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# ECONOMIC EFFICIENCY OF INVESTMENTS IN THE GROWING OF MEDICINAL HERBS AND SPICES

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## ABSTRACT

Medicinal herbs are important for human nutrition and industrial processing. The main goal of research is assessment of economic effectiveness of investments in seedlings production and establishment of plantation under mentioned crops. Analysis involves data from the coal mine complex in Pljevlja (Montenegro), while implies dynamic methods such are Net Present Value, (Modified) Internal Rate of Return, and Payback Period. Although research results favored the seedlings production, determined crossover rate indicates some opposite conclusions. Inconsistency in conclusions according to Net Present Value and Internal Rate of Return occurs only for certain range of discount rate. Research also implies sensitive analysis of crossover rate according to changes in volume of invested assets. So, management could make appropriate decisions towards the investments in medicinal plants production. Derived results suppose that investment in production of medicinal herbs seedlings is economically more effective for all discount rates above the crossover rate (6.08%).

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## Introduction

Medicinal plants (herbs) and spices have been used in human nutrition and medicine since prehistoric times (Sam, 2019; Sachan et al., 2018). Nowadays, they are used as fresh or processed in human diet and medicine, as a compound of animal feed, or raw material in several sectors of industry (i.e. cosmetics and perfumery, pharmacology, food and feed industry, cookery, light chemical industry, etc.), (Jackson, Snowdon, 1990;

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Mirzaei Aghsaghali, 2012; Wiart, 2012; Živković et al., 2019; Saranraj, Sivasakthi, 2014). They are grown as domesticated varieties in organized industrial production or picked in a wild form in nature (Dhar et al., 2000; Jeločnik et al., 2012). Depending on plant species, they could be successfully grown all over the world, both in open field or greenhouse, in soil or hydroponic (Maggini et al., 2011; Hakimi et al., 2022; Luković et al., 2023). They could be consumed as fresh or processed (dried and milled as powder, in form of oils, tinctures, etc.), (Balentine et al., 1999). They could be used as the whole plants or just as the part of a plant (e.g. radix, leaves, stalk, flower, seeds, fruits, etc.), (Dragland et al., 2003, Done et al., 2012; Botezatu & Andrei, 2012)).

There are a lot of benefits linked to the growing and further use of the medicinal herbs and spices. Above all, they have therapeutic and healing effects towards the most of diseases and malfunctioning in human organism, they are taste and quality enhancer in food products, they are precious compounds within the cosmetics and pharmacy preparations, etc. (Abdel Aziz et al., 2016; Dini, 2018; Jabeen et al., 2022). During their life cycle, they are able to synthesize a number of chemical compounds useful in protection and curing against several diseases and pathogens, such are cardiovascular and neurological issues, diabetes, cancer, arthritis, dementia, etc. (Andrei et al., 2014; Preethi et al., 2010; Chaudhari et al., 2021; Mayekar et al., 2021).

Global market of the mentioned plants is constantly growing affected by an increase in demand (Inoue et al., 2019). Current market worldwide is worth over the 170 mld USD, while it has annual growth over the 3.5% in the last several years (FMI, 2023). Although the growing of medicinal herbs and spices is profitable, some estimations show that the most of profit is concentrated in processing and retail, while, for example, plant collectors take less than 7% of market price of final product (Schippmann et al., 2002). It has to be mentioned that the value of plants and products entering into the global trade is not ultimate, as the large part is naturally consumed or sold on black market (in grey zone), (Farnsworth, Soejarto, 1991).

In line with the health benefits they carry on, medicinal herbs and spices fully correspond to nature, good life habits and sustainable development (Van Wyk, Prinsloo, 2018). Besides the fact that their production brings the income to farmers and rural communities affecting the poverty alleviation processes, the premise of their healthiness drives the growers to act entirely with the principles of good agricultural practice, protecting the local environment and landscapes (Shinwari, 2010; Wondimu et al., 2007).

It is not so rare that medicinal herbs and spices or some other crops are grown on areas that formerly were used for certain form of mining (Pruvot et al., 2006; Dutta, Maharia, 2012; Vaculik et al., 2013; Blanco et al., 2022). In these cases, the environment of the previous mine pits has to be entirely remediated and re-cultivated, or simply ecologically cleaned and brought to primal purpose – agriculture (Ignatyeva et al., 2020; Tichy, Mejstrik, 1996). At this moment, mentioned crops become protectors of rural communities of further mainly soil and water degradation, while they bring certain economic and social benefits too. Of course, investing in such a production has

some costs, usually higher than production in regular conditions (on real agricultural land). So, investment requires deeper techno-economic preparation for decision making process in order to avoid potential failures. From the aspect of economic assessment of planned investment benefits, commonly used dynamic methods are the ones of investment effectiveness evaluation, such are NPV, IRR, PBP (Miletić & Radić, 2022; Kodir et al., 2017; Jeločnik, Subić, 2020; Ergina et al., 2020; Dončić et al., 2022; Pantić et al., 2022; Subić et al., 2021).

The main paper's goal is to present the evaluation of economic effectiveness of investments in seedlings production and establishment of plantation under the medicinal herbs and spices, while making an adequate investment decision towards the available investment alternatives. Paper presents the certain selection mechanism based on calculation of crossover rate's value, towards the choosing the optimal investment alternative by decision maker.

Research was based on the following hypothesis:

H1: Investments in growing of medicinal herbs (in seedlings production and its plantation growing) is economically justified.

H2: Use of the Net Present Value and Internal Rate of Return could lead to different conclusions in investment analysis, i.e. to favoring of different investments (in seedlings production, or plantation growing).

H3: Deviations from initial (expected) level of investment and net cash flow could have large impact to selection between available investment alternatives in medicinal herbs production.

### **Methodological Framework**

The data from the public coal mine enterprise in Pljevlja (Montenegro) are used in the research as data source, as well as available scientific and professional literature focused on seedlings growing and plantation production of medicinal herbs and spices. All data and derived results are presented by adequate tables and Figures. All values are given in EUR.

For the assessment of economic effectiveness of investments, the discounting methods are used, such are the Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PBP), (Subić et al., 2020). Besides, the investments are also assessed by the Modified Internal Rate of Return (MIRR), whose level, unlike classic IRR, depends on the level of discount rate (Barry, Robison, 2014).

When comparing investments, i.e. considering which investment is more economically acceptable, different levels of discount rates were used, while, based on that, the level of crossover rate was determined (the level of the discount rate at which NPVs of compared investments are mutually equal), (Park, Matunhire, 2011). The value of crossover rate is determined according to the differential net cash flow of reconsidered investments, by calculating its internal interest rate (Noe et al., 2003). In addition, it



was analyzed how the level of crossover rate is affected by the variations in level of initial investments and the net cash flow from investment.

### Results with Discussion

As a part of sustainable maintaining of the abandoned coal mining pits area (at 100 ha), after finishing the remediation and re-cultivation processes, management of the public coal mine enterprise strives to establish certain lines of agricultural production. Final decision has been focused on the sector of medicinal herbs and spices production (Coal mine enterprise AD Pljevlja, 2023a, b.).

In line with that, there are two investments that could be realized, i.e. investment in machinery and equipment for crops growing with establishing of plantation of certain plant species (with the application of modern technological solutions), or investment in crops' seedlings production facilities (contemporary greenhouses) and required equipment and machines. Enterprise management has to decide which of the two offered investments has to be financed, according to economic effects they produce.

Medicinal herbs and spices that will be grown in the final selection involve the following crops: Lavender Grosso and English Lavender, Sage, Thyme, Hyssop, Oregano, Winter Savory, Sweet Wormwood, Lovage, and Parsley. All plants will be grown as a long-term plantation, as well as perennial or annual crops. It was assessed that these are the plants that possess large market potential with constantly increasing demand and selling prices at the regional markets (as fresh raw material or processed products).

Initial value of investment in crops' seedling production is 87,309 EUR. This investment includes the purchase of two greenhouses with a steel structure (single-aisle greenhouses, 10 m wide, with 3.5 m high flat sides, and the overall height of 5.5 m in the ridge), as well as the supporting equipment in greenhouse production, i.e. 28 tables for a greenhouse (2 m x 8.5 m x 1 m). Investment in crops growing (establishment of organic plantation system) includes the purchase of required equipment and machinery (tractors, trailers, sprayers, water tanks, plows, planters, chisel plows, medicinal plant pickers, diggers, turner plows, tillers, harrows and seedbeds maker), establishment of long-term plantations (Lavender Grosso and English Lavender) and other (investment works), whereby the initial investment amounts 256,927 EUR (*Table 1*). An economic effect of use of the appropriate machinery in medical herbs production is discussed by Ivanović et al. (2007).

**Table 1.** Overall investment in organic crops growing or seedlings production (in EUR)

No.	Element	Seedlings production		Plants growing	
		Total investment	Share in total investment (%)	Total investment	Share in total investment (%)
<b>I</b>	<b>Fixed assets</b>	<b>79,372</b>	<b>90.91</b>	<b>233,570</b>	<b>90.91</b>
1.	Facilities	39,578	45.33	-	-
2.	Equipment and mechanization	39,794	45.58	196,800	76.60

No.	Element	Seedlings production		Plants growing	
		Total investment	Share in total investment (%)	Total investment	Share in total investment (%)
3.	Long-term plantations	-	-	33,650	13.10
4.	Other			3,120	1.12
<b>II</b>	<b>PWC</b>	<b>7,937</b>	<b>9.09</b>	<b>23,357</b>	<b>9.09</b>
<b>Total (I+II)</b>		<b>87,309</b>	<b>100.00</b>	<b>256,927</b>	<b>100.00</b>

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

The financing scheme (available sources) for planned investments are identical, i.e. in both cases the largest part of investment will be financed with own (corporate) assets (fixed assets), while the permanent working capital (PWC) will be financed from a short-term loan (*Table 2.*).

**Table 2.** Financing sources for realization of investment alternatives (in EUR)

No.	Element	Seedlings production		Plants growing	
		Total investment	Share in total investment (%)	Total investment	Share in total investment (%)
<b>I</b>	<b>Own assets</b>	<b>79,372</b>	<b>90.91</b>	<b>233,570</b>	<b>90.91</b>
1.	Fixed assets	79,372	90.91	233,570	90.91
<b>II</b>	<b>Other sources</b>	<b>7,937</b>	<b>9.09</b>	<b>23,357</b>	<b>9.09</b>
1.	PWC	7,937	9.09	23,357	9.09
<b>Total (I+II)</b>		<b>87,309</b>	<b>100.00</b>	<b>256,927</b>	<b>100.00</b>

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

After determining all incomes and expenses incurred during the investment's exploitation, the net profit (income statements) for seedlings production (*Table 3.*) and medicinal herbs and spices growing (*Table 4.*) was defined. It has to be noted that, according to current regulations in Montenegro, the income tax rate is 9% for amounts up to 100,000 EUR, while for amounts over 100,000 EUR tax covers 9,000 EUR + 12% on the amount over 100,000 EUR. Generally, in both investments (except in the initial year of plantation establishment) there is an achieved positive net profit in entire period of investments exploitation.

In line with data from the income statements, the economic flow for both investments is performed, while in the last year of investments' use (10th year) the salvage value of the investments is also presented (*Table 5. and 6.*). It is visible that, at the second alternative, the economic flow is negative in the first and sixth year of exploitation, as a result of plantation reestablishment after five years of using.

Table 3. Income statement in seedlings production (in EUR)

No.	Element	Years											
		I	II	III	IV	V	VI	VII	VIII	IX	X		
<b>I</b>	<b>Total incomes</b>	<b>155,930</b>	<b>155,930</b>	<b>155,930</b>	<b>155,930</b>	<b>155,930</b>	<b>149,200</b>	<b>149,200</b>	<b>149,200</b>	<b>149,200</b>	<b>149,200</b>	<b>149,200</b>	<b>149,200</b>
1.	Sale incomes	155,930	155,930	155,930	155,930	155,930	149,200	149,200	149,200	149,200	149,200	149,200	149,200
<b>II</b>	<b>Total expenditures (1+2)</b>	<b>151,508</b>	<b>151,296</b>	<b>151,296</b>	<b>151,296</b>	<b>151,296</b>	<b>135,777</b>	<b>135,777</b>	<b>135,777</b>	<b>135,777</b>	<b>135,777</b>	<b>135,777</b>	<b>135,777</b>
1.	Business expenditures	151,296	151,296	151,296	151,296	151,296	135,777	135,777	135,777	135,777	135,777	135,777	135,777
1.1.	Material costs	17,576	17,576	17,576	17,576	17,576	15,946	15,946	15,946	15,946	15,946	15,946	15,946
1.2.	Non-material costs without depreciation and interest	125,783	125,783	125,783	125,783	125,783	111,894	111,894	111,894	111,894	111,894	111,894	111,894
1.3.	Depreciation	7,937	7,937	7,937	7,937	7,937	7,937	7,937	7,937	7,937	7,937	7,937	7,937
2.	Financial expenditures	212	0	0	0	0	0	0	0	0	0	0	0
2.1.	Interest	212	0	0	0	0	0	0	0	0	0	0	0
<b>III</b>	<b>Gross profit (I-II)</b>	<b>4,422</b>	<b>4,634</b>	<b>4,634</b>	<b>4,634</b>	<b>4,634</b>	<b>13,423</b>	<b>13,423</b>	<b>13,423</b>	<b>13,423</b>	<b>13,423</b>	<b>13,423</b>	<b>13,423</b>
<b>IV</b>	<b>Income tax</b>	398	417	417	417	417	1,208	1,208	1,208	1,208	1,208	1,208	1,208
<b>V</b>	<b>Net profit (III-IV)</b>	<b>4,024</b>	<b>4,217</b>	<b>4,217</b>	<b>4,217</b>	<b>4,217</b>	<b>12,215</b>	<b>12,215</b>	<b>12,215</b>	<b>12,215</b>	<b>12,215</b>	<b>12,215</b>	<b>12,215</b>

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

Table 4. Income statement in plantation crops growing (in EUR)

No.	Element	Years											
		I	II	III	IV	V	VI	VII	VIII	IX	X		
<b>I</b>	<b>Total incomes</b>	<b>67,763</b>	<b>177,828</b>	<b>218,768</b>	<b>245,975</b>	<b>272,664</b>	<b>202,298</b>	<b>264,060</b>	<b>272,664</b>	<b>272,664</b>	<b>272,664</b>	<b>272,664</b>	<b>272,664</b>
1.	Sale incomes	67,763	177,828	218,768	245,975	272,664	202,298	264,060	272,664	272,664	272,664	272,664	272,664
<b>II</b>	<b>Total expenditures (1+2)</b>	<b>306,844</b>	<b>162,735</b>	<b>176,269</b>	<b>175,738</b>	<b>173,988</b>	<b>251,971</b>	<b>166,661</b>	<b>165,036</b>	<b>171,107</b>	<b>163,756</b>	<b>163,756</b>	<b>163,756</b>
1.	Business expenditures	306,220	162,735	176,269	175,738	173,988	251,971	166,661	165,036	171,107	163,756	163,756	163,756
1.1.	Material costs	242,731	85,325	85,899	95,383	86,403	185,554	96,352	86,305	86,305	86,305	86,305	86,305
1.2.	Non-material costs without depreciation and interest	43,810	57,730	70,690	60,675	67,906	46,736	50,629	59,052	65,123	57,771	57,771	57,771
1.3.	Depreciation	19,680	19,680	19,680	19,680	19,680	19,680	19,680	19,680	19,680	19,680	19,680	19,680
2.	Financial expenditures	623	0	0	0	0	0	0	0	0	0	0	0
2.1.	Interest	623	0	0	0	0	0	0	0	0	0	0	0
<b>III</b>	<b>Gross profit (I-II)</b>	<b>-239,081</b>	<b>15,094</b>	<b>42,499</b>	<b>70,237</b>	<b>98,676</b>	<b>-49,673</b>	<b>97,400</b>	<b>107,628</b>	<b>101,557</b>	<b>108,908</b>	<b>108,908</b>	<b>108,908</b>
<b>IV</b>	<b>Income tax</b>	<b>0</b>	<b>1,358</b>	<b>3,825</b>	<b>6,321</b>	<b>8,881</b>	<b>0</b>	<b>8,766</b>	<b>9,915</b>	<b>9,187</b>	<b>10,069</b>	<b>10,069</b>	<b>10,069</b>
<b>V</b>	<b>Net profit (III-IV)</b>	<b>-239,081</b>	<b>13,735</b>	<b>38,674</b>	<b>63,916</b>	<b>89,795</b>	<b>-49,673</b>	<b>88,634</b>	<b>97,712</b>	<b>92,370</b>	<b>98,839</b>	<b>98,839</b>	<b>98,839</b>

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

Table 5. Economic flow in seedlings production (in EUR)

No.	Element	Zero moment	Years													
			I	II	III	IV	V	VI	VII	VIII	IX	X				
<b>I</b>	<b>Total inflow (1+2)</b>	<b>0.0</b>	<b>155,929.7</b>	<b>155,929.7</b>	<b>155,929.7</b>	<b>155,929.7</b>	<b>155,929.7</b>	<b>155,929.7</b>	<b>155,929.7</b>	<b>155,929.7</b>	<b>149,199.7</b>	<b>149,199.7</b>	<b>149,199.7</b>	<b>149,199.7</b>	<b>149,199.7</b>	<b>157.136,9</b>
1.	Total income	0.0	155,929.7	155,929.7	155,929.7	155,929.7	155,929.7	155,929.7	155,929.7	155,929.7	149,199.7	149,199.7	149,199.7	149,199.7	149,199.7	149,199.7
	Salvage value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7,937.1
2.	2.1. Fixed assets	0.0														0.0
	2.2. PWC	0.0														7,937.1
<b>II</b>	<b>Total outflow (3+4+5)</b>	<b>87,308.7</b>	<b>143,775.8</b>	<b>143,775.8</b>	<b>143,775.8</b>	<b>143,775.8</b>	<b>143,775.8</b>	<b>143,775.8</b>	<b>143,775.8</b>	<b>143,775.8</b>	<b>129,047.8</b>	<b>129,047.8</b>	<b>129,047.8</b>	<b>129,047.8</b>	<b>129,047.8</b>	<b>129,047.8</b>
	Investment	87,308.7														
3.	3.1. In fixed assets	79,371.6														
	3.2. In PWC	7,937.1														
4.	Costs without depreciation and interest	0.0	143,358.8	143,358.8	143,358.8	143,358.8	143,358.8	143,358.8	143,358.8	143,358.8	127,839.8	127,839.8	127,839.8	127,839.8	127,839.8	127,839.8
5.	Income tax	0.0	397.9	417.0	417.0	417.0	417.0	417.0	417.0	417.0	1,208.0	1,208.0	1,208.0	1,208.0	1,208.0	1,208.0
<b>III</b>	<b>Net cash flow (I-II)</b>	<b>-87,308.7</b>	<b>12,153.8</b>	<b>12,153.8</b>	<b>12,153.8</b>	<b>12,153.8</b>	<b>12,153.8</b>	<b>12,153.8</b>	<b>12,153.8</b>	<b>12,153.8</b>	<b>20,151.8</b>	<b>20,151.8</b>	<b>20,151.8</b>	<b>20,151.8</b>	<b>20,151.8</b>	<b>28,089,0</b>

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

Table 6. Economic flow in plantation crops growing (in EUR)

No.	Element	Zero moment	Years											
			I	II	III	IV	V	VI	VII	VIII	IX	X		
<b>I</b>	<b>Total inflow (1+2)</b>	<b>0.0</b>	<b>67,762.8</b>	<b>177,828.3</b>	<b>218,768.1</b>	<b>245,975.2</b>	<b>272,664.2</b>	<b>202,297.9</b>	<b>264,060.4</b>	<b>272,664.2</b>	<b>272,664.2</b>	<b>272,664.2</b>	<b>272,664.2</b>	<b>296,021.2</b>
1.	Total income	0.0	67,762.8	177,828.3	218,768.1	245,975.2	272,664.2	202,297.9	264,060.4	272,664.2	272,664.2	272,664.2	272,664.2	272,664.2
	Salvage value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23,357.0
2.	2.1. Fixed assets	0.0												0.0
	2.2. PWC	0.0												23,357.0
<b>II</b>	<b>Total outflow (3+4+5)</b>	<b>256,927.0</b>	<b>286,540.4</b>	<b>144,413.0</b>	<b>160,413.8</b>	<b>162,379.2</b>	<b>163,189.0</b>	<b>232,290.5</b>	<b>155,746.7</b>	<b>155,271.7</b>	<b>160,614.1</b>	<b>154,145.0</b>		
	Investment	256,927.0												
3.	3.1. In fixed assets	233,570.0												
	3.2. In PWC	23,357.0												
4.	Costs without depreciation and interest	0.0	286,540.4	143,054.6	156,588.9	156,057.8	154,308.1	232,290.5	146,980.8	145,356.4	151,427.3	144,076.0		
5.	Income tax	0.0	0.0	1,358.4	3,824.9	6,321.3	8,880.8	0.0	8,765.9	9,915.3	9,186.8	10,068.9		
<b>III</b>	<b>Net cash flow (I-II)</b>	<b>-256,927.0</b>	<b>-218,777.6</b>	<b>33,415.3</b>	<b>58,354.2</b>	<b>83,596.0</b>	<b>109,475.2</b>	<b>-29,992.6</b>	<b>108,313.7</b>	<b>117,392.5</b>	<b>112,050.1</b>	<b>141,876.2</b>		

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

The economic analysis starts from the assumption that investments in seedling production and plantation production are observed as independent and mutually competitive investments. Respectively, there is a question - If the investor had to select only one of considered investments, which investment would be more acceptable? Based on the presented economic flows for both investment alternatives, adequate assessment indicators are determined (*Table 7*).

