023).

One of the major factors contributing to the widening distance between markets and businesses and one of the largest marketing difficulties is the internet (Figure 2). The way businesses operate and interact with their clients, consumers, and society at large has changed because to digital marketing. It is becoming into a crucial and imperative tool to meet the ongoing issues in the marketing industry.

In the implementation of the business process, there is a large amount of information that must be processed and directed to the executors. An adequate information system created for business needs should provide assistance in the areas of: planning and decision-making, business management and control, supervision of financial operations and human resources management (Stevanovic et al. 2022).

One of the major changes in the digitalization economy is the fast growth of global internet advertising revenue (Figure 1), multi-layered internet platforms, which often facilitate transactions between individual sellers of goods and services and peer-to-peer transactions (P2P). It previously took place outside the traditional business structure (Cipek, Ljutić, 2021).

Figure 1. Global internet advertising revenue from 2017 to 2027 (in billion U.S. dollars)

Source: <https://www.statista.com/statistics/237800/global-internet-advertising-revenue/>

One of the most often used examples to describe globalization is the expansion of the Internet during the last ten years. In the era of information and growing economic networks, electronic commerce, or e-Commerce, is viewed as one of the primary tools for promoting company expansion, labor mobility, and human connections (Saura, et al. 2017). However, the ubiquity of digital marketing also presents challenges. As the online landscape becomes increasingly cluttered with advertisements, businesses must find innovative ways to stand out and capture the attention of their target audience. This requires a thorough understanding of consumer behavior, market trends, and the ability to effectively utilize various digital advertising channels.

Digital marketing in agribusiness

Digital marketing encompasses any marketing campaigns that use technology or the internet in some way. Businesses use digital platforms, such as websites, social networks, email, and their own sites, to communicate with their current and future clients. Utilizing a multitude of digital platforms and networks to connect with customers where they spend a lot of time: online (Figure 2). It is essential for academics and managers to comprehend social media's function in the marketing setting. Current marketing research does not examine social media marketing in a comprehensive, all-encompassing manner. The term "holistic" describes the idea that the constituent parts of the overall structure are inextricably linked to one another (Felix, et al., 2017).

Figure 2. Methods of digital marketing



Source: (Desai, 2019)

The agriculture sector may utilize a range of strategies to advertise its goods and services on social media. One strategy is sponsored content, in which advertisements are visibly shown adjacent to consumers' regular activity. Because they are made for shorter content and have sizable user populations, social media platforms like Facebook, Instagram, and Twitter are frequently utilized for sponsored content advertising. In a similar vein, social media may be utilized to communicate with clients and potential clients directly. The industry may promptly address any queries from people interested in their products and services and receive immediate response through postings and comments (Dašić, et al., 2023).

Understanding better what consumers value in products and sustainable businesses is one of the key areas for the growth of sustainability. In today's digital age, the role of digital marketing in the agribusiness industry cannot be underestimated. As consumers increasingly turn to the internet for information and purchasing decisions, agribusinesses must adapt and utilize digital marketing strategies to stay competitive (Dašić, et al., 2022). One of the key advantages of digital marketing in agribusiness is the ability to reach a wider audience. With the help of social media platforms, blogs, and websites, agribusinesses can increase their visibility and engage with consumers from all over the world. This allows them to not only promote their products but also educate consumers about sustainable farming practices and the environmental benefits of choosing agribusiness products.

Digital marketing also offers agribusinesses the opportunity to gather valuable data and insights about their target audience. By analyzing website traffic, engagement on social media, and customer feedback, agribusinesses can gain a deeper understanding of consumer preferences and behavior. This information can be used to develop more targeted marketing strategies, tailor product offerings, and improve overall customer satisfaction. Additionally, digital marketing allows for real-time interactions

and feedback, enabling agribusinesses to quickly respond to customer inquiries and concerns, building trust and loyalty in the process (Dašić, et al., 2023).

Another benefit of digital marketing in the agribusiness industry is the potential to enhance supply chain efficiency. Through digital platforms, agribusinesses can connect with suppliers, distributors, and retailers, streamlining the process of getting products from farm to market. This allows for better coordination and planning, reducing wastage and increasing profits. Moreover, digital marketing can facilitate direct-to-consumer sales, eliminating the need for intermediaries and reducing transportation costs. Overall, digital marketing enables agribusinesses to optimize their operations, improve productivity, and drive sustainable growth (Zenga, et al., 2017).

E-commerce is clearly shown itself to be a key opportunity for cost reductions and demand development. Although some agri-food items' qualities provide some difficulties for companies looking to promote their goods online, there is still a lot of hope for the future of e-commerce in agriculture. The anticipation for agri-food e-commerce is further reinforced by the food supply chain's high degree of fragmentation. A vertical chain of following manufacturing, service, and trade operations that begin with the production of agricultural inputs leads to the provision of finished food products to clients. Incorporating e-strategy into participant interactions and trade operations in the food sector, as well as altering the configuration and connections at various levels and linkages of the food supply chain, is what is meant by "AE." (Fritz et al., 2004).

Following the mergers of some of the biggest agribusinesses in the world, questions have been raised regarding the new organizations' potential to serve as responsible global citizens and whether they would have an adverse effect on vulnerable rural people, particularly smallholder men and women farmers. These new businesses will be expected to play significant roles in identifying answers to the most pressing agricultural problems that the world is now confronting since they are innovation leaders in the agriculture sector. In order to close the innovation gap and make sure that sound science reaches nations where state funding for agricultural research is not a high priority, the private sector has a special voice and obligation. A new way of thinking about the sharing of technology is necessary to accelerate agricultural innovation and provide access to those advantages in order to better the lives of smallholder farmers. (Gafiney, et al., 2019).

Conclusion

New technologies have redefined agro-business, providing innovative solutions to address various challenges faced by the industry. Precision agriculture, genetic engineering, and blockchain are just a few examples of how technology is shaping the future of agriculture. These advancements ensure sustainable practices, increase productivity, and improve supply chain management. However, it is also important to carefully evaluate the potential risks and ethical implications associated with these technologies to ensure responsible adoption and sustainable agricultural practices.

Today, conventional forms of promotion are solely used by digital marketing to draw in customers and draw them into the virtual world. Digital marketing makes use of the most recent technology that enable you to communicate with clients in an efficient manner, as well as the traditional company growth strategies of Internet resources and conventional methods of promotion. It is crucial to take into account a number of factors when using digital marketing tools, including: high interactivity, which manifests in direct and prompt feedback to the audience; measurability of any user actions; and the ability to tailor advertising messages and products for particular target audience segments.

Agribusinesses now depend on digital marketing more than ever to promote their goods, interact with customers, and streamline operations. Agribusinesses may reach a bigger audience, get insightful data, and improve supply chain effectiveness by using the power of digital platforms. As the digital landscape continues to evolve, it is crucial for agribusinesses to stay abreast of the latest digital marketing trends and techniques in order to remain competitive in the industry.

For farmers looking to get more exposure, internet marketing is a fantastic tool. Through the use of contemporary technology, farmers may quickly enhance their competitive edge and reach a larger audience by developing social media-based Internet promotion methods. The senior population's poor network infrastructure or lack of education account for the underutilization of information technology and tools.

Conflict of interests

The authors declare no conflict of interest.

References

1. Babu, V.P., & Ramamoorthy, R. (2020). A study on social media and digital marketing. *Malaya Journal of Matematik*, S(2), 3193-3195, <https://doi.org/10.26637/MJMOS20/0821>
2. Cipek, K., & Ljutić, I. B. (2021). The influence of digitalization on tax audit. *Oditor*, 7(1), 37-69. <https://doi.org/10.5937/Oditor2101037C>
3. Day, G.S. (2011) Closing the Marketing Capabilities Gap. *Journal of Marketing*, 75, 183–195. <https://journals.sagepub.com/doi/10.1509/jmkg.75.4.183>
4. Dašić, D., & Jeličić, G. (2016). Marketing of personality and/or sportsmen personal branding. *Sports, media and business*, 2(2), 51–57. Retrieved from <https://www.smb.edu.rs/index.php/smb/article/view/90>
5. Dašić, D., Tošić, M., & Deletić, V. (2020). The impact of the COVID-19 pandemic on the advertising and sponsorship industry in sport. *Bizinfo (Blace)*, 11(2), 105-116. DOI: 10.5937/bizinfo2002105D
6. Dašić, D., Ratković, M., & Pavlović, M. (2021) Comercial aspects Personal branding of athletes on social networks. *Marketing, Vol 52, br 2*, 118-132. <https://scindeks-clanci.ceon.rs/data/pdf/0354-3471/2021/0354-34712102118D.pdf>.

7. Dašić, D., Stanić, T., & Živković, D. (2022). Market of agricultural and food products in the republic of Serbia: possibilities and implications. *Economics of Agriculture*, 69 (1), 57–74. <https://doi.org/10.5937/ekoPolj2201057D>
8. Dašić, D., Ratković, M. Marčetić, A., & Tošić, M. (2023) Promotion on the internet as a function of agribusiness development in central serbia. *Economics of Agriculture*, Vol 70, 6p.2, 479-491- <https://doi.org/10.59267/ekoPolj2302479D>,
9. Dašić, D. (2023). Application of delphi method in sports. *Sports, media and business*, 9(1), 59–71. <https://doi.org/10.58984/smb2301059d>
10. Dwivedi, Y.K., Ismagilova, E., Hughes, D.L., Carlson, J., Filieri, R., Jacobson, J., Jain, V., Karjaluoto, H., Kefi, H., Krishen, A., Kumar, V., Rahman, M.M., Raman, R., Rauschnabel, P.A., Rowley, J., Salo, J., Tran, J.A., & Wang, W. (2021). Setting the future of digital and social media marketing research: Perspectives and research propositions. *International Journal of Information Management*, 59, 102168. <https://www.sciencedirect.com/science/article/pii/S0268401220308082>
11. Desai, V. (2019). Digital Marketing: A Review. *International Journal of Trend in Scientific Research and Development (IJTSRD)*.196-200. <https://doi.org/10.31142/ijtsrd23100>
12. Dunakhe, K. & Panse, C. (2022). Impact of digital marketing – a bibliometric review, *International Journal of Innovation Science*, Vol. 14 No. 3/4, pp. 506-518. <https://doi.org/10.1108/IJIS-11-2020-0263>
13. Dubbelink, S.I, Herrando, C., & Constantinides, E. (2021). Social Media Marketing as a Branding Strategy in Extraordinary Times: Lessons from the COVID-19 Pandemic. *Sustainability*, 13, [10310.https://doi.org/10.3390/su131810310](https://doi.org/10.3390/su131810310)
14. Fritz, M., Hausen, T., & Schiefer, G. (2004). Developments, development directions of electronic trade platforms in US and European agri-food markets: impact on sector organization. *International Food and Agribusiness Management Review* 7: 1-21. <https://ideas.repec.org/a/ags/jfaamr/8146.html>
15. Felix, R., Rauschnabel, P., & Hinsch, C. (2017). Elements of strategic social media marketing: A holistic framework. *Journal of Business Research*, 70, 118–126. [doi:10.1016/j.jbusres.2016.05.001](https://doi.org/10.1016/j.jbusres.2016.05.001)
16. Gaffney, J., Challendera, M., Califfa, K., & Harden, K.(2019).Building bridges between agribusiness innovation and smallholder farmers: A review, *Global Food Security* 20, 60-65, <https://doi.org/10.1016/j.gfs.2018.12.008>
17. Han, R., Lam, H. K., Zhan, Y., Wang, Y., Dwivedi, Y. K., & Tan, K. H. (2021). Artificial intelligence in business-to-business marketing: a bibliometric analysis of current research status, development and future directions. *Industrial Management & Data Systems*, 121(12), 2467–2497. <https://doi.org/10.1108/imds-05-2021-0300>
18. Hassan, A. (2021). The Usage of Artificial Intelligence in Digital Marketing: A Review. Applications of Artificial Intelligence in Business, *Education and Healthcare*, 357–383. https://doi.org/10.1007/978-3-030-72080-3_20

19. Yosep, M.A, Mohamed, M., Yusliza, M.Y, Saputra, J., Muhammad, Z.,& Bon, A.T. (2021). Does Digital Marketing Platforms affect Business Performance? A Mini-Review Approach. *Proceedings of the 11th Annual International Conference on Industrial Engineering and Operations Management Singapore*, March 7-11. <http://ieomsociety.org/ieom/proceedings/>
20. Kanttila N. K. (2004). Digital Content Marketing: A Literature Synthesis, *Journal of Marketing Management*, Volume 20, Issue 1-2, pg-45-65. <https://doi.org/10.1362/026725704773041122>
21. Kotane, I., Znotina, D., & Hushko, S. (2019). Assessment of trends in the application of digital marketing. *Scientific Journal of Polonia University*, 33(2), 28-35. <https://doi.org/10.23856/3303>
22. Knoblich, S., Martin, A., Nash, R., & Stansbie, P. (2017). Keys to success in social media marketing (SMM) – Prospects for the German airline industry. *Tourism and Hospitality Research*, 17(2), 147-164. <https://doi.org/10.1177/1467358415610415>
23. López García, J., Lizcano, D., Ramos, C. & ve Matos, N. (2019). Digital Marketing Actions That Achieve a Better Attraction and Loyalty of Users: An Analytical Study, *Future Internet*, 11, 130, 1-16. <https://doi.org/10.3390/fi11060130>
24. Leeflang, P.S.H., Verhoef, P.C., Dahlström, P., & Freundt, T. (2014) Challenges and solutions for marketing in a digital era. *Eur. Manag. J.*, 32, 1–12. <https://doi.org/10.1016/j.emj.2013.12.001>
25. Mason, A. N.; Narcum, J.; & Mason, K. (2021). Social Media marketing gains importance after COVID-19, *Cogent Business & Management*, 8:1, 1870797, <https://doi.org/10.1080/23311975.2020.1870797>
26. Marino, S. (2023). Strategy-Changing Digital Marketing Statistics for 2023. <https://www.wordstream.com/blog/ws/2022/04/19/digital-marketing-statistics>
27. Mohamud, A., & Alkhayyat, A. (2022). *The impact of artificial intelligence in digital marketing*. School of Business, Society and Engineering, Mälardalen University. <https://www.diva-portal.org/smash/get/diva2:1663148/FULLTEXT01.pdf>
28. Nabieva, N. (2021). The use of digital technology in marketing. *Buletin of Science and Practice*, T 7, 375-381. <https://doi.org/10.33619/2414-2948/67/42>
29. Nica, E., Popescu, G. H., Poliak, M., Kliestik, T., & Sabie, O. M. (2023). Digital Twin Simulation Tools, Spatial Cognition Algorithms, and Multi-Sensor Fusion Technology in Sustainable Urban Governance Networks. *Mathematics*, 11(9), 1981.
30. Patil, V., & Kumar, A. (2021). A viewpoint on digital marketing and usage of social media tools during covid-19 pandemic. *Academy of Marketing Studies Journal*, 25(2). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3884016
31. Rakić, M., & Rakić, B. (2019). The market power of digital consumers in 24/7/365 connected world. *Megatrend revija*, Vol. 16, № 2,: 79-100. <https://scindeks-clanci.ceon.rs/data/pdf/1820-3159/2019/1820-31591902079R.pdf>
32. Saura, J., Sanchez, P. & Suarez, L. (2017). Understanding the Digital Marketing Environment with KPIs and Web Analytics, *Future Internet*, 9, 76, www.mdpi.com/1999-5903/9/4/76

33. Statista Research Department (2023). Digital advertising worldwide - statistics & facts. <https://www.statista.com/topics/7666/internet-advertising-worldwide/#topicOverview>
34. Stevanović, A., Mitrović, S., & Rajković, A. (2022). Application of information technologies and the internet in modern business. *Oditor*, 8(2), 54-74. <https://doi.org/10.5937/Oditor2202054S>
35. Slijepčević, M., Radojević, I., & Perić, N. (2020). Considering modern trends in digital marketing. *Marketing*, 51(1), 34-42. <https://doi.org/10.5937/markt2001034S>
36. Serohina, N., Petryshchenko, N. & Andrić, B. (2019). Digital Marketing in Hotels, *Marketing and Digital Technologies*, Vol: 3(3), 35-42. <https://mdt-opu.com.ua/index.php/mdt/article/view/75/73>
37. Tiwari, S. (2018). *History of Digital Marketing: The Evolution that started in the 1980s.*, <https://www.digitalvidya.com/blog/history-of-digital-marketing/>
38. Trusov, M. Bucklin, R.E., & Pauwels, K. (2009). Effects of Word-of-Mouth Versus Traditional Marketing: Findings from an Internet Social Networking Site. *Journal of Marketing*: Vol. 73, No.5,90-102. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1129351
39. Tavana, M., Shaabani, A., Raeesi Vanani, I., & Kumar Gangadhari, R. (2022) A Review of Digital Transformation on Supply Chain Process Management Using Text Mining. *Processes*, 10, 842. <https://doi.org/10.3390/pr10050842>
40. Wibowo, A., Chen, S.-C., Wiangin, U., Ma, Y., & Ruangkanjanases, A. (2021). Customer Behavior as an outcome of Social Media Marketing: The Role of Social Media Marketing Activity and Customer Experience. *Sustainability*, 13, 189. <https://doi.org/10.3390/su13010189>
41. Zenga, Y., Jiab, F., Wanc, L., & Guo, H. (2017). E-commerce in agri-food sector: a systematic literature review. *International Food and Agribusiness Management*, Volume 20 Issue 4, 439-460; DOI: [10.22434/IFAMR2016.0156](https://doi.org/10.22434/IFAMR2016.0156)

BRANDING OF THE DESTINATION OF PODGORINA THROUGH THE ROUTE OF “RAKIJA ŠLJIVOVICA”, A UNESCO HERITAGE ROUTE

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ABSTRACT

Plum brandy is one of the most recognizable symbols of Republic of Serbia. Production of plum brandy is recently on the UNESCO list and can be a very significant factor in the process of promoting the destination from the aspect of tourism. Looking at the current situation, through positive examples of practice and a review of the theoretical framework, the collection of statistical data obtained on the basis of previous research, it was observed that the destination of Podgorina has numerous predispositions for branding. The aim of this paper is to point out the importance of the formation of “The Rakija Šljivovica Route”, where the production of plum brandies would be a significant component of the branding process of the destination. In this way, permanent migration from rural to urban areas would be slowed down, the rich cultural heritage of this region, agriculture and traditional occupations would be revived.

Introduction

There is extensive literature of plum and plum brandy, as well as oral discussions. Production of plum brandy was included in the list of intangible cultural heritage of Serbia and then in the prestigious UNESCO list. Plum, and especially plum brandy, are one of the most recognizable symbols of Serbia and one of the first associations

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with our country among foreigners. In the destination, plum growing dominates the fruit production, while a huge percentage of the total plums produced is processed into plum brandy. Through the paper, in addition to the analysis of fruit production, and was analyzed the concept of intangible cultural heritage was explained, as well as its importance and influence on the branding of the tourist destination. At the end, it was considered how the production of plum brandy - šljivovica as an intangible cultural heritage of Serbia can be a component of attraction in the process of branding the destination of Podgorina through the formation of the "The Rakija Šljivovica Route" and its tourism valorization for the purpose of strengthening Podgorina villages and stopping depopulation in this area.

Based on the objectives of the paper, the following is set:

1. Basic hypothesis: The branding of the destination Podgorina through the formation of the "Podgorina Rakija Šljivovica Route" leads to greater interest of tourists in visiting this destination.
2. Auxiliary hypothesis 1: Increased interest in visiting the destination of Podgorina enables faster development of tourism in the destination.
3. Auxiliary hypothesis 2: The development of tourism in the destination Podgorina leads to the economic empowerment of Podgorina villages.
4. Auxiliary hypothesis 3: The economic empowerment of Podgorina villages stops the depopulation of the area and creates the conditions for a return to the countryside.

The theoretical framework of the intangible cultural heritage and source of value of the tourist destination brand

UNESCO World Heritage List is also used as a means of attracting large numbers of tourists, given that the tangible or intangible heritage on this list is an important attraction for tourists (Ryan & Silvano, 2009; Huang et al., 2012). The number of tourists visiting World Heritage Sites is steadily increasing (Shackley, 2006; Yang et al., 2010), which encourages communities to preserve it and present it in the best possible manner to tourists. Bearing in mind the importance of the UNESCO cultural heritage list, the subject of research in this study is the examination of intangible cultural heritage in the context of cultural and agro tourism based on traditional Serbian spirit. The paper also gives recommendations for a new modern form of tourism - route of „rakija šljivovica“. According to Portuguese creative tourism network, creative tourism combines different elements of tourism and creative content and incorporates them into the lifestyle. Consumers or travelers desire to participate actively in the experience and explore their creative potential or activities in the location (CREATOUR, 2017).

According to the basic division based on the type of material, cultural heritage is divided into: (Krivošejev, 2014)

- Movable material cultural heritage
- Immovable material cultural heritage
- Intangible cultural heritage

All natural and anthropogenic resources that are an integral part of one ambient unit represent tourist resources and as such can be used for tourist purposes and contribute to the economic development of each destination. After the completion of the shaping process, cultural resources can become or are becoming tourist resources of a destination, and after the completion and shaping of the process of presentation and interpretation, they become a cultural product. Based on the degree of attractiveness, aesthetics, uniqueness and landmarks, the cultural, touristic and economic value of each resource is assessed, and this assessment is also influenced by the favorable geographical location, traffic connections and distance from the emission centers, as well as by the source of demand and its size and finally the position of resources in relation to competitive and complementary tourist destinations (Mc Kercher & du Cros, 2002).

In recent years, a shift in focus has been observed in the cultural tourism sector, both on the demand side and on the supply side, in the direction from the dominant representation of immovable to movable and intangible heritage and products of cultural industries. This move, in addition to all the positive sides, also hides certain dangers, primarily related to the uncontrolled exploitation of these resources. For this reason, the management of cultural heritage as a whole implies systemic care, so that it is accessible, not only to present, but also to future generations (Jelinčić, 2010). The offer of tourism based on cultural resources intensifies the mutual influence of culture and tourism and reduces the negative effects on local communities. While the promotion of tangible cultural heritage has a long tradition, intangible heritage is just beginning to take its place in the tourist offer (Steward, 1981; Bandić, 1997).

Intangible cultural heritage consists of non-physical aspects of a certain culture, that is, social customs created during the historical development of a specific social community. (Krivosejev, 2014). According to the “Convention on the Preservation of the Intangible Cultural Heritage” intangible cultural means practices, representations, expressions, knowledge and skills as well as instruments, objects, artifacts and cultural spaces connected with them - which communities, groups and in some cases individuals recognize as part of their cultural inheritance. Such intangible cultural heritage, which is passed down from generation to generation, is recreated by communities and groups depending on their environment, their interaction with nature and their history, providing them with a sense of identity and continuity and thus promoting respect for cultural diversity and human creativity” (Official Gazette of the RS, 2010).

According to this Convention, intangible cultural heritage is manifested in several areas: (Official Gazette of the RS, 2010)

- oral traditions and expressions, including language as a carrier of intangible cultural heritage,

- performing arts,
- social customs, rituals and festive events,
- knowledge and customs concerning nature and space,
- skills related to traditional crafts

In order to preserve intangible cultural heritage, it is necessary to act according to the principles of sustainable development, i.e. in the direction of passing it on to the next generations and create the conditions for that process to be sustainable with constant interaction with nature and with respect for cultural diversity and human creativity. The achievement of this goal also depends on the interest of the community and the bearers themselves to preserve their intangible cultural heritage and pass it on to future generations. The success in achieving this goal, also, depends to a large extent on the cooperation of all actors in the chain of the protection system, which consists of the bearers of the heritage, local community, institutions and professional bodies.

According to Morgan branding was applied to consumer products long before the industrial revolution, but the idea of tourist destinations that follows the formulation of brand strategy (Morgan et al., 2015). According to Becker and Cameron, tourism destination marketing should “encompass all activities and processes that connect sellers and buyers, focusing on responding to consumer demands and competitive positioning (Baker & Cameron, 2008). Kerr and Miletić conclude that “The brand of the destination provides the promise of a pleasant travel experience to a certain destination for potential visitors, and for those who have already visited a certain destination, it serves to consolidate and strengthen the memory of good experiences” (Kerr, 2006; Miletić et al., 2023).

In addition to these characteristics, the destination brand includes the perceptions that a person has about a place and the key characteristics that the end users of tourist services remember. These are permanent and essentially values that differentiate a destination from competing areas. In order to achieve results, a strategic approach to destination branding is very important, and it includes the ways in which a destination communicates with the target group, while at the same time, nurturing, developing and presenting all the characteristics of the destination so that in the process it establishes, strengthens and even changes its image and reputation (Handbook on Tourism Destinations Branding, 2009). The conclusion is that the destination brand exists only and exclusively in the eyes of the consumer, not the creator of the offer.

According to the UNWTO, the main characteristics and forms of the tourist product are: accommodation services for visitors, catering services, passenger transportation (in road, rail, ship and air traffic), rental services of means of transport, services of travel agencies and other reservation services, cultural, sports and recreational services, specific tourist products (tourist souvenirs, etc.) and tourist services specific to a certain country (UNWTO, 2022). The goal of branding geographic locations for tourism purposes is to make people aware that that location exists and to acquire positive associations about that location (destination).

Veljković and Đorđević (2011) in their paper “Branding the destination and creating value for tourists”, and based on the views of Becker, Cameron and Hankinson, say that “the key factors of the success of the branding strategy are: strategic orientation, developing the appropriate identity of the destination, creating the desired image, involvement of stakeholders and good implementation, monitoring and revision of the strategy. That is why it is necessary to: develop an appropriate branding culture, establish appropriate leadership, ensure good cooperation between departments, create partnerships between interested parties, as well as establish adequate communication. Building and nurturing a destination brand is therefore a strategic decision and, generally speaking, it goes through several stages, namely: market research, analysis and determination of strategic development directions; developing brand identity and desired image; introducing and presenting the brand to the target market, communicating its vision; implementation (strategy) of the brand and monitoring, evaluation and revision. The main goals of destination branding are related to the stages of consumer guidance from ignorance to visiting the destination, and according to the primary tourist motives. That is why it is necessary to differentiate it from the competition, develop awareness and recognition among potential visitors, create a positive image (and thus increase the probability of visiting the destination) and create a strong and convincing brand identity”.

Innovative cultural and tourist products enrich the basic product, ie. destination brand, will increase consumption, tourist length of stay and satisfaction their stay (Gajić et al., 2021). When we talk about destination branding, we must know that it involves connecting different elements of value that already exist at the destination into a single whole, and this is achieved by integrating the elements of value of different carriers of the tourist offer at the destination, as well as natural and anthropogenic characteristics. In this way, the destination becomes recognizable on the market, guarantees quality, offers an unforgettable experience and emotional benefits for tourists. “Tourism is seen as a necessity due to the promotion of the tourist destination and building its identity through the goods of tangible and intangible cultural heritage, which ultimately provides funds for its preservation. The development of tourism based on cultural and historical heritage needs to be viewed through the prism of the funds secured in this manner, which can be directed to the protection and further promotion of heritage” (Sančanin et al., 2023).

As already stated, there are different sources of value in tourist destinations and it is difficult to observe them separately, because tourists perceive them as a unique value, which influences the creation of a unique experience. The main sources of value in destinations can be:

1. The quality and organization of natural attractions: the possibility of staying and visiting the unique natural environment; the existence of natural facilities for various activities (swimming, skiing, surfing, rafting, etc.); arrangement and adequate content with natural attractions in the destination (night lights, entertainment facilities, attractive viewpoints, etc.);

2. The existence of cultural and historical sights and the possibility of visiting them: the existence of organized tours and the mood in the group during the tour; the familiarity of the locality and its importance in world history and culture; arrangement and presentation on the site (inscriptions, interpretation...);
3. The quality of the content of the stay in the destination: the existence of activities that do not exist near the place of permanent residence (diving, skiing, etc.); the possibility of getting to know new landscapes, history, architecture and culture; entertainment during the stay (cafes, discos, etc.); the possibility of getting to know and getting closer to the local population and tourists from other areas;
4. Built content and infrastructure with or outside of natural attractions that increase the comfort of stay: the connection of different attractions into a single whole; separate centers of natural attractions that offer the possibility of enjoyment, rest and activities (aqua parks, sports fields, etc.); facilities with natural attractions that enable an active holiday (ski jumping hills/ jumping ramp*, scooter rental...);
5. Destination information: information about attractions and experiences in the destination; information about hotels and other providers of tourist offers (local agencies, restaurants, etc.);
6. The brand of the destination and economic actors in the destination: the image and brand of the destination per se; the hotel brand in the destination; the brand of the tour operator that organizes the trip to the destination; the brand of local travel agencies that provide services; familiarity and image of localities and attractions in the destination. (Veljković, Đorđević, 2011, p. 53);
7. The image of the tourist destination, which has an impact on the recognition of the experience that can be experienced in the destination and also affects the social value for tourists (to what extent the stay in a certain destination reflects the social status of the tourist). (Veljković, Đorđević, 2011, p. 55)

Contemporary theory that deals with topics in the field of tourism states that the brand of a tourist destination has a significant influence on the decision-making process on the demand side regarding the choice of destination. The basic values created by brands can be systematized as follows

1. The recognizability of the offer (which can be treated as the recognizability of the carrier or destination);
2. A clear idea of the benefits (values) and experience that tourists can get during their stay and use of services in tourist destinations;
3. Different values that distinguish the destination from other destinations (in essence, the basis of the created value implies that, with minimal risks, the

basic competitive advantage of the destination compared to others is clearly recognized; in this way, the need for additional information collection is reduced and the risks in the process are minimized decision-making, which is reflected in increasing value for consumers);

When we consider afore stated, we conclude that the value in destinations is a very complex category, and the destination brand is singled out as a special element of value, which leads to the conclusion that in modern business conditions, the brand has great importance. The importance of the brand in tourism stems from the fact that the brand is a significant source of value for tourists, and that it affects the value created and delivered to tourists, which ultimately affects the destination's competitiveness on the market. When we observe the impact of a brand on consumers and their purchase decisions, we start from the analysis of the basic dimensions of the brand: (Keller et al., 2008).

Materials and Methodology

The methodological framework includes an overview of the theoretical field of cultural, intangible heritage and destination branding for the purpose of tourism development. By defining the basic terms and collecting data at the table through the analysis of existing statistical data, obtained in previous research, the analysis of a positive example of the impact of receiving UNESCO protection on the development of tourism, the results were obtained. Secondary sources were also used, such as domestic and foreign literature, data from the Tourism Development Strategy in the Republic of Serbia, especially the Draft of Osečina Development Program 2023-2027 (Draft Tourism Development Program of the Osečina Municipality 2023-2027). Using the analysis method, the relevant characteristics of the tourist potential and shortcomings of the destination and intangible heritage were observed and recommendations were given for future development, which can significantly improve the rural areas of the Republic of Serbia, Podgorina. Description as a method was used to interpret the available data. The synthesis led to the confirmation of the initial hypotheses.

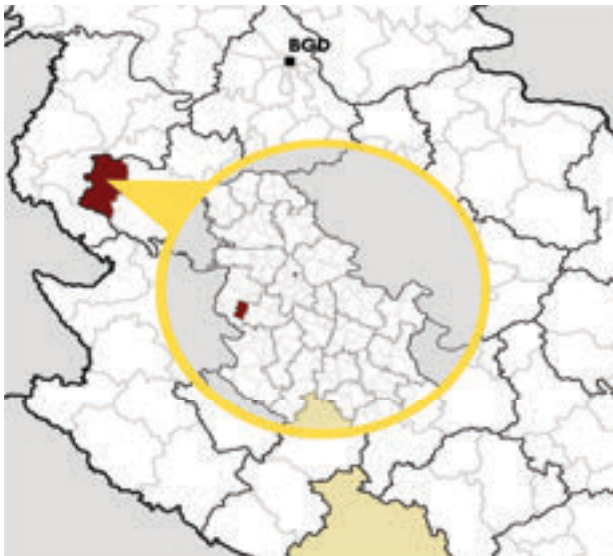
Geographical - traffic and relevant demographic and tourist characteristics

Podgorina stretches east from Podrinje, to the Tamnava, Kolubara and Ljig rivers and includes the Valjevska basin and the Suvobor, Povlen, Jablanik and Medvednik mountains. The name Podgorina comes from the time when dense forests prevailed in the area. The municipality of Osečina, with an area of 319 km², is located in Podgorina, in the west of central Serbia, and has a relatively good geographical and traffic position. Its territory is crossed by two state roads. The state border with Bosnia and Herzegovina, at a distance of 44 km, and the proximity of the future highway Belgrade - Požega and the railway line Valjevo - Loznica, offer the possibility of yourist animation of transit traveler and excursionists.

Osečina is 120 km far from Belgrade, 128 km from Novi Sad, 34 km from Valjevo, 57 km from Šabac, and 151 km from Kragujevac, which is favorable for domestic tourism (*Figure 1*). The poor state of the local network of roads and traffic infrastructure, in

particular, makes communication difficult and affects the isolation of certain settlements and localities in terms of functionality and development. The roads have unfavorable geometrical characteristics, which is mainly due to the hilly and mountainous configuration of the terrain. Limiting factors are inadequate and incomplete roads and their irregular and inadequate maintenance. Traffic and tourist signage is solid but sporadic, which reduces traffic safety and the accessibility of some tourist locations. Rural settlements are still untapped tourist potential, slightly represented in the tourist offer (*Table 1*). Eliminating these weaknesses is hampered by the lack of material resources. The passage of the state road of the first order through the town of Osečina is also a disadvantage, because at every intervention within the urban area traffic is stopped.

Figure 1. Map of the destination location



Source: authors

Based on the guidelines from the Spatial Plan of the Republic of Serbia 2010 to 2020, the southern hilly-mountainous part of the Municipality of Osečina belongs to the primary tourist destinations with a dominant summer and modest winter offer in the Valjevo-Podrinjska Planina-Drina stretch. However, in the municipality of Osečina, not much has been invested in tourism for decades, so the material base of tourism is in the process of being formed.

According to the first results of the 2022 Census of Population, Households and Dwellings, 10,011 inhabitants live in the municipality of Osečina according to the 2022 census, 2,525 less than in 2011. The population density is 31.38 people/km², which is far from the average for RS, which is 75.65 people/km². The average age of the municipality's population is 45.9 years, which is above the average for Serbia of 42.2 years.

Table 1. Available data on tourist traffic

Year	Number of overnight stays
2017.	294
2018.	283
2019.	386
2020.	744
2021.	1788
2022.	1915

Source: Tourist organisation “Podgorina” Osečina.

Table 2. Percentage of domestic and foreign tourists

Domestic tourists	Foreign tourists
82,67%	17,33%

Source: Tourist organisation “Podgorina” Osečina

Table 3. Accommodation in the municipality of Osečina in 2023.

Type of accommodation	Name/place	category	Number of objects	Number of beds	Number of rooms
Hotel	-	-	-	-	-
Motel	-	-	-	-	-
Hostel	Sport center „Osečina“	-	1	22	8
Total			1	22	8
Private accommodation					
Lodgings for the night	Restaurant with lodging for the night „Dragić“	-	1	12	6
	Lodging for the night „Čava S“	-	1	23	7
	Restaurant with lodging for the night „Dragić“	-	1	8	3
Rural households	„Sokolske kolibe-Rožanj“ (Igor Rabat)	***	1	2	1
	Aleksandar Lukič	***	1	8	4
Total			6	75	29

Source: Tourist organisation “Podgorina” Osečina

Plum brandy - šljivovica as part of the branding strategy of the destination of Podgorina by forming “The Rakija Šljivovica Route”

The list of intangible cultural heritage of Serbia includes 55 elements that form the core of Serbia’s cultural identity. On the proposal of the National Museum from Čačak on October 15, 2015 the production method of šljivovica spirit, was entered as an intangible cultural heritage of Serbia on the list of intangible cultural heritage of Serbia under number 30 (National Register of Intangible Cultural Heritage, 2022).

Traditional „šljivovica“ was registered in 2022 (17.COM) on the Representative List of Intangible Cultural Heritage of Humanity. “The element includes complex knowledge and skills for the preparation of drinks in the home environment as well as its use in everyday and ritual practices. Preparation has multiple phases involving families and communities. Plums are most often grown on family farms and harvested in the fall. They are boiled for 20 to 30 days and then distilled in handmade copper stills to produce a mild spirit. A stronger spirit is obtained by the second distillation. The last stage is aging in a barrel, usually made of oak, for at least one year. On festive occasions and during family celebrations, šljivovica accompanies toasts with wishes for health and well-being. It is also an important part of traditional medicine, where medicinal herbs or fruits are added to obtain medicines against colds and pains or antiseptics. In winter, boiled spirit is consumed. The practice is mainly passed down within families and communities, with younger members acquiring knowledge over time through gradual involvement in the various stages of preparation and use of plum spirit. Women also attach great importance to the transmission of knowledge and skills related to rituals, traditional medicine and gastronomy. Related craft knowledge, such as making copper vessels, is transmitted in workshops” (UNESCO, 2022).

A place on the UNESCO list ensures global visibility and recognizability of the product, which now places the tourist potential of the brand and destination in a very significant and favorable position. Serbia now has 5 elements on UNESCO’s Representative List of Intangible Cultural Heritage, namely: family Saint Patron’s Day since 2014, kolo - a traditional folk dance since 2017, singing with the fiddle since 2018, Zlakusa pottery since 2020 and now plum spirit from 2022. In this way, the number of foreign tourists could be significantly increased, since this ratio is very unfavorable today (*Table 2*), but the imminent inclusion of Šljivovica on the UNESCO list could very well start this trend. “Cultural heritage is a tool of the tourism industry to attract tourists to visit a country” (Stojanović et al., 2022).

Plums and plum products, especially spirit, occupy a special place in Serbian tradition, whether it is customs and beliefs or everyday life. This claim is supported by a large number of toponyms and family surnames that have plum or spirit as their base, and this tells us about the origin, lifestyle, occupations, etc. of the progenitors of those families and the regions where they lived and worked or came from. (Lazić, 2007). In his book “Šljiva, bre!”, Petar Lazić talks about how much the plum is represented in Serbian customs and ceremonies and how important it is in Serbian culture and tradition. A large number of folk epic songs talk about plum spirit and its influence on the combat morale and heroism of the Serbian insurgents in the battles against the Turkish invaders. Hence, Pavle Sofronić from Niš, writing about plum, says, “It goes without saying that in today’s civilized society, there is a different opinion about spirit.” But let’s not forget that our heroic ancestors would have had a hard time freeing themselves with their bare fists from their centuries-old oppressors, if they drank milk and boza instead of spirit” (Sofronić, 1990). Spirit is highly represented in the customs of the annual and life cycle, and because of this, in some Serbian regions, it has completely or partially

supplanted wine from cult practice. (Stojaković, 2000). Spirit is produced in almost every rural household, but it is mostly consumed there, because it is drunk on various occasions, so that there is no celebration in Serbs that can pass without the use of spirit (Antonić, 2004).

As plum brandy ranks as one of the most recognizable symbols of Serbia and that the production of plum spirit is on the list of intangible cultural heritage of Serbia and that as such it must be one of the significant factors in the process of promoting Serbia from the aspect of tourism. A special aspect and the most significant fact of this claim is the fact that since 2022, šljivovica spirit has been included in the UNESCO list of intangible cultural heritage, and as such, it now represents not only the heritage of Serbia, but also the heritage of humanity, which is a new moment and strength of the brand's potential .

Plum is the most represented fruit crop in the territory of the municipality of Osečina, because it occupies 56% of the total area of agricultural land under fruit. (Strategy of rural development and agricultural development in the municipality of Osečina from 2016 to 2026, p. 39). Despite the large number of processing capacities, 70% of the plums produced in the municipality of Osečina are processed into spirit, of which 95.6% is consumed in Serbia (Strategy of rural development and agricultural development in the municipality of Osečina from 2016 to 2026). Based on these data, the conclusion is made that plum brandy - šljivovica and the production process should be a trump card in the process of branding destination of Podgorina by creating "The Rakija Šljivovica Route" as a new tourist product of the destination.

As already mentioned, a large share of plum processing goes to spirit, and in the area of Osečina, only one company is engaged in the production of alcoholic beverages, while the rest of the processing capacities are within rural households. The chance for plum brandy - šljivovica to become a brand of the destination, and the "rakija šljivovica" as a new tourist product of this destination, can be found in the event that spirit producers are included in tourist flows, that production is modernized, that the products of local brandy producers occupy a significant place in the catering offer of the destination, enriching the catering offer in households that provide or will provide services in rural tourism with local specialties and products produced at the destination. In this way, the agrarian tourism of the destination develops, the village develops and further depopulation is prevented. The benefits for tourists are multiple, in addition to getting to know the sights and famous people of the destination, enjoying the exceptional natural beauty, they can try the gastronomic offer of the destination and enjoy the flavors of the spirit of this region, but during their stay they can experience the life of a Podgorina peasant and participate in the process of making plum brandy and make plum brandy which they produced, they take with them as a personalized souvenir.