**Table 7.** Comparing the elements of investment analysis related to seedlings production and establishment of selected crops growing

Indicators	Investment	
	Seedlings production	Plantation establishment
Investment (EUR)	87,308.76	256,927.00
NPV (EUR)	25,488.89	6,119.05
IRR (%)	12.07	7.24
MIRR (%)	9.78	7.14
PBP (years)	7.98	9.92
Discount rate (%)	7.00	7.00

*Source:* Authors' calculations according to data from Coal mine enterprise AD Pljevlja, 2023a, b.

Previously performed analyzes showed that both investments are economically justified according to the all observed indicators (net present value - NPV, internal rate of return - IRR, modified internal rate of return – MIRR, or payback period - PBP). This is a reason why the comparison of required financial assets for investments has to be done, as well as the economic effects derived from the observed investments exploitation (*Table 7*). Initially used discount rate reflects current value of the available external capital at the regional market.

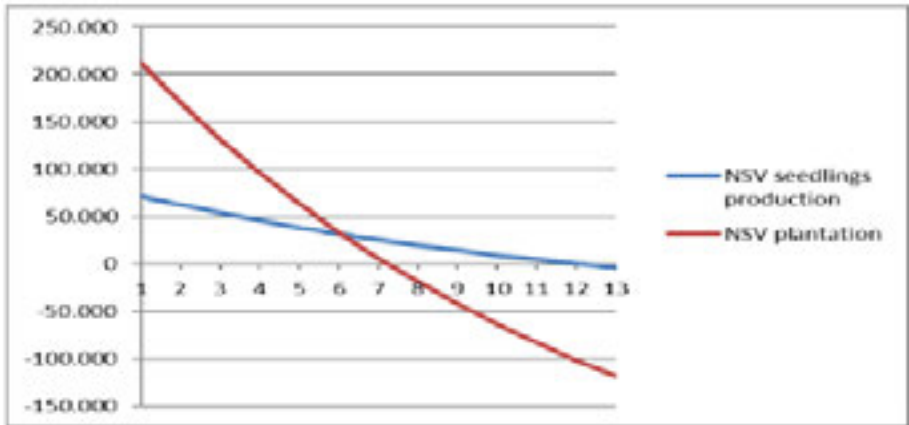
It is obvious that, for the observed period, the investment in seedlings production is economically more acceptable, as it requires smaller investment, while its NPV, IRR and MIRR are higher than the same indicators for the establishment of plantation. At same time, its PBP is quite shorter.

Meanwhile, it has to be considered that the amount of NPV (including the results and conclusions of the performed analysis) is strongly affected by the level of discount rate. While the IRR is constant (regardless the height of discount rate), it is known that the value of NPV is decreasing by the rise of discount rate (Gogić, 2014). In order to investigate the abovementioned at defined investments, their NPV for discount rates from the range 1-13% (*Figure 1*) is determined. Used upper limit for discount rate of 13% is determined according to the fact that IRR for investment in seedlings production is 12.07%, i.e. the NPV values for all discount rates higher than 12.07% will be negative.

It can be noticed that, for a certain discount rate (i.e. crossover rate), both observed investments have the same amount of NPV. If the discount rate is higher or lower than the fixed one (in this case 6.08%), preference should be given only to one of the observed investments (Bierman, Smidt, 2007). Therefore, it is possible that for a certain

range of discount rates (higher than the crossover rate), NPV and IRR could lead to the same conclusion, while for another range of discount rates (lower than the crossover rate), NPV and IRR could give contradictory results and conclusions (Ivanović, 2013).

**Figure 1.** NPV for various discount rates (in EUR, %)



*Source:* According to the authors' calculations.

The crossover rate could be determined as the IRR of differential net cash flow of the observed investments (Ivanović, Marković, 2018; Ren, 2022). By applying this approach, it is determined that the crossover rate is 6.08%. In other words, if the discount rate is higher than the crossover rate, the investment in the seedlings production is economically more acceptable according to both criteria (NPV and IRR). Contrary to that, if the discount rate is lower than the crossover rate, NPV of plants growing in plantation is higher, while the investment in the seedlings production has higher IRR. During the conduction of this analysis, the attention should be paid to the fact that the crossover rate is changing by itself depending on the variation of different factors included in the calculation. So, the influence of the change in amount of initial investments (in zero moment) on the value of crossover rate was examined, while the same procedure was carried out for the amount of net income from the economic flow (net cash flow), (Table 8).

**Table 8.** Variation of crossover rate

Change in investment value	New crossover rate	Change in net cash flows	New crossover rate
-20%	7.74%	-20%	4.29%
-10%	6.88%	-10%	5.25%
0%	6.08%	0%	6.08%
+10%	5.33%	+10%	6.81%
+20%	4.63%	+20%	7.45%

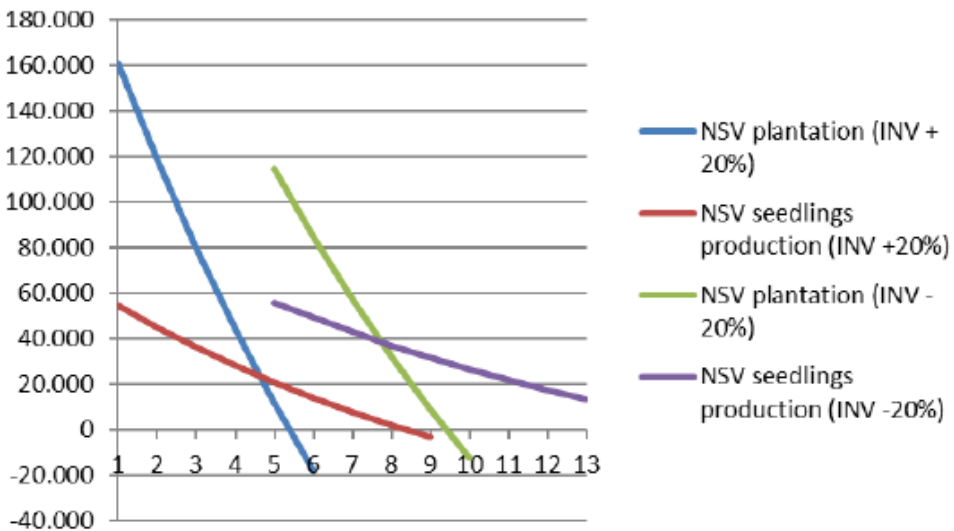
*Source:* According to the authors' calculations.



Change in the amount of initial investment and net cash flow in a favorable direction for the investor (i.e. decrease in investment value and increase in net cash flow) leads to an increase in the level of crossover rate. At the same time, the decrease in investments volume causes a slightly higher growth of the crossover rate than the growth of net cash flow. Completely opposite conclusions could be drawn in case of unfavorable business conditions, such as the growth in the level of investment and decrease in net cash flow value.

In order to get a better insight into the consequences that would occur due to positive or negative variations in the volume of initial investment (zero moment) for 20%, it is not enough just to calculate the corresponding crossover rates, but also the NPV (for different levels of the discount rate), as well as the IRR in the observed cases (*Figure 2.*).

**Figure 2.** Change in indicator value in line to different volume of investment (in EUR, %)



*Source:* According to the authors' calculations.

In relation to the results derived from the basic assumptions (shown in previous *Figure 1.*), in case of investment growth for 20%, there has come to an expected decrease in the NPV, but also the IRR (at this moment it amounts 5.39% for investment in crops growing at established plantation, while it was reduced to 8.40% in case of investment in seedlings production). On the other hand, the decrease in initial investment for 20% will cause an increase in the NPV and the IRR (for investment in plants growing at the plantation it will grow to 9.42%, while for investment in seedlings production it will increase to even 17.04%).

The results derived towards the trend of crossover rate compared to available business conditions could help investors to make a profound decision about an adequate selection between mutually exclusive investments (especially considering the investor preferences regarding the use of NPV and/or IRR in the process of making business decisions).

The initial hypothesis are proven by the results of the reserch.

## Conclusions

The performed analysis points out that the investment in seedlings of medicinal plants and spices production is more economically effective than the investment in their plantation growing. This conclusion refers to the application of projected discount rate of 7%, that cause all parameters more favorable in seedlings production (including IRR, whose value does not depend on the level of discount rate). This conclusion could be made for all levels of discount rate above the crossover rate, which, according to initial data, amounts 6.08%. On the other hand, for discount rates lower than the crossover rate, the value of NPV leads to favoring one investment, while the use of IRR leads to favoring the other investment.

Additionally, the fact that certain parameters (such are the amounts of investment and cash flow) may deviate from their expected (initial) values has been considered, leading to a change in values of all indicators of investment analysis (including the change in crossover rate). The abovementioned additionally complicates the decision-making process. Nevertheless, the final decision related to investing (the selection of more acceptable investment) cannot be based only on the indicators of economic analysis, but also on the procurement and sales market analysis, whose impact is also important in making investment decision.

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## Conflict of interests

The authors declare no conflict of interest.

## References

1. Abdel Aziz, S., Aeron, A. & Kahil, T. (2016). *Health Benefits and Possible Risks of Herbal Medicine*. In: Garg, N., Abdel Aziz, S., Aeron, A. (eds.) *Microbes in Food and Health*, Springer, Cham, Germany, pp. 97-116.
2. Andrei, D. R., Gogonea, R. M., Zaharia, M., & Andrei, J. V. (2014). Is Romanian rural tourism sustainable? Revealing particularities. *Sustainability*, 6(12), 8876-8888.
3. Botezatu, M., & Andrei, J. (2012). Implications of the environmental factors on the economic efficiency of capital investments. A Romanian perspective in terms of a sustainable economy. *Journal of Environmental Protection and Ecology*, 13(1), 382-391.
4. Balentine, D., Albano, M. & Nair, M. (1999). Role of medicinal plants, herbs, and spices in protecting human health. *Nutrition reviews*, 57(9), 41-45.
5. Barry, P. & Robison, L. (2014). Economic rates of return and investment analysis. *The engineering economist*, 59(3), 231-236.

6. Bierman, H. & Smidt, S. (2007). *The capital budgeting decisions: Economic analysis of investment projects*. 9<sup>th</sup> edition, Routledge, Boca Raton, USA.
7. Blanco, G., Campos, M., Dors, P., Menegon, N. & Hanazaki, N. (2022). Is it safe to consume medicinal plants in mined areas? Investigating possible effects caused by a metal-contaminated plant in southern Brazil. *Acta Botanica Brasilica*, 36, e2021abb0338, <https://doi.org/10.1590/0102-33062021abb0338>
8. Chaudhari, R., Dhole, V., More, S., Kushwaha, S. & Takarkhede, S. (2021). Shealth Benefits of Herbs and Spices - review. *World Journal of Pharmaceutical Research*, 10(3), 1050-1061.
9. Coal mine enterprise AD Pljevlja (2023a). *Techno-economic elaborate of production of seedlings of medicinal plants and spices in organic system for 10 plant species with employee's education*. Rico Training Centre, Belgrade, Institute of Agricultural Economics, Belgrade, Serbia.
10. Coal mine enterprise AD Pljevlja (2023b). *Technology of medicinal plants and spices growing in organic system for 10 plant species with employee's education*. Rico Training Centre, Belgrade, Institute of Agricultural Economics, Belgrade, Serbia.
11. Dhar, U., Rawal, R. & Upreti, J. (2000). Setting priorities for conservation of medicinal plants: A case study in the Indian Himalaya. *Biological conservation*, 95(1), 57-65.
12. Dini, I. (2018). *Spices and herbs as therapeutic foods*. In: Holban, A., Grumezescu, A. (eds.) *Food quality: Balancing health and disease*, Academic Press, Cambridge, USA, pp. 433-469.
13. 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>
14. Done, I., Chivu, L., Andrei, J., & Matei, M. (2012). Using labor force and green investments in valuing the Romanian agriculture potential. *Journal of Food Agriculture & Environment*, 10(3-4), 737-741.
15. Dragland, S., Senoo, H., Wake, K., Holte, K. & Blomhoff, R. (2003). Several culinary and medicinal herbs are important sources of dietary antioxidants. *Journal of nutrition*, 133(5), 1286-1290.
16. Dutta, R. & Maharia, R. (2012). Antioxidant responses of some common medicinal plants grown in copper mining areas. *Food Chemistry*, 131(1), 259-265.
17. Ergina, E., Ergin, S. & Sidorenko, I. (2020). *Ecological and economic evaluation of the disturbed lands recultivation projects in the republic of Crimea*. In: IOP Conference Series: Earth and Environmental Science, 459(2), 022021.IOP Publishing, London, UK.
18. Farnsworth, N. & Soejarto, D. (1991). Global importance of medicinal plants. *The conservation of medicinal plants*, 26(26), 25-51.

19. FMI (2023). *Herbs and Spices Market*. Portal of the Future Market Insights (FMI), Newark, USA, retrieved at: [www.futuremarketinsights.com/reports/herbs-and-spices-market](http://www.futuremarketinsights.com/reports/herbs-and-spices-market), 20<sup>th</sup> July 2023.
20. Gogić, P. (2014). *Teorija troškova sa kalkulacijama u proizvodnji i preradi poljoprivrednih proizvoda [Costs theory with calculations in production and processing of agro-food products]*. Faculty of Agriculture, University in Belgrade, Serbia.
21. Hakimi, Y., Fatahi, R., Naghavi, M. & Shokrpour, M. (2022). *The position of medicinal plants in Greenhouse and Vertical cultures*. In: Medicinal Plants, Mechanization & Processing Congress (MPMP2022), Karaj, Iran, February 2022, pp. 1-9.
22. Ignatyeva, M., Yurak, V. & Pustokhina, N. (2020). Recultivation of post-mining disturbed land: Review of content and comparative law and feasibility study. *Resources*, 9(6), 73.
23. Inoue, M., Hayashi, S. & Craker, L. (2019). *Role of medicinal and aromatic plants: Past, present, and future*. In: Perveen, S., Al Taweel, A. (Eds.) *Pharmacognosy-medicinal plants*, IntechOpen, London, UK, pp. 1-13.
24. Ivanović, S. & Marković, T. (2018). *Upravljanje investicijama u agrobiznisu [Investment management in agri-business]*. Faculty of Agriculture, University in Belgrade, Serbia.
25. Ivanović, S. (2013). *Analiza investicija u stočarskoj proizvodnji [Investment analysis in livestock production]*. Faculty of Agriculture, University in Belgrade, Serbia.
26. Ivanović, S., Pajić, M. & Ivanović, L. (2007). Choosing type of chamomile harvester based on current value of usage costs. *Acta Horticulturae* 749, p.p. 259- 264.
27. Jabeen, N., Kiruthiga, V., Vinodhini, A. & Rudrapal, M. (2022). *Herbs, Spices, and Dietary Constituents as Sources of Phytoantioxidants*. In: Rudrapal, M. (edt.) *Phytoantioxidants and nanotherapeutics*, Wiley, NY, USA, pp. 55-76.
28. Jackson, B. & Snowdon, D. (1990). *Atlas of microscopy of medicinal plants, culinary herbs and spices*. Belhaven Press, London, UK.
29. Jeločnik, M. & Subić, J. (2020). *Evaluation of economic efficiency of investments in organic production at the family farms*. In: Course for trainers: Organic farming, eco-market and their capitalization through the entrepreneurial initiative, Platania, M., Jelocnik, M., Gostin, I. (Eds.) Alexandru Ioan Cuza University, Iasi, Romania, pp. 261-300.
30. Jeločnik, M., Bekić, B. & Subić, J. (2012). Aspects of development of Serbian agriculture in the context of the global economic crisis. *Scientific Papers Series: Management, Economic Engineering in Agriculture and Rural Development*, 12(1), 87-91.
31. Kodir, A., Hartono, D., Haeruman, H. & Mansur, I. (2017). Integrated post mining landscape for sustainable land use: A case study in South Sumatera, Indonesia. *Sustainable Environment Research*, 27(4), 203-213.

32. 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.
33. Maggini, R., Kiferle, C., Guidi, L., Pardossi, A. & Raffaelli, A. (2011). *Growing medicinal plants in hydroponic culture*. In: Greensys-2011, ISHS Acta Horticulturae, 952:697-704.
34. Mayekar, V., Ali, A., Alim, H. & Patel, N. (2021). A review: Antimicrobial activity of the medicinal spice plants to cure human disease. *Plant Science Today*, 8(3), 629-646.
35. Miletić, S., & Radić, S. (2022). Evolution of earnings management practice: A new threat to the quality of financial reports. *Oditor*, 8(3), 117-142. <https://doi.org/10.5937/Oditor2203117M>
36. Mirzaei Aghsaghali, A. (2012). Importance of medical herbs in animal feeding: A review. *Annals of Biological Research*, 3(2), 918-923.
37. Noe, T., Rebello, M. & Wang, J. (2003). Corporate financing: An artificial agent-based analysis. *The Journal of Finance*, 58(3), 943-973.
38. 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>
39. Park, S. & Matunhire, I. (2011). Investigation of factors influencing the determination of discount rate in the economic evaluation of mineral development projects. *Journal of the Southern African Institute of Mining and Metallurgy*, 111(11), 773-780.
40. Preethi, R., Devanathan, V. & Loganathan, M. (2010). Antimicrobial and antioxidant efficacy of some medicinal plants against food borne pathogens. *Advances in biological Research*, 4(2), 122-125.
41. Pruvot, C., Douay, F., Herve, F. & Waterlot, C. (2006). Heavy metals in soil, crops and grass as a source of human exposure in the former mining areas (6 pp). *Journal of soils and sediments*, 6, 215-220.
42. Ren, J. (2022). *The Scenario Analysis for NPV and IRR in Mutually Exclusive Projects*. In: 7<sup>th</sup> International Conference on Financial Innovation and Economic Development (ICFIED 2022), pp. 2964-2968, Atlantis Press, Amsterdam, the Netherlands.
43. Sachan, A., Kumar, S., Kumari, K. & Singh, D. (2018). Medicinal uses of spices used in our traditional culture: Worldwide. *Journal of Medicinal Plants Studies*, 6(3), 116-122.
44. Sam, S. (2019). Importance and effectiveness of herbal medicines. *Journal of pharmacognosy and phytochemistry*, 8(2), 354-357.
45. Saranraj, P. & Sivasakthi, S. (2014). Medicinal plants and its antimicrobial properties: A review. *Global Journal of pharmacology*, 8(3), 316-327.

46. Schippmann, U., Leaman, D. & Cunningham, A. (2002). *Impact of cultivation and gathering of medicinal plants on biodiversity: Global trends and issues*. In: Biodiversity and the ecosystem approach in agriculture, forestry and fisheries, FAO, Rome, Italy, pp. 1-21.
47. Shinwari, Z. (2010). Medicinal plants research in Pakistan. *Journal of Medicinal Plants Research*, 4(3), 161-76.
48. Subić, J., Jeločnik, M., Nastić, L. & Vasile, J. (2021). *Economic Effects of Plum Plantation Establishment*. In: Sustainable agriculture and rural development, Subic et al. (eds.), Institute of Agricultural Economics, Belgrade, pp. 149-162.
49. Subić, J., Nastić, L. & Roljević Nikolić, S. (2020). Economic effects of investment in dairy farming. *Western Balkan Journal of Agricultural Economics and Rural Development*, 2(2), 135-146.
50. Tichy, R. & Mejstrik, V. (1996). Heavy metal contamination from open-pit coal mining in Europe's Black Triangle and possible remediation. *Environmental Reviews*, 4(4), 321-341.
51. Vaculik, M., Jurkovič, L., Matejkovič, P., Molnarova, M. & Lux, A. (2013). Potential risk of arsenic and antimony accumulation by medicinal plants naturally growing on old mining sites. *Water, Air, & Soil Pollution*, 224, 1-16.
52. Van Wyk, A. & Prinsloo, G. (2018). Medicinal plant harvesting, sustainability and cultivation in South Africa. *Biological Conservation*, 227, 335-342
53. Wiart, C. (2012). *Medicinal plants of China, Korea, and Japan: Bioresources for tomorrow's drugs and cosmetics*. CRC press, Boca Raton, USA.
54. Wondimu, T., Asfaw, Z. & Kelbessa, E. (2007). Ethnobotanical study of medicinal plants around 'Dheeraa'town, Arsi Zone, Ethiopia. *Journal of Ethnopharmacology*, 112(1), 152-161.
55. Živković, A., Pantić, N., & Rosić, M. (2019). Fiscal sustainability of the macroeconomic system of European Union members. *Oditor*, 5(2), 32-41. <https://doi.org/10.5937/Oditor1902033Z>



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# DETERMINANTS OF CAPITAL STRUCTURE IN THE AGRICULTURAL SECTOR: EMPIRICAL EVIDENCE FROM LISTED COMPANIES

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## ABSTRACT

This study investigated the capital structure of 18 publicly traded agricultural companies over a 10-year period (2012-2022), specifically focusing on short-term debt to total liabilities (SHTDTL). Employing a dataset of 121 observations, the strategic financing decisions of these firms in the Republic of Srpska's stock market were analyzed. The study examines the impact of various factors, including total debt to total equity (TDTC), tangible assets (TOA), company size (CS), current assets ratio (CR), current assets to total assets (CAA), return on equity (ROE), and return on assets (ROA), on capital structure choices. Results reveal that TOA, CAA, and ROE significantly positively influence the short-term debt ratio, while CS and ROA have a significant negative impact. This research sheds light on the financial decision-making of agricultural enterprises, offering insights that can inform their financing strategies and improve financial performance.

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## Introduction

Capital structure represents the combination of long-term financing, encompassing both debt and equity, employed by a company to fund its fixed assets (Khan et al., 2021). The choice of the optimal capital structure depends on many factors. The most important are

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the cost of debt and the ratio of borrowed and equity capital and so on. In this regard, the composition of the capital structure includes ratios such as the ratio of debt and capital structure to earnings of the company. (Khan et al., 2021). The trade-off theory of capital structure argues that firms choose a mix of debt and equity that minimizes the overall cost of financing their long-term assets (Hoang et al., 2021). The pecking order theory of capital structure claims that firms prefer to finance their investments with their own cash flow. The alternative is to finance growth and development with their own capital (Jarallah et al., 2019). The agency theory of capital structure posits that managers might make capital structure decisions that prioritize their self-interests over the best interests of the company's shareholders. Agricultural companies in Republika Srpska play a pivotal role in the economy, especially in many developing nations. The agricultural sector is a cornerstone for ensuring food security and generating employment opportunities. The Republika Srpska boasts 893,540 hectares of arable land, which is around 0.952 hectares per inhabitant, placing it among the top European countries in terms of agricultural land availability. The agricultural sector contributes to the region's economic landscape, accounting for approximately 8.9% of Republika Srpska's total GDP and employing around 20% of its workforce. Despite these strengths, agricultural businesses encounter distinct financial challenges compared to other industries. These risks can have a significant impact on the profitability, liquidity, asset structure, and growth opportunities of agricultural firms, which can in turn affect their capital structure choices. Hence, comprehending the capital structure within agricultural enterprises in a developing nation holds paramount significance for managers, investors, policymakers, and the scholarly community engaged in studying these subjects. In our research, we narrowed our focus to examine a selected sample comprising 18 companies operating within Republika Srpska's agricultural sector. This scrutiny spanned from 2012 to 2022, providing a full insight into the financial dynamics of these enterprises. The sample size of 121 observations was a result of specific circumstances within the local business landscape. During that period, some companies were delisted from the stock exchange due to majority ownership changes, with a single entity acquiring over 90% of their shares, subsequently leading to their delisting. Additionally, a few other companies faced financial distress, eventually entering bankruptcy proceedings or undergoing liquidation. These events, while reducing the number of available observations, provided valuable insights into the dynamics of capital structure decisions and their consequences within this unique context.

The reports of listed joint-stock companies from the agricultural sector from the website of the Banja Luka Stock Exchange were analyzed. The analysis implied the calculation of various ratios and indicators to measure their capital, profitability, liquidity, asset structure, and growth potential. Bearing in mind the analysis of listed joint-stock companies, during the analysis of the capital structure, the thought that decisions on the capital structure of the company are of great importance was guided, because they can deeply affect the profitability of the company and, consequently, the satisfaction of the shareholders of that company (Horak, et al., 2020). Accordingly, good financial

choices can increase the market value of capital, while bad-advised decisions can erode it. Achieving the right balance in the capital structure is a crucial prerequisite for any business. However, defining what constitutes an optimal capital structure remains a complex challenge (Ionescu et al., 2018; Stevanović et al., 2022; Florea, 2019; Pantić et al., 2022; Frýd, et al., 2020).

Existing studies illuminate a plethora of diverse and sometimes contradictory factors that demand consideration when formulating strategic financial decisions (Belas, et al., 2018).

Recognizing the crucial role played by the ratio of short-term debt to total liabilities, a fundamental ratio for evaluating a company's liquidity and risk profile, it was designated as the dependent variable in our study. In this study, panel data regression analysis was used to estimate the effects of the independent variables on the dependent variable. The dependent variable is the short-term debt to total liabilities ratio (SHTDTL), which measures the proportion of a firm's liabilities that are due within one year. The independent variables are (in alphabetical order) the company size (CS), current assets to total assets (CAA), current ratio (CR), return on assets (ROA), return on equity (ROE) and tangibility of assets (TOA). These variables are commonly used in the literature on capital structure as proxies for different theories or factors that influence capital structure decisions. (Tekić et al., 2021).

We tested the following hypothesis:

H0: Null hypothesis: All observed variables do not equally influence the dependent variable.

H1: Alternative hypothesis: All observed variables equally influence the dependent variable.

In line with that, the research will explore the following research questions:

- How do different variables interrelate and influence the short-term debt to total liabilities ratio (SHTDTL) in listed agricultural sector companies in Republika Srpska?
- What are the crucial determinants of capital structure in the agricultural sector, and how do they manifest in the financing choices of listed companies in Republika Srpska?
- How do capital structure decisions impact the financial performance of companies in the agricultural sector of Republika Srpska?
- What financing strategies do listed companies in the agricultural sector of Republika Srpska employ, and how are these strategies linked to specific firm characteristics?

How can we better understand the relationship between long-term and short-term financial obligations in listed agricultural sector companies, and what factors should be considered when making capital structure decisions ?.

## Materials and methods

In this study, the focus was on the ratio of short-term debt to liabilities (SHTDTL). As mentioned, the data used were taken from the official website of the Banja Luka Stock Exchange, or from the total financial reports and non-financial reports of the observed companies.

The sample selection criteria were as follows:

- The company must be listed on the Banja Luka Stock Exchange for at least ten consecutive years during the research period.
- The company must belong to agricultural sector.
- The company must have complete and consistent financial data for each year of observation.

The results in Serbia indicate that the capital structure significantly affects the value of agro-food companies, with the nature of this impact depending on the profitability of investment projects (Janković et al., 2022; Manić et al., 2022). Therefore, financial managers of agro-food companies must carefully consider the decision regarding the choice of capital structure as one of the key issues in the process of generating and increasing the company's value. Apart from these analyses, attempts have been made in the Balkans to theoretically and empirically show the impact of ownership characteristics on the capital structure and business success of companies. In her study, Tica (2002) showed that ownership characteristics do not affect the business success of the sample companies, but performance is influenced by other internal and external factors.

These studies offer valuable insights regarding the choices firms make regarding their capital structure across various developing nations. However, there is still a lack of research on specific sectors or regions that may have unique features or challenges that affect capital structure choices (Hajisaaid, 2020). Grujić et al. (2023) examined the capital structure of publicly listed companies on the Banja Luka Stock Exchange. Their study used the ratio of short-term debt to total liabilities as the dependent variable and various fundamental business indicators as independent variables, such as current ratio, return on equity, return on assets, fixed assets, current assets to total assets, total debt to total capital and company size. Their study utilized various fundamental indicators like return on equity, return on assets, fixed assets, current ratio, current assets to total assets, total debt to total capital, and firm size. Their findings revealed the significant impact of variables like fixed assets/total assets and net profit/average equity on the dependent variable, highlighting the varying influences of different variables on different types of companies.

This study employs seven key independent variables to analyze capital structure determinants. The dependent variable, Leverage (TDTC), measures a firm's indebtedness by calculating the ratio of total debt to total equity. While maintaining debt below 50% of the capital structure is often advisable, real-world practices frequently exceed this threshold, with implications varying by economic conditions.

Fixed assets (TOA) are shown to have a positive impact on leverage, as they can serve as collateral for loans, reducing bankruptcy risks. Company size (CS), often associated with larger firms, tends to correlate positively with leverage due to diversified debt capital and lower direct bankruptcy costs.

The Current Ratio (CR) and the ratio of Current Assets to Total Assets (CAA) were analyzed to assess liquidity and working capital management. Additionally, Return on Assets (ROA) and Return on Equity (ROE) were considered as measures of profitability, given their significance in influencing capital structure decisions.

These carefully selected variables enable a comprehensive exploration of capital structure determinants among public companies on the Banja Luka Stock Exchange. Annual data spanning 10 years facilitates a robust empirical analysis (Table 1)

**Table 1.** - Description of dependent and independent variables in the model

Formula	Acronym	Description	Expected effects – negative/positive causality	Supporting theories
Debt = Short-term debt to total liabilities	SHTDTL	short-term debt to total liabilities	-	-
Leverage = Total debt to total equity	TDTC	total debt to total capital	(-)	Trade-Off Theory
Fixed assets = Fixed assets/Total assets	TOA	the tangibility of assets	(-)	Collateral display
Company size = ln (Sales revenue)	CS	company size	(+)	Trade-Off Theory
Liquidity = Current ratio (Current assets/Current liabilities)	CR	current ratio	(-)	Trade-Off Theory
Liquidity= (Current Assets/ Total Assets)	CAA	current assets to total assets	(+)	Trade-Off Theory
Profitability= Net Profit/Average Equity (ROE)	ROA	return on equity	(-)	Trade-Off Theory
Profitability= Net Profit/Average Assets (ROA)	ROE	return on assets	(-)	Trade-Off Theory

Source: (Alihodžić, 2020)

This comprehensive set of independent variables has been selected to capture a wide array of financial and operational factors that may potentially influence capital structure decisions in the context of our study. The relationships between these variables and the dependent variable (leverage) will be investigated through robust statistical analysis to gain a nuanced understanding of the determinants of capital structure in the Banja Luka Stock Exchange context.

Traditional regression analysis is a common method for identifying and examining specific theories of capital structure and factors influencing it (Rajan & Zingales, 1995). Lemmon et al. (2008) argue that traditional changes in leverage become largely insignificant when accounting for fixed effects on firms. Frank and Goyal (2009) investigated the influence of stock and debt market conditions, as well as macroeconomic

adjustments on leverage. To achieve a better understanding of the observed variables, Alihodžić (2020) established a regression model:

$$\text{SHTDTL}_{i,t} = \beta_0 + \beta_1 \text{TDC}_{i,t} + \beta_2 \text{QR}_{i,t} + \beta_3 \text{CR}_{i,t} + \beta_4 \text{TOA}_{i,t} + \beta_5 \text{CS}_{i,t} + \beta_6 \text{ROA}_{i,t} + \beta_7 \text{ROE}_{i,t} + \varepsilon_{i,t}$$

Where:

$\text{TDC}_{i,t}$  – total debt to total capital ratio of the company

$\text{QR}_{i,t}$  – current ratio of company  $i^{\text{th}}$  in period  $t$ .

$\text{CR}_{i,t}$  – current assets to total assets ratio of company

$\text{TOA}_{i,t}$  – fixed assets of company  $i^{\text{th}}$  in period  $t$ .

$\text{CS}_{i,t}$  – size of company  $i^{\text{th}}$  in period  $t$

$\text{ROA}_{i,t}$  – return on assets of company  $i^{\text{th}}$  in period  $t$ .

$\text{ROE}_{i,t}$  – return on equity of company  $i^{\text{th}}$  in period  $t$ .

$\varepsilon_{i,t}$  - error term for company  $i^{\text{th}}$  in period  $t$ .

This regression model allows for the analysis of how these various financial and operational variables relate to the total debt-to-total capital ratio of the company. It offers a quantitative framework for assessing how these factors influence the capital structure decisions of the companies in our analysis. The coefficients ( $\beta$ ,  $\beta_1$ ,  $\beta_2$ ,  $\beta_3$ ,  $\beta_4$ ,  $\beta_5$ ,  $\beta_6$ ,  $\beta_7$ ) represent the estimated relationships between these variables and the dependent variable ( $\text{SHTDTL}_{i,t}$ ). This model serves as the foundation for the empirical analysis of capital structure determinants in the context of the study.

## Results

The study examined 121 observations from listed agricultural companies in Republika Srpska over a 10-year period. Key variables included Total Debt to Total Capital (TDC), Current Assets to Total Assets (CAA), and Short-Term Debt to Total Liabilities (SHTDTL), which exhibited varying levels of volatility. TDC showed the highest volatility with a standard deviation of 3,810.87, followed by CAA (standard deviation 284.45), and SHTDTL (standard deviation 3,033). These figures align with previous findings (Alihodžić, 2020). (Table 2).

The descriptive statistics provide insights into the data's distribution and variability. For example, the mean TDC is 357.4186, indicating a higher debt-to-equity ratio on average. The SHTDTL mean is 1.218169, but the significant standard deviation (3.133) indicates variability across companies.

**Table 2.** - Summary of Descriptive Statistics for Dependent and Independent Variables (2012-2022)

	<i>SHTDTL</i>	<i>TDTC</i>	<i>TOA</i>	<i>CS</i>	<i>CR</i>	<i>CAA</i>	<i>ROA</i>	<i>ROE</i>
Mean	1.218	357.419	0.481	5.169	2.842	52.545	-0.031	-0.036
Standard Error	0.285	346.443	0.029	0.178	0.678	25.859	0.049	0.009
Median	1.000	0.374	0.448	5.837	0.967	1.106	0	-0.001
Mode	1.000	0	0	0	1.018	0	0	0
Standard Deviation	3.134	3,810.869	0.314	1.963	7.461	284.449	0.541	0.094
Sample Variance	9.819	14,522,726.126	0.099	3.852	55.660	80,911.128	0.292	0.009
Kurtosis	63.991	120.953	-1.172	2.174	55.796	61.837	48.336	23.816
Skewness	7.900	10.997	0.025	-1.728	6.889	7.498	-4.693	-4.380
Range	29.062	41,926.608	1.000	7.290	69.297	2,642.058	6.724	0.731
Minimum	0	0	0	0	0	0	-4.692	-0.658
Maximum	29.062	41,926.608	1.000	7.290	69.297	2,642.058	2.032	0.073
Sum	147.398	43,247.646	58.207	625.456	343.922	6,357.889	-3.805	-4.349
Count	121.000	121.000	121.000	121.000	121.000	121.000	121.000	121.000
Confidence Level (95,0%)	0.564	685.932	0.057	0.353	1.343	51.199	0.097	0.017

*Source:* own calculations

The correlation matrix shows low to moderate correlations between variables. For instance, TOA and CR exhibit a strong negative correlation (-0.8958), implying that companies with more fixed assets tend to have lower current ratios. On the contrary, TOA and ROA show almost no correlation. (Table 3).

**Table 3.** – Correlation matrix

	<i>SHTDTL</i>	<i>TDTC</i>	<i>TOA</i>	<i>CS</i>	<i>CR</i>	<i>CAA</i>	<i>ROA</i>	<i>ROE</i>
<i>SHTDTL</i>	1.000							
<i>TDTC</i>	-0.036	1.000						
<i>TOA</i>	0.027	0.132	1.000					
<i>CS</i>	0.035	-0.013	0.328	1.000				
<i>CR</i>	-0.039	-0.035	0.095	0.056	1.000			
<i>CAA</i>	0.025	-0.010	-0.186	0.069	-0.061	1.000		
<i>ROA</i>	0.028	-0.791	-0.002	0.033	0.272	-0.061	1.000	
<i>ROE</i>	-0.208	-0.516	-0.247	0.038	0.151	0.045	0.651	1.000

*Source:* own calculations

A noteworthy observation from this study is that a substantial number of companies displayed high levels of debt, some exceeding 50%, and even surpassing 100%. In certain extreme cases, the ratio of liabilities to assets reached as high as 598.02. Prolonged high indebtedness may signal low liquidity or even insolvency, as it suggests that companies have sustained losses that exceed their capital. Additionally, many companies relied on short-term loans to finance both current and partially fixed assets, potentially indicating

solvency issues and severe financial challenges. On average, fixed assets accounted for a mere 0.48% of the total assets across all observed companies during the 2012 to 2022 period (Table 4).

Many companies had high debt levels, exceeding 50% and, in extreme cases, 100% or more of liabilities to assets. On average, fixed assets accounted for just 0.48% of total assets. The multiple R value of 0.7408 suggests a significant positive correlation between independent variables (TOA, CS, CR, CAA, ROE, ROA) and SHTDTL emphasizing the intricate interplay of these factors in shaping capital structure decisions. (Table 4). This comprehensive analysis contributes valuable insights into the dynamics of capital structure determinants on the Banja Luka Stock Exchange, shedding light on the complexities of financial decision-making in this context.

**Table 4.** – Regression Statistics

Multiple R	0.7408
R Square	0.5488
Adjusted R Square	0.5209
Standard Error	0.0652
Observations	121

*Source:* own calculations

The F-statistic (19.64) indicates the overall statistical significance of the regression model. The very low p-value ( $5.33 \times 10^{-17}$ ) confirms the strong influence of independent variables on SHTDTL. (Table 5).