Modern tourists show an interest in local culture and lifestyles and during their travels buy souvenirs that symbolize the destination, which increases the chances of placing the offer, increasing income and developing the destination. Such tourists will pay a

higher price for a unique, authentic, modernly designed and packaged product, and if you add to that the possibility of visiting the places of production, participating in the production or just observing the production process, it increases the experience of the destination and influences repeat visits. “The unique tourist product “target” is the expectations of modern tourists, who are increasingly moving from the saturated mass tourist market to non-standard tourist products, striving for new experiences and unforgettable occurrences” (Borović, et al., 2022).

Bela Muhi in her work “Marketing aspects of the branding strategy of rural tourism of Vojvodina” says that the characteristics of modern tourism are the search for peculiarities, and that they are hidden in all aspects of local culture - peace, silence, clean air, ecologically healthy food, local wine and spirit, fresh vegetables, rural ambience, agricultural crops and domestic animals, specific rural architecture, old folk customs and almost forgotten crafts.

The driver of tourism in Podgorina can be plum farming, especially the production of plum brandy. “Although there are still no official data, according to some estimates, around 25% of tourists in the world annually opt for rural tourism” (Borović, et al., 2022). Agrarian or village or rural tourism or this new rakija tourism implies a combination of local values which in symbiosis with quality spirits and an adequate hospitality can start such a small and insufficiently developed tourist destination. This claim is based on examples of good practice in the country and neighboring countries, which concern wine tourism, as well as numerous relevant literature that follows this field of tourism. Wine tourism in Serbia is expanding, Croatia, Slovenia, Italy and Austria have made great progress in this area of tourism and are considered leaders and generate large revenues from this type of tourism.

Table 4. Advantages and limitations of branding the destination of Podgorina through the formation of „The Rakija Šljivovica Route“

advantages	limitations
geographical position	limited space suitable for tourism
traffic connectivity	accommodation
environmental natural characteristics	insufficient number of contents for recreation and animation
natural and anthropogenic factors	marketing and management
cultural heritage	modernization of the production process
events	financing
UNESCO protected intangible cultural heritage	government assistance and development strategies
rural tourism	better quality of roads

Source: Authors

Recommendations for the development and branding of the destination through “The Rakija Šljivovica Route”

The good geographical position of the destination of Podgorina, adequate traffic connections with emission centers, and preserved nature, natural and anthropogenic factors, numerous and colorful cultural heritage (material and immaterial) (*Figure 2*), many manifestations, among which the Plum Fair is one of the most famous and in the most important plum farming not only in Serbia but also in the surrounding area, provide an excellent basis for the development of this type of tourism in this destination (*Figure 3*). Natural resources along with cultural heritage represent an important factor in the development of rural tourism in the Republic of Serbia (Cvijanović, et al., 2022).

Figure 2. Rich cultural heritage - Tešman Soldatović's homestead



Source: Authors, 2022.

“The Rakija Šljivovica Route” should be designed and organized in such a way that tourists visit spirit producers along a pre-planned route and during those visits follow all stages of spirit production, participate in the production stages, but also get to know local history, culture, customs and traditions, the way of life of the locals and at the end they enjoy consuming spirit and local specialties during those visits. As this is a predominantly rural area and all producers are located in rural areas, this can be an additional comparative advantage of the destination, as this destination becomes an ideal place for vacation and escape from urban life.

Figure 3.18th Plum fair Osečina



Source: Tourist organization “Podgorina” Osečina

According to the data of the Republic Institute for Statistics of Serbia and the National Team for the Revival of Serbian Villages, plums are grown on 74,000 hectares in Serbia, and 42 million plum trees have been planted on this area. The annual production of fresh plums is 550,000 tons. According to the same source, the Toplički and Kolubar districts are one of the leaders in plum production in Serbia. Out of the total amount of plums produced, 20% of the crop is processed through several stages of processing, while 80% is processed into brandy. The export of prunes is about 5500 tons per year.

In Osečina, plum is the most represented fruit crop, as it occupies 56% of the total area of agricultural land under fruit. (Strategy of rural development and agricultural development in the municipality of Osečina from 2016 to 2026). Despite the large number of processing capacities, 70% of the plums produced in the municipality of Osečina are processed into brandy, of which 95.6% is consumed in Serbia. (Strategy of rural development and agricultural development in the municipality of Osečina from 2016 to 2026).

We conclude that šljivovica brandy and the production process should be a trump card in the process of branding the Podgorina destination by creating the path of brandy as a new tourist product. As already mentioned, a large share of plum processing goes to brandy, and in the area of Osečina, only one company is engaged in the production of alcoholic beverages, while the rest of the processing capacities are within rural households. We only see the chance for šljivovica brandy to become a destination brand. In order for small farms that are also producers of plum brandy to be included in tourist flows in full, it is necessary that these households will be enriched with catering facilities, primarily tasting rooms (arrangement of existing spaces or construction of new ones) in which they would present themselves, taste and sell household products

with an accent on spirit. Further development would go in the direction of construction or adaptation of existing household capacities for the needs of tourist accommodation and finally the development of recreation and animation content (*Table 3*). All these contents should correspond to the ambient whole both in terms of architecture and the use of materials for their construction and decoration. In this way, the surplus household products are sold, the incomes that are used for the functioning of the household and its development are actualized. (*Table 4*).

Conclusions

The paper presents the state of production and processing of plums in the destination of Podgorina, which shows that a large percentage of the processing of all plums produced belongs to the production of spirit. It also shows how to brand a destination and what are the advantages of destination branding not only from the tourism side, but also from the economy in general, and how the production of plum spirit as an intangible cultural heritage can be a component of destination branding. In order to overcome these problems, it is necessary to establish cooperation with all stakeholders in the destination and to approach the branding of the destination in an organized manner from the point of view of spirit production as a component of attraction in that process. In order to achieve this, institutional and financial assistance from the state is needed through relevant ministries and administrations, as well as cooperation with the local government unit through incentive programs for agricultural producers. Serbia, as well as the destination Podgorina itself, have good prerequisites for the development of agrarian tourism and the development of rakija tourism through the formation of the “Podgorina Rakija Šljivovica Route”, as explained in the paper, which can greatly improve the tourist offer of the destination through the inclusion of rakija/spirit producers in the first place of rural households .

The creation of the “rakija šljivovica” route is a serious undertaking that requires an organized and well-coordinated process of involving tourism policy makers at all levels in the country. This process implies the networking of existing spirit producers with other stakeholders at the destination and their inclusion in tourist flows. In order to make this process as good as possible and as “painless” as possible for small producers, it is necessary to standardize the quality of spirit and modernize the production in order to meet the standards prescribed by law, but at the same time to maintain the traditionality in production, further steps in this process go in the direction of enriching the hospitality offers of households and the expansion of capacities for accommodation and food for tourists. Installation of tourist signage, construction of parking lots and road infrastructure would greatly help to mark small agricultural households as points of tourist activity in the destination.

The problems during this research were the difficult availability of information and the lack of cooperation of local self-government units. The results could be useful in further planning to overcome some of the negative consequences of urbanization and rural abandonment. Considering the complexity and multidisciplinary of organizing

and implementing activities in the field of tourism, this paper tries to point out concrete activities and measures of the active policy of developing destinations and brands of the Republic of Serbia. In some further research, other elements of Serbia's intangible cultural heritage that are on the UNESCO list could be researched as potentials for tourism development.

Conflict of interests

The authors declare no conflict of interest.

References

1. Antonić, D. (2004). *Srbija među šljivama*. Beograd, Bel Guest. [*in English*: Antonić, D. (2004). *Serbia among plums*, Belgrade, Bel Guest.].
2. Baker, M., & Cameron E. (2008). *Critical success factors in destination marketing*, Tourism and Hospitality Research, 8.
3. Bandić, D. (1997). *Carstvo zemaljsko, carstvo nebesko*. Beograd, BIGZ. [*in English*: Bandić, D. (1997). *Kingdom of Earth, Kingdom of Heaven*, Belgrade, BIGZ.].
4. Borović, S., Stojanović, K., & Cvijanović, D. (2022). The Future of Rural Tourism in The Republic of Serbia. *Economics of Agriculture*, 69(3), 925–938.
5. CREATOUR (2017). The State of the Art in Creative Tourism. Call for Projects. CREATOUR
6. Cvijanović, D., Borović, S., & Stojanović, K. (2022). The Possibility of Revitalizing Rural Areas through the Promotion of Cultural Tourism In The Republic Of Serbia. *International Journal Knowledge*, 55(1), 21-26.
7. Gajić, T., Vukolić, D., & Stojanović, K. (2021). Nematerijalno kulturno nasleđe kao turistički atraktor – case study of Sremska Mitrovica“. *ODITOR* Vol. VII, Br. S01/2021. [*in English*: Gajić, T., Vukolić, D., & Stojanović, K. (2021). Intangible cultural heritage as a tourist attraction - case study of Sremska Mitrovica“. *ODITOR* Vol. VII, No. S01/2021.].
8. George, E.W. (1995). *Diversification strategies of one-industry towns*. Saint Mary's University, Halifax.
9. *Handbook on Tourism Destinations Branding*, (2009). Published by the World Tourism organization and the European Travel Commission, Madrid, Spain.
10. Huang, C. H., Tsaur, J. R., & Yang, C. H. (2012). Does world heritage list really induce more tourists? Evidence from Macau. *Tourism Management*, 33(6), 1450-1457. <https://doi.org/10.1016/j.tourman.2012.01.014>
11. Inskeep, E. (1991). *Tourism Planning: An integrated and Sustainable Development Approach*. New York: Van Nostrand Reinhold.
12. *Intangible cultural heritage of Serbia*, Retrieved from: <https://nkns.rs/> (May 4, 2022).
13. Jelinčić, D. A. (2010). *Kultura u izlogu*. Zagreb, Intermedia. [*in English*: Jelinčić, D. A. (2010). *Culture in the window*. Zagreb, Intermedia.].

14. Keller, K. L., Aperia, T., & Georgson, M. (2008). *Strategic brand management - A European perspective*. Pearson Education Limited, Harlow, England.
15. Kerr, G. (2006). From destination brand to location brand. *Journal of Brand Management*, Vol. 13, No. 4/5, 276 – 283.
16. Krivošejev, V. (2014). *Upravljanje baštinom i održivi turizam*. Valjevo - Beograd, Narodni muzej Valjevo i Artis centar [in English: Krivošejev, V. (2014). *Heritage management and sustainable tourism*. Valjevo - Belgrade, Valjevo National Museum and Artis Center.].
17. McKercher, B., & du Cros, H. (2002). *Cultural tourism - The Partnership Between Tourism and Cultural Heritage Management*. New York, The Haworth Hospitality Press.
18. Miletić, R., Pantović, D., & Veliverronena, L. (2023). Dark tourism in Serbia: Case study of the Kragujevački oktobar Memorial Park. *Hotel and Tourism Management*, 11(1), 127–144. <https://doi.org/10.5937/menhottur2301127M>
19. Morgan, N., Pritchard, A., & Prajd, R. (2015). *Destinacija kao brend*. Beograd: Clio. [in English: Morgan, N., Pritchard, A., & Pride, R. (2015). *Destination as a brand*. Belgrade: Clio.].
20. Muhi, B. (2009). Marketinški aspekti branding strategije seoskog turizma Vojvodine. *Turističko poslovanje*, broj 4, Beograd, Visoka turistička škola. [in English: Muhi, B. (2009). Marketing aspects of the branding strategy of rural tourism in Vojvodina. *Tourism business*, number 4, Belgrade, High School of Tourism.].
21. *Nacrt Programa razvoja turizma opštine Osečina 2023-2027*, Opština Osečina [in English: *Draft Tourism Development Program of the Osečina Municipality 2023-2027*, Osečina Municipality.].
22. Ryan, J., & Silvanto, S. (2009). The World Heritage List: The making and management of a brand. *Place Branding and Public Diplomacy*, 5(4), 290-300. <https://doi.org/10.1057/pb.2009.21>
23. Sančanin, B., Penjišević, A., & Stojanović, K. (2023). Key cultural-historical determinants of tourism improvements of the Municipality of Bač. *Hotel and Tourism Management*, 11 (1) 177-191.
24. Shackley, M. (2006). Visitor management at world heritage sites. In *Managing world heritage sites* (pp. 109-120). Routledge
25. Sofronić, P. N., (1990). *Glavnije bilje u narodnom verovanju i pevanju kod nas Srba*. Beograd, Štamparija „Sv. Sava“ (1912), reprint „Bigz“ (1990). [in English: Sofronić, P. N., (1990). *The most important plants in folk belief and singing among us Serbs*. Belgrade, Printing house “St. Sava” (1912), reprint “Bigz” (1990).].
26. Stjuard, Dž. (1981). *Teorija kulturne promene*. Beograd, BIGZ. [in English: Steward, J. (1981). *Theory of cultural change*. Belgrade, BIGZ.].
27. Stojaković, V. (2000). *Srpska šljiva ranka*. Beograd, Etnografski muzej. [in English: Stojaković, V. (2000). *Serbian plum ranka*. Belgrade, Ethnographic Museum.].

28. Stojanović K., Borović S., & Cvijanović D. (2022). Nove metode kroz digitalne medije u savremenoj održivosti kulturnog graditeljskog nasleđa. *Naučno-stručni skup „Digitalni mediji u funkciji održivog razvoja kulturnog nasleđa”* / [ed. Branislav Sančanin], 82-114. [in English: Stojanović K., Borović S., & Cvijanović D. (2022). New methods through digital media in the contemporary sustainability of cultural architectural heritage. *Scientific and professional meeting “Digital media in the function of sustainable development of cultural heritage”* / [ed. Branislav Sančanin], 82-114.].
29. *Strategija ruralnog razvoja i razvoja poljoprivrede u opštini Osečina od 2016. do 2026. godine*, (2016). Opština Osečina. [in English: *Strategy of rural development and agricultural development in the municipality of Osečina from 2016 to 2026*, (2016). Osečina Municipality.].
30. UNESCO, (2022). *UNESCO, Culture, Intangible Heritage Lists, Social practices and knowledge related to the preparation and use of the traditional plum spirit – šljivovica*. <https://ich.unesco.org/en/RL/social-practices-and-knowledge-related-to-the-preparation-and-use-of-the-traditional-plum-spirit-ljivovica-01882> pristupljeno 07.01.2023.
31. UNWTO, (2022). Retrieved from: www.unwto.org/pdf/Understanding_Tourism-BasicGlossary_EN.pdf (July 27, 2022).
32. Veljković, S., & Đorđević, A. (2011). Brendiranje destinacije i stvaranje vrednosti za turiste. *Ekonomске ideje i praksa*, broj 3, Beograd [in English: Veljković, S., & Đorđević, A. (2011). Destination branding and value creation for tourists. *Economic Ideas and Practice*, No. 3, Belgrade.].
33. Wanda, G. E., Mair, H. & Reid, D. G. (2009). *Rural Tourism Development: Localism and Cultural Change*. Channel View Publications, UK.
34. Yang, C. H., Lin, H. L., & Han, C. C. (2010). Analysis of international tourist arrivals in China: The role of World Heritage Sites. *Tourism management*, 31(6), 827-837. <https://doi.org/10.1016/j.tourman.2009.08.008>
35. Лазих, П. (2007). *Шљива, бре!*. Београд, Службени гласник. [in English: Lazić, P. (2007). *Plum, bre!*. Belgrade, Official Gazette.].
36. *Службени гласник РС*. (2010). Међународни Уговори, бр. 1/2010 од 21.5.2010. [in English: *Official Gazette of RS*. (2010). International Treaties, no. 1/2010 from 21.5.2010.].

PROMOTION OF UNHEALTHY FOOD AND ITS INFLUENCE ON ANTISOCIAL BEHAVIOR

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ABSTRACT

The goal of this paper is to explore the issue of promoting unhealthy food and its potential impact on antisocial behavior in contemporary society using methods of structural and functional analysis, quantitative and qualitative analysis, comparative analysis, descriptive methods, and survey methods. Unhealthy food with high-calorie, harmful nutritional ingredients, can cause a myriad of health issues, such as obesity, cardiovascular conditions, and diabetes, but in some instances, it can affect the behavior of individuals. The paper investigates how such promotion can affect individuals' eating patterns and health, with a particular focus on the development of antisocial behaviors. It also considers risk factors, including socioeconomic aspects and the influence of the media, that support the promotion of unhealthy food. This paper also discusses potential strategies to reduce the promotion of unhealthy food and promote healthier choices to mitigate the negative effects on antisocial behavior and enhance societal well-being.

Introduction

Contemporary society is confronted with numerous challenges related to health and consumer behavior, with one of the prevailing and significant issues being the marketing of unhealthy food (Afshin et al., 2019). The widespread availability of fast

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food, sugary beverages, high-fat and high-sugar snacks, and various other calorie-dense, low-nutrient foods raises substantial concerns regarding their potential impact on individuals' health. Of particular concern is the aggressive promotion of such foods, targeting diverse demographic groups, including children and adolescents.

A study featured in the *Lancet* scientific journal asserts that dietary habits are a primary factor in one out of every five recorded deaths (Afshin et al., 2019). Developed nations are inundated with food items rich in calories, sugar, fat, and sodium while lacking in essential nutrients and dietary fiber. These foods often contain a range of emulsifiers, flavor enhancers, and synthetic additives. The introduction of the NOVA food classification system (Monteiro et al., 2017) has facilitated the identification of food items that meet the specific criteria for ultra-processed foods (Vignola et al., 2021). Substantiated research studies (Global Panel on Agriculture and Food Systems for Nutrition, 2016) have indicated that the eating of ultra-processed foods is associated with a higher prevalence of diseases, disorders, and an elevated risk of mortality. Such risks include the development of cardiovascular diseases (Bonaccio et al., 2022), neurological conditions (Esposito et al., 2023), obesity, diabetes, and respiratory ailments (Li et al., 2023), all linked to the consumption of ultra-processed foods. Additionally, there is substantial evidence suggesting that ultra-processed foods can lead to addictive behaviors (LaFata & Gearhardt, 2022). The consumption of such foods has been found to increase the risk of mental disorders, including symptoms of depression (Lee & Choi, 2023) and anxiety (Werneck et al., 2020), as well as negatively affecting psychosocial functioning in adolescents (Reales-Moreno et al., 2022), often leading to antisocial behaviors.

Consequently, the impact of this unhealthy food on antisocial behavior is gaining acknowledgment among criminologists. It is increasingly being incorporated into discussions concerning risk factors, encompassing family, school, and environmental influences, biological factors including genetics and psychophysiological elements, environmental risk factors, neuropsychological components, and the learning and situational factors typically considered. In light of these findings, there is a growing call for strict regulation and control of the promotion of such unhealthy food. This is essential since numerous research studies emphasize that the advertising of these food products and beverages through media channels popular among children significantly shapes their choices and consumption habits, ultimately resulting in a variety of adverse outcomes related to dietary health (Šapić et al., 2018).

Methodology

This paper used various methods, including structural and functional analysis to assess the impact of specific foods on human health. Descriptive methods clarified effects, and a street-intercept survey collected data on adolescents' dietary choices. Quantitative and qualitative analyses identified modifiable risk factors for strategic integration into prevention and intervention strategies, enhancing societal responses.

A critical review of unhealthy food and its impact on mental and physical health

The scope of unhealthy or harmful food can be divided into two categories. In the first group are foods that are unhealthy due to chemical or bacteriological contamination, while the second group consists of food products that meet the primary criteria of safety but contain unauthorized or excessive amounts of harmful substances. According to some recommendations (Karpov, 2020), the list of harmful products includes foods with the following characteristics: Evident signs of poor quality; discrepancy between the actual properties and desired characteristics of the product; products with unknown or expired expiration dates; products not compliant with the prescribed quality requirements; products with incomplete documentation from suppliers or manufacturers that confirm the origin of food products, their quality, safety, and other necessary certificates issued in accordance with established rules.

Unhealthy eating is a global health issue that significantly contributes to the rise of chronic diseases such as obesity, diabetes, and cardiovascular conditions. Investigations exploring the link between unhealthy dietary patterns, characterized by high sugar and fat content, along with processed foods, have shed light on the association between such diets and elevated susceptibility to mental disorders, notably depression and anxiety. The impact of unhealthy eating on children's health and cognitive development is a concerning aspect, given the increased availability of fast food and sweets in modern society. Research findings establish connections between inadequate nutritional intake within one's diet and the initiation of chronic ailments like obesity, type 2 diabetes, and cardiovascular disorders. These medical conditions place significant strains on healthcare systems across the globe. With urbanization and lifestyle changes, people are increasingly turning to fast food, leading to unbalanced diets and a lack of essential nutrients. Unhealthy food is often more affordable than healthy options, which can lead individuals with lower incomes to prefer cheaper but less nutritionally valuable choices. This can contribute to health inequalities. Research shows a connection between unhealthy eating and mental issues such as depression and anxiety.