**Table 5.** – Statistical significance calculation

Description	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	7	0.585070793	0.083581542	19.63556295	5.33356E-17
Residual	113	0.48100043	0.004256641		
Total	120	1.066071223			

*Source:* own calculations

**Table 6.** – Statistical significance calculation

Description	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	- 0,011775	0.018	-0.672	0.503	- 0.046	0.023
TDTC	- 0,006725	0.002	-3.528	0.001	- 0.011	-0.003
TOA	0,000003	0.000	0.942	0.348	- 0.000	0.000
FS	-0,084601	0.021	-4.023	0.000	- 0.126	-0.043
CR	0,005520	0.003	1.696	0.093	- 0.001	0.012
CATA	-0,000436	0.001	-0.500	0.618	- 0.002	0.001
ROA	0,000011	0.000	0.528	0.598	- 0.000	0.000
ROE	-0,130181	0.020	6.543	0.000	0.091	0.170

*Source:* own calculations

Inserting the results of the table into the formula gives the result:

$$\text{SHTDTL}_{i,t} = -0,011775 - 0,006725 \text{ TDTC} + 0,000003 \text{ TOA}_{i,t} - 0,084601 \text{ FS} + 0,005520 \text{ CR} - 0,000436 \text{ CATA} + 0,000011 \text{ ROA} + 0,130181 \text{ ROE}$$

The t-statistic and p-value for each coefficient assess whether it significantly differs from zero. A substantial t-statistic (in absolute value) and a low p-value indicate statistical significance at a specific confidence level, typically 95% or higher. A positive coefficient signifies a positive relationship between the independent and dependent variables, while a negative coefficient indicates a negative relationship. For instance, the coefficient of CS (company size) is approximately -0.0846. This implies that, with all other variables held constant, a one percent increase in FS leads to an approximate 0.0846 percent decrease in SHTDTL. The t-statistic for this coefficient is -4.0229, and the p-value is 0.0001, signifying its statistical significance at the 99% confidence level. This suggests a robust negative relationship between FS and SHTDTL (Table 6).

Our study revealed several crucial determinants of capital structure. The primary factors influencing capital structure choices in the agricultural sector were tangible assets, company size, and short-term financial capabilities.

Tangible assets, as our analysis demonstrated, are the most influential determinants of capital structure in this sector. Companies with substantial tangible assets, such as land, buildings, and equipment, have a valuable resource that they can use as collateral when seeking debt financing. This reduces the perceived risk for lenders, making it easier for asset-rich companies to obtain debt capital. In times of economic uncertainty, having tangible assets as collateral provides a safety net, which explains why companies with higher levels of tangible assets tend to rely more on debt financing.

Company size emerged as another significant determinant of capital structure. Larger agricultural companies typically have greater access to equity financing options, including issuing stocks or attracting investment. This financial flexibility allows them to rely less on debt for capital. Smaller companies, on the other hand, may lack the resources and investor appeal of larger firms, leading them to use debt as a primary source of financing.

Therefore, a positive correlation between company size and the reliance on equity financing was observed, with larger companies favoring equity to debt. The short-term financial capabilities of agricultural companies were also a critical determinant of capital structure. Companies with robust short-term financials, characterized by healthy cash flows and the ability to meet their short-term obligations, have a more favorable risk profile in the eyes of lenders. These companies are better positioned to take on debt and repay it on time. Consequently, they exhibit a propensity to use debt as a financing tool to support their growth and operational needs.

Additionally, our research uncovered an intriguing finding regarding the relationship between short-term debt and long-term financial stability. It was observed that a higher proportion of short-term debt could potentially lead to reduced long-term financial



stability for companies in the agricultural sector. This phenomenon could manifest as decreased profitability and heightened financial risks during economic recessions. Therefore, it is essential for agricultural companies to strike a balance between short-term and long-term obligations to maintain their financial health and sustainability.

### Discussions

The results of this study suggest that the determinants of short-term debt ratio for listed companies in the agricultural sector in Republika Srpska are complex and can vary depending on the specific factors considered. To analyze these relationships, a regression model was established based on Alihodžić's (2020) paper. Notably, Alihodžić found that Current Ratio (CR) had the weakest influence, and this study concurs with CR's limited impact. However, contrary to Alihodžić's findings, this research suggests that Return on Equity (ROE) has the least influence on the dependent variable.

The results indicate that a one percent increase in the Total Assets (TOA) indicator, all else being equal, results in a null change in short-term debt to total liabilities, defying the expected negative causality. On the other hand, Return on Equity (ROE) negatively affects the dependent variable across the entire sample and when examined individually. Surprisingly, Return on Assets (ROA) still maintains a positive effect despite the anticipated negative causality. The negative coefficient for ROA implies that an increased return on assets is associated with a decreased short-term debt ratio. Companies with higher profitability may find it more feasible to secure long-term financing, thus reducing their short-term debt obligations.

Our findings are consistent with the trade-off theory of capital structure (Jensen & Meckling, 1976), which suggests that companies use their fixed assets as collateral to obtain lower-cost long-term financing. A negative and significant effect of profitability, as measured by return on assets (ROA) or return on equity (ROE), on the short-term debt ratio was also observed. This finding aligns with the pecking order theory of capital structure.

The study's findings are similar to those of previous studies. For example, a study by Kahya et al. (2020) found that tangibility of assets, current assets to total assets, and return on equity have a positive influence on the short-term debt ratio, while company size and return on assets have a negative influence. However, the study's findings also differ from those of previous studies. For example, a study by Martinez et al. (2019) found that company size has a negative influence on the short-term debt ratio. This may be due to the different samples and methodologies used in the two studies. Our findings are similar to those of Grujić et al. (2023) in some aspects.

For instance, it was found that fixed assets/total assets and current assets/total assets have a significant positive influence on the short-term debt ratio. This suggests that these variables reflect the liquidity and collateral value of companies, which affect their ability and willingness to borrow short-term. It was also found that return on equity (ROE) has a negative influence on the short-term debt ratio. This implies that more

profitable companies tend to rely less on external financing, especially short-term debt, and use their retained earnings to fund their investments

One of the most intriguing findings from our study is the potential risk associated with a higher level of short-term debt. While short-term debt can provide quick access to capital for seasonal needs, it may also expose companies to greater financial instability during economic downturns. Agricultural companies must carefully assess the trade-offs between short-term and long-term financing and develop strategies that align with their specific financial objectives and risk tolerance.

The study was limited to a sample of listed companies in Republika Srpska. Future research could broaden the scope to include companies from diverse countries, exploring additional factors such as ownership type and macroeconomic environments. Further studies could expand on this analysis by investigating various variables in different regions and sectors, exploring potential moderating effects of ownership type on the relationship between independent variables and short-term debt ratios. Such comprehensive studies would provide a deeper understanding of capital structure decisions, aiding both academic research and practical applications within the agricultural sector and beyond.

## Conclusions

The study emphasizes the importance of firm size, return on equity, and total debt to total capital ratio in determining the short-term debt to total capital ratio of companies. Understanding these relationships can provide valuable insights for financial managers and policymakers in making informed decisions regarding capital structure and financial risk management.

Research focused on a sample of 18 companies operating within Republika Srpska's agricultural sector between 2012 and 2022. This scrutiny provided us with a complete insight into the financial dynamics and characteristics of these enterprises. The sample size of 121 observations resulted from specific circumstances within the local business landscape. During that period, some companies were delisted from the stock exchange due to two main reasons. First, certain companies experienced ownership changes, where a single owner acquired over 90% of their shares, prompting a legal form change and subsequent delisting. Second, a few other companies faced financial distress, eventually entering bankruptcy proceedings or undergoing liquidation. These events, while reducing the number of available observations, provided valuable insights into the dynamics of capital structure decisions and their consequences within this unique context.

The multiple regression analysis reveals a statistically significant relationship between firm size (FS) and the short-term debt to total capital ratio (SHTDTL). A one-percent increase in FS results in an approximate 0.0846-percent decrease in SHTDTL, indicating a robust negative association. Moreover, the statistically significant coefficients for ROE and TDTC, expressed in percentage terms, suggest that both factors influence SHTDTL. A one-percent increase in ROE leads to an approximate 0.1302-percent

increase in SHTDTL, while a one-percent increase in TDTC results in an approximate 0.0067-percent decrease in SHTDTL. The remaining variables, TOA, CR, and CATA, do not exhibit statistically significant relationships with SHTDTL.

The negative relationship between TDTC and SHTDTL implies that companies with higher total debt tend to have lower short-term debt, and vice versa. This could be explained by the fact that companies with higher total debt may have more long-term debt, which reduces their need for short-term financing. The negative relationship between FS and SHTDTL suggests that larger companies tend to have lower short-term debt, and vice versa. This could be explained by the fact that larger companies may have more access to external financing sources, such as equity or long-term debt, which reduces their reliance on short-term debt. The positive relationship between ROE and SHTDTL implies that companies with higher returns on equity tend to have higher short-term debt, and vice versa. This could be explained by the fact that companies with higher returns on equity may have more growth opportunities, which require more short-term financing. The statistically insignificant coefficients of TOA, CATA, and ROA could be due to the fact that these variables are not relevant for the short-term debt decisions of the companies, or that they are correlated with other variables in the regression model.

To conclude, the results of the multiple regression analysis suggest that the short-term debt to total liabilities ratio of the companies is mainly influenced by the total debt to total capital ratio, the firm size, the return on equity, and the current ratio. These variables explain about 67% of the variation in the SHTDTL of the companies, as indicated by the R-squared value of 0.67. The regression model is statistically significant at the 95% confidence level, as indicated by the F-statistic of 51.23 and the p-value of 0.000. The findings provide valuable insights into the determinants of the short-term debt structure of the companies and can inform the financial decisions of managers and policymakers to optimize capital structure and manage financial risk effectively.

### **Conflict of interests**

The authors declare no conflict of interest.

### **References**

1. Alihodžić, A. (2018). *Evaluacija i upravljanje finansijskim performansama preduzeća*. Beograd: Ekonomski institut. [in English: Alihodžić, A. (2018). Evaluation and management of the company's financial performance. Belgrade: Economic Institute.].
2. Alihodžić, A. (2020). A study of the capital structure in the construction sector of Republika Srpska. *Bankarstvo*, 49(1), 37-66. doi:10.5937/bankarstvo2001037A
3. Banja Luka Stock Exchange (2023). <https://www.blberza.com/pages/annualreports.aspx>

4. Belas, J., Gavurova, B., & Toth, P. (2018). Impact of selected characteristics of SMES on the capital structure. *Journal of Business Economics and Management*, 19(4), 592-608. <https://doi.org/10.3846/jbem.2018.6583>
5. Drozdowska, M., & Witkowski, B. (2016). Credit growth in Central, Eastern, and South-Eastern Europe: The case of foreign bank subsidiaries. *International Review of Financial Analysis*, Elsevier, 43(c), 146-158. DOI: <https://doi.org/10.1016/j.irfa.2015.11.010>
6. Florea, A. M., Bercu, F., Radu, R. I., & Stanciu, S. (2019). A fuzzy set qualitative comparative analysis (fsQCA) of the agricultural cooperatives from south east region of Romania. *Sustainability*, 11(21), 5927.
7. Frank, M., & Goyal, V. (2009). Capital structure decisions: which factors are reliably important? *Financial management*, 38(1), 1-37.
8. Frýd, L., Machová, V., Horák, J., & Pardal, P. (2020). The wage impact on the net value-added in the agricultural sector. *Littera Scripta*, (1).
9. Grujić, M., Janjić, D. & Todorović, A. (2023). Analiza strukture kapitala listiranih akcioanrskih društava na tržištu kapitala u razvoju. *Financing*, 14(1), 53-71. [*in English*: Grujić, M., Janjić, D. & Todorović, A. (2023). Analysis of the capital structure of listed joint-stock companies on the developing capital market. *Financing*, 14(1), 53-71].
10. Hajisaaid, A. M. S. A. (2020). The effect of capital structure on profitability of basic materials Saudi Arabia firms. *Journal of Mathematical Finance*, 10(4), 631-647. <https://10.4236/jmf.2020.104037>
11. Hoang, L. D., Viet, N. Q., & Anh, N. H. (2021). Trade-off theory and pecking order theory: Evidence from real estate companies in Vietnam. *Economics and Business Quarterly Reviews*, 4(2).
12. Horak, J., Suler, P., Kollmann, J., & Marecek, J. (2020). Credit absorption capacity of businesses in the construction sector of the Czech Republic—Analysis based on the difference in values of EVA entity and EVA equity. *Sustainability*, 12(21), 9078. DOI: <https://doi.org/10.3390/su12219078>
13. Ionescu, R. V., Zlati, M. L., Antohi, V. M., & Stanciu, S. (2018). Reduced inequalities as factor of sustainable development: The analysis under econometric models. *Sustainability*, 10(10), 3523.
14. Janković-Perić, M., Jovanović, D., & Fedajev, A. (2022). Is capital structure important for the value of agro-food corporations in Serbia?. *Economics of Agriculture*, 69(2), 425-439.
15. Jarallah, S., Saleh, A. S., & Salim, R. (2019). Examining pecking order versus trade-off theories of capital structure: New evidence from Japanese firms. *International Journal of Finance & Economics*, 24(1), 204-211. <https://doi.org/10.1002/ijfe.1657>

16. Jensen, M., & Meckling, W. (1976). Theory of the company: Managerial behavior, agency costs and ownership structure. *Journal of financial economics*, 3(4), 305-360. DOI: [https://doi.org/10.1016/0304-405X\(76\)90026-X](https://doi.org/10.1016/0304-405X(76)90026-X)
17. Kahya, E. H., Ersen, H. Y., Ekinçi, C., Taş, O., & Simsek, K. D. (2020). Determinants of capital structure for companys in an Islamic equity index: comparing developed and developing countries. *Journal of Capital Markets Studies*, 4(2), 167-191.
18. Khan, M. A., Rehan, R., Chhapra, I. U., & Sohail, A. B. (2021). Capital structure theories: A comprehensive review. *Revista Geintec-Gestao Inovacao E Tecnologias*, 11(3), 1562-1574.
19. Li, L., & Islam, S. (2019). Company and industry specific determinants of capital structure: Evidence from the Australian market. *International Review of Economics & Finance*, 59, 422-437. DOI: 10.1016/j.iref.2018.10.007
20. Manić, A., Manić, S., Novaković, S., & Karabašević, D. (2022). Job Satisfaction of employees in the municipal police (militia) of the Republic of Serbia. *Oditor*, 8(3), 1-41. <https://doi.org/10.5937/Oditor2203001M>
21. Martinez, L. B., Scherger, V., & Guercio, M. B. (2019). SMEs capital structure: trade-off or pecking order theory: a systematic review. *Journal of Small Business and Enterprise Development*, 26(1), 105-132. DOI: <https://doi.org/10.1108/JSBED-12-2017-0387>
22. 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>
23. Rajan, R., & Zingales, L. (1995). What do we know about capital structure? Some evidence from international data. *The journal of Finance*, 50(5), 1421-1460. DOI: <https://doi.org/10.1111/j.1540-6261.1995.tb05184.x>
24. 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>
25. Tekić, D., Mutavdžić, B., Milić, D., Novković, N., Zekić, V., & Novaković, T. (2021). Credit risk assessment of agricultural enterprises in the Republic of Serbia: Logistic regression vs discriminant analysis. *Ekonomika poljoprivrede*, 68(4), 881-894. DOI: <https://doi.org/10.5937/ekoPolj2104881T>
26. Tica, T. (2022). Analysis of the impact of ownership characteristics on the capital structure and business success of companies in the Balkan beverage industry. *Anali Ekonomskog fakulteta u Subotici*, 47, 79-96. <https://doi.org/10.5937/AnEkSub2247079T>

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# FOOD IMPORT, FOOD PRICE INFLATION, WAGES AND AGRICULTURAL EMPLOYMENT IN SOUTH AFRICA

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## ABSTRACT

Agricultural industry plays a significant role in the South African economy, specifically in creating jobs. However, this sector is facing significant challenges owing to economic and social unrest. Within the application of both Autoregressive Distributed Lag (ARDL) and Error Correction Model (ECM) on time series data from 2010q1 to 2021q4; this paper assessed the effects of food imports, inflation, and real wage on agricultural employment in South Africa. The results from bounds testing indicated that food imports, inflation and real wage stimulate long-term disruptions in agricultural employment. However, short-run results indicated that agricultural employment is only affected by the real wage. Based on these findings, this study suggests a policy that incorporation of both inflation rate and real wages policy to improve employment in the agricultural industry. Additionally, easing the import of food products that are complements to domestic agricultural products should be another strategy to increase the number of people employed in the agricultural industry.

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## Introduction

The agriculture sector in South Africa is important for food production and also extends to poverty reduction and national economic growth (Daya, Ranoto and Letsoalo, 2006; Vickers, 2014; Garidzirai, Meyer & Muzindutsi, 2019). Additionally, irrespective of its informal nature, the agriculture industry contributes to job creation specifically for low-skilled labour. Owing to its contribution to economic and social development, the agricultural sector is among the largest economic sectors in South Africa (Sihlobo & Nel, 2016). Although the South African agricultural sector experienced declining

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growth in its contribution to the gross domestic product, this sector remains important regarding job creation. In 2021, for instance, this sector recorded 7 percent of the total employment (Arnoldi, 2021). Additionally, while other economic sectors were laying down their employees as a result of the coronavirus pandemic, the agricultural sector was the only one to experience employment growth during the covid-19. During the third quarter of 2021, the number of people employed in the agricultural sector increased by 829 000 which meant approximately 3 percent growth compared to 2020 (Sihlobo, 2022).

The production and employability capacity of the agricultural sector does not depend on the sector's endogenous factors. It, however, depends on other exogenous factors such as the national inflation rate, wage rate and the quantity of imported agricultural products. For instance, in March 2020 the minimum wage increased by 3.5 percent compared to 2019 and increased further in 2021 by 1.5 percent. This increase in minimum wages caused the farm worker's wage to increase by 16 percent in 2021 (Department of Employment and Labour, 2021). There are only a few studies that investigated the effect of minimum wage growth on employment. Even those conducted focused only on the relationship between employment and domestic worker. A recent study of this nature was conducted by Dinkelman and Ranchhod (2012) and its findings concluded no difference between employment levels before the introduction of the minimum wage law in 1999 and after the implementation of the law. The question here is to know if their results can be generalised to the effect of minimum wage growth on employment levels in the agricultural sector.

Another economic variable that may influence agricultural employment is the inflation rate. Since the 2008 financial crisis, food price inflation become an interesting subject for research and discussion (Ngidi, 2016). Unfortunately, while the world and South Africa, in particular, were recovering from the price shock caused by the 2008 fiscal crisis, COVID-19 came and worsened the global economic situation. The proof was that between 2019 and 2021, food inflation increased by almost 9 percent; that is 3.4 in 2019 and 5.4 in 2021. Besides the effect of COVID-19, South African food inflation was also aggravated by international commodity prices such as crude oil prices that increased by more than 30 percent (Sikuka & Geller, 2021). Some domestic drivers that contributed to food inflation in South Africa between 2020 and 2021 include electricity tariff increases that increased by more than 15 percent, and minimum wages that increased by more than 16 percent (Sikuka & Geller, 2021).

South Africa is not sufficient to produce all the needed food items for her population. Therefore, improving agricultural trade can increase food availability and thereafter reduces food inflation. The effect of agricultural trade on the South African food markets can easily be elucidated using the scenario of the war between Russia and Ukraine. Just after the Russian invasion of Ukraine, the price of Bread and cereals increased by 3.16 percent while Oils and fats increased by more than 0.45 percent. Food price inflation is still expected to increase by 6.5 at the end of this year and up to 9 percent by early 2023 ([Writer](#), 2022). In terms of food inflation growth, increasing food imports

might bring a solution to food shortages. However, an increase in food imports impedes the demand for domestic agricultural products. As suggested by the Keynesian theory of employment, low demand leads to low demand for labour, thus unemployment growth (Keynes, 1937). South Africa being a net exporter of agricultural products can experience a negative trend in its employability capacity if the level of food product imports increases.

Given the current economic situation where inflation is escalating, workers fighting for wage increments and open trading regulations, it is important to investigate the effect of changes within the aforementioned factors on agricultural employment in South Africa. The next section of this paper discusses the data and methodology employed by the study. Subsequently, the study findings are presented, and this is discussed. The last section of the study provides a concise summary of the study followed by the study implication and recommendations.

## **A brief review of the empirical literature**

### **Inflation vs employment/unemployment**

The most of theoretical literature does not focus on the relationship between employment and inflation, it rather highlights the correlation between inflation and unemployment. Consequently, the majority of empirical studies also assess the cointegration between unemployment and inflation. The early work of Phillips (1958) analysed the relationship between unemployment and wage inflation. This study's results suggested the existence of an inverse relationship between the two variables. This implies that a negative relationship exists between unemployment and inflation. In other, words, a positive relationship exists between inflation and employment. The findings of Phillips (1958) were supported by Samuelson and Solow's (1960) findings suggesting also an inverse relationship between inflation and unemployment. Phillips (1958)'s study results were supported by several studies conducted in different countries within different periods. Those studies include Al-Zeaud and Al-Hosban (2015), Furuoka (2007), Furuoka, Munir and Harvey (2013), Katria, Bhutto, Butt, Domki, Khawaja and Khalid, (2013). Contrary to the findings of the aforementioned studies, the study of Touny (2013) found a positive relationship between inflation and unemployment. Furthermore, Fuhrer, Kodrzycki, Little and Olivei (2009) argue that the trade-off between unemployment and inflation last only for a temporal period of the economic cycle. This argument was corroborated by a recent study by Buthelezi (2023) in various states of the United States where for a given period the relationship between the two variables was negative and positive for the rest of analysed period. A similar study was conducted by Egede, Aminu, Hamma and Ademola-John (2023) in Nigeria and the results confirmed those of Buthelezi's (2023) study.



## **Wage vs employment/unemployment**

Wage increment can be seen as one of the factors that enhance purchasing power of workers and thus leads to both inflation and unemployment. The study conducted by Namini and Hudson (2019) revealed that high wage stimulates inflation and unemployment within developing countries. Another study was conducted by Gandhi, & Ruffini (2022) assessing the effect of high minimum wages on employment in the United States. The study findings indicated that increasing wages leads to an increase in the number of working hours for the existing employees and thereafter reduces the employability capacity of employers as the expected production can be achieved through the extension of working hours. In other words, this study's results supported the existence of an inverse relationship between the employment rate and wage rate. Contrary to these results, the study of Neumark and Shirley (2022) also conducted in the United States, suggested that the negative effect of wage increment on employment level remains valid only for less-skilled employees and with no established industries. In support of the aforementioned findings, the study of Neumark (2018) concluded that wage increment does not come as a free lunch, but rather at the expense of job loss for low-skilled employees (workers).

## **Import flows vs Employment**

There is no sufficient empirical literature on the effect of food import on domestic employment, this is because most studies analyse the effect of trade on employment. Yet trade openness involves imports and exports. Additionally, few studies that investigated the impact of imports on employment generally focussed on the manufacturing sector rather than the agriculture sector. Nonetheless, the effect of import on local employment was analysed by Malgouyres (2016) in France. The author investigated how Chinese exports influence the labour market in France. The study results indicated that not only do the import flows reduce labour income, but they also cause a decline in employment levels. Contrary to Malgouyre's (2016) findings, the study conducted by Mohler et al. (2018) in Switzerland indicated that import flows do not destroy jobs in Switzerland. Given the shortage of literature on import's effect on the agriculture sector. The subsequent section provides approaches and methods used to analyse the implication of food import flows and other explanatory variables on employment within the South African agricultural sector.

## **Data and methodology**

### **Sample and data source**

The study followed a quantitative approach and it employed secondary data acquired from the Quantec EasyData. The data consists of quarterly observations from the first quarter of 2010 to the fourth quarter of 2021. Two reasons motivated the choice of sample size. The first motivation was built on the data availability while the second was that we intended to evaluate the effect of food import, food price and wage inflation on

agricultural employment during the post-2008 financial crisis. Since the study variables differ in terms of measurements, all variables were transformed into the natural logarithm to create a common basis and measure the responsiveness of the dependent variable towards shocks in regressors. To ensure that employed data produces effective results, the study employed stationarity and unit root tests as discussed in a subsequent section.

### Unit Root Test (Test for Stationarity)

A time-series data is said to be at a stationary state if its variance and mean are invariable over time. In other words, a nonstationary time series is one with flexible mean and variance. Using the stationary variable or series free of unit root is the only way to obtain accurate regression results. Therefore, prior to regression analysis, if a variable is not stationary at level, it has to be differenced until the unit root is taken out and the variable becomes stationary. The  $\Delta Y_t = Y_t - Y_{t-1}$  is the formula employed in taking a nonstationary variable to a stationarity level. The literature represents numerous procedures or tests to detect unit roots within a given variable. The most used tests include the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test to detect the unit roots, and the KPSS test identifies whether a specific variable is stationary or not. This study made use of the Augmented Dickey-Fuller (ADF) through equation 1 to assess the presence or absence of unit roots within variables of interest.

$$\Delta Y_t = \alpha_1 Y_{t-1} + \sum_{j=1}^p \gamma_j \Delta Y_{t-j} + e_t$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{j=1}^p \gamma_j \Delta Y_{t-j} + e_t \quad (1)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \sum_{j=1}^p \gamma_j \Delta Y_{t-j} + e_t$$

The unit test was performed under the following hypotheses:

$H_0$ :  $Y_t$  is not I(0) or  $Y_t$  has a unit root (is not stationary)

$H_1$ :  $Y_t$  is I(0) or  $Y_t$  has no unit root (is stationary)

The rejection of the null hypothesis ( $H_0$ ) implies that the variable has a unit root or is not stationary at the level. Therefore, it has to be differentiated to become stationary.

Failure to reject the  $H_0$  means that the variable is stationary at level [I(0)]. In case the ARDL approach is selected for the cointegration test, the ADF test is used to ensure that none of the used variables is I(2).

### Cointegration and ARDL model specification

Cointegrating the relationship between time series or variables infers that those variables tend to move together in the long run. Various approaches such as Engle-Granger (1987), Phillips and Hansen (1990), the Johansen-Juselius (1992) and the ARDL approach.

The ARDL approaches is often selected based on its flexibility. It can be applied to variables with different integration orders, and it also has the power to produce truthful results in a small sample size (Pesarn, Shin and Smith, 2001). Consequently, given the study sample and the author's intention to analyse the relationship among variables using a single equation, the ARDL was selected as the best model for the study.

The estimated single linear ARDL equation (2) represents the study model that elucidates the effect of food imports, food price inflation and wages on agricultural employment. The model is made of four macroeconomic variables namely food imports (FIMP), food price inflation (CPI), wage inflation (WAGE) and agricultural employment (EMP). The subsequent is the equation expressing a mathematical relationship between the aforementioned variables:

$$\Delta LEMP_t = \alpha_0 + \sum_{j=1}^k \beta_j \Delta LEMP_{t-j} + \sum_{j=1}^k \varphi_j \Delta LFIMP_{t-j} + \sum_{j=1}^k \delta_j \Delta LCPI_{t-j} + \sum_{j=1}^k \vartheta_j \Delta LWAGE_{t-j} + \gamma_1 LEMP_{t-1} + \gamma_2 LFIMP_{t-1} + \gamma_3 LCPI_{t-1} + \gamma_4 LWAGE_{t-1} + u_t \quad (2)$$

Where  $\Delta LEMP_t$ ,  $\Delta LFIMP_t$ ,  $\Delta LCPI_t$  and  $\Delta LWAGE_t$  represent denote changes in the natural log of agricultural employment, food imports, food price inflation, and wage inflation respectively in period  $t$ . while  $\beta_j$ ,  $\varphi_j$ ,  $\delta_j$  and  $\vartheta_j$  indicate the short-run coefficients, long-run coefficients are represented by  $\gamma_1$ ,  $\gamma_2$ ,  $\gamma_3$  and  $\gamma_4$ . In equation (2)  $\alpha_0$ ,  $k$  and  $u_t$  denote the intercept, lag operator and error term respectively.

The bound test for cointegration was established on the following hypotheses:

$$H_0 : \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 0 \text{ (no cointegration)}$$

$$H_1 : \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq 0 \text{ (variables cointegrate)}$$

The decision to reject either  $H_0$  or  $H_1$  is made based on the comparison between the calculated F statistic and critical values. In this study, the author is interested in the rejection of  $H_0$ . The latter is rejected if the calculated F statistic exceeds the value of the upper bound critical values. The rejection of the  $H_0$  suggests that changes in independent variables (food imports, wage and food inflation) influence the long-run behaviour of the dependent variable (agricultural employment).

In case the analysed variables cointegrate, the error correction model is performed as expressed in equation 3:

$$\Delta LEMP_t = \alpha_0 + \sum_{j=1}^k \beta_j \Delta LEMP_{t-j} + \sum_{j=1}^k \varphi_j \Delta LFIMP_{t-j} + \sum_{j=1}^k \delta_j \Delta LCPI_{t-j} + \sum_{j=1}^k \vartheta_j \Delta LWAGE_{t-j} + \lambda_1 ECT_{t-1} + u_t \quad (3)$$

The  $\lambda_1$  represents error correction term (ECT) coefficient. For accuracy, the latter has to be statistically significant with a negative sign. The presence of a negative and statistically significant error term coefficient implies that any model's short deviation from the equilibrium will converge towards long-run equilibrium. Thus, the higher the ECT coefficient, the faster the model converges towards long-term equilibrium.

### Toda-Yamamoto causality test

The causal relationship is generally established through the Granger causality test. However, this test produces accurate results only if applied to variables with the same integration order. Therefore, if a given study analyses variables with mixture integration order such as I (0) and I (1), it is important to apply the Toda-Yamamoto test for a causal relationship. Given that the Toda-Yamamoto causality test is built on the vector autoregressive (VAR) model, it is capable of estimating causation among variables irrespective of their integration order (Squalli, 2007; Meçik & Koyuncu, 2020). The application of the Toda-Yamamoto test requires first determining both the optimum lag length ( $p$ ) and the maximum integration degree ( $d_{max}$ ). The current study built the Toda-Yamamoto test on the subsequent VAR model:

$$Y_t = \alpha_0 + \sum_{i=1}^{p+d_{max}} \alpha_1 Y_{t-i} + \sum_{i=1}^{p+d_{max}} \alpha_2 X_{t-i} + u_{yt} \quad (4)$$

$$X_t = \beta_0 + \sum_{i=1}^{p+d_{max}} \beta_1 Y_{t-i} + \sum_{i=1}^{p+d_{max}} \beta_2 X_{t-i} + u_{xt} \quad (5)$$

Where Y and X (the study variables) are alternating as dependent and independent variables in each equation.

## Finding and discussion

### Descriptive statistics

The descriptive statistics of summary statistics provide basic information characteristics of the data set and the study's sample. Table 1 represents the summary of statistics for the current study. The mean for variables is 6.66, 4.42, 4.33 and 4.96 for LEMP, LFIMP, LCPI and LWAGE respectively. As displayed in Table 1, agricultural employment has a high mean value compared to other variables. This suggests that during the analysed period agricultural employment increased more compared to the other variables in the study. The kurtosis value of 3.72 indicates that the food imports variable is characterised by a leptokurtic distribution while other variables (LEMP, LCPI and LWAGE) are

characterised by platykurtic distribution as their kurtosis is less than 3. Besides, the data sample is normally distributed as the skewness values are close to zero and the Jarque-Bera's probability value is greater than 0.05 for each variable. Lastly, the standard deviation values suggest high fluctuation of the study variables. Nonetheless, wages experienced more oscillations compared to the remaining variables.

**Table 1.** Summary of statistics

	<b>LEMP</b>	<b>LFIMP</b>	<b>LCPI</b>	<b>LWAGE</b>
Mean	6.66	4.42	4.33	4.95
Std. Dev.	0.11	0.14	0.18	0.20
Skewness	-0.44	-0.62	-0.16	-0.30
Kurtosis	1.74	3.72	1.74	1.84
Jarque-Bera	4.75	4.16	3.38	3.39
Probability	0.09	0.13	0.18	0.18

### Correlation analysis

The correlation coefficient is one of the statistical measures that assist in forecasting the degree to which changes in one variable's value can cause changes in the other variable value. Table 2 displays the correlation coefficients for the study variables. The probability values of all independent variables are statistically significant implying that changes in any of these variables (food imports, wage and food inflation (CPI)) cause a change in the dependent variables (agricultural employment). Additionally, all indecent variables are negatively correlated to agricultural employment except for the inflation rate.

**Table 2.** Pearson correlation coefficients

<b>Variable</b>	<b>LEMP</b>	<b>FIMP</b>	<b>LCPI</b>	<b>LWAGE</b>
LEMP	1.00			
P-value	-----			
FIMP	-0.61	1.00		
P-value	0.00	-----		
LCPI	0.81	0.81	1.00	
P-value	0.00	0.00	-----	
LWAGE	-0.83	0.81	0.10	1.00
P-value	0.00	0.00	0.00	-----

### Unit root test

The study employed a traditional unit root test namely the augmented Dickey and Fuller (1975). The results from the test are reported in Table 3. The results indicated that only the inflation rate is stationary at level. In other words, other variables namely LEMP, LFIM, LWAGE had a unit root and became stationary after the first difference. Since variables are a mixture of I(0) and I(1) and the research focuses on a one-way relationship between variables (from independent variables to the dependent variable),

the ARDL model is the appropriate approach to assess the cointegration between variables. The next section provides and elucidates the results of bounds testing.

**Table 3.** Unit root results

Series	Levels		First difference		Integration status
	Intercept	Intercept & trend	Intercept	Intercept & trend	
LEMP	0.54	0.454	0.00**	-----	I(1)
LFIM	0.51	0.41	0.00**	-----	I(1)
LCPI	0.02	-----	-----	-----	I(0)
LWAGE	0.39	0.68	0.00**	-----	I(1)

### Bounds testing and long-run relationship analysis

Comparing two information criteria namely AIC and SBIC, the ARDL (3, 0, 0, 2) was selected as the best model to estimate both long-run and short-run relationships among variables. Table 4 reports the bounds testing for cointegration results. These results confirm that the value of calculated F-statistics (6.72) is greater than the upper bounds critical values even at 0.01 level of significance. This implies the rejection of the null hypothesis for no cointegration in favour of the alternative hypothesis for cointegration. Therefore, based on these results, it can be concluded that a long-run relationship exists between food imports, inflation, wages and South African agricultural employment. The estimated long-run relationships are summarised by the subsequent Equation 6.

**Table 4.** Bounds testing for cointegration

F-statistic	Critical value	Lower bounds	Upper bounds
6.724370	10%	2.72	3.77
	5%	3.23	4.35
	1%	4.29	5.61

$$\text{LEMP} = 1.78 - 4.81 \cdot \text{LCPI} + 0.14 \cdot \text{LFIMP} + 4.63 \cdot \text{LWAGE} \quad (6)$$

The results in Equation 6 shows that a positive long-run relationship exists between food imports, wages and agricultural employment while an inverse relationship exists between agricultural employment and inflation rate. The coefficient of inflation rate suggests that a one percent increase in the inflation rate causes agricultural employment to decline by 4.81 percent. In contrast, a one percent increase in both food imports and wages results in a 0.14 percent and 4.63 percent increase in agricultural employment. Looking at the coefficients of independent variables, one can conclude that wages and inflation rate play a very significant role in agricultural employment compared to the role played by food imports.

The negative relationship between agricultural employment and the inflation rate implies that when food prices increase while wages and income remain constant some consumers reduce their consumption. This causes low demand for agricultural products demand and consequently a reduction in labour workers' demand. On the other hand,

a positive relationship between food import and wages implies that when real wages increase consumers have enough money to spend on food. Thus, real wages increase the demand for agricultural products which leads to high demand for labour and job creation in the agricultural sector. The positive effect of food imports on employment in South African agricultural employment means that most imported goods are not produced in South Africa and may play a role in complementing South African agricultural products.

### Analysis of the short-run relationships

The error correction model (ECM) results of the cointegration estimated in Equation 6 are summarised in Table 5. The coefficient ( $\lambda_1$ ) of the error correction term ( $ECT_{t-1}$ ) possesses desired characteristics namely negative sign and statistically significant at 0.01 significant level as its absolute t-statistics is 5.398 and P-value is 0.000. The coefficient of -0.57 indicates that approximately 57 percent of short-term shocks are corrected each quarter. In other words, it takes about 1.76 (1/0.57) quarter for any change in food import, inflation and real wage to have a full effect on agricultural employment. Considering the short-term effect of independent variables on the dependent variable, the wage is the only variable with a statistically significant effect to impact the short-term behaviour of agricultural employment. Similar, to the long-term effect of real wage on agricultural employment, the former variable positively influences short-term employment in the agricultural industry.

**Table 5.** ECM and short-run results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LEMP(-1))	0.16	0.13	1.24	0.22
D(LEMP(-2))	0.23	0.127	1.91	0.06
D(LWAGE)	1.76	0.437	4.04	0.00
D(LWAGE(-1))	-0.91	0.47	-1.95	0.06
$ECT_{t-1}$	-0.57	0.11	-5.40	0.00

### Causality analysis

When estimated variables are cointegrating, there should be at least a single causality between those variables. As the unity root suggested that variables under consideration were a combination of I(0) and I(1), the Toda-Yamamoto causality test was employed to further determine causality and short-run relationship between variables. The results reported in Table 6 indicate confirm the short-run relationship results. As indicated in Table 5, the real wage is the only significant variable to causes short-term changes in agricultural employment. Similarly, the T-Y granger causality test suggests a unidirectional causal relationship between employment and real wages. Additionally, a unidirectional relationship exists between inflation and real wages. The real wage has power has the power to cause short-term changes in employment while changes in the former variables are also caused by inflation.

**Table 6.** T-Y Granger causality test results

Excluded lags	Dependent variable			
	LEMP	LCPI	LFIM	LWAGE
LEMP	-----	0.29 (0.59)	2.47 (0.12)	0.88 (0.34)
LCPI	3.02 (0.08)	-----	1.90 (0.17)	6.59 (0.01)
LFIM	0.59 (0.44)	4.24 (0.04)	-----	2.67 (0.10)
LWAGE	3.55 (0.04)	1.53 (0.22)	2.69 (0.10)	-----

Note: P-values in brackets

### Diagnostic test

Various stability and diagnostic test were performed to ensure the robustness of results from the ARDL, ECM and T-Y approaches. Table 7 reports the summary of performed tests. The null hypothesis of all residual tests (Jarque-Bera, LM and white test) was not rejected. This implies that the residuals of employed approaches are free of heteroscedasticity, and serial correlation and are normally distributed. Furthermore, the results from conducted stability tests (Ramsey RESET, CUSUM and CUSUMSQ) indicated that the used model was correctly specified and that the model parameters are stable. In other words, the relationship between agricultural employment, real wages, food import and inflation were consistent during the analysed period.

**Table 7.** Diagnostic tests results

Test	H0	P-value	Decision
White	Homoscedasticity	0.59	Do not reject H0
LM test	No serial correlation	0.75	Do not reject H0
Jarque-Bera	Normality in residuals	0.55	Do not reject H0
Ramsey RESET	Correctness in the model specification	0.92	Do not reject H0
CUSUM	The model is stable at a 5 percent level of significance		
CUSUMSQ	The model is stable at a 5 percent level of significance		

### Conclusion and recommendations

Agricultural employment plays an important role in the South African economy and South Africans' well-being. However, in most cases researchers focus on non-agricultural employment leaving a gap in this sector. For that reason, the current study employed the Autoregressive Distributed Lag (ARDL), Error correction model (ECM) and Toda-Yamamoto test to assess the impact of food import, inflation and real wages on agricultural employment in South Africa. The study findings established a long-run relationship between food import, inflation and real wages in agricultural employment where both food imports and real wages increase the number of people employed in the agricultural industry. Nonetheless, a high inflation rate was found to impede



job creation or employment growth in the agriculture industry. When comparing the effect of the three independent variables on employment, the results indicated that food imports have a small long-run impact compared to real wage and inflation rates. This implies the seriousness of inflation and wages on employment.