Aggressive advertising and marketing of unhealthy food often result in increased consumption of such products. This food industry strategy has a global reach and can influence people's diets worldwide. The lack of education on the nutritional value of food and its impact on health contributes to the global problem of unhealthy eating. Increasing perception of the significance of healthy eating can perform a fundamental role in attending to this issue. Here is an overview of the most common and dangerous products falling into the category of unhealthy food can encompass various food categories that may have a negative impact on health:

- **Fast Food:** Fast food restaurants offer high-calorie meals that are often rich in saturated fats, trans fats, salt, and sugars. Typical items include burgers with fries, pizzas, and fried chicken products.
- **Soft Drinks:** These beverages often contain large amounts of added sugars, and other additives. Regular consumption of soft drinks is linked with a greater risk of obesity, diabetes, and heart diseases.

- Sweets and Snacks: These products often have high levels of additives, sugar, salt, and saturated fats. Chips, chocolates, candies, and similar items can contribute to excess calories and poor health.
- Processed Meat: Sausages, ham, hot dogs, and other processed meat products often contain significant amounts of salt and additives linked to an increased risk of cardiovascular diseases.
- Instant Noodles and Ready Meals: These products often have high levels of sodium, saturated fats, and additives. The quick and easy preparation of these meals may attract consumers but often comes at the expense of nutritional value.
- Pastries and Cakes: Cakes, cookies, pies, and similar products often have high levels of sugar, fats, and refined carbohydrates, contributing to obesity and diabetes.
- Instant Soups: Ready-made soups and noodles that come in pouches or cups often contain high levels of sodium, and sometimes trans fats.
- Frozen Ready Meals: Many frozen ready meals are rich in salt, fats, and additives to extend shelf life and improve taste.
- Ice Cream: Besides containing significant sugar content, ice cream can also be high in saturated fats, contributing to an increased overall calorie intake.
- Fried Foods: Crispy foods fried in deep oil frequently contain saturated fats and trans fats, which are tied to an increased susceptibility to cardiovascular ailments.

When considering these food items in comparison to the typical daily diets of many, it becomes evident that unhealthy food is an inseparable aspect of modern life for a significant portion of the population.

The correlation between unhealthy dietary patterns and antisocial behavior

The relationship between the consumption of nutritious food, human physical well-being, and increased longevity remains stable, just as the link between unhealthy dietary habits and the onset of various diseases persists. However, the fast-paced nature of modern life has seemingly led to the underestimation of the importance of making wise and high-quality meal choices, which can significantly impact mental health and brain function. This impact encompasses psychological and behavioral responses that manifest through cognitive processes, emotions, and behaviors, ultimately influencing tendencies toward aggressive and criminal inclinations. Recognizing this connection should serve as an impetus for society to surmount the challenges and diminish the promotion of unhealthy food, with the aim of preventing detrimental outcomes like antisocial behavior, characterized by transgressions of societal norms, self and other neglect, explicit or concealed hostility, and purposeful aggression directed towards others.

If the adage “we are what we eat” holds true, it raises critical questions about the transformations we undergo. The well-established connection between our dietary choices and the escalating problem of obesity is widely acknowledged. Importantly, we must acknowledge that our dietary intake not only influences body weight but also plays a significant role in shaping brain composition (Crawford & Casperd, 1976). Food functions as the primary energy source for brain functions (Leonard & Robertson, 1997) and provides essential components for neurotransmitters (Gómez-Pinilla, 2008) governing interneuronal communication, essentially shaping the brain’s operational environment. Despite the brain constituting only 2% of body mass, it consumes around 20% of available energy (Leonard & Robertson, 1997). Paradoxically, modern dietary patterns have undergone substantial changes in a relatively brief period without a thorough examination of potential impacts on brain function or behavior (Gesch, 2005). What is often overlooked is that established dietary adequacy standards were not originally developed with brain function or behavioral outcomes in mind (op. cit., 2005). Given the presented information, it appears that as a society, we have once again demonstrated the destructive aspect of human nature by neglecting the potential physiological impacts on people’s mental health.

The notion that our dietary choices affect our mental state has a historical precedent dating back to antiquity. An 1899 article in the *Journal of the American Medical Association* posited that “proper nutrition is our most powerful agent” in addressing conditions like melancholy (Eyman, 1899). In 1954, Dr. George Watson and Andrew L. Comrey conducted a controlled study, published in the *Journal of Psychology*, suggesting that a vitamin-mineral concoction might ameliorate symptoms in individuals with diverse mental disorders (Watson & Comrey, 1954). Despite the limited scientific attention it initially received, this study gained recognition through the media (Powers, 1954). Notably, the renowned actress and fashion designer Gloria Swanson became an ardent proponent of nutritional interventions as preventive measures against juvenile delinquency, referencing the work of these two authors and contending that improper nutrition was the root cause of such behavior (Reynolds, 1958). In 1972, Dr. Watson authored “*Nutrition and Your Mind*,” a book that drew substantial scientific and professional attention (Watson, 1972). Within this context, Dr. Schoenthaler’s work emerges as a prominent contributor. His noteworthy 1980 study, conducted within a juvenile detention facility under the jurisdiction of the Virginia Department of Corrections, involved covertly introducing dietary modifications focused on reducing added sugars, resulting in a remarkable 45% reduction in documented disciplinary actions among juveniles who experienced the altered diet for three months (Schoenthaler, 1982). This study was of modest scale, involving a total of 58 juveniles, of which 24 were exposed to the dietary transition, yet it yielded encouraging results and prompted subsequent research conducted in various correctional facilities (Logan & Schoenthaler, 2023). By 1985, Schoenthaler and his collaborators expanded their research to 12 correctional institutions and observed a 47% decrease in documented infractions and other indicators of antisocial behavior as a consequence of dietary

adjustments aimed at reducing sugar and fat content (Schoenthaler, 1984; Schoenthaler & Bier, 1985). Considering the high prevalence of ultra-processed food consumption in Western industrialized societies, where individuals are frequently consuming diets predominantly comprised of 80% ultra-processed foods, researchers have embarked on explorations into the physiological, metabolic, and craving-related effects of these dietary choices. Dr. Chris van Tulleken's book "Ultra-Processed People" and a study conducted under the supervision of Dr. Tim Spector at King's College London, involving participants placed on an ultra-processed diet for two weeks, highlight the cognitive repercussions associated with the habitual intake of such foods (Logan & Schoenthaler, 2023; Van Tulleken, 2023; Kingston, 2023; Luković et al., 2023). In alignment with the aforementioned, the testimony of Dr. Martin Blinder, a distinguished professor of forensic psychiatry, who served as the defense psychiatrist in the trial of Dan White, stands as a compelling reference. Dr. Blinder, in response to inquiries, underscored the substantial body of evidence indicating that the excessive consumption of what is often characterized as unhealthy food, replete with high sugar and preservatives, has the potential to induce antisocial and even violent behavior. He cited studies in which individuals predisposed to react to these deleterious stimuli exhibit a profound transformation and engage in conduct they would not typically display (Linder, n.d). Within this framework, a multitude of indicators reaffirm the correlation between the consumption of unhealthy dietary items and their influence on psychological responses, which can lead to shifts in mood and contribute to violent actions and antisocial conduct. The hypothesis posits a connection between food types, nutritional impact, and psychological-behavioral responses with potential implications for reducing crime rates. Nutritional impact assumes a pivotal role in brain function and neurotransmitter production, thereby exerting influence over behavior and mood. A well-rounded diet that incorporates micronutrient-rich foods, such as fish, has been associated with decreased instances of aggressive behavior. Conversely, diets high in fats and sugars can perturb brain neural pathways, giving rise to potential withdrawal symptoms and behavioral alterations. Food insecurity, especially during childhood, amplifies the risk of falling into poverty and unemployment, thereby elevating the propensity for criminal activity. Furthermore, a study examining the interplay between work conditions and food choice strategies among employed parents, notably working mothers, revealed that workplace conditions significantly influence the selection between nutritious meals and fast food options, with potential ramifications for the mental well-being of the entire family. It's worth noting that meal preparation times have dwindled, leading to increased consumption of meals outside the home, particularly fast food and take-out options (Blisard et al., 2020; Heidari et al., 2023). The presented information implies that recent studies pertaining to both healthy and unhealthy dietary patterns should not be considered in isolation from the domain of mental health. The substitution of ultra-processed foods characterized by elevated sugar and fat content, inclusive of additives – substances incorporated into food to modify its sensory properties – with wholesome dietary paradigms, bears the potential to exert influence over neuropsychiatric outcomes, resulting in the amelioration of depressive and anxious symptomatology

and an enhancement in overall quality of life. The implementation of such interventions on a global scale holds the promise of significant contributions to public health and the potential to yield substantial cost savings within the healthcare sector. Nevertheless, the resistance and neglect of scientific advancements within this sphere, particularly those exploring the nexus between dietary patterns, antisocial conduct, and the mechanisms of the criminal justice system, are likely underpinned by economic interests advocating for the flourishing multinational conglomerates operating in the realm of sugar and ultra-processed food and beverage industries.

Destructive role of mass media in promoting unhealthy food

The analysis of media content reveals a substantial prevalence of advertisements for unhealthy food in mass media, with companies producing such food often sponsoring popular media events. Mass media exert their influence generally through their programming content and advertising content (see more: Bjelajac & Filipović, 2020). Mass media performs a crucial role in promoting unhealthy food through aggressive marketing strategies, leading to increased consumption of such food. Media advertisements for unhealthy food often employ manipulative techniques to capture the target audience's attention, potentially resulting in uncontrolled calorie intake and poor dietary habits. Mass media creates a false perception of unhealthy food, portraying it as attractive, delicious, and desirable. Children are particularly vulnerable to media influence regarding unhealthy food, as they are frequently the target of aggressive marketing campaigns. Media platforms often neglect their responsibility to consumers when it comes to promoting unhealthy food, creating an atmosphere in which fast and unhealthy meals are accepted and normalized. Mass media frequently collaborate with the food industry, perpetuating unhealthy food products through various media formats, including films, television, and social networks. Unethical marketing practices in promoting unhealthy food through mass media can lead to serious health consequences for consumers, including an increased risk of heart disease, diabetes, and other chronic illnesses. Educational campaigns and media literacy must become essential elements in the fight against the destructive role of mass media in promoting unhealthy food. Regulatory measures and control of marketing activities related to unhealthy food on media platforms are necessary to reduce the negative impact of mass media on dietary habits and public health.

Aggressive marketing campaigns and advertisements often portray unhealthy meals in a way that makes them appealing and desirable. Regular depictions of fast food, sweets, and sugary drinks create a subconscious impression that these products are an integral part of everyday life. Media content often reflects societal trends. If unhealthy food is frequently featured in movies, television shows, or on social media, it easily becomes part of the cultural norm. Media companies often collaborate with food brands, promoting their unhealthy food products through sponsorships, competitions, or other events. Children are especially susceptible to media influence. If characters that children admire are shown consuming unhealthy food, children may perceive

these products as desirable and tasty. The lack of education on healthy eating in media content can result in insufficient consumer recognition of the benefits of healthy food and the dangers of consuming unhealthy meals. Media sometimes creates a false perception that healthy food is less tasty or less appealing. This can encourage people to turn to unhealthy options under the belief that they are more delicious or satisfying. Normalizing unhealthy meals through media often has serious consequences for public health, fueling the obesity epidemic and related diseases. Education, regulatory measures, and media literacy are key factors in combating this negative influence.

Manipulating consumer emotions is a successful strategy in media promotion of unhealthy food. This approach to marketing campaigns is often used to construct an emotional connection between consumers and products. Advertisements for unhealthy food often focus on creating feelings of joy, enjoyment, and satisfaction. Depictions of happy people enjoying food generate positive emotions, connecting those emotions with the product. Colors, music, and slogans are carefully used to evoke specific emotional reactions. Warm colors and cheerful music can stimulate feelings of warmth and comfort. Campaigns often attempt to establish a false connection between the product and the consumer's identity. Advertisements suggest that consuming a specific food will make a person modern, successful, or desirable in society. Using positive and likable characters in ads can establish an emotional link between consumers and the product. Characters who appear happy and content while consuming the product can encourage others to seek the same experience. Emotional storytelling is often used in marketing campaigns to elicit emotional reactions. Emotional stories can create a deeper connection between consumers and the product. Visual elements such as juicy and enticing food displays can trigger strong emotional reactions. The portrayal of people who are happy and successful after consuming the product creates the illusion that this food is associated with personal success and happiness. Manipulating emotions in media promotion of unhealthy food often leads consumers to make decisions based on emotional impulses rather than rational considerations. Education about these marketing tactics can be crucial in developing consumer media literacy.

In an effort to familiarize consumers with unhealthy food, media often promote so-called "social pressure" and peer influence. Peers often serve as behavior models, and if they frequently consume unhealthy food, it can encourage others to follow the same pattern. If it is common among peers to consume fast food or high-sugar snacks, individuals may feel pressured to conform to those norms to feel accepted. If someone speaks positively about a particular unhealthy meal or snack, it can influence others' decisions to try it. Eating often serves as a social event. Consuming unhealthy food during shared meals can strengthen social bonds among peers. Peers often enjoy eating together at fast-food restaurants. Group dynamics can encourage individuals to adopt food choices that are common in their group. Fear of exclusion or stigmatization can motivate individuals to conform to the dietary norms of their group. If images and posts about unhealthy meals are frequent among peers, it can reinforce the desire of others to try the same. Education about healthy dietary options, the development of media

literacy, and the promotion of positive peer influences can be crucial in combating this social pressure to consume unhealthy food.

Given the serious public health consequences arising from the destructive impact of the media on dietary habits, there is a strong need for regulations and education regarding the role of media in promoting unhealthy food. Limiting false or deceptive marketing messages can help inform consumers. Regulations may include strict rules that ban marketing activities for unhealthy food targeted at children, as children are particularly susceptible to media influence. Establishing standards of transparency and ethical practices in media campaigns can reduce emotional manipulation and false product representation. Rules that restrict advertising of unhealthy food during children's programs or on platforms popular among children can help reduce the influence of media on the dietary habits of the youngest consumers.

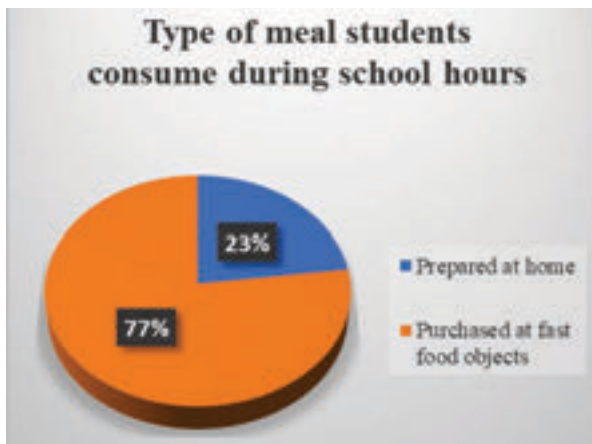
Results and discussion

During adolescence, nutritional vulnerability rises as a result of increased nutritional needs, but the quality of diets among this age group frequently declines markedly (Heslin & McNulty, 2023). A study within the “Teži ravnoteži (in English: Striving for Balance)” project, a national campaign initiated by the Serbian Chamber of Commerce in support of the National Program for Obesity Prevention started by the Ministry of Health of the Republic of Serbia, sheds light on the eating habits of Serbian citizens. The results of an online survey within this project in October 2023 provide intriguing insights. The primary conclusion of this study is that the majority of citizens, 68% of them, moderately pay attention to their diet, while 17% of the respondents are very mindful of their nutrition. Alarming, 15% of respondents do not pay attention to their diet at all (Teži ravnoteži, 2023). Furthermore, the study reveals that most citizens inform themselves about the nutritional values of products by reading nutritional labels on items, with 41% of respondents choosing this option, while 28% obtain information from the media (magazines, websites, and television) (op. cit., 2023). The research also indicates that 45% of citizens gather information about nutritional values through content on social media (op. cit., 2023), which highlights certain inconsistencies in the results. As the research questions asked were not provided in the report of the results, it can be concluded that respondents were separately asked about their use of social media. The research methodology, conducted online, imposes certain limitations on the sample and, consequently, the results. It somewhat guides the results towards those respondents who, broadly speaking, pay attention to their nutrition. Hence, the actual results are likely slightly less favorable than those presented. Nevertheless, the presented results are illustrative and provide insights into citizens' perception of healthy nutrition and the impact of both traditional and new media on shaping their views and, consequently, dietary habits.

Below, we provide details of our research conducted for the “Origins of Criminal Behavior” monograph by Željko Bjelajac, which did not make it into the final manuscript due to the tragic events in May of this year (2023) that interrupted the school year, and

consequently, our research. We resumed the research at the beginning of the new school year and concluded it on November 1, 2023. The research aimed to investigate the number of students regularly consuming ultra-processed food and sugary, unhealthy beverages using random sampling, conducted on the streets near elementary and high schools in Belgrade and Novi Sad. The research was conducted from March 1, 2023, to May 1, 2023, and then resumed on September 1, and concluded on November 1, 2023. The target group of the research comprised students in higher grades of elementary and high schools in Belgrade and Novi Sad. Over the four months, a total of 1043 respondents were contacted, of which 310 declined to answer the questions, while 733 did, constituting our research sample. The research was conducted by the authors of this text along with collaborators. The sample selection was done through street-intercept random sampling near said elementary and high schools. Respondent selection was made on the day of the survey using random sampling. The research technique was a personal, face-to-face technique, and the research instrument was the questionnaire. Based on the methodology established during the research, the sample encompassed the following respondent categories: gender structure – 54% females and 46% males; age structure – 44% aged 11-15 and 56% aged 16-19. In terms of education/profession, the sample consisted of 9% - elementary school 5th graders, 9% - 6th graders, 13% - 7th graders, 13% - 8th graders, 12% - high school 1st graders, 15% - high school 2nd graders, 14% - high school 3rd graders, and 15% - high school 4th graders. The questionnaire consisted of two research questions: whether, during school breaks, they bring food from home or purchase food from nearby catering establishments, and how often, on a weekly basis, they consume energy drinks or carbonated beverages. For the first question, of the 733 respondents who answered the survey, 169 or 23% responded that they bring pre-prepared food to school from home, while 564 or 77% reported that they purchase meals during school hours from catering establishments near the school, meaning they are consuming fast food.

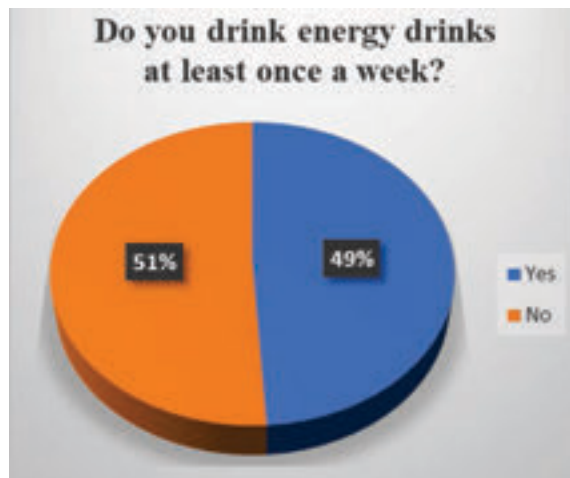
Figure 1. Type of meal students consume during school hours



Source: Authors' research

As for the second question regarding how often students consume energy drinks and carbonated beverages on a weekly basis, the results show some overlap, with the majority of respondents who consume energy drinks also consuming carbonated beverages. When we look at the students who drink energy drinks at least once a week, out of the 733 respondents, 359, or 49%, answered affirmatively. As for the number of respondents who reported consuming carbonated beverages at least once a week, 616 respondents answered affirmatively, which makes up 84% of the total number of respondents. Interestingly, the percentage of elementary and high school students who consume energy drinks at least once a week differs by one percentage point from a similar study we published in 2021. In that research, the percentage of students who consumed energy drinks at least once a week was 48% (Bjelajac, Filipović & Banović, 2021).

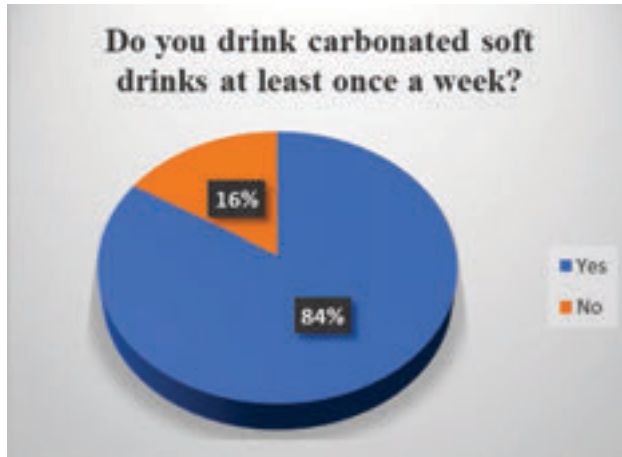
Figure 2. Percentage of respondents who drink energy drinks at least once a week



Source: Authors' research

This information is indeed concerning. Even though the number of respondents who consume energy drinks has increased by one percentage point over the past two years, practically half of the elementary and high school students consume energy drinks at least once a week, which is one of the unhealthiest dietary choices due to enormous level of sugar.