The short-run results suggested that the real wage is the only variable that stimulates changes in agricultural employment. These results were confirmed by findings from the Toda-Yamamoto granger causality test where real wage was the only significant variable to cause short-term changes in agricultural employment. Given the power of real wages on agricultural employment in both the long run and short run, South African policymakers should consider policies that incorporate both inflation and real wages. High inflation impedes real wages which, in return, significantly impacts agricultural employment. Easing the import of food products that complement domestic agricultural products should be another strategy to increase the number of people employed in the agricultural sector.

### Conflict of interests

The authors declare no conflict of interest.

### References

1. Al-zeaud, H., & Al-hosban, S. (2015). Does the Phillips curve exist? An empirical evidence from Jordan. *European Scientific Journal*, 11(10), 253 – 275.
2. Arnoldi, M. (2021). Agriculture remains a star performer in the economy, but still needs govt support. Retrieved May 28, 2022, from <https://www.engineeringnews.co.za/article/agriculture-remains-a-star-performer-in-the-economy-but-still-needs-govt-support-2021-06-03>
3. Buthelezi, E. M. (2023). Impact of Inflation in Different States of Unemployment: Evidence with the Phillips Curve in South Africa from 2008 to 2022. *Economies*, 11(1), 1 – 12.
4. Daya, Y., Ranoto, T.R., & Letsoalo, M.A. (2006). Intra-Africa Agricultural Trade: A South African Perspective. Pretoria: Department of Agriculture.
5. Egede, Y., Aminu, U., Hamma, A., & Ademola-John, C. I. (2023). Revisiting the Validity of Phillips Curve in Nigeria: An ARDL Approach. *Management and Economics Review*, 8(1), 24-34.
6. Engle, R.F., & Granger, C.W. (1987). Cointegration and Error Correction: Representation, Estimation and Testing. *Econometrica*, 55, 251-276.
7. Fuhrer, J., Kodrzycki, Y. K, Little, J.S, & Olivei, G .P. (2009). Understanding Inflation and the Implications for Monetary Policy: A Phillips Curve Retrospective. Cambridge, Massachusetts: Massachusetts Institute of Technology.
8. Furuoka, F., Munir, Q., & Harvey, H (2013). Does the Phillips Curve Exist in Philippines? *Economics Bulletin*, 33(3), 2001-2016.

9. Furuoka, K. (2007). Does the “Phillips Curve” Really Exist? New Empirical Evidence from Malaysia. *Economics Bulletin*, 5(16), 1-14.
10. Gandhi, A., & Ruffini, K. (2022). Minimum wages and employment composition. Working Paper.
11. Garidzirai, R., Meyer, D. F., & Muzindutsi, P. F. (2019). The impact of economic sectors on local economic development (led): the case of the Capricorn region, Limpopo province, South Africa. *International Journal of economics and finance studies*, 11(2), 20-35.
12. Johansen, S. (1988). Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control*, 12, 231-254.
13. Katria, S., Bhutto, A. N., Butt, F., Domki, A.A., Khawaja, H .A., & Khalid, J. (2013). Is There Any Tradeoff Between Inflation and Unemployment? The Case of SAARC Countries. In: International Conference on Business Management, 28 March 2012, Thailand. pp1-22.
14. Keynes, J.M. (1937). The General Theory of Employment. *The Quarterly Journal of Economics*, 2(51):209-223.
15. Malgouyres, C. (2017). The impact of Chinese import competition on the local structure of employment and wages: Evidence from France. *Journal of Regional Science*, 57(3), 411-441.
16. Meçik, O., & Koyuncu, T. (2020). The Relationship between Migration and Economic Growth in Turkey: Toda-Yamamoto Causality Test. *Journal of the Human and Social Sciences Researches*, 9(3), 2618-2638.
17. Mohler, L., Weder, R., & Wyss, S. (2018). International trade and unemployment: towards an investigation of the Swiss case. *Swiss journal of economics and statistics*, 154, 1-12.
18. Neumark, D. (2018). Employment effects of minimum wages. *IZA World of Labor*.
19. Neumark, D., & Shirley, P. (2022). Myth or measurement: What does the new minimum wage research say about minimum wages and job loss in the United States?. *Industrial Relations: A Journal of Economy and Society*, 61(4), 384-417.
20. Pesarn, M.H, Shin,Y. & Smith, R.J., (2001). Bounds testing approaches to the analysis of Level relationships. *Journal of Applied Econometrics* 16, 289-326.
21. Phillips, A .W (1958). The Relation between Unemployment and the Wage Rates in the United Kingdom, 1861-1957. *Economica*, 25(100), 283–299.
22. Phillips, P. C. and Hansen, B. E. 1990. Statistical inference in instrumental variables regression with I (1) processes. *The Review of Economic Studies*, 57(1), 99-125.
23. Samuelson, P A, and Solow, R M (1960). Analytical aspects of anti-inflation policy. *American Economic Review*, 50 (2), 177-194.

24. Siami-Namini, S., & Hudson, D. (2019). Inflation and income inequality in developed and developing countries. *Journal of Economic Studies*, 46 (3), 611-632.
25. Sihlobo, W., & Nel, L., (2016). Is South Africa's agricultural sector addressing inclusive socio-economic development. *Opportunity for Change*, 68, 65-81.
26. Squalli, J. (2007). Electricity consumption and economic growth: Bounds and causality analyses of OPEC members. *Energy Economics*, 29(6), 1192- 1205.
27. Vickers, B. (2014). Towards a trade policy for development: the political economy of South Africa's external trade, 1994–2014. *Strategic Review for Southern Africa* 36(2): 57–79.
28. [Writer](#), S. 2022. How Russia's war in Ukraine is pushing up prices in South Africa. Retrieved May 28, 2022, from <https://businesstech.co.za/news/finance/568200/how-russias-war-in-ukraine-is-pushing-up-prices-in-south-africa/>.

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# ROBOTIC SYSTEMS IN FOOD AND BEVERAGE PREPARATION FACILITIES: KEY IMPLICATIONS FOR LEADERS AND HUMAN RESOURCES

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## ABSTRACT

The aim of this paper is to examine and analyze the use of robotic systems in facilities for food and beverage preparation. The research was conducted using a specially designed questionnaire, which was completed by 219 respondents working in food and beverage preparation facilities during 2023. The data analysis applied descriptive statistics, Kolmogorov-Smirnov test, Levene's test, Mann-Whitney U test and Kruskal-Wallis H test. Research results showed that more than 60% employees in food and beverage preparation facilities consider that robotic systems perform routine and simple tasks (67.12%), allow employees to focus on more complex tasks (66.67%), are faster and more efficient (61.93%), provide significant cost savings (64.68%), and do not fear that a robotic system will replace them (76.71%). The obtained results could serve as a basis for leaders and human resource managers in facilities for food and beverage preparation when considering the implementation of robotic systems.

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## Introduction

Every workplace at the time of the fifth industrial revolution (Industry 5.0) has gained new attributes and characteristics. The workplace is getting more and more integrated with modern robotic systems, which are replacing many human-performed tasks. In the field of food and beverages preparation it is crucial to establish and maintain high quality standards. Robotic systems provide many opportunities and benefits. Employees will no longer have to do physically demanding, monotonous, routine, and boring jobs (Kwanya, 2023). Furthermore, mobile robots and exoskeletons make some tasks easier and less physically demanding, enabling women to work in roles previously dominated by men (Breque et al.,

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2021). Tasks such as packing, palletizing, picking, placing, injecting, pouring, polishing, screwing, dosing, welding, and gluing are traditionally where robots are extensively utilized (Doyle Kent & Kopacek, 2020). With technological advancements, modern robots are increasingly employed in creative tasks, including those held by scientists, researchers, medics, and programmers (Murashov et al., 2016). Jobs in customer service, such as bank tellers, cashiers, travel agents, and receptionists, face a high likelihood of being phased out in the future (Fantina et al., 2022). Human resources, finance, accounting, insurance, telecommunication, information technology systems, education, banking, supply chain management, legal services, real estate management, and logistics are among the areas where robots are increasingly being used (Lievano- Martinez et al., 2022; Siderska, 2020). There were already 12 million service robots in operation, with the potential for exponential growth (Solaiman, 2017). In 2015, a density of 160 robots per 10000 employees was observed in Italy, 301 in Germany, and 501 in South Korea (Carrozza, 2019). Most industrial robots are used in the automotive (35%) and electrical/electronics (31%) industries (Hudson, 2019). Robots are being more and more implemented in agriculture with the aim to increase agricultural productivity, optimize the efficiency, and taking jobs that are dull, dirty, and dangerous (Van Wynsberghe et al., 2022). Robots are considered as an integral element of the fourth agricultural revolution oriented to contemporary information and communication technologies and agricultural robots (Benos et al., 2023).

There are numerous benefits of robots and robotic systems at the workplace. Robots are less expensive than humans and make fewer mistakes during work. They are unaffected by working conditions such as noise, pollution, and temperature, and they can process much more data in less time (Abok & Kwanya, 2016; Nakitare et al., 2020). Contemporary robotic systems can automate non-standardized, non-routine, and intellectual tasks (Ivančić et al., 2019), as well as to improve the quality and variety of products and services (Ing et al., 2022). One of the most significant advantages for organizations is that robots are highly efficient and productive. Apart from the benefits, some of the identified disadvantages of robots include a lack of creativity, a lower level of interaction, intense feelings of oddity and a lack of social interaction, and the inability to react adequately in some unstructured, sudden, and unexpected circumstances (Ivanov, 2019; Savela et al., 2021). Furthermore, many human workers distrust robots, viewing them as volatile, uncertain, complicated, and ambiguous (Kopp et al., 2021; Maddahi et al., 2021).

Currently, various types of robots are found in tourism and hospitality, such as reception robots, porter robots, guide robots, concierge robots, and room service delivery robots (Song et al., 2022a). In the hospitality industry, robots perform a range of tasks such as checking in guests, cleaning rooms, delivering items, providing concierge services, preparing food, making drinks, entertaining guests, guiding guests, and presenting information (Huang et al., 2021; Chen et al., 2023). A key feature of service robots is their humans-like appearance or behavior, which allows them to execute more complex activities (Fu et al., 2022). According to predictions, service robots will replace around 25% of employees in the hospitality business by 2030 (Bowen & Morosan, 2018).

## The role and importance of robotic systems in food and beverage preparation facilities

Robotic systems can perform a variety of tasks in food and beverage preparation facilities in a safer, more individualized, and more effective manner. In practice, many kitchens employ robotic systems such as the dishwasher packaging robot, the burger flipping robot, and the sausage frying robot, which can chop food, peel lettuce, stir-fry, check fruit ripeness, and assess food freshness and quality (Sochacki et al., 2023). Furthermore, modern kitchen robots perform various tasks such as slicing vegetables, whisking ingredients, baking, grilling, retrieving items, and preparing meals (Bernier, 2023). Rising operational costs, declining profitability, and labor shortages have led to increased use of robotic systems in food and beverage preparation facilities (Tanksley, 2023). In contrast to the food industry and food/beverage preparation, agriculture has long been resistant to this robotization trend, because agricultural production has high level of unpredictability and dynamism (Marinoudi et al., 2021). Moreover, agricultural work has unique requirements due to its extremely seasonal nature, therefore the typical robotics development trends from other industries cannot be easily copied and transferred to agriculture (Martin et al., 2022). *Table 1* presents various types of robots used in food and beverage preparation facilities.

**Table 1.** Example of robots used in facilities for food and beverage preparation and service

Name of the robot	Location	Food	Activities
Rube Goldberg-esque	San Francisco, California	Hamburger	Handles the entire burger-making process: grinding beef, frying patties, toasting buns, dispensing condiments and assembling burgers.
BreadBot	Walla Walla, Washington	Bread	Blends, prepares and cooks the dough using a mix of dry ingredients.
<u>Picnic</u> Pizza Station	Seattle, Washington	Pizza	Automates pizza preparation, reducing food waste, while enabling users to customize the machine for adding precise, consistent amounts of cheese, sauce and toppings to each pizza.
BaristaBots	Atlanta, Georgia	Coffee	Automated kiosk-style machines that take and fulfill custom coffee orders.
<u>Blendid</u>	Sunnyvale, California	Smoothie	Utilizes a mechanical arm to dispense ingredients, blend, pour into a cup, and serve.
Bear Robotics' self-driving Servi robots	Redwood City, California	Food and drinks delivery	Runs food or drinks, buses table, greets and seat guests, equipped with multiple cameras for navigating custom floor plans.
Matradee	Austin, Texas	Food and drinks delivery	Obstacle-avoiding delivery robot with up to 12 hours of battery life.

*Source:* Adapted from Gottsegen, 2023

The most common use of robots in food and beverage preparation facilities is to perform manual and repetitive tasks, while other tasks are predominantly handled by human employees. However, with advancing technology, robots are increasingly capable of preparing meals from start to finish (Berezina et al., 2019).

Robotic system appliances offer a high degree of accuracy, uniform taste, and quality, adhering to safety regulations, and providing consistency and efficiency in food and beverage preparation (Bernier, 2023). In terms of food preparation, robotic systems are more efficient and reliable than human employees, producing results that are more consistent, precise, and result in less food waste (Tanksley, 2023).

### **Research methodology, materials, and methods**

The aim of this research is to examine and analyze the use of robotic systems in facilities for food and beverage preparation, and to provide recommendations to leaders and human resource managers on effectively guiding the adoption process of robotic systems. The imposed hypotheses are:

**Hypothesis 1:** The application of robotic systems in facilities for food and beverage preparation has numerous positive effects.

**Hypothesis 2:** Personal characteristics of employees, such as gender, age, education, marital status, and children, influence their perception of the use of robotic systems in facilities for food and beverage preparation.

**Hypothesis 3:** The country where respondents work influences their perception of the use of robotic systems in facilities for food and beverage preparation.

The empirical research was conducted using a specially designed questionnaire. The first part of the questionnaire included questions about respondents' gender, age, education, country, employment type, marital status, children status, and type of facility in which they are employed. Following these profile questions, respondents were asked to answer statements regarding their perceptions of the effects of robotic systems in their working environment in facilities for food and beverage preparation. Eight statements were grouped into a scale named "Effects of the Application of Robotic Systems in the Work Environment" and were measured on a seven-point Likert scale, from 1 (strongly disagree) to 7 (strongly agree).

From October to November 2023, the questionnaire was distributed among employees in facilities for food and beverage preparation in four countries: Serbia, Croatia, Bosnia and Herzegovina, and Montenegro. The questionnaire was sent to 719 employees in facilities for food and beverage preparation. After two kind follow-up e-mails, a total of 458 respondents filled in the questionnaire indicating the response rate of 63.70% which is considered as acceptable in social sciences (from 30% to 70%) (De Vaus, 2013), especially in hospitality industry where is much harder and challenging to collect answers (Keegan & Lucas, 2005). Out of all respondents, 219 of them answered that they already have robotic systems at their workplace, while other respondents do

not have those systems implemented. For further analysis of data was used answers from 219 respondents (30.46% response rate). All responses were analyzed using the Statistical Software for Social Sciences, SPSS, version 21.0.

Cronbach's Alpha coefficient for the measurement scale "Effects of Application of Robotic Systems in the Work Environment" was 0.752, indicating high reliability for the scale (DeVellis, 2003). The normality of the data distribution was examined using the Kolmogorov-Smirnov test, along with histograms, skewness, kurtosis, the normal probability curve, and the boxplot. The results for the scale "Effects of Application of Robotic Systems in the Work Environment", with a significance (Sig.) of 0.000, indicated that the assumption of normal data distribution was not met. As a result, non-parametric statistical techniques were used for statistical analysis within the measurement scales. Mann-Whitney U test was used to compare differences between two groups, while the Kruskal-Wallis H test was used to compare differences among three or more groups with a 95% confidence interval. Levene's test for equality of variances was applied in all tests comparing differences between groups, meeting the assumption of variance homogeneity in all cases ( $p > 0.05$ ).

### Research results

Table 2 shows the basic information about the respondents who participated in this research and have implemented robotic systems at their workplaces. Nearly an equal number of men and women participated in the research. In terms of age, more than half of the respondents (56.6%) are between 36 and 55 years old, followed by those aged 18 to 35 years (39.7%). A small number of respondents (3.7%) are over 55 years old. More than half of the respondents (54.3%) have completed high school, followed by those with a college or university education (29.2%). The majority of respondents are from Croatia (38.8%), followed by Serbia (27.4%). Regarding employment type, the majority are in indefinite employment relationships (72.6%). More than 60% of respondents have a partner and children.

**Table 2.** Basic information about respondents

	Answers	N	%
Gender	Male	110	50.2
	Female	109	49.8
Age	18-35	87	39.7
	36-55	124	56.6
	Over 55	8	3.7
Education	Primary School	7	3.2
	Secondary School / High School	119	54.3
	College/University Undergraduate for Bachelor Programs	64	29.2
	University / Graduate School for master's Programs	26	11.9
	University / Graduate School for PhD Programs	3	1.4



	Answers	N	%
Country	Serbia	60	27.4
	Croatia	85	38.8
	Bosnia and Herzegovina	48	21.9
	Montenegro	26	11.9
Employment type	Permanent or Full Time Employment	159	72.6
	Seasonal or Contractual Employment	60	27.4
Marital status	Married/Partnership	153	69.9
	Single/Divorced/Widowed	66	30.1
Children status	With children	134	61.2
	Without children	85	38.8

Source: Authors' calculations

Regarding the workplaces of the respondents (as shown in *Table 3*), the majority are employed in hotel restaurants (30.6%). The next largest group works in pizzerias and restaurants serving Chinese or Mexican food (24.7%).

**Table 3.** Workplaces of survey respondents

Workplaces	N	%
Hotel restaurant	67	30.6
Exclusive restaurant	47	21.5
Classic bar-restaurant	27	12.3
Pizzeria, restaurant serving Chinese or Mexican food	54	24.7
Cafeteria, cafe bar, bistro, beach bar	24	11.0

Source: Authors' calculations

*Table 4* presents the responses to the statements in the measurement scale "Effects of the Application of Robotic Systems in the Work Environment". The highest mean values were for the statements indicating that employees do not fear being replaced by robotic systems at work (5.71) and that robotic systems allow employees to focus on more complex tasks (5.18). More than 60% of respondents believe that robotic systems perform only routine and simple tasks (67.12%), enable employees to focus on more complex tasks (66.67%), are faster and more efficient (61.93%), provide significant cost savings (64.68%), and do not fear replacement by robotic systems (76.71%).

**Table 4.** Results regarding the scale "Effects of the Application of Robotic Systems in the Work Environment"

Statements	Answer	N	%	M	SD
Robotic systems perform only routine and simple tasks.	Agree	147	67.12	4.34	2.260
	Neutral	9	4.11		
	Disagree	63	28.77		
In certain workplaces, robotic systems have totally replaced humans.	Agree	106	48.40	4.12	2.559
	Neutral	6	2.74		
	Disagree	107	48.86		

Statements	Answer	N	%	M	SD
Robotic systems provide customers a unique experience.	Agree	90	41.28	3.81	2.438
	Neutral	18	8.26		
	Disagree	110	50.46		
When compared to humans, robotic systems are faster and more efficient.	Agree	135	61.93	4.77	2.559
	Neutral	6	2.75		
	Disagree	77	35.32		
Robotic systems result in significant cost savings.	Agree	141	64.68	4.99	2.508
	Neutral	6	2.75		
	Disagree	71	32.57		
Robotic systems allow employees to focus on more complex tasks.	Agree	144	66.67	5.18	2.468
	Neutral	7	3.24		
	Disagree	65	30.09		
I do not fear that a robotic system will take my place at work.	Agree	168	76.71	5.71	1.924
	Neutral	22	10.05		
	Disagree	29	13.24		
I feel comfortable working in an environment where robots are my colleagues.	Agree	111	50.68	4.34	2.260
	Neutral	34	15.52		
	Disagree	74	33.79		

Source: Authors' calculations

To examine the proposed hypotheses, a Mann-Whitney U test was conducted. The results are presented in *Table 5*.