Figure 3. Percentage of respondents who drink carbonated soft drinks at least once a week



Source: Authors' research

The fact that 84% of the respondents consume carbonated drinks at least once a week is also alarming, as it implies the intake of an exceptionally high amount of sugar and other unhealthy ingredients, such as artificial colors, flavor enhancers, etc. It's not surprising that the Ministry of Health of the Republic of Serbia has initiated the National Program for Obesity Prevention. It's worth noting that such programs also serve to prevent the onset and development of diseases related to excessive consumption of unhealthy ingredients, food, and beverages, such as diabetes, cardiovascular diseases, and others. We specifically chosen to research the dietary and nutritional habits of adolescents, as they remain globally overlooked in nutritional strategies and policies worldwide (see more: Hargreaves et al., 2022). Additionally, clearer guidelines and campaigns to address nutritional confusion and misinformation are needed, as well as limited approvals for unhealthy food outlets near schools to discourage obesogenic environments (Luković & Šilc, 2021; Božić & Milošević, 2021; Uhlmann et al., 2023). Implement stricter regulations on the marketing of unhealthy drinks and foods. Improve food labeling to ensure people of all ages can make well-informed decisions. Conducting similar research annually and tracking the results of government efforts would be interesting and useful to assess whether they yield the expected outcomes or if efforts to increase the share of healthy food in the overall diet need to be synergized with other stakeholders in the healthy eating chain.

Conclusions

The connection between unhealthy dietary choices and antisocial behavior lacks clarity in scientific understanding. Nevertheless, numerous studies underscore the link between eating habits and behavioral patterns, highlighting the prevalence of unhealthy diets in both daily life and media. Influential corporations, backed by substantial financial resources, shape consumer demand and awareness through their

impact on the media landscape, resulting in a cascade of effects on individuals and society. Resolving this intricate issue demands an interdisciplinary approach, with education playing a pivotal role. Society needs to be informed about the advantages of a healthy diet and the detrimental effects of unhealthy choices. Developing media literacy, particularly among young people, is crucial for comprehending and critically evaluating advertising. Integrating education on this matter into school curricula and public campaigns is crucial, emphasizing the importance of balanced diets and the repercussions of excessive consumption. Responsible media practices and educational initiatives featuring real-life health consequences contribute to fostering awareness in society. Ultimately, a comprehensive strategy involving both regulatory measures and educational efforts is essential to counteract the adverse influence of the media on eating behavior and promote well-informed decision-making.

Conflict of interests

The authors declare no conflict of interest.

References

1. Afshin, A., Sur, P. J., Fay, K., Cornaby, L., Ferrara, G., Salama, J., Mullany, E. C., Abate, K. H., Abbafati, C., Zegeye, A., Afarideh, M., Aggarwal, A., Agrawal, S., Akinyemiju, T., Alahdab, F., Bacha, U., Bachman, V. F., Badali, H., Badawi, A., . . . Murray, C. J. L. (2019). Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*, 393(10184), 1958–1972. [https://doi.org/10.1016/s0140-6736\(19\)30041-8](https://doi.org/10.1016/s0140-6736(19)30041-8)
2. Bjelajac, Ž., & Filipović, A. (2020b). The role of the media in the affirmation of the culture of food safety. *Ekonomika Poljoprivrede (1979)*, 67(2), 609–622. <https://doi.org/10.5937/ekopolj2002609b>
3. Bjelajac, Ž., Filipović, A., & Banović, B. (2021). Instruments of support in promotion of healthy food and food safety culture. *Ekonomika Poljoprivrede (1979)*, 68(1), 241–255. <https://doi.org/10.5937/ekopolj2101241b>
4. Blisard, N., Lin, B., Cromartie, J., & Ballenger, N. (2002). America's Changing Appetite: Food consumption and spending to 2020. *Food Review: The Magazine of Food Economics*, 25(1), 2–9. <https://doi.org/10.22004/ag.econ.266240>
5. Bonaccio, M., Costanzo, S., Di Castelnuovo, A., Persichillo, M., Magnacca, S., De Curtis, A., Cerletti, C., Donati, M. B., De Gaetano, G., & Iacoviello, L. (2021). Ultra-processed food intake and all-cause and cause-specific mortality in individuals with cardiovascular disease: the Moli-sani Study. *European Heart Journal*, 43(3), 213–224. <https://doi.org/10.1093/eurheartj/ehab783>
6. Božić, A., & Milošević, S. . (2021). Critical success factors for new dishes in gastronomic offer of Belgrade restaurants. *Hotel and Tourism Management*, 9(2), 51–62. <https://doi.org/10.5937/menhottur2102051B>

7. Crawford, M., Casperd, N., & Sinclair, A. J. (1976). The long chain metabolites of linoleic and linolenic acids in liver and brain in herbivores and carnivores. *Comparative Biochemistry and Physiology. B. Comparative Biochemistry*, 54(3), 395–401. [https://doi.org/10.1016/0305-0491\(76\)90264-9](https://doi.org/10.1016/0305-0491(76)90264-9)
8. Esposito, S., Bonaccio, M., Ruggiero, E., Costanzo, S., Di Castelnuovo, A., Gialluisi, A., Esposito, V., Innocenzi, G., Paolini, S., Cerletti, C., Donati, M. B., De Gaetano, G., & Iacoviello, L. (2023). Food processing and risk of central nervous system tumours: A preliminary case–control analysis from the Mediterranean Diet in relation to Cancer of brain (MEDICEA) study. *Clinical Nutrition*, 42(2), 93–101. <https://doi.org/10.1016/j.clnu.2022.11.016>
9. Eyman, H. C. (1899). The Neurotic's Diet. *JAMA*, XXXIII(9), 515. <https://doi.org/10.1001/jama.1899.92450610001001e>
10. Gesch, C. B. (2005). The potential of nutrition to promote physical and behavioral well-being. In: Huppert F.A., Baylis N, Keverne B (eds) *The Science of Well-being*. Proceedings of the Royal Society (Chapter 7, pp. 171-214). Oxford University Press, <https://doi.org/10.1093/acprof:oso/9780198567523.003.0007>
11. Global Panel on Agriculture and Food Systems for Nutrition (2016). *Food Systems and Diets: Facing the Challenges of the 21st Century*. Global Panel on Agriculture and Food Systems for Nutrition, <http://glopan.org/sites/default/files/ForesightReport.pdf>
12. Gómez-Pinilla, F. (2008). Brain foods: the effects of nutrients on brain function. *Nature Reviews Neuroscience*, 9(7), 568–578. <https://doi.org/10.1038/nrn2421>
13. Hargreaves, D., Mates, E., Menon, P., Alderman, H., Devakumar, D., Fawzi, W., Greenfield, G., Hammoudeh, W., He, S., Lahiri, A., Liu, Z., Nguyen, P. H., Sethi, V., Wang, H., Neufeld, L. M., & Patton, G. C. (2022). Strategies and interventions for healthy adolescent growth, nutrition, and development. *The Lancet*, 399(10320), 198–210. [https://doi.org/10.1016/s0140-6736\(21\)01593-2](https://doi.org/10.1016/s0140-6736(21)01593-2)
14. Heidari, M., Jokar, Y. K., Madani, S. H., Shahi, S., Shahi, M. S., & Goli, M. (2023). Influence of food type on human Psychological–Behavioral responses and crime reduction. *Nutrients*, 15(17), 3715. <https://doi.org/10.3390/nu15173715>
15. Heslin, A. M., & McNulty, B. (2023). Adolescent nutrition and health: characteristics, risk factors and opportunities of an overlooked life stage. *Proceedings of the Nutrition Society*, 82(2), 142–156. <https://doi.org/10.1017/s0029665123002689>
16. Карпов, О. (2020, December 10). *Вредные продукты питания, список. Классы опасности продукции. Классификация вредных и безопасных пищевых продуктов*. FoodbayBlog: Онлайн-журнал О Пищевой Индустрии, Сельскохозяйственной Промышленности, Производстве Продуктов И Оборудования [in English: Karpov, O. (2020, December 10). Harmful food products, list. Hazard classes of products. Classification of harmful and safe food products. FoodbayBlog: An online journal about the food industry, agricultural industry, and the production of food products and equipment], https://foodbay.com/wiki/it_is_interesting/2017/04/19/klassy-opasnosti-produkzii/

17. Kingston, A. (2023, June 28). I ate Ultra-Processed foods, my twin didn't. the results were shocking. *Newsweek*. <https://www.newsweek.com/ultra-processed-food-health-study-1808647>
18. LaFata, E. M., & Gearhardt, A. N. (2022). Ultra-Processed food addiction: an epidemic? *Psychotherapy and Psychosomatics*, *91*(6), 363–372. <https://doi.org/10.1159/000527322>
19. Lee, S., & Choi, M. (2023). Ultra-Processed Food Intakes Are Associated with Depression in the General Population: The Korea National Health and Nutrition Examination Survey. *Nutrients*, *15*(9), 2169. <https://doi.org/10.3390/nu15092169>
20. Leonard, W. R., & Robertson, M. L. (1997). Comparative primate energetics and hominid evolution. *American Journal of Physical Anthropology*, *102*(2), 265–281. [https://doi.org/10.1002/\(sici\)1096-8644\(199702\)102:2](https://doi.org/10.1002/(sici)1096-8644(199702)102:2)
21. Li, H., Li, S., Yang, H., Zhang, Y., Ma, Y., Hou, Y., Zhang, X., Sun, L., Borné, Y., & Wang, Y. (2023). Association of Ultra-Processed Food Intake with Cardiovascular and Respiratory Disease Multimorbidity: A Prospective Cohort Study. *Molecular Nutrition & Food Research*, *67*(11). <https://doi.org/10.1002/mnfr.202200628>
22. Linder, D. O. (n.d). The Trial of Dan White: Trial Testimony of Dr. Martin Blinder (Defense Psychiatrist). *Famous Trials, University of Missouri-Kansas City School of Law*. <https://www.famous-trials.com/danwhite/601-blindertestimony>
23. Logan, A. C., & Schoenthaler, S. J. (2023). Nutrition, Behavior, and the Criminal Justice System: What Took so Long? An Interview with Dr. Stephen J. Schoenthaler. *Challenges*, *14*(3), 37. <https://doi.org/10.3390/challe14030037>
24. Logan, A. C., & Schoenthaler, S. J. (2023). Nutrition, Behavior, and the Criminal Justice System: What Took so Long? An Interview with Dr. Stephen J. Schoenthaler. *Challenges*, *14*(3), 37. <https://doi.org/10.3390/challe14030037>
25. Luković, M., Pantović, D., Kostić, M., Veljović, S., Bugarčić, J. (2023), Food plant diversity in cultural ecosystem services perspective: edible plants as a driver for improving the offer of gastro-tourism, *Ecologica*, *30* (110), 201-208, <https://doi.org/10.18485/ecologica.2023.30.110.5>
26. Luković, M., & Šilc, U. (2021). Management of continental saline ecosystems in the Republic of Serbia – Are these ecosystems suitable for nature-based tourism?. *Hotel and Tourism Management*, *9*(2), 37–49. <https://doi.org/10.5937/menhottur2102037L>.
27. Monteiro, C. A., Cannon, G., Moubarac, J., Levy, R. B., Da Costa Louzada, M. L., & Jaime, P. C. (2017). The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *Public Health Nutrition*, *21*(1), 5–17. <https://doi.org/10.1017/s1368980017000234>
28. Powers, J. (1954, October 13). New, simple method of treating mental illness. *Fort Worth Star-Telegram*, 22.

29. Reales-Moreno, M., Tonini, P., Escorihuela, R. M., Solanas, M., Fernández-Barrés, S., Romaguera, D., & Contreras-Rodríguez, O. (2022). Ultra-Processed Foods and Drinks Consumption Is Associated with Psychosocial Functioning in Adolescents. *Nutrients*, 14(22), 4831. <https://doi.org/10.3390/nu14224831>
30. Reynolds, D. D. (1958, April 15). Miss Swanson packs a lunch and fashionably comes to call. *News and Record*, 6.
31. Schoenthaler, S. J. (1982). The effect of sugar on the treatment and control of antisocial behavior: A double-blind study of an incarcerated juvenile population. *International Journal of Biosocial Research*, 3(1), 1–9.
32. Schoenthaler, S. J. (1984). Diet Crime and Delinquency-A Review of the 1983 and 1984 Studies. *International Journal for Biosocial Research*, 6(2), 141-153.
33. Schoenthaler, S. J., & Bier, I. D. (1985). Diet and delinquency: Empirical testing of seven theories. *International Journal of Biosocial Research*, 7(2), 108-131.
34. Šapić, S., Furtula, S., & Durkalić, D. (2018). Prestige and national identity as predictors of food products purchase. *Economics of Agriculture*, 65(2), 643-657., doi:10.5937/ekoPolj1802643S
35. Teži ravnoteži. (2023, October 11). *Predstavljени rezultati istraživanja u okviru nacionalne kampanje "Teži ravnoteži"*. Teži ravnoteži. [in English: Striving for Balance (2023, October 11). Research results from the national campaign "Striving for Balance" presented. Striving for Balance] <https://teziravnotezi.rs/2023/10/11/1029/>
36. Uhlmann, K., Ross, H., Buckley, L., & Lin, B. B. (2023). Food in my life: How Australian adolescents perceive and experience their foodscape. *Appetite*, 190, 107034. <https://doi.org/10.1016/j.appet.2023.107034>
37. Van Tulleken, C. (2023). *Ultra-Processed People: The Science Behind the Food That Isn't Food*; W.W. Norton.
38. Vignola, E., Nazmi, A., & Freudenberg, N. (2021). What Makes Ultra-Processed Food Appealing? A critical scan and conceptual model. *World Nutrition*, 12(4), 136–175. <https://doi.org/10.26596/wn.202112483-135>
39. Watson, G. (1972). *Nutrition and Your Mind*, Harper and Row.
40. Watson, G., & Comrey, A. L. (1954). Nutritional replacement for mental illness. *The Journal of Psychology*, 38(2), 251–264. <https://doi.org/10.1080/00223980.1954.9712934>
41. Werneck, A. O., Vancampfort, D., Oyeyemi, A. L., Stubbs, B., & Silva, D. (2020). Joint association of ultra-processed food and sedentary behavior with anxiety-induced sleep disturbance among Brazilian adolescents. *Journal of Affective Disorders*, 266, 135–142. <https://doi.org/10.1016/j.jad.2020.01.104>

AN OVERVIEW ASSESSING OF THE EUROPEAN UNION AGRICULTURAL SECTORIAL DYNAMICS: A DRAFT ANALYSIS FROM THE ROMANIAN PERSPECTIVE

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ABSTRACT

The evolution of European agriculture is a result of the numerous paradigm transformations and reforms occurring during the time. The intensification and specialization of the agricultural sector have determined a set of challenges and changes which has imposed a dramatic shift from the traditional European agricultural model. The main aim of this paper is to assess and evaluate in a draft manner the European Union's agricultural sectorial dynamics from the Romanian perspective. In order to identify main trends and gaps in the European agricultural sector and argue the aims and scope of the research some of representative indexes were analyzed and presented in the specific context: nominal. Using the descriptive analysis of indexes such as: value, price, and volume of the agricultural production, farm specializations, agricultural income per annual work unit (Indicator A) and key components, agricultural output, and intermediate consumption, this current research provides an insight introduction to the agricultural sector of the European Union (EU). The main analysis results could serve as inputs for policymakers in drafting the agricultural guidelines in terms of functionality and application in understanding the sectorial evolutions.

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Introduction

The position of agriculture in today's economic landscape has changed dramatically in recent times. Originally a cornerstone of employment and a major contributor to Gross Domestic Product (GDP), it has now adapted to embrace technology and contribute to international trade. While its direct share of GDP may vary from region to region, the importance of agriculture in driving economic growth, ensuring food security, and promoting environmental sustainability remains unchallenged. It is an indispensable sector of modern economies. With the world's population surging at an unprecedented rate and with a European Union age gap advancing, the need to increase agricultural production and efficiency has become a critical issue in both current and future debates about the role and place of agriculture in the actual contemporary economy.

The continuous reforms of the Common Agricultural Policy (CAP) and the ongoing challenges posed by climate change have led to an increased heterogeneity within European agriculture. In their study, (Giannakis et. al.(2015) investigated the varied agricultural performance across the EU-27, seeking to understand the underlying drivers of these differences. Mastronardi et.al.(2015) presented insightful findings from their research on the environmental impact of Italian farms engaged in agri-tourism versus those not involved in such activities. This study highlighted the unique environmental footprints of these two types of farms, providing a nuanced view of agriculture's intersection with tourism.

Rybczewska-Błażejowska et. al. (2018) evaluate the eco-efficiency performance of agriculture in the sector by integrating life cycle assessment (LCA) and data envelopment analysis (DEA) methods to assess the eco-efficiency of the agricultural sector at a broader level. Their study encompassed the agricultural output of all 28 EU member states, offering a detailed landscape of the sector's environmental performance. Crecana and Crecana,(2019) have focused on identifying innovative strategies to enhance the efficiency of Romanian agricultural farms amidst broader economic growth. This research aimed at providing actionable insights for improving farm performances in the context of Romania's evolving economy. Pishgar-Komleh et. al. (2021) in their study utilized a Window Slack-Based Measurement Data Envelopment Analysis (W-SBM-DEA) model, factoring in undesirable outputs, to assess the agricultural performance of the EU-27 from 2008 to 2017. Their analysis revealed notable stability in the European agricultural sector, with countries like the Netherlands, Italy, and Malta exhibiting particularly consistent performance.

Radenović et. al. (2022), categorized EU countries based on the progression in their agricultural economic performance. Through a cluster analysis approach, they investigated various key indicators, such as the aggregate input of the labor force, the annual real income of agricultural factors per work unit, the overall output of agriculture, the gross added value in the agricultural sector, and the production from livestock. This study spanned two distinct periods, 2015–2017 and 2018–2020, offering a dynamic view of the economic trends in the EU's agricultural sector.

As the agricultural sector's relative significance declines in relative terms, other industries like manufacturing, services, and technology are rising to fill the economic void. These sectors are expanding rapidly, compensating for agriculture's reduced contribution, and reshaping the economic landscape. This emphasis underlines the urgent need to address agricultural sector development and sustainability challenges. Consequently, scholars and policymakers aim to implement innovative and sustainable practices in agriculture, with a growing interest in doing so. These approaches aim to meet the urgent needs of a constantly expanding world population while ensuring the preservation of long-term environmental and economic stability.

As Amuda (2022) argues agriculture is an essential element in achieving economic development and recognizing its importance, countries formulate and implement agricultural strategies aimed at stimulating agricultural production and, thereby, raising the standard of living of those involved in agriculture.

The CAP milestones have reflected a continuous evolution from a focus on production and price support to a more holistic approach encompassing environmental sustainability, climate change mitigation, and social equity. The CAP delivers a policy framework for today's agriculture that not only supports the economic viability of farming but also addresses the pressing challenges of sustainability, climate change, and rural development. The forthcoming direction of the CAP is expected to maintain equilibrium among varied requirements, adapting to new challenges and opportunities in the agricultural sector.

Although agriculture is an essential part of Romania's economy, making a significant contribution to its GDP and providing job opportunities, there is a strong need to restructure and increase the productivity of the sector. However, as previously discussed in numerous studies in the literature (Reidsma et al., 2007; Andrei et al., 2020; Eder et al., 2021; Dias et al., 2021; Ait Sidhoum et al., 2023; Bertoni et al., 2023), the economic feasibility for farmers remains a concern due to challenges such as small land holdings, accessing markets and pricing mechanisms.

Popescu et. al.(2019) assess the impact of fixed capital, energy use, and domestic material consumption are reshaping Romania's internal economic model, by applying an intensive version of the Cobb-Douglas function to analyze these effects from an economic standpoint. The findings highlight key factors at both the Romanian and EU-28 levels that are pivotal in forming effective economic policies. Notably, the study points out that Romanian agriculture, while accounting for about 30% of Europe's farms, contributes just 3% to the EU's total agricultural output. In related research (Florea et. al., 2019) explored farmers' motivations for joining or leaving agricultural associations in Southeast Romania, suggesting ways to enhance the sustainability of these cooperative models.

Han, (2016) emphasized the need for a thorough post-analysis in agricultural sector trade negotiations. This approach aims to refine agricultural policies by balancing the interests of both agricultural and non-agricultural sectors more impartially. Borodina et.

al. (2018), discussed the exclusion of agricultural lands from local and rural development. It was observed that the dominance of large-scale land contracts and changes in land use patterns are undermining the sustainability of agriculture and rural communities.

Andrei and Dragoi (2019) analyzed in-depth the progression of the agricultural sector among several EU-28 states from 2006 to 2015, analyzing a wide range of data that included vegetal and animal production, labor force, and gross value added in the agri-food sector. (Himics et. al., 2019; Pantović et al., 2023) employed a partial equilibrium model (CAPRI) to assess the impact of hypothetical greenhouse gas reduction subsidies on the EU farming sector and global food markets.

Garske et. al.(2021) investigated the environmental potential and challenges of digitalization in agriculture, providing an assessment of relevant EU legal frameworks for digital technology in agriculture. Pishgar-Komleh et. al. (2021) used a Window Slack-Based Measurement Data Envelopment Analysis (W-SBM-DEA) model to measure the EU-27 agricultural sector's performance, with a focus on eco-efficiency and comparison between older and newer EU member states. Lastly, Jarosz-Angowska et. al.(2022) evaluated how European integration has influenced the agricultural competitiveness of countries that joined the EU post-2004, revealing both improvements and disparities in the agricultural trade competitiveness of these countries.

The agricultural sector is multi-dimensional, reflecting its complex and integral role in global economies and societies. Understanding and improving this performance requires a balanced approach that considers economic efficiency, environmental sustainability, technological advancement, and social impact. Investigating the agricultural sector's efficiency within the European Union (EU) can be evaluated using a range of indicators, including agricultural output, agricultural income, agricultural prices, and resource performance as already have been carried on in numerous studies as (Andrei & Dragoi, 2019; Guth, & Smędzik-Ambroży, 2020; Choiet al., 2021; Stoian et al., 2022; Nilsson et al., 2022, Constantin et al., 2021).

The main aim and scope of the research was to draft an analytical assessment, providing a comprehensive overview of the evolutionary trends and significant transformations within the agricultural sector of the European Union, all viewed through the specific lens of Romania's experiences and developments. The research aligns with other studies such as: (Anghelache, (2018), Andrei et al., 2020; Constantin et al., 2021; Denisa et al., 2022 and Borda et al., 2023) and extends the investigations by narrowing the perspective through the country approach. Through a focused, country-centric approach, this research highlights some of the unique aspects of Romania's agricultural dynamics, taking into account contemporary challenges within the broader EU framework. The intention is not only to map the trajectory of Romania's agricultural sector post-EU integration but also to identify and analyze some of the specific factors that have shaped its current state. This in-depth examination aims to present nuances and specificities of Romanian agriculture and to provide insights that could contribute to a more tailored and effective policy-making process within the EU, specifically addressing the needs and characteristics of individual member states.

Data and methodology

In order to achieve the main aims and scope of the research and writing a draft analysis in overview assessment of the European Union agricultural sectorial dynamics from the Romanian perspective were considered and analyzed representative index such as: developments in the output of the agricultural industry and farm specialization, work performance in the agricultural sector and agricultural output and intermediate consumption.

The data sets were extracted from the Eurostat database, specifically from the sections on Statistics Explained on agriculture (Eurostat, 2023c) and ‘Agricultural Statistics,’ (Eurostat, 2023a, Eurostat, 2023b) including the explanatory notes dedicated to agriculture.

In order to achieve the main aim and scope of the research several indicators were considered and employed in the study, as they are described in table 1. The indicators considered are considered as defined in Eurostat methodology. The indicators and approach of such a study have been carefully planned to ensure that the choice of indicators, data sources, time frame, and methodology are all in line with the research objectives and provide a comprehensive and reliable analysis of the EU agricultural sector from the Romanian perspective. Table 1 presents the main indicators employed in the study, time-period availability of the data, availability source, and the web link where the datasets are available.

Table 1. Main data description

Description of the data	Time-period availability of the data	Availability source	Link
Output of the agricultural industry (volume, nominal price, nominal value)	2007-2022	Economic accounts for agriculture - indices: volume, price, values	https://ec.europa.eu/eurostat/databrowser/view/AACT_EAA05/default/table?lang=en&category=agr.aact.aact_eaa
Farm specializations: crop, livestock, and mixed farming	2005-2020	Agri-environmental indicator – specialization	https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agri-environmental_indicator_-_specialisation#Assessment
Agricultural income per annual work unit (Indicator A)	2007-2022	Economic accounts for agriculture - agricultural income	https://ec.europa.eu/eurostat/databrowser/view/aact_eaa06/default/table?lang=en
Factor income	2007-2022	Economic accounts for agriculture - agricultural income	https://ec.europa.eu/eurostat/databrowser/product/page/sdg_02_20
Total annual work unit (AWU)	2007-2022	Agricultural labour input statistics: indices	https://ec.europa.eu/eurostat/databrowser/view/aact_ali02/default/table?lang=en
indices agricultural output	2007-2022	Economic accounts for agriculture - indices: volume, price, values	https://ec.europa.eu/eurostat/databrowser/view/aact_eaa05/default/table?lang=en

Description of the data	Time-period availability of the data	Availability source	Link
Indices agricultural intermediate consumption	2007-2022	Economic accounts for agriculture - indices: volume, price, values	https://ec.europa.eu/eurostat/databrowser/view/aact_eaa05/default/table?lang=en

Source: the authors based on the Eurostat database survey

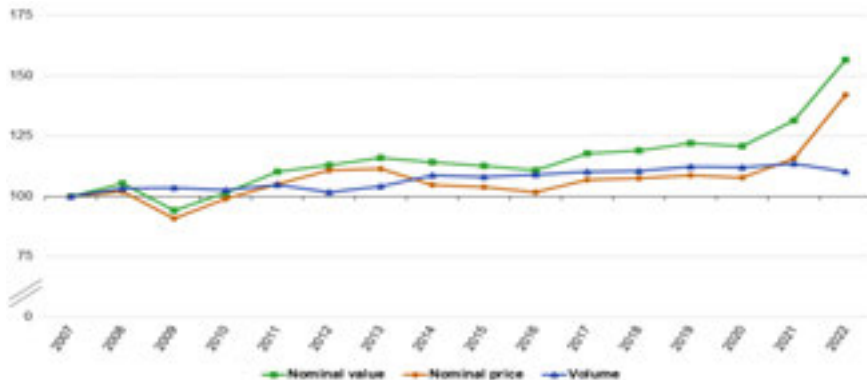
As the study aims to draft an overview assessment of the EU agricultural sectorial dynamics from a member state perspective, descriptive analysis was applied. This approach allows for the identification of some of the fundamental characteristics of the agricultural sector across different EU member states. As for methodology, it was focused on descriptive analysis with an emphasis on data augmentation to identify trends, limitations, and future developments in the context of the EU agricultural sector. The study extends and provides valuable information on trends, constraints, and future directions to design policy and strategic decisions through a combination of descriptive analysis and data augmentation.

Results and Discussions

Developments in the output of the agricultural industry and farm specialization

Figure 1 presents an overview of the agricultural production trends in the European Union over a period of fifteen years, revealing a significant rise in both nominal value and price indices in the latter part of the period, especially after 2020. The steady volume index during this period indicates that the aforementioned value gains are a result of price increases and not an upsurge in agricultural commodity production quantities. The indices indicate either steady conditions or moderate growth as of the beginning of 2020. Subsequently, a notable upsurge in both nominal value and price is observable, possibly implying the impacts of factors like the COVID-19 pandemic, modifications in agricultural policies within the EU, inflationary dynamics, or other noteworthy economic changes.

Figure 1. Developments in the output of the agricultural industry, (2007 = 100, basic prices, EU, 2007-2022)



Source: Eurostat (online data code: aact_eaa05)

The nominal value trajectory reveals minor oscillations but predominantly exhibits an upward trend. The initial phase was characterized by stability until around 2014, which was followed by a slight decline, a plateau, and impressive growth from 2021 onwards. This trend mirrors the nominal value of the agricultural sector's output. The period between 2007 and 2014 exhibited minor fluctuations that were close to the base 100 index, proposing a steady value when considering inflation.

The nominal price index exhibits fluctuations, experiencing a slight rise until approximately 2015 followed by a descent and plateau until a sudden increase in 2022. The significant increase observed in the latest recorded year may indicate a rise in agricultural output prices, an increase in output volume, or a combination of both, influenced by factors such as market demands, production costs, inflation trends, or legislative reforms affecting the agriculture sector. The agricultural output volume index is notable for its relative stability and minimal deviations around the base index value, avoiding any significant long-term increases or decreases until a noticeable upswing in 2021.

The disparity between the nominal value and output volume in the latter years of the graph indicates that the rise in nominal value is chiefly driven by price inflation rather than a substantive growth in the amount of agricultural commodities produced. The noticeable increase in both nominal value and price in recent years can be attributed to a combination of factors, including inflationary pressures, changes in supply and demand dynamics, policy adjustments, and external influences such as climate shifts or changes in the global economic environment.

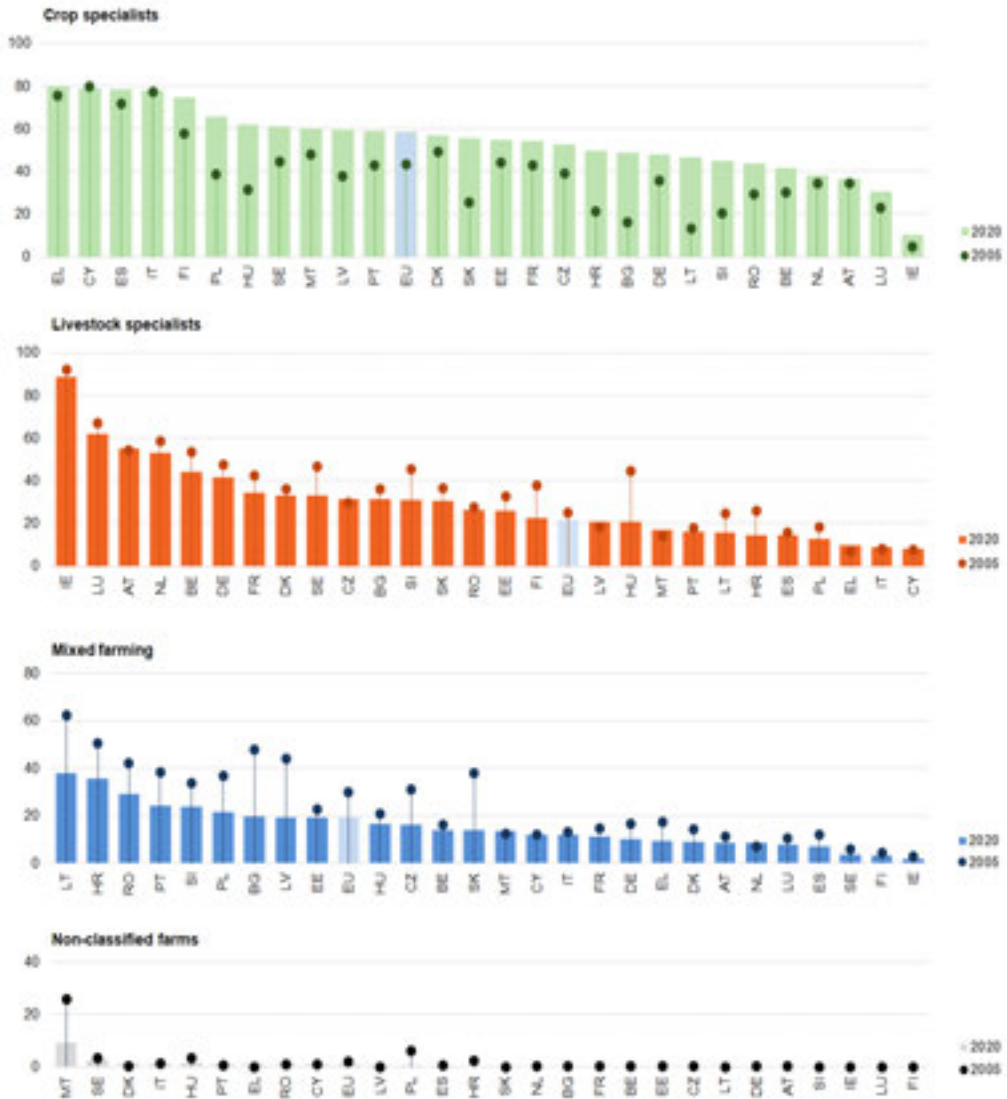
According to Eurostat (2023), in the year 2022, all three indices recorded a considerable upswing, indicating substantial growth or the emergence of inflationary pressures in that year. Before 2021, the volume index was surprisingly steady compared to the nominal value and price indices, which exhibit more significant variability, implying irregular price changes not always consistent with production volume adjustments. The most significant growth rates were observed in Estonia, where there was a surge of 44.4% in output value. Poland followed closely with a significant increase of 43.2%, albeit based on its national currency metrics. Lithuania registered a substantial rise as well, with output value climbing by 42.2%. Several other European countries have seen a notable increase in their agricultural output values, with Latvia, Germany, Finland, Ireland, Austria, Slovakia, and Slovenia all experiencing increases ranging from 20% to 35%. This suggests a widespread trend of growth. In contrast, Cyprus highlights an increase of 4.9%, Romania recorded a more moderate increase of 5.5% - also in local currency terms - and Spain registered a 9.9% rise in the value of output. While these increases are more moderate than the others, they signal a positive shift in agricultural output value.

Farm specialization

During the period 2005 to 2020, there appears to be a dynamic shift in farm specialisation within the EU. This shift may be influenced by factors such as EU agricultural policy, technological progress, market globalisation, environmental concerns, and changes

in consumer preferences. The variation among countries highlights the heterogeneity within the EU concerning agricultural practices and structural modifications within the agricultural sector. In order to analyze the shift in farm specialisation within the EU, the data employed for analyses were available during the time interval of 2005 to 2020. In this context, for the analysis it was considered the range head.

Figure 2. Farm specializations: crop, livestock, and mixed farming, (% share of all farms, 2005 and 2020)



Source: Eurostat, 2023 (online data code: ef_lus_main)

Figure 2 illustrates a comparison of the percentage distribution of different types of farm specialisations across EU member states for 2005 and 2020. The four specialisations are categorized as Crop Specialists, Livestock Specialists, Mixed Farming, and Non-Classified Farms. This data enables an analysis of the changes and trends in agricultural practices over 15 years

According to Figure 2, the agricultural sector in the EU is diverse and places a strong emphasis on both crop and livestock farming. The production of crops, specifically through field cropping and the cultivation of cereals, oilseeds, and protein crops, constitutes a significant portion of the agricultural industry. Meanwhile, livestock farming is also significant, with a specific focus on dairy and mixed farming practices. The existence of diverse and multifaceted farms indicates that EU farmers are utilizing techniques to optimize their resources and potentially safeguard against fluctuations in the market and climate. The diversification of farm specializations illustrates the varied climates, cultures, and dietary habits within the EU. There is a noticeable variation in the proportion of holdings specialising in crop production between countries, with some countries showing a marked decrease and others an increase over the 15-year period, which may indicate a change in agricultural policy, adaptation to market requirements, or environmental changes affecting the viability of crops. In contrast, the reduction in the number of farms solely dedicated to crops across the EU was less pronounced compared to those that focused on mixed or livestock farming.

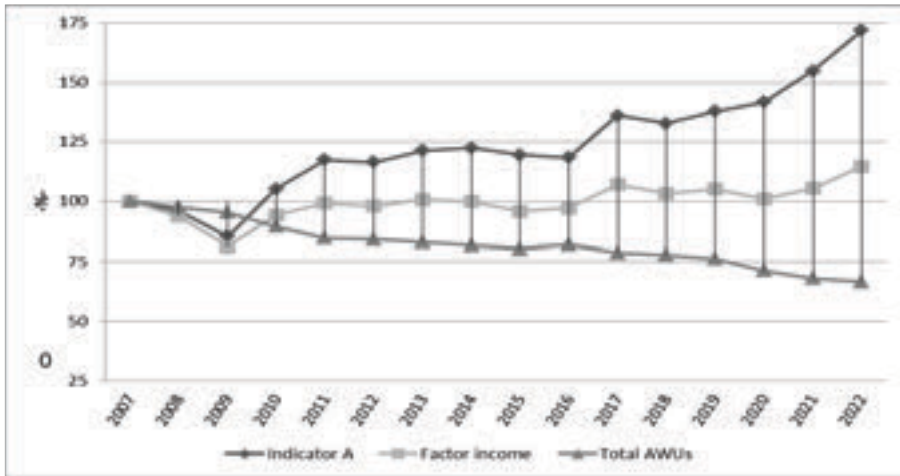
The increase in crop specialist farms within some Member States, including Croatia, Portugal, and Lithuania, suggests a potential shift from livestock specialization or mixed farming towards crop specialization. Greece boasted the highest percentage of crop specialist farms, rising slightly from 75.7% in 2005 to 80.0% in 2020. In contrast, only 9.9% of Ireland's farms specialized in crops. Most Member States experienced an increase in the proportion of farms specializing in crops, particularly in Hungary, Bulgaria, and Lithuania. Italy and Cyprus deviated from this trend, displaying minimal change, although in both countries almost four-fifths of the holdings were already specialised in crops.

Countries with the highest proportion of crop specialists in 2020 are predominantly situated in the eastern and southern regions of Europe. This may reflect the agronomic conditions and economic situations that favour crop specialisation in these regions. Economic factors such as market saturation or reduced profitability may also contribute to this trend. A reduction in specialisation in livestock farming can be observed in multiple European Union (EU) countries, and several factors may be influencing this trend. These include the escalating expenses associated with livestock farming, the possibility of a shift in consumer preferences towards diets comprised primarily of plant-based products, and heightened standards set by regulatory bodies

Work performance in the agricultural sector

An important indicator in measuring agricultural performance is Agricultural income per annual work unit (Indicator A) and key components.

Figure 3. Agricultural income per annual work unit (Indicator A) and key components (2007 = 100, EU, 2007-2022)



Source: authors based on Eurostat, (2023), and Eurostst (2023a - online data codes: aact_eaa06, aact_eaa05, and aact_ali02)

Figure 3 presents the trend of ‘Agricultural income per annual work unit’ (Indicator A) and its components ‘Factor income’ and ‘Total Annual Work Units (AWUs)’ in the European Union (EU) from 2007 to 2022. The figure utilizes 2007 as the base year (2007 = 100) and suggests that the EU agricultural sector is undergoing a transformation characterised by increasing income per AWU and sustained factor income, despite a declining agricultural labour force.

There is a significant rise in Indicator A (agricultural income per AWU) from 2007 to 2022, with certain fluctuations. Particularly, after 2020, there is a distinct surge, thus indicating a noteworthy increase in agricultural income per AWU in the final two years of the dataset. The marked rise in Indicator A after 2020 can be associated with several factors, including alterations to agricultural policy, shifts in the market, and the influence of global events, such as the COVID-19 pandemic, on farming practices and food prices. Additionally, factor income has also experienced a growing trend during the same period, but with less fluctuation in comparison to Indicator A. Therefore, it suggests that factor income (involving land, labour, capital, and entrepreneurship) in agriculture has steadily increased.

The total number of annual working units (AWUs) is decreasing, implying a decline in the number of individuals employed in the agriculture sector or an improvement in sectoral efficiency via mechanisation.

According to Eurostat (2023), the agricultural sector in the European Union saw a significant increase in income in 2022, as measured by the real factor income per Agricultural Work Unit (AWU), which rose by 11.0% compared to the previous year. This was primarily attributable to an 8.6% growth in factor income, achieved despite a 2.1% reduction in the total agricultural workforce.

Upon examination of individual EU member states, a distinct trend of growth or stability in agricultural income per AWU was identified in 2022. This trend was particularly noticeable in some of the EU's primary agricultural producers. According to Eurostat, (2023), datasets, Germany demonstrated a 57.8% increase, followed by Poland with a 23.6% rise, France with 11.5%, and Italy with 9.0%. Other noteworthy percentage increases were recorded in Luxembourg (31.8%), Estonia (29.0%), Sweden (26.4%), Austria (25.4%), Ireland (16.7%), Slovenia (15.0%), Belgium (13.6%), Lithuania (12.6%), Denmark (12.4%), and Greece (11.4%).