**Table 5.** Mann-Whitney U test results for hypotheses examination

	Answers	N	M	Md	U	Z	p
Gender	Male	108	96.34	4.75	4584	-2.565	0.010*
	Female	106	118.14	5.38			
Employment type	Permanent or Full Time Employment	154	110.83	5.31	4480	-0.416	0.678
	Seasonal or Contractual Employment	60	106.90	5.13			
Marital status	Married/Partnership	148	106.40	5.25	4590.5	-0.580	0.562
	Single/Divorced/Widowed	66	111.77	5.31			
Children status	With children	129	103.68	5.38	5175.5	-0.832	0.405
	Without children	85	110.88	5.13			

Source: Authors' calculations

Mann-Whitney U test results revealed statistically significant differences in responses between males (Md=4.75, n=108) and females (Md=5.38, n=106), U=4584, Z=-2.565, p=0.010.

However, Mann-Whitney U test results did not show statistically significant differences regarding employment type, marital status, or children status.

Additionally, the Kruskal-Wallis H-test was conducted to examine the proposed hypotheses. The results of this test are presented in *Table 6*.

**Table 6.** Results of the Kruskal-Wallis H-test

	Answers	N	M	Md	$\chi^2$	df	p
Age	18-35	87	109.17	5.25	0.108	2	0.947
	36-55	119	106.42	5.12			
	Over 55	8	105.44	4.87			
Education	Primary School	7	97.29	4.87	12.831	4	0.012*
	Secondary School / High School	115	115.25	5.50			
	College/University Undergraduate for Bachelor Programs	63	111.60	5.25			
	University / Graduate School for master's Programs	26	71.42	3.50			
	University / Graduate School for PhD Programs	3	60.83	4.25			
Country	Serbia	84	97.58	4.69	33.219	3	0.000*
	Croatia	58	81.31	4.00			
	Bosnia and Herzegovina	24	147.85	5.94			
	Montenegro	48	136.33	5.81			

Source: Authors' calculations

The Kruskal-Wallis H-test results revealed no statistically significant differences in responses based on respondents' age,  $\chi^2(df=2, n=214)=0.108, p=0.0947$ .

Further, Kruskal-Wallis H-test results showed that there are statistically significant differences in responses based on education levels,  $\chi^2(df=4, n=214)=12.831, p=0.012$ . Compared to other educational levels, respondents with secondary education showed the highest median score (Md=5.50), followed by those with a high school education (Md=5.25).

Finally, the Kruskal-Wallis H-test results revealed statistically significant differences in responses based on the country of the respondents. The results,  $\chi^2(df=3, n=214)=33.219, p=0.000$ , indicated that respondents from Bosnia and Herzegovina had the highest median score (Md=5.94) compared to other countries.

### Discussion of research findings

Results from the conducted research confirmed *Hypothesis 1*, indicating that the *application of robotic systems in facilities for food and beverage preparation leads to numerous positive effects*. More than 60% of respondents stated that robotic systems perform routine and simple tasks (67.12%), enable employees to focus on more complex tasks (66.67%), are faster and more efficient (61.93%), provide significant cost savings (64.68%), and do not fear that a robotic system will replace them (76.71%).

Statistical tests (Mann-Whitney U test and Kruskal-Wallis H-test) showed statistically significant differences in the answers of respondents regarding their gender and education, while there were no statistically significant differences concerning age, marital status, and number of children. Female respondents and those who have completed secondary and high school education are more positively oriented towards the application of robotic systems. This partially confirms *Hypothesis 2*, which proposed that *personal characteristics of employees such as gender, age, education, marital status, and children influence perceptions of robotic system applications in food and beverage preparation facilities*. Gender and education impact perceptions, while age, marital status, and number of children have no impact.

Furthermore, the Kruskal-Wallis H-test confirmed *Hypothesis 3*, suggesting that *the country where the respondents work influences their perception of robotic systems in food and beverage preparation facilities*. Respondents from Bosnia and Herzegovina gave the highest mean values, indicating the most positive perceptions of robotic systems in facilities for food and beverage preparation. They are followed by employees from Montenegro, Serbia, and finally, Croatia.

Various studies have shown that robots have replaced humans in many tasks within the hospitality industry, improving ease of tasks and service quality, streamlining service processes, and freeing employees from repetitive and monotonous tasks (McCartney & McCartney, 2020; Liu et al., 2022; Song et al., 2022b). The use of robots offers numerous organizational benefits, including lower costs, higher productivity, and profits (Kim et al., 2023; Madhan et al., 2023), as well as attracting customer interest and improving customer experiences while reducing employees workload and stress (Song et al., 2022a; Palrão et al., 2023; Xu et al., 2023). These changes herald the advent of Hospitality 5.0, representing collaborative work between humans and machines to achieve a resilient, sustainable and human-centric world (Xu et al., 2023).

The adoption of modern technological solutions requires extensive changes in human resource management and leadership styles (Hajal & Rowson, 2020). Firstly, facilities for food and beverage preparation implement robotic systems to better position themselves in the market and attract customers interested in modern technologies. Robotic systems also largely address labor shortages and excessive employee workloads (Berezina et al., 2019). Leaders should recognize that, alongside the benefits, some identified disadvantages of robots include a lack of creativity, limited interaction levels, and an inability to adequately react in unstructured, sudden, or unexpected situations (Ivanov, 2019). Moreover, modern robots will pose new challenges to employees' social and psychological well-being, as limited interaction with colleagues can lead to a lack of excitement, challenge, and team spirit (Starchos & Schüll, 2021). Key messages for leaders and human resource managers are:

- Bearing in mind that one of the biggest obstacles to implementing robots is employee awareness and perceptions (Tanksley, 2023), leaders need to build a culture of acceptance of robots in the workplace. This is particularly important

as interactions between humans and service robots, which are intended to coexist and continuously improve their features, will intensify.

- Employees should acquire adequate knowledge and skills regarding robots, including organized training on robotic systems, how to work alongside them, and monitoring their fundamental features. Employees need sufficient knowledge to adjust and leverage their new ‘co-workers’.
- It is important to eliminate employees’ fear of job loss. Leaders should clarify that robots will take over monotonous, simple, and routine tasks, allowing employees more time for demanding activities. Furthermore, the application of robots necessitates the presence of employees to supervise their work and creates new positions for technical maintenance of robots.

With a planned and systematic approach by leaders and human resource managers in implementing robotic systems, employees can be well-educated and aware of the benefits for both the organization and themselves.

### **Conclusion**

The purpose of this research was to examine and analyze the key benefits of robotic systems in facilities for food and beverage preparation and to provide useful insights for leaders and human resource managers in these facilities considering the introduction of contemporary robotic solutions. The survey, conducted in 2023 involving 219 respondents working in food and beverage preparation facilities in four countries (Serbia, Croatia, Bosnia and Herzegovina, and Montenegro), revealed numerous benefits of using robotic systems. Their appliance is primarily manifested in the automation of routine and simple tasks, enabling employees to focus on more complex tasks. Robotic systems have proven to be faster and more efficient than human labor and offer significant cost savings. More positive perceptions of robotic systems in these facilities were noted among female respondents, those with secondary and high school education, and respondents that work in Bosnia and Herzegovina compared to the other three countries. The majority of respondents do not fear that robotic systems will replace them.

The significance of this research lies in the fact that food and beverage preparation facilities are relying more and more on robotic technologies, which might save costs and increase efficiency. The food industry is among those where automation will likely have a big impact in the future.

The results have significant implications for leaders and human resource managers. They highlight the need for adequate organizational preparation for the introduction of robotic systems in food and beverage preparation facilities. Through a planned approach, employee training, and effective communication, employees can be made aware of the benefits and positive effects of robotic systems. Furthermore, research results clearly indicated the potential for robotization in food and beverage preparation

facilities in the future. In this manner, stakeholders and policy makers can be better informed about the deployment of robotic systems. They may use obtained findings as the basis for evaluation of the whole impact of robotic systems in food and beverage preparation facilities and make well-informed decisions, particularly concerning the lack of skilled human employees.

This research provides valuable insights but also has limitations. The participant pool was limited to 219 respondents from four countries: Serbia, Croatia, Bosnia and Herzegovina, and Montenegro. Due to national and cultural differences, the results cannot be generalized to other countries. Additionally, the closed-ended nature of the survey questions limited the depth of analysis and conclusions. Therefore, future research on this topic should employ diverse methods such as case studies, observations, and interviews to comprehensively understand the benefits of robotic systems from various perspectives and organizational contexts. Moreover, with ongoing technological advancements, longitudinal studies are recommended to examine shifts in employees' perceptions and behaviors towards robotic systems over time.

### Conflict of interests

The authors declare no conflict of interest.

### References

1. Abok, V. A., & Kwanya, T. (2016). Maximising the potential of social media to deliver academic library services to students: A case study of the Technical University of Kenya Library. *Inkanyiso*, 8(2), 147–155.
2. Benos, L., Moysiadis, V., Kateris, D., Tagarakis, A.C., Busato, P., Pearson, S., & Bochtis, D. (2023). Human-Robot Interaction in Agriculture: A Systematic Review. *Sensors (Basel)*, 23(15), 6776. doi: 10.3390/s23156776
3. Bernier, K. (2023). Cooking Robots: Revolutionizing the Modern Kitchen, Retrieved from <https://howtorobot.com/expert-insight/cooking-robots-revolutionizing-modern-kitchen> (November 21, 2023)
4. Berezina, K., Ciftci, O., & Cobanoglu, C. (2019). Robots, Artificial Intelligence, and Service Automation in Restaurants. In S. Ivanov & C. Webster (Eds.), *Robots, Artificial Intelligence, and Service Automation in Travel, Tourism and Hospitality* (pp. 185–219). Emerald Publishing Limited, Leeds. doi:10.1108/978-1-78756-687-320191010
5. Bowen, J., & Morosan, C. (2018). Beware hospitality industry: the robots are coming. *Worldwide Hospitality and Tourism Themes*, 10(6), 726-733. <https://doi.org/10.1108/WHATT-07-2018-0045>
6. Breque, M., De Nul, L., & Petridis, A. (2021). *Industry 5.0 towards a sustainable, human-centric and resilient European industry*. European Commission, Brussels.

7. Carrozza, M. C. (2019). *The Robot and Us. An 'Antidisciplinary' Perspective on the Scientific and Social Impacts of Robotics*. Springer, Switzerland.
8. Chen, M., Wang, X., Law, R., & Zhang, M. (2023). Research on the Frontier and Prospect of Service Robots in the Tourism and Hospitality Industry Based on International Core Journals: A Review. *Behavioral Science*, 13, 560. <https://doi.org/10.3390/bs13070560>
9. De Vaus D. (2013). *Surveys in Social Research*. Routledge, London. <https://doi.org/10.4324/9780203501054>
10. DeVellis, R. F. (2003). *Scale Development. Theory and Application*. Sage Publications, Inc.
11. Doyle Kent, M., & Kopacek, P. (2020). Do We Need Synchronization of the Human and Robotics to Make Industry 5.0 a Success Story? In N. M. Durakbasa & M. G. Gençyılmaz (Eds.), *Digital Conversion on the Way to Industry 4.0. ISPR 2020. Lecture Notes in Mechanical Engineering* (pp. 302–311). Springer, Cham. [https://doi.org/10.1007/978-3-030-62784-3\\_25](https://doi.org/10.1007/978-3-030-62784-3_25)
12. Fantina, R., Storozhuk, A., & Goyal, K. (2022). *Introducing Robotic Process Automation to Your Organization. A Guide for Business Leaders*. Apress.
13. Fu, S., Zheng, X., & Wong, I. A. (2022). The perils of hotel technology: The robot usage resistance model. *International Journal of Hospitality Management*, 102, 103174. <https://doi.org/10.1016/j.ijhm.2022.103174>
14. Gottsegen, G. (2023). 14 Restaurant Robots Changing the Food Industry (updated by Velazquez, Rose on Apr 3, 2023). Retrieved from <https://builtin.com/robotics/robots-in-restaurants-food-service> (November 21, 2023)
15. Hajal, G. El., & Rowson, B. (2020). The future of hospitality jobs. *Research in Hospitality Management*, 10(1), 55-61. DOI: 10.1080/22243534.2020.1790210
16. Huang, D., Chen, Q., Huang, J., Kong, S., & Li, Z. (2021). Customer-robot interactions: Understanding customer experience with service robots. *International Journal of Hospitality Management*, 99, 103078. <https://doi.org/10.1016/j.ijhm.2021.103078>
17. Hudson, J. (2019). *The Robot Revolution. Understanding the Social and Economic Impact*. Edward Elgar Publishing, UK.
18. Ing, L.Y., Grossman, G., & Christian, D. (2022). Digital Transformation: 'Development for All'? In L.Y Ing & D. Rodrik (Eds.), *New Normal, New Technology, New Financing* (pp. 76-88). ERIA and IEA, Jakarta.
19. Ivanov, S. (2019). Ultimate transformation: How will automation technologies disrupt the travel, tourism and hospitality industries? *Zeitschrift für Tourismuswissenschaft*, 11(1), 25-43. DOI: 10.1515/tw-2019-0003

20. Ivančić, L., Suša Vugec, D., & Bosilj Vukšić, V. (2019). Robotic Process Automation: Systematic Literature Review. In C. Di Ciccio, R. Gabryelczyk, L. Garcia-Banuelos, T. Hernaus, R. Hull, M. Indihar Štemberger, A. Ko, & M. Staples (Eds.), *Business Process Management. Blockchain and Central and Eastern Europe Forum Proceedings* (pp. 280-295). Springer, Switzerland.
21. Keegan, S. N., & Lucas, R. (2005). Hospitality to hostility: dealing with low response rates in postal surveys. *International Journal of Hospitality Management*, 24(2), 157-169. <https://doi.org/10.1016/j.ijhm.2004.06.006>
22. Kim, T., Lee, O-K. D., & Kang, J. (2023). Is it the best for barista robots to serve like humans? A multidimensional anthropomorphism perspective. *International Journal of Hospitality Management*, 108, 103358. <https://doi.org/10.1016/j.ijhm.2022.103358>
23. Kopp, T., Baumgartner, M., & Kinkel, S. (2021). Success factors for introducing industrial human–robot interaction in practice: An empirically driven framework. *The International Journal of Advanced Manufacturing Technology*, 112(3), 685–704. <https://doi.org/10.1007/s00170-020-06398-0>
24. Kwanya, T. (2023). Working with Robots as Colleagues: Kenyan Perspectives of Ethical Concerns on Possible Integration of Co-bots in Workplaces. In D. O. Eke, K. Wakunuma & S. Akintoye (Eds.), *Responsible AI in Africa. Challenges and Opportunities* (pp. 65-99). Palgrave Macmillan, Cham. [https://doi.org/10.1007/978-3-031-08215-3\\_4](https://doi.org/10.1007/978-3-031-08215-3_4)
25. Lievano-Martinez, F. A., Fernandez-Ledesma, J. D., Burgos, D., Branch-Bedoya, J. W., & Jimenez-Builes, J. A. (2022). Intelligent Process Automation: An Application in Manufacturing Industry. *Sustainability*, 14, 8804. <https://doi.org/10.3390/su14148804>
26. Liu, X. S., Yi, X. S., & Wan, L. C. (2022). Friendly or competent? The effects of perception of robot appearance and service context on usage intention. *Annals of Tourism Research*, 92, 103324. <https://doi.org/10.1016/j.annals.2021.103324>
27. Maddahi, Y., Kalvandi, M., Langman, S., Capicotto, N., & Zareinia, K. (2021). RoboEthics in COVID-19: A case study in dentistry. *Frontiers in Robotics and AI*, 8, 612740. <https://doi.org/10.3389/frobt.2021.612740>
28. Madhan, K., Shagirbasha, S., Kumar Mishra, T., & Iqbal, J. (2023). Adoption of service robots: exploring the emerging trends through the lens of bibliometric analysis. *International Hospitality Review*. DOI 10.1108/IHR-12-2022-0058
29. Marinoudi, V., Lampridi, M., Kateris, D., Pearson, S., Sørensen, C.G., & Bochtis, D. (2021). The Future of Agricultural Jobs in View of Robotization. *Sustainability*, 13(21), 12109. <https://doi.org/10.3390/su132112109>



30. Martin, T., Gasselín, P., Hostiou, N., Feron, G., Laurens, L., Purseigle, F., & Ollivier, G. (2022). Robots and transformations of work in farm: a systematic review of the literature and a research agenda. *Agronomy for Sustainable Development*, 42, 66, <https://doi.org/10.1007/s13593-022-00796-2>
31. McCartney, G., & McCartney, A. (2020). Rise of the machines: towards a conceptual service-robot research framework for the hospitality and tourism industry. *International Journal of Contemporary Hospitality Management*, 32(12), 3835–3851. doi:10.1108/ijchm-05-2020-0450
32. Murashov, V., Hearl, F., & Howard, J. (2016). Working Safely with Robot Workers: Recommendations for the New Workplace. *Journal of Occupational and Environmental Hygiene*, 13(3), 61-71. <https://doi.org/10.1080/15459624.2015.1116700>
33. Nakitare, J., Sawe, E., Nyambala, J., & Kwanya, T. (2020). The emerging roles of academic librarians in Kenya: Apomediarities or infomediarities? *Library Management*, 41(6/7), 339–353. DOI 10.1108/LM-04-2020-0076
34. Palrão, T., Rodrigues, R. I., Madeira, A., Mendes, A. S., & Lopes, S. (2023). Robots in Tourism and Hospitality: The Perception of Future Professionals. *Human Behavior and Emerging Technologies*, 7172152. <https://doi.org/10.1155/2023/7172152>
35. Savela, N., Oksanen, A., Pellert, M., & Garcia, D. (2021). Emotional reactions to robot colleagues in a role-playing experiment. *International Journal of Information Management*, 60, 102361. <https://doi.org/10.1016/j.ijinfomgt.2021.102361>
36. Siderska, J. (2020). Robotic Process Automation – a driver of digital transformation? *Engineering Management in Production and Services*, 12(2), 21-31. doi: 10.2478/emj-2020-0009
37. Solaiman, S. M. (2017). Legal personality of robots, corporations, idols and chimpanzees: A quest for legitimacy. *Artificial Intelligence and Law*, 25(2), 155–179. <https://doi.org/10.1007/s10506-016-9192-3>
38. Song, Y., Zhang, M., Hu, J., & Cao, X. (2022a). Dancing with service robots: The impacts of employee-robot collaboration on hotel employees' job crafting. *International Journal of Hospitality Management*, 103, 103229. <https://doi.org/10.1016/j.ijhm.2022.103220>
39. Song, H., Wang, Y-C., Yang, H., & Ma, E. (2022b). Robotic employees vs. human employees: Customers' perceived authenticity at casual dining restaurants. *International Journal of Hospitality Management*, 106, 103301. <https://doi.org/10.1016/j.ijhm.2022.103301>
40. Sochacki, G., Abdulali, A., Khadem Hosseini, N., & Iida, F. (2023). Recognition of Human Chef's Intentions for Incremental Learning of Cookbook by Robotic Salad Chef. *IEEE Access*, 11, 57006 – 57020. DOI: 10.1109/ACCESS.2023.3276234

41. Starchos, I., & Schüll, A. (2021). Stressed by Boredom in Your Home Office? On „Boreout“ as a Side-effect of Involuntary Distant Digital Working Situations on Young People at the Beginning of Their Career. In *Proceedings of the 23<sup>rd</sup> International conference on Enterprise Information Systems* (pp. 557-564). DOI: 10.5220/0010479405570564
42. Tanksley, T. (2023). Robots in Food Service: Everything you NEED to know. Retrieved from <https://www.richtechrobotics.com/blog/robots-in-food-service>, (November 23, 2023)
43. Van Wynsberghe, A., Ley, M., & Roeser, S. (2022). Ethical Aspects of Human–Robot Collaboration in Industrial Work Settings. In M. I. Aldinhas Ferreira & S. R. Fletcher (Eds.), *The 21st Century Industrial Robot: When Tools Become Collaborators. Intelligent Systems, Control and Automation: Science and Engineering* (pp. 255–266). Springer International Publishing, Cham, Switzerland. [https://doi.org/10.1007/978-3-030-78513-0\\_14](https://doi.org/10.1007/978-3-030-78513-0_14)
44. Xu, J., Hsiao, A., Reid, S., & Ma, E. (2023). Working with service robots? A systematic literature review of hospitality employees’ perspectives. *International Journal of Hospitality Management*, 113, 103523. <https://doi.org/10.1016/j.ijhm.2023.103523>



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# REVIVAL OF THE HOTEL INDUSTRY: THE IMPACT OF FOOD WASTE REDUCTION ON SERBIA'S ECONOMIC PROSPECTS

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## ABSTRACT

Food waste represents a global issue with serious economic, environmental, and social implications. This study investigates the impact of food waste on the economic stability of hotels and restaurants in the Republic of Serbia using a structural modeling approach. The survey included 136 managers across 30 hotels in various cities and mountainous regions of the Republic of Serbia. Results indicate a high awareness of the food waste issue and identify key factors affecting the economic stability of these enterprises. Although no significant link was found between biodiversity, climate, and environment, as well as economy with economic stability, a positive relationship between social environment and economic stability was discovered. This research model provides a deeper understanding of the factors shaping food waste management practices in hotels and restaurants, thereby offering guidelines for enhancing the economic stability of these sectors.