However, the upward trend in agricultural income per AWU was not consistent throughout the EU. Some countries suffered significant downturns. Romania experienced the steepest decline, with a decrease of 21.8%, followed by Portugal and Malta, which saw declines of 10.5% and 9.0% respectively. These varying trends underline the diverse economic landscapes and challenges that EU member states encounter within the agricultural industry. Figure 3 suggests that the agricultural sector in the EU is undergoing a transformation characterized by increased income per AWU and sustained factor income, despite a declining agricultural workforce. This points to a potential increase in efficiency and productivity but also necessitates a closer examination of labor dynamics and rural development policies.

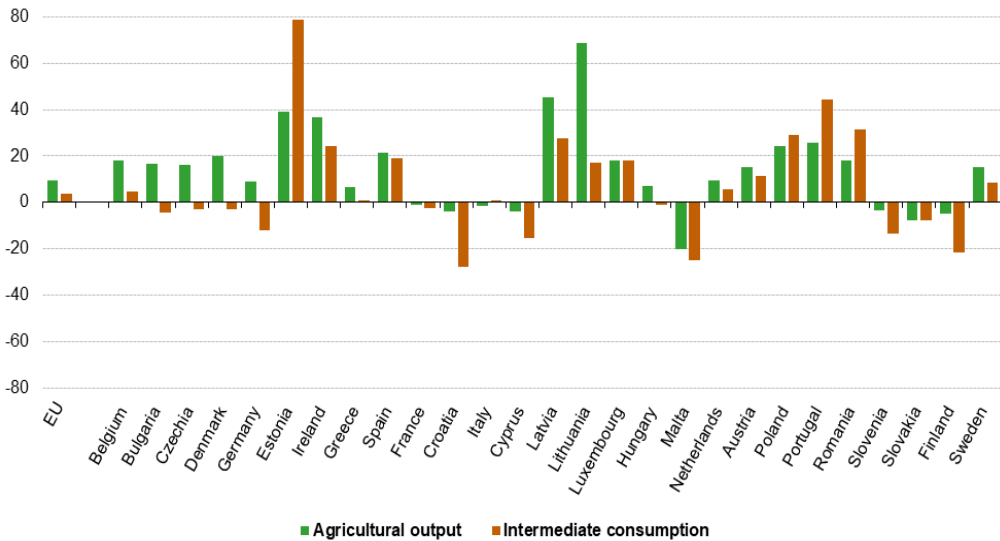
The divergence between the trends of Indicator A and Total AWUs might suggest that the increase in agricultural income per AWU is not necessarily due to increased factor income alone but could be influenced by a reduction in the labor force (AWUs). This could be a result of technological advancements leading to mechanization, thus requiring fewer workers but resulting in higher income per remaining worker. The resilience of factor income in the face of declining AWUs may be indicative of successful adaptation within the agricultural sector to external pressures, such as environmental challenges or changing market demands.

The stable increase in factor income indicates that the overall economic environment for agriculture has been improving. This could be due to better market prices for agricultural products, more efficient production methods, or supportive agricultural policies. In terms of economics, the decline in total AWUs together with the increase in income per AWU could indicate higher productivity per worker. However, it may also raise concerns about the sustainability of agricultural labour markets and rural economies. The information may also reflect wider socio-economic trends such as urbanisation, which may draw labour away from agriculture, or demographic changes such as an ageing rural population.

Agricultural productivity and consumption

Agricultural productivity and consumption are critical indicators of the economic health of the agricultural sector. These indicators not only reflect the efficiency and sustainability of agricultural practices but also have profound implications for food security, trade balances, and environmental sustainability. According to (Vasile et al. 2022), the agricultural output volume indices reflect the relative level of agricultural goods produced, while intermediate consumption reflects the resources used to produce these goods.

Figure 4. Change in the volume indices of agricultural output and of intermediate consumption in EU-27, (% , 2007-2022)



Source: Eurostat, (2023a) (online data codes: aact_eaa05)

Figure 4 displays the change in volume indices of agricultural output and intermediate consumption among the EU member states between 2007 and 2022, offering a comprehensive insight into the agricultural economic dynamics within the EU. At the EU level, there appears to be a slight overall decrease in agricultural output and a more marked decrease in intermediate consumption. This suggests that while agricultural production has not significantly grown, the efficiency of input use may have improved.

The data presented in Figure 4 offers an overview of varying trends in agricultural productivity and input use across the EU. While some countries exhibit growth and efficiency, others show signs of contraction, each with its unique set of economic, environmental, and policy implications.

Germany stand out with a significant increase in agricultural output and a slight rise in intermediate consumption which suggests a strong growth in productivity and possibly an expansion or intensification of agricultural production. In the case of Ireland,

both output and intermediate consumption have increased significantly, indicating an expansion in agricultural activities which may also be becoming more resource-intensive. Also, Estonia and Luxembourg recorded substantial increases in output with relatively stable intermediate consumption, suggesting they have made efficiency gains.

Malta and Slovakia demonstrate significant declines in both output and intermediate consumption, indicating a contraction in the agricultural sector, possibly due to structural challenges or external pressures. Ireland, Estonia, and Luxembourg also demonstrate notable increases in agricultural output without a corresponding rise in intermediate consumption, which could imply a similar trend of improved efficiency. On the other end, Romania and Slovakia show a decrease in agricultural output alongside a rise in intermediate consumption which indicates a potential issue with agricultural productivity or adverse conditions such as economic challenges, environmental factors, or policy changes that could be impacting output.

Figure 4 also highlights countries like Portugal, Greece, and Spain, where there is a reduction in both output and intermediate consumption. While this could suggest a decrease in the overall scale of agriculture, it may also reflect a shift towards less resource-intensive farming or a response to decreased demand.

Conclusions

The agricultural sector in the European Union is shaped by multiple elements like crop yield, financial returns, pricing dynamics, and green practices. The EU's farming industry faces obstacles related to trade instability, heightened prices of commodities, and the ongoing climate crisis. As a result, these factors are likely to affect the growth in key agricultural areas in the upcoming years.

The main findings are the general framework of the agricultural trends and could be employed by policymakers, economists, and stakeholders in the agricultural sector to analyze the performance, identify best practices, and address challenges within the EU's agricultural industry. It is important to consider that these figures could be influenced by many factors, including policy changes, economic conditions, technological advances, environmental factors, and shifts in demand.

Limitations and future direction of research

In the context of ongoing sectoral transformations, investigating the evolution of the European agricultural sector with a focus on country-specific components represents a highly relevant and wide-ranging area of research. The current research, while attempting to be comprehensive in its approach to the assessment of the dynamics of the agricultural sector of the European Union from the Romanian perspective, encounters several limitations that should be taken into account. Market dynamics and environmental factors have a major impact on the agricultural sector, and these complex and rapidly changing factors are not captured in this research. The descriptive nature of our analysis provides an overview of the existing conditions, without expanding

any of the argumentation or emphasis on some of the possible causal relationships among the variables employed in the analysis. In this context, future research could address and expand the topic by including additional data and variables and taking into consideration a more contextual approach.

Conflict of interests

The authors declare no conflict of interest.

References

1. Ait Sidhoum, A., Canessa, C., & Sauer, J. (2023). Effects of agri-environment schemes on farm-level eco-efficiency measures: Empirical evidence from EU countries. *Journal of agricultural economics*, 74(2), 551-569.
2. Amuda, Y. J. (2022). Evaluation of Agricultural Policies and Programmes for Sustainable Future Farming Intensification in Nigeria. *International Journal of Service Science, Management, Engineering, and Technology (IJSSMET)*, 13(1), 1-13.
3. Andrei, J. V., & Dragoi, M. C. (2019). Analysis of the European agricultural context. In *The common agricultural policy and Romanian agriculture* (pp. 32-62). Wallingford UK: CABI.
4. Andrei, J. V., Popescu, G. H., Nica, E., & Chivu, L. (2020). The impact of agricultural performance on foreign trade concentration and competitiveness: empirical evidence from Romanian agriculture. *Journal of Business Economics and Management*, 21(2), 317-343.
5. Andrei, J. V., Popescu, G. H., Nica, E., & Chivu, L. (2020). The impact of agricultural performance on foreign trade concentration and competitiveness: empirical evidence from Romanian agriculture. *Journal of Business Economics and Management*, 21(2), 317-343.
6. Anghelache, C. (2018). Structural analysis of Romanian agriculture. *Romanian Statistical Review Supplement*, 66(2), 11-18.
7. Bertoni, D., Cavicchioli, D., & Latruffe, L. (2023). Impact of business transfer on economic performance: the case of Italian family farms. *International Journal of Entrepreneurship and Small Business*, 48(2), 186-213.
8. Borda, Á. J., Sárvári, B., & Balogh, J. M. (2023). Generation Change in Agriculture: A Systematic Review of the Literature. *Economies*, 11(5), 129.
9. Borodina, O., Yarovy, V., & Mykhailenko, O. (2017). Agricultural land concentration and land grabbing in the EU: modern challenges. *Economy and Forecasting*, (4), 109-124.
10. Choi, H. S., Jansson, T., Matthews, A., & Mittenzwei, K. (2021). European agriculture after Brexit: does anyone benefit from the divorce?. *Journal of Agricultural Economics*, 72(1), 3-24.

11. Constantin, M., Rădulescu, I. D., Andrei, J. V., Chivu, L., Erokhin, V., & Gao, T. (2021). A perspective on agricultural labor productivity and greenhouse gas emissions in context of the Common Agricultural Policy exigencies. *Економика пољопривреде*, 68(1), 53-67.
12. Crecana, D. N., & Crecana, C. D. (2019). Increasing the Performance of Agricultural Holdings in Romania-an Imperative for their Management. *Revista de Management Comparat International*, 20(2), 112-121.
13. Denisa, I., Jean, R., Andrei, V., Chivu, L., Erokhin, V., Gao, T., & Nancu, D. (2022). A short review on European developments in agricultural output price indices during 2008-2017: Are there significant changes?. *Економика пољопривреде*, 69(1), 107-117.
14. Dias, C., Gouveia Rodrigues, R., & Ferreira, J. J. (2021). Small agricultural businesses' performance—What is the role of dynamic capabilities, entrepreneurial orientation, and environmental sustainability commitment?. *Business Strategy and the Environment*, 30(4), 1898-1912.
15. Eder, A., Salhofer, K., & Scheichel, E. (2021). Land tenure, soil conservation, and farm performance: An eco-efficiency analysis of Austrian crop farms. *Ecological Economics*, 180, 106861.
16. Eurostat (2022). Agri-environmental indicator – specialization, available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agri-environmental_indicator_-_specialisation#Assessment, accessed: [07.10.2023].
17. Eurostat (2023). Performance of the agricultural sector, available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Performance_of_the_agricultural_sector#Value_of_agricultural_output, accessed: [09.11.2023].
18. Eurostat (2023a), Economic accounts for agriculture - indices: volume, price, values, available at: https://ec.europa.eu/eurostat/databrowser/explore/all/agric?lang=en&subtheme=agr.aact.aact_eaa&display=card&sort=category&extractionId=AACT_EAA05, accessed: [03.10.2023].
19. Eurostat (2023b), AGRICULTURE Database section, available at: <https://ec.europa.eu/eurostat/web/agriculture/database>, accessed: [05.10.2023].
20. Eurostat (2023c), Statistics Explained on agriculture, available at: <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agriculture>, accessed: [07.10.2023].
21. Florea, A. M., Capatina, A., Radu, R. I., Serban, C., Boboc, M. G., Stoica, C., ... & Stanciu, S. (2019). Limiting Factors that Influence the Formation of Producer Groups in the South-East Region of Romania: A Fuzzy Set Qualitative Comparative Analysis (fsQCA). *Sustainability*, 11(6), 1614.
22. Garske, B., Bau, A., & Ekardt, F. (2021). Digitalization and AI in European agriculture: a strategy for achieving climate and biodiversity targets?. *Sustainability*, 13(9), 4652.

23. Giannakis, E., & Bruggeman, A. (2015). The highly variable economic performance of European agriculture. *Land Use Policy*, 45, 26-35.
24. Guth, M., & Smędzik-Ambroży, K. (2020). Economic resources versus the efficiency of different types of agricultural production in regions of the European Union. *Economic research-Ekonomska istraživanja*, 33(1), 1036-1051.
25. Han, S. H. (2016). An Analysis of Ex-post Evaluation on Korea-EU FTA with respect to the Agricultural Sector. *Journal of the Korea Academia-Industrial cooperation Society*, 17(7), 648-655.
26. Himics, M., Fellmann, T., & Barreiro-Hurle, J. (2020). Setting climate action as the priority for the common agricultural policy: a simulation experiment. *Journal of Agricultural Economics*, 71(1), 50-69.
27. Jarosz-Angowska, A., Nowak, A., Kołodziej, E., & Klikocka, H. (2022). Effect of European Integration on the Competitiveness of the Agricultural Sector in New Member States (EU-13) on the Internal EU Market. *Sustainability*, 14(20), 13124.
28. Mastronardi, L., Giaccio, V., Giannelli, A., & Scardera, A. (2015). Is agritourism eco-friendly? A comparison between agritourisms and other farms in Italy using farm accountancy data network dataset. *SpringerPlus*, 4(1), 1-12.
29. Nilsson, P., Bommarco, R., Hansson, H., Kuns, B., & Schaak, H. (2022). Farm performance and input self-sufficiency increases with functional crop diversity on Swedish farms. *Ecological Economics*, 198, 107465.
30. Pantović, D., Luković, M., Lakićević, M. (2023), Evaluation of tourism at rural areas in the European Union, *Proceedings of the Faculty of Economics in East Sarajevo*, Issue 27, 11-18.
31. Pishgar-Komleh, S. H., Čechura, L., & Kuzmenko, E. (2021). Investigating the dynamic eco-efficiency in agriculture sector of the European Union countries. *Environmental Science and Pollution Research*, 28(35), 48942-48954.
32. Popescu, G. H., Andrei, J. V., Nica, E., Mieilă, M., & Panait, M. (2019). Analysis on the impact of investments, energy use and domestic material consumption in changing the Romanian economic paradigm. *Technological and Economic Development of Economy*, 25(1), 59-81.
33. Radenovic, Ž., Krstić, B., & Marković, M. (2022). Economic Performance of Agriculture in the European Union Countries. *Zagadnienia Ekonomiki Rolnej*, 370(1), 5-21.
34. Reidsma, P., Ewert, F., & Oude Lansink, A. (2007). Analysis of farm performance in Europe under different climatic and management conditions to improve understanding of adaptive capacity. *Climatic Change*, 84, 403-422.
35. Rybaczewska-Błażejowska, M., & Gierulski, W. (2018). Eco-efficiency evaluation of agricultural production in the EU-28. *Sustainability*, 10(12), 4544.

36. Stoian, M., Ion, R. A., Turcea, V. C., Nica, I. C., & Zemeleaga, C. G. (2022). The Influence of Governmental Agricultural R&D Expenditure on Farmers' Income—Disparities between EU Member States. *Sustainability*, 14(17), 10596.
37. Vasile, A. J., Rădulescu, I. D., Chivu, L., Erokhin, V., Nancu, D., Gao, T., & Vasić, M. (2022). A short descriptive analysis of the European evolutions of input price indices of agricultural products between 2008-2017: patterns, trends and implications. *Strategic Management*, 27(3), 39-47.

ЗАПИСНИК
са XVI. (шеснаесте) ванредне седнице Скупштине
НАУЧНОГ ДРУШТВА АГРАРНИХ ЕКОНОМИСТА БАЛКАНА (НДАЕБ)
одржане 14.11.2023. године електронским путем.

Констатовано је да је кворум за ову седницу испуњен, с обзиром да је 42 чланова измирило чланарину за 2023. годину (према достављеној евиденцији). Тиме су формално – правно (према Статуту) обезбеђени услови за правоснажно одлучивање, с обзиром да се електронској седници одазвало 30 чланова, од 42 чланова колико их испуњава услове за одлучивање.

Седници су се одазвали, односно гласали следећи чланови НДАЕБ-а: Биљана Грујић Вучковски, Дејан Дашић, Јелена Димовски Станојевић, Јонел Субић, Лана Настић, Љубица Ковачевић, Маријана Јовановић Тодоровић, Марко Јелачник, Наташа Кљајић, Милош Пјанић, Нада Мијајловић, Предраг Вуковић, Радомир Јовановић, Сања Добричанин, Соња Лазаревић, Тања Вујовић, Тања Станишић, Владимир Радивојевић, Зоран Јокић, Зорица Васиљевић, Данијела Пантовић, Маја Младеновић, Горица Цвијановић, Милан Марковић, Александра Федајев, Дејан Секулић, Андреј Жан Василе, Ферхат Ђејвановић, Драго Цвијановић и Горан Максимовић,

ДНЕВНИ РЕД

1. Молба Националног института за економска истраживања „Costin C. Kirişescu“ – Румунске академије из Букурешта, да буду суиздавачи часописа Економика пољопривреде, а сходно члану 13. Статута НДАЕБ-а, Председништво НДАЕБ-а је донело Одлуку да предложи Скупштини НДАЕБ-а (сходно члану 25. Статута НДАЕБ-а) да National Institute for Economic Research “Costin C. Kirişescu” - Romanian Academy (Национални институт за економска истраживања „Costin C. Kirişescu“ – Румунске академије), буде један од суиздавача часописа Економика пољопривреде од 01.01.2024. године.

Чланови Скупштине НДАЕБ-а, једногласно су донели Одлуку о усвајању предлога Председништва НДАЕБ-а, односно да се прихвати молба Националног института за економска истраживања „Costin C. Kirişescu“ – Румунске академије из Букурешта, Румунија, да буду суиздавачи часописа Економика пољопривреде од 2024 године.

Задужују се Председник НДАЕБ-а и главни и одговорни уредник часописа да спроведу ову Одлуку. Другим речима, први став члана 13. Статута НДАЕБ-а који гласи „Друштво, у сарадњи са Институтом за економику пољопривреде - Београд и Академијом економских наука-Букурешт (Република Румунија) издаје часопис: „Економика пољопривреде”, мења се и сада гласи: „Друштво, у сарадњи са Институтом за економику пољопривреде – Београд, Академијом економских наука - Букурешт и Националним институтом за економска истраживања „Цостин Ц. Киритесцу“ – Румунска академија (Република Румунија) издаје часопис: „Економика пољопривреде”.

Председник НДАЕБ-а

Проф. др Горан Максимовић

На основу члана 22. Закона о удружењима („Сл. гласник РС”, бр. 51/09), Скупштина Научног друштва аграрних економиста Балкана - Београд, на седници одржаној дана 03.12. 2010. године, усвојила је

С Т А Т У Т НАУЧНОГ ДРУШТВА АГРАРНИХ ЕКОНОМИСТА БАЛКАНА

I Опште одредбе

Члан 1.

Научно друштво аграрних економиста Балкана, са седиштем у Београду (у даљем тексту: Друштво, или скраћени назив: НДАЕБ), је добровољна, невладина, отворена, недобитна организација афирмисаних академских аграрних економиста-стручњака који се баве научним теоријским и практичним истраживањима и имају објављене научне радове.

Подручје делатности Друштва је територија Републике Србије, као и територија бивших југословенских република, суседних и других држава (у складу са прописима тих држава).

Члан 2.

НДАЕБ чине слободно и добровољно удружени чланови-аграрни економисти и други стручњаци који се научно баве питањима аграра и села, односно теоријом и праксом мултифункционалног аграрног и руралног развоја, који су стекли звање магистра, односно научни степен доктора из области агроекономских, агрономских, економских, социолошких и других сродних наука.

Члан 3.

НДАЕБ је правно лице са правима, обавезама и одговорностима које му припадају по основу Устава Републике Србије, Закона и овог Статута.

Члан 4.

Седиште НДАЕБ је у Београду, ул. Кнеза Милоша 9/1, у пословним просторијама Савеза инжењера Србије (раније: Савез пољопривредних инжењера и техничара Југославије).

Члан 5.

НДАЕБ има свој печат, округлог облика, са ободним натписом исписаним на српском језику ћирилицом: „Научно друштво аграрних економиста Балкана, Београд”

И на енглеском језику „Balkan Scientific Association of Agricultural Economists”, са стилизованим словима НДАЕБ/BSAAE у средини.

Друштво има амблем, у боји и црно-белој техници: амблем је правоугаоног облика стилизоване отворене књиге, са усправном овалном површином у средини, која асоцира на зрно жита на чијим је половинама стилизован скраћени назив НДАЕБ.

НДАЕБ има меморандум, са амблемом и својим пуним називом на српском и енглеском језику и другим потребним подацима.

Рад НДАЕБ је јаван.

II Јавност рада и сарадња

Члан 6.

НДАЕБ обавештава своје чланове и јавност о својим активностима: одржавање Конгреса, симпозијума, саветовања, предавања, расправа и других научно - стручних скупова, затим студијским путовањима, стручним екскурзијама, посетама међународним научним скуповима у земљи и иностранству.

За јавност рада одговорни су Председништво и Председник Друштва.

Члан 7.

НДАЕБ обезбеђује јавност рада и путем свог часописа „Економика пољопривреде”, објављивањем зборника радова, монографија и других публикација и саопштења у средствима јавног информисања, као и достављањем на увид јавности извештаја о свом раду и обиму и начину стицања и коришћења средстава.

Члан 8.

Друштво сарађује са другим сродним научно-стручним институцијама, привредним удружењима из области пољопривреде, развоја села и агроиндустријског комплекса, одговарајућим асоцијацијама других земаља и међународним организацијама аграрних економиста.

Члан 9.

Одлуку о ступању у чланство других институција доноси Председништво НДАЕБ.

III Циљеви, задаци и делатности НДАЕБ

Члан 10.

Полазећи од креативне улоге и значаја које у области аграрног развоја имају аграрни економисти, НДАЕБ има следеће циљеве:

а) унапређење и развој аграрно-економске науке, научних метода аграрно-економских истраживања и пољопривредне струке;

б) унапређивање привредног система и усавршавање макроекономске и аграрне политике ;

в) унапређивање и развој производње, прераде и промета хране афирмисањем примене савремених научних и технолошких достигнућа и заштите човекове радне и животне средине;

г) унапређивање и развој система образовања аграрних економиста, стручних кадрова и пољопривредних произвођача у складу са савременим потребама;

д) неговање и развијање начела морала и етичких норми у професионалном раду и заштити достојанства аграрно-економске науке и струке.

Члан 11.

У складу са својим циљевима, НДАЕБ има задатке да:

(1) прати развој и међузависност економских, социолошких, технолошких и еколошких проблема производње, прераде и промета хране;

(2) проучава питања економичности, продуктивности рада, економских услова привређивања и конкурентске пољопривреде у процесима либерализације трговине и регионалних интеграција;

(3) прати развој аграрно-економске науке и проблеме научно-истраживачког рада, иницира и организује одржавање научно-стручних скупова из тих области;

(4) подстиче укључивање својих чланова у програмске активности Европске асоцијације аграрних економиста (European Association of Agricultural Economists-EAAE) и других сличних организација;

(5) издаје часописе, монографије и друге публикације из области аграрне економије, самостално или у сарадњи са другим суиздавачима;

(6) брине о друштвеном положају и афирмацији аграрно-економске и пољопривредне науке и струке, кроз доделу награда и признања;

(7) на захтев других институција, или самоиницијативно, даје мишљења о предлозима и идејама за решавање питања из области аграрне политике, развоја пољопривреде, руралног и регионалног развоја.

Члан 12.

Ради остваривања својих циљева и стицања добити, Друштво обавља следеће активности:

22110- Издавачка делатност (издавање и продаја књига и других публикација)

22130- Издавање часописа и сличних издања;

73201- Истраживање у друштвеним и хуманистичким наукама; 74130- Истраживање тржишта и консалтинг;

80420- Остало образовање (организовање предавања, семинара, симпозијума, конгреса);

91120- Делатност струковних удружења;

Наведене делатности Друштво може да обавља након регистрације истих код Агенције за привредне регистре.

Ове делатности су мањег обима, односно обављају се у обиму потребном за остваривање циљева Друштва.

IV Издавачка делатност

Члан 13.

Друштво, у сарадњи са Институтом за економику пољопривреде – Београд, (Република Србија), Академијом економских наука - Букурешт и Националним институтом за економска истраживања „Costin C. Kiritescu“ – Румунска академија (Република Румунија) издаје часопис: „Економика пољопривреде”.

Часопис објављује оригиналне научне радове, прегледне чланке, стручне радове, претходна саопштења, приказе и осврте, из области за које је Друштво основано Радови, који се категоризују као научни, морају имати позитивне рецензије, извод, кључне речи и резиме на једном од светских језика, ISBN и УДК број и категорију рада према Стандардима Министарства науке и Правилима Уредништва. Редакција часописа је састављена од еминентних научних радника из више земаља и институција.

Часопис редовно излази у четири броја годишње; размењује се са свим балканским и више других земаља у свету; реферише се у релевантним секундарним публикацијама и базама података; у штампаној и електронској форми доступан је

у Народној библиотеци Србије и на сајту оснивача.

Часопис има категорију водећег часописа за једну од области науке за коју је Друштво основано.

Члан 14.

Главни уредник часописа „Економика пољопривреде” врши следеће послове

- прима, оцењује и распоређује радове;
- одређује рецензенте;
- води комуникацију са ауторима, рецензентима, библиотекама, претплатницима, научним и другим институцијама;
- стара се техничкој припреми, лекторисању, редиговању и штампању;
- одговоран је за извршење дела финансијског плана Друштва који се односи на активности часописа.

Главни уредник се бира на време од 4 године и може бити поново изабран.

V Чланство, права, обавезе и признања

Члан 15.

Чланство у НДАЕБ је индивидуално.

Ступање у чланство Друштва врши се на основу писаног захтева, који садржи: личне податке, ЈМБГ или број пасоша, научно звање, организацију запослења, адресу и изјаву да је подносилац упознат са одредбама Статута Друштва и да их прихвата.

Одлуку о пријему у Друштво доноси Председништво Друштва. Друштво води евиденцију о својим члановима.

Члан 16.

Чланство НДАЕБ чине: сарадници, чланови и редовни чланови. Сарадник НДАЕБ може да постане лице које испуњава следеће услове:

- да је, по правилу, магистар наука, односно да има завршене дипломске студије-мастер,
- да се бави научним радом и
- да има објављене радове у областима: агроекономских, агрономских, економских, социолошких и других сродних наука.

Кандидат за члана НДАЕБ, поред услова предвиђених за сарадника, треба да испуњава и следеће услове: да је доктор наука, најмање у звању доцента, односно научног сарадника, да има већи број објављених радова и саопштења на научним скуповима.

Кандидат за редовног члана НДАЕБ, поред услова предвиђених за члана, треба да испуњава и следеће услове: да има објављене књиге, односно монографије и већи број радова и саопштења на научним скуповима, да је у звању редовног професора, односно научног саветника.

Члан 17.

Чланови Друштва имају следећа права и дужности да: да буду правовремено обавештени о одлукама и активностима Друштва, подносе предлоге и мишљења за остваривање циљева и задатака Друштва, учествују у извршавању одлука, задатака и планова Друштва, редовно плаћају чланарину, чувају углед и интересе Друштва.

Члан 18.

Друштво може чланове прогласити заслужним, односно почасним члановима Друштва.

Заслужним чланом може да се прогласи члан који се истакао својим вишегодишњом стручном или друштвеном активношћу на остваривању циљева и задатака Друштва.

Почасним чланом Друштва може да се прогласи истакнути стручни или друштвени радник, који је својим радом допринео развоју аграрне економије и укупне активности Друштва.

Заслужни и почасни чланови Друштва дужни су да учествују у свим активностима Друштва, да својим радом афирмишу његов углед и доприносе изучавању и решавању аграрних проблема.

Заслужне и почасне чланове проглашава Скупштина НДАЕБ на предлог Председништва.

Члан 19.

Појединим члановима Друштва који су се истакли вишегодишњим радом, Скупштина Друштва на предлог Председништва, може да додели следећа признања: Дипломе, плакете, похвалнице и сл.

Члан 20.

Чланство Друштва престаје: изјавом о иступању из чланства, искључењем и смрћу члана Друштва.

Разлози за искључење су следећи:

- ако намерно или грубом непажњом проузрокује штету Друштву или члановима Друштва,
- учествује у радњама које онемогућавају извршавање циљева због којих је Друштво основано, својим понашањем спречава или отежава рад Друштва.

VI Органи Друштва

Члан 21.

Органи Друштва су: Скупштина, Председништво, Председник, Извршни и Надзорни НДАЕБ може имати Потпредседника и Почасног председника.

Члан 22.

Скупштину чине сви чланови Друштва, односно, сви чланови Друштва, који су у години одлучивања уплатили чланарину за ту календарску годину.

Седнице Скупштине могу бити редовне и ванредне.

Редовна седница Скупштине одржава се најмање једном годишње.

Скупштину сазива Председник најмање недељу дана раније, уз објављива

ње дневног реда, места и времена одржавања Скупштине.

У случају ванредних ситуација или не могућности да се чланови Друштва не могу састати, Скупштина се може одржати електронским путем.

Ова одредба важи за све остале Органе Друштва (Председништво, Извршни и Надзорни одбор).

Члан 23.

Скупштином руководи председник Друштва са члановима Председништва. Скупштина усваја Пословник о раду и утврђује начин гласања о избору органа

Гласање у Скупштини је јавно, ако Скупштина друкчије не одреди.

На Скупштини се одлуке доносе већином гласова присутних чланова Друштва, с тим да седници мора присуствовати најмање 51% чланова Друштва од оних који су у години одлучивања уплатили чланарину за ту календарску годину.

Члан 24.

Ванредна седница Скупштине мора се сазвати ако захтев за њено сазивање, у писаном облику, поднесе најмање двадесет чланова Друштва.

Седницама Скупштине могу присуствовати почасни чланови Друштва, као и друга позвана лица, без права одлучивања.

Члан 25.

Скупштина Друштва:

- Усваја Статут, његове измене и допуне;
- Доноси друга општа акта значајна за рад Друштва;
- Бира и разрешава Председника и чланова Председништва Удружења;
- Бира и разрешава Главног уредника часописа „Економика пољопривреде“;
- Бира и разрешава Председника и чланове Извршног и Надзорног одбора;
- Усваја годишњи извештај о раду Друштва;
- Одлучује о удруживању у савезе;
- Одлучује о статусним променама (припајање, спајање и подела Друштва);
- Одлучује о покретању поступка за накнаду штете;
- Одлучује о давању пригодних награда.

Члан 26.

Председништво Друштва:

- Стара се о остваривању циљева Друштва;
- Доноси план прихода и расхода и на крају календарске године подноси Скупштини извештај о истим;
- Предлаже Скупштини план, односно динамику активности;
- Предлаже измене и допуне Статута и других аката;
- Сазива и припрема седнице Скупштине Друштва;
- Организује конгресе, саветовања, симпозијуме, семинаре и друге научно-стручне састанке;
- Одлучује о формирању секција, стручних актива и других облика организовања;

- Одлучује о захтевима за пријем у чланство Друштва ;
 - Образује Издавачки савет и редакцију часописа „ Економика пољопривреде, монографија и других публикација које издаје Друштво ;
 - Утврђује висину чланарина и котизација;
 - Доноси Пословник о свом раду ;
 - Одлучује о ванредном ангажовању лица за обављање административних и финансијских послова;
 - Бира представнике Друштва у другим струковним асоцијацијама ;
 - Обавља и друге послове у складу са одлукама и закључцима Скупштине .
- Мандат чланова Председништва траје 4 године и могу бити поново бирани.

Члан 27.

Председник Друштва:

- Заступа Друштво;
- председава и руководи радом Друштва;
- Наредбодавац је за извршење финансијског плана Друштва;
- Стара се о спровођењу одлука Скупштине и Председништва;
- Закључује Уговоре о раду ,са лицима са стране, за обављање административних и финансијских послова,
- Закључује Уговор о заради са секретаром Друштва;
- Закључује уговор о заради са председником и главним и одговорним уредником часописа „Економика пољопривреде”

У случају одсутности замењује га неко од чланова Председништва. Председник Друштва је и председник Председништва.

Члан 28.

Председник Друштва може бити само лице које има пребивалиште или боравиште на територији Републике Србије.

Председник је дужан да се придржава овлашћења одређених овим Статутом и одлукама Скупштине и Председништва Друштва.

Председник се бира за време од 4 године и може бити поново изабран.

Члан 29.

Извршни одбор је оперативно-управни орган Друштва који обезбеђује ефикасност и рационалност у раду Друштва, у складу са Статутом и закључцима Скупштине и Председништва.

Извршни одбор чине: Председник, Секретар и Главни уредник часописа „Економика пољопривреде”.

Члан 30.

Надзорни одбор је орган друштва који се стара о законитости пословања и рада Друштва

Скупштина бира Председника и два члана Надзорног одбора.

Седнице Надзорног одбора се одржавају по потреби, а најмање једном

годишње. Мандат чланова Надзорног одбора траје четири године, и могу бити поново изабрани.

Надзорни одбор обавља следеће послове: прати и контролише спровођење

Закона, Статута и других аката Друштва, контролише материјално и финансијско пословање Друштва и његових органа, подноси Председништву и Скупштини извештај о свом раду.

Члан 31.

Друштво има Секретара, кога бира скупштина Друштва на време од 4 године, и може бити поново изабран.

Секретар друштва обавља стручно- административне послове, и то:

- Помаже Председнику у припремању седница и води записнике са седница Скупштине, Председништва, Извршног и Надзорног одбора;

- Води регистре записника са седница, чува документа утврђена овим Статутом, као и списак чланова Друштва, осим финансијских извештаја;

- Помаже Председнику у припреми одлука и благовременом обавештавању чланова Друштва и осталих заинтересованих лица;

- Врши и друге послове које му повери Председник Друштва, а у вези су са радом Друштва.

Секретар је одговоран за организовање рада и извршавања одлука Скупштине, Председништва, Извршног и Надзорног одбора.

Члан 32.

Сваки члан Друштва може да покрене поступак пред надлежним судом за утврђивање ништавости општег акта Друштва који је донет супротно Статуту или другом општем акту Друштва, односно за утврђивање ништавости појединачног акта Друштва који је донет супротно Закону, Статуту или другом општем акту Друштва.

Члан 33.

Чланови органа Друштва одговарају солидарно за штету коју својом одлуком проузрокују Друштву, ако је та одлука донета грубом непажњом или са намером да се

штета проузрокује, осим ако су у поступку доношења одлуке издвојили своје мишљење у записник.

Одредба претходног става односи се и на радње заступника Друштва.

Поступак за накнаду штете покреће се на основу одлуке Скупштине Друштва.

Одлуком се може одредити посебан заступник Друштва за поступак накнаде штете.

VII Имовина Друштва

Члан 34.

Ради остваривања својих циљева, Друштво стиче имовину на следећи начин:

- чланаринама,
- добровољним прилозима,
- субвенцијама из буџета државних органа за научноистраживачки рад,
- донацијама и поклонима (у новцу или у натури),
- котизацијама учесника на скуповима које организује Друштво,
- завештањима домаћих правних и физичких лица,
- каматама на улоге,
- закупнином,
- дивидендама и
- на други законом дозвољен начин.

Члан 35.

Средства које Друштво добије из буџета републике Србије за реализовање програма од јавног интереса (у области науке), искључиво користи за реализовање одобреног програма.

Друштво је у обавези да једанпут годишње учини доступним јавности извештаја о свом раду и о обиму и начину стицања и коришћења средстава и тај извештај доставља даваоцу средстава.

Члан 36.

Друштво води пословне књиге и сачињава финансијске извештаје.

Годишњи обрачуни и извештаји о активностима Друштва подносе се члановима Друштва на увид почетком сваке календарске године, док Скупштина Друштва усваја исте на редовној седници која се одржава такође почетком календарске године.

Члан 37.

За своје обавезе Друштво одговара целокупном својом имовином.

Чланови Друштва и органа Друштва могу лично да одговарају за обавезе Друштва ако поступају са имовином Друштва као да је у питању њихова имовина или злоупотребе Друштво као форму за незаконите или преварне сврхе.

Члан 38.

Имовина Друштва може да се користи једино за остваривање његових статутарних циљева.

Имовина Друштва не може се делити његовим члановима, оснивачима, члановима органа Друштва, Председнику, запосленима или са њима повезаним лицима.

Одредба овог члана не односи се на давање пригодних награда и накнада оправданих трошкова насталих остваривањем статутарних циљева Друштва (путни трошкови, дневнице, трошкови преноћишта и сл.), уговорене теретне обавезе и исплату зарада запослених.

Члан 39.

За случај престанка Друштва као прималац његове имовине одређује се Република Србија, односно јединица локалне самоуправе на чијој се територији налази седиште Друштва.

VIII Статусне промене

Члан 40.

Друштво може променити правни положај на основу одлуке Скупштине Друштва. Статусне промене су: припајање, спајање, подела и престанак рада Друштва.

Председништво Друштва утврђује предлог одлуке о промени правног положаја Друштва.

Председник друштва обавештава чланове Друштва о сазиву седнице Скупштине најмање 30 дана пре одржавања седнице Скупштине.

Обавештење из претходног става садржи нарочито: разлог сазивања Скупштине и место у седишту Друштва где се члановима Друштва стављају на увид следећа документа: Предлог одлуке о промени правног статуса Друштва, извештај Председништва Друштва о разлозима за промену правног статуса Друштва и тачан опис права и обавеза која се преносе, односно која се спајају, уколико се ради о припајању и спајању Друштва. Уколико се ради о подели Друштва, подноси се деобни биланс.

Члан 41.

Скупштина Друштва доноси одлуку о промени правног положаја Друштва

Одлука из претходног става доноси се квалификованом већином, тј. за исту би требало да гласа 2/3 свих чланова Друштва.

Члан 42.

Друштво губи статус правног лица брисањем из регистра Друштва. Брисање из регистра врши се:

- ако број чланова смањи испод броја оснивача потребног за оснивање, а Председништво Друштва не донесе одлуку о пријему нових чланова;
- ако Скупштина Друштва донесе одлуку о престанку рада;
- ако је извршена статусна промена која има за последицу престанак Друштва;
- ако се утврди да Друштво не обавља активности на остваривању статутарних циљева или ако су протекле најмање 2 године од одржавања последње седнице Скупштине Друштва;
- Ако је Друштву забрањен рад;
- Стечајем

IX Општи акти

Члан 43.

Статут Друштва је основни општи акт којим се уређује организација и функционисање Друштва.

Скупштина Друштва доноси Статут већином гласова.

Измене и допуне Статута врше се по истом поступку као и приликом доношења, с тим што измене и допуне предлаже Председништво Друштва.

Статут Друштва ступа на снагу осмог дана од дана објављивања на огласној табли Друштва.

Х Прелазне и завршне одредбе

Члан 44.

НДАЕБ је правни следбеник Друштва аграрних економиста Југославије, у бившој СФРЈ, односно у СР Југославији и Државној заједници Србије и Црне Горе.

НДАЕБ је правни наследник оснивачких и издавачких права институционалних претходника Друштва – Заједнице научно-истраживачких установа за економику пољопривреде и Друштва аграрних економиста Југославије, у односу према часопису “Економика пољопривреде”.

Члан 45.

Тумачење Статута врши орган који га је донео.

Члан 46.

Статут Друштва објављује се у часопису “Економика пољопривреде”, на Српском и Енглеском језику.

Члан 47.

Ступањем на снагу овог Статута престаје да важи Статут који је донела Скупштина Друштва на седници одржаној 07.12.2007. године, који је објављен у часопису „Економика пољопривреде“, ЕП 2008 (55) 1 (107-136).

Председник Скупштине Друштва

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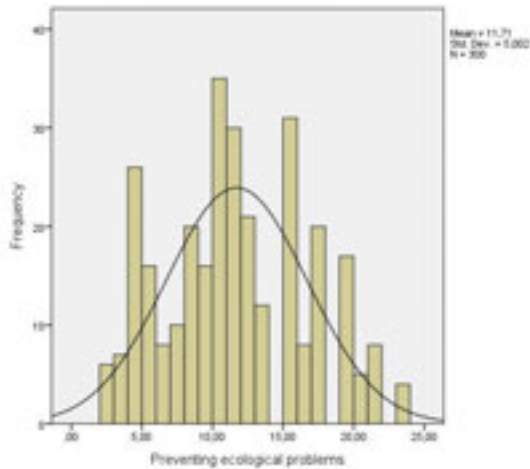
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Example:**Table 1.** The distribution cost of packaged goods from Subotica to retail-store objects

Indicators	Period			Total
	Month 1	Month 2	Month 3	
Distance crossed (km)	12.926	11.295	13.208	37.429
Fuel consumption (litre)	3.231	2.823	3.302	9.356
Value of fuel consumption (RSD)	242.378	211.790	247.653	701.821
Total time spend on touring (hour)	314	266	417	997
Value of total time spend on touring (RSD)	47.048	39.890	62.570	149.508
Number of tours	98	77	102	277
Toll value (RSD)	0	0	0	0
Number of pallets transported (piece)	1.179	976	1358	3.513
Total weight transported (kg)	602.600	429.225	711.116	1.742.941
Vehicle maintenance costs (RSD)	203.858	164.970	224.806	593.634
Lease costs (RSD)	480.938	454.214	565.784	1.500.936
Total sum (RSD)	974.222	870.864	1.100.813	2.945.899

Source: Petrović, 2012

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Figure 1. Agriculture, value added (% of GDP)

Source: Authors' calculations

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