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## Introduction

Food waste is defined as using food intended for human consumption for non-edible purposes, diverting it for animal feed, or discarding edible food (FAO, 2019). Hospitality, as a large sector of the hospitality industry, contributes significantly to the global economy by providing lodging and dining services to travelers all over the world. However, this sector is confronted with a significant challenge: food waste, which has serious ecological, social, and economic consequences. Food services in hotels represent

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an organizational unit whose primary function is to provide food and beverages to the guests (Collison & Colwill, 1987; Al-Maliky & EIKhayat, 2012; Hersey & Blanchard, 2013; Ai & Zheng, 2019). Hotels generate 49% of their revenue from accommodation, 42% from food services, and 9% from other services (Kasavan et al., 2017; Aamir et al., 2018; Eriksson et al., 2018; Kim et al., 2019). Hotels, particularly large chains, serve thousands of meals daily via restaurants, banquets, and room service, with a significant portion of food going to waste. This includes kitchen scraps, banquet leftovers, and uneaten buffet food (Suthar & Singh, 2015; Chen & Jai, 2018; Abeliotis et al., 2015; McAdams et al., 2019). Food waste in the hospitality industry not only contributes to environmental degradation by producing methane in landfills, but it also wastes resources used in production, transportation, and preparation (Suthar & Singh, 2015; Chen & Jai, 2018; Abeliotis et al., 2015). Furthermore, it causes a significant economic loss for hotels due to the costs of procurement, preparation, and food storage. Reducing food waste can result in cost savings and increased profits.

The issue of food waste within the hospitality sector, which accounts for about 12% of all food waste, is a notable concern but has not been sufficiently explored in scientific studies. Despite its critical nature, there's a lack of comprehensive research in this area. Tackling food waste not only addresses environmental concerns but also has a profound impact on the global economy. The agriculture, food production, and distribution sectors are vital to the economic health of numerous nations. A deeper understanding of food science and technology can lead to more efficient agricultural practices, improved food production methods, and better international food trade. Progress in this field is essential for economic advancement, job creation, and the enhancement of food safety standards (Chakona & Shackleton, 2017; Berkowitz et al., 2016; Gajić et al., 2023; Bugarčić et al., 2023; Nica et al., 2023).

This study sought to assess the impact of food waste on the economic stability of the hotel industry. It used factor analysis to identify critical elements involved in this interplay. Structural modeling was then used to investigate how these identified food waste elements (climate and environmental factors, economic aspects, biodiversity, and the social environment) influence economic stability. The study also aimed to deepen our understanding of how food waste impacts operational expenses, profit margins, and sustainability in the hospitality sector. This study, which makes significant contributions to the fields of sustainability and economics, delves into a relatively unknown area by investigating the effects of food waste on the economic balance in hotels. It provides important strategies for hotel managers and policymakers to maximize food resource utilization. The findings reveal a multifaceted link between food waste and economic stability in the hospitality industry, highlighting the study's innovative approach to a previously unexplored topic.

### **Literature review**

The issue of food waste is becoming increasingly important on a global scale, garnering attention from both political and social sectors. This problem goes beyond simply

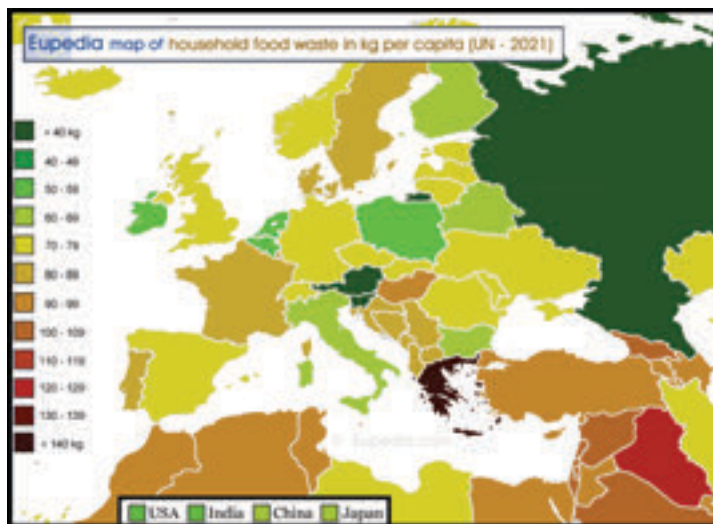
squandering edible items, it involves the loss of a variety of resources such as water, land, financial investment, and energy (Thanh et al., 2010; Oberlin, 2013; Thyberg & Tonjes, 2016; Halloran et al., 2014). These losses have profound effects on both the environment and the economies of nations. Recent scholarly research in this area has been extensive and varied, examining numerous facets of food waste. These studies cover a range of topics including waste in households, waste management in the hospitality industry, sustainability practices, methods for quantifying food waste, strategies for its reduction, waste across the entire food supply chain, solid waste management techniques, and historical analyses of programs like national school lunch initiatives (FAO, 2020; Petrović et al., 2023; Camilleri-Fenech et al., 2020; Juvan et al., 2018). The Food and Agriculture Organization (FAO, 2019) has presented startling figures, estimating that about a third of the food produced globally is either wasted or unnecessarily thrown away. Food waste can be categorized into two main types: 'food loss,' which includes any uneaten edible items from unharvested crops to unconsumed food in homes and stores, and 'food waste,' which pertains to food that spoils during transportation or fails to reach retail destinations (Nicholes et al., 2019; Mekoth & Thomson, 2018; Nahman et al., 2012; Hennchen, 2019).

The food waste scenario in the United States, especially in restaurants, is a significant issue, with estimates suggesting that these establishments generate between 22 and 33 billion pounds of food waste annually (Strotmann et al., 2017; Corrado & Sala, 2018; Petrović et al., 2023; Bugarčić et al., 2023; Dusmanescu et al., 2016). Additionally, other sectors like schools, hotels, and hospitals contribute an extra 7 to 11 billion pounds of waste each year. A notable observation is that restaurants end up not serving 4 to 10 percent of the food they purchase (Collison & Colwill, 1987; Thanh et al., 2010; Hersey & Blanchard, 2013; Chakona & Shackleton, 2017). This could be attributed to various factors such as oversized meal portions, inefficiencies in the supply chain, and the diversity of menu offerings leading to increased waste. Research from Cornell University indicates that customers typically leave about 17 percent of their meals uneaten in restaurants, and alarmingly, 55 percent of these edible leftovers end up being discarded (Suthar & Singh, 2015; Nahman et al., 2012; Al-Maliky & ElKhayat, 2012; Tajfel & Turner, 2004). Factors within the kitchen, including over-preparation of food, poor storage practices, and the non-utilization of leftover food, further exacerbate the problem of food loss ().

Buffet-style restaurants are particularly vulnerable to high levels of waste, mainly because health regulations often prevent them from repurposing or donating excess food. In developing countries, the majority of food loss occurs during the post-harvest and processing stages, which accounts for about 44% of the global food waste (Berkowitz et al., 2016; Aamir et al., 2018; Eriksson et al., 2018; Abeliotis et al., 2015; Gajić et al., 2023b). This is frequently due to inadequate practices, technological constraints, financial limitations, and a lack of efficient infrastructure for proper transportation and storage. In stark contrast, developed countries, which are responsible for 56% of global food waste, see about 40% of this waste occurring at the consumer level (Chen & Jai,

2018; Kim et al., 2019; Halloran et al., 2014; Thyberg & Tonjes, 2016). This is largely driven by consumer behaviors, values, and attitudes towards food. Additionally, a significant portion of food waste in these regions results from misunderstandings about expiration labels on products and the improper handling of prepared foods (Kasavan et al., 2017; Oberlin, 2013; McAdams et al., 2019; Nicholes et al., 2019). A study from 2018 highlighted that in the European Union, 10% of the 88 million tons of food thrown away annually is actually waste (Chen & Jai, 2018; Kim et al., 2019; Halloran et al., 2014).

**Figure 1.** Map of household food waste (2021) This map is based on the data from UNEP Food Waste Index Report



The Zero Waste concept is an innovative approach and strategy that encourages people to modify their lifestyles and daily habits in order to reduce waste production. This concept establishes visionary goals and proposes solutions to reduce waste generation in modern society (Kasavan et al., 2017; Oberlin, 2013; McAdams et al., 2019; Nicholes et al., 2019). With the problem of massive waste production that society struggles to manage, ethical concerns arise, particularly in terms of environmental protection (Mekoth & Thomson, 2018; Corrado & Sala, 2018; FAO, 2020; Hennchen, 2019). According to estimates, Serbia discards approximately 247,000 tons of edible food each year, which equates to 30-40 kg per person (Juvan et al., 2018; Ai & Zheng, 2019; Camilleri-Fenech et al., 2020; Petrović et al., 2023; Vukolić et al., 2022; Sima & Gheorghe, 2014)). The household, hospitality, and retail sectors have been identified as major food waste generators. It is estimated that the domestic hospitality sector produces around 40,000 tons of food waste per year, of which up to 99% ends up in landfills, emitting greenhouse gases equivalent to approximately 28,000 tons of CO<sub>2</sub> (Gajić et al., 2022; Bugarčić et al., 2023; Strotmann et al., 2017; Petrović et al., 2023).

Hotels and restaurants are obligated to generate large amounts of food waste. After food consumption, waste can occur as a result of oversized portions, inefficient service methods, and menu diversity, which influences consumer decisions (Tajfel & Turner, 2004; Suthar & Singh, 2015; Nahman et al., 2012; Thyberg & Tonjes, 2016). The types of waste produced in hotels and restaurants vary according to the food materials used. Examples include eggshells, potato and fruit peels, bones, food scraps, and packaging materials (Thanh et al., 2010; Oberlin, 2013; Halloran et al., 2014; Berkowitz et al., 2016). Typically, the priority order goes from prevention to reuse, recycling, and finally disposal (Chakona & Shackleton, 2017; Collison & Colwill, 1987; Kasavan et al., 2017; Eriksson et al., 2018). Others would prefer to optimize prevention if it fails. This means redirecting waste for human and animal consumption (Aamir et al., 2018; Chen & Jai, 2018; Kim et al., 2019; McAdams et al., 2019). Alternatively, waste can be composted or used for renewable energy production (Tajfel & Turner, 2004; Suthar & Singh, 2015; Nahman et al., 2012). Hotel waste management practices include prevention and reduction, recycling, donation, composting, monitoring, improving ingredient procurement and storage, smart food sales, menu design, staff training, customer engagement, portion control, and service model changes (FAO, 2020; Juvan et al., 2018; Camilleri-Fenech et al., 2020; Gajić et al., 2023).

Many authors emphasize the critical interplay between climate, environment, economy, social factors, and biodiversity within the food system, all of which have a substantial impact on economic stability (Petrović et al., 2023; Strotmann et al., 2017; Bugarčić et al., 2023; Hennchen, 2019). Favorable climate and environmental conditions, coupled with a well-performing economy, can lead to increased agricultural productivity, lower food shortages, and price fluctuations, ultimately promoting economic stability (Corrado & Sala, 2018; Mekoth & Thomson, 2018; Abeliotis et al., 2015; Al-Maliky & ElKhayat, 2012). Additionally, social inclusivity and a supportive environment, along with biodiversity, contribute to addressing food waste and enhancing resource efficiency, benefiting both social and economic stability (Hersey & Blanchard, 2013; Ai & Zheng, 2019; Nicholes et al., 2019; Petrović et al., 2023). Understanding these intricate relationships is crucial for addressing challenges related to sustainability, food waste, and economic resilience in this ever-changing world (Tajfel & Turner, 2004; Thanh et al., 2010; Suthar & Singh, 2015; Chen & Jai, 2018).

The assumption is that biodiversity plays a key role in reducing food waste and enhancing economic stability (Al-Maliky & ElKhayat, 2012; Kasavan et al., 2017; Eriksson et al., 2018; Kim et al., 2019; Vukolić et al., 2023). Biodiversity encompasses the variety of life on Earth, including different species, ecosystems, and genetic resources (Berkowitz et al., 2016; Aamir et al., 2018; McAdams et al., 2019; Abeliotis et al., 2015). This assumption suggests that regions with rich biodiversity are behind this hypothesis lies in the connection between biodiversity and ecosystem services that more likely to address food waste challenges and achieve economic stability. The rationale b directly impact agriculture and various economic sectors. A diversified and balanced ecosystem can provide essential services such as pollination, natural water purification, and pest



control, which are of vital importance for sustainable agriculture and, consequently, economic stability (Hersey & Blanchard, 2013; Chakona & Shackleton, 2017; Nahman et al., 2012; Halloran et al., 2014).

*H1: Biodiversity has a significant positive impact on Economic Stability.*

Climate and the environment encompass factors such as weather patterns, natural resources, and environmental quality (Thyberg & Tonjes, 2016; Oberlin, 2013; Mekoth & Thomson, 2018; Corrado & Sala, 2018). It is believed that regions with favorable climates, abundant natural resources, and well-maintained environments are more likely to impact food waste and economic stability positively (FAO, 2020; Hennchen, 2019; Nicholes et al., 2019; Ai & Zheng, 2019; Wang et al., 2018). Such regions often have advantages in agriculture, energy production, and overall productivity. For instance, consistent and favorable weather conditions can lead to higher agricultural yields, reducing the economy's vulnerability to food shortages and price fluctuations (Collison & Colwill, 1987; Al-Maliky & ElKhayat, 2012; Hersey & Blanchard, 2013). Additionally, the presence of a clean and well-preserved environment can enhance the quality of life, attract investments, and stimulate economic growth (Suthar & Singh, 2015; Chen & Jai, 2018; Abeliotis et al., 2015; McAdams et al., 2019; Sima & Gheorghe, 2017). Therefore, this hypothesis establishes a positive relationship between climate, the environment, and economic stability.

*H2: Climate and environment have a significant positive impact on Economic Stability.*

Economic stability is closely linked to the issue of food waste (Nicholes et al., 2019; Mekoth & Thomson, 2018; Nahman et al., 2012; Hennchen, 2019). A stable economy can support initiatives aimed at reducing food waste by providing resources and incentives for businesses and individuals to adopt sustainable practices (Berkowitz et al., 2016; Aamir et al., 2018; Eriksson et al., 2018; Abeliotis et al., 2015). Moreover, the reduction of food waste can contribute to economic stability by optimizing resource use, reducing costs, and enhancing the overall economic well-being of communities (Tajfel & Turner, 2004; Suthar & Singh, 2015; Nahman et al., 2012; Thyberg & Tonjes, 2016). As a result, this hypothesis suggests a positive relationship between the overall state of the economy and economic stability.

*H3: The economy has a significant positive impact on Economic Stability.*

A socially inclusive and supportive environment can also play a key role in addressing food waste issues (Corrado & Sala, 2018; Mekoth & Thomson, 2018; Abeliotis et al., 2015; Al-Maliky & ElKhayat, 2012). When communities have access to quality education and healthcare, there is not only a higher probability of having a qualified and healthy workforce but also greater awareness of the importance of sustainable practices, including reducing food waste (Hersey & Blanchard, 2013; Chakona & Shackleton, 2017; Nahman et al., 2012; Halloran et al., 2014). Furthermore, reducing food waste can have a positive impact on social and economic stability. Less food waste implies more efficient resource utilization, which can lead to cost savings for individuals

and businesses (Thyberg & Tonjes, 2016; Oberlin, 2013; Mekoth & Thomson, 2018; Corrado & Sala, 2018). These savings can contribute to overall economic well-being improvement, especially for vulnerable communities (Collison & Colwill, 1987; Thanh et al., 2010; Hersey & Blanchard, 2013; Chakona & Shackleton, 2017). Thus, this hypothesis suggests a positive association between the social environment and economic stability.

H4: *The social environment has a significant positive impact on Economic Stability.*

## Methodology

### *Objective of the Study*

The aim of the study was to investigate the different perceptions of hotel management in the Republic of Serbia, with a special focus on determining opinions about the impact of food waste on Economic Stability.

### *Sample*

The study used a purposeful sample of 136 managers from 30 hotels. These hotels are located in four major cities: Belgrade, Novi Sad, Subotica, and Sombor, as well as two mountain hotels in Kopaonik and Zlatibor. This diverse sample was chosen to ensure representation from various geographic locations and hotel types, allowing for a comprehensive understanding of Serbia's hotel industry.

### *Questionnaire Design and Data Collection*

The data collection process used a structured questionnaire that was carefully designed to assess and capture multiple aspects of hotel management. Given that we did not find a structured questionnaire through the literature review on the given issue, because the authors only dealt with the literature review and suggestions for reducing food waste, we decided to construct the questionnaire ourselves according to previous review manuscripts. The focus was on food waste management, economics, and environmental sustainability. The survey was conducted in the field, face to face with the participating managers. This method enabled real-time interactions, further clarification of queries, and a faster response rate. Throughout the study, ethical guidelines were strictly followed. Participants were given clear explanations of the study's objectives, and they provided informed consent. Respondents' privacy was protected through strict confidentiality and anonymity.

### *Construction of the Questionnaire*

The questionnaire included 15 questions that used a 5-level Likert scale to assess respondents' attitudes, perceptions, and practices. The scale went from "Strongly disagree" (1) to "Strongly agree" (5). The questionnaire contained a comprehensive series of statements, each of which addressed specific aspects of food waste and its impact on the hotel industry, including economic efficiency, environmental and social sustainability.

### *Data analysis*

The responses to each of the 15 questionnaire items were summarized using descriptive statistics such as mean and standard deviation. These statistics provided an overview of the central tendencies and variability in participants' perceptions. In this study, the Cronbach's alpha value of 0.837 for the set of items indicates a high level of internal consistency and reliability in the responses, implying that the items together form a coherent measure of attitudes and perceptions about food waste. Factor analysis was used to investigate the latent variables or constructs present in the questionnaire data (Kasavan et al., 2017; Aamir et al., 2018; Eriksson et al., 2018; Kim et al., 2019). This analysis aimed to uncover patterns and relationships between survey items, allowing for a deeper understanding of the key factors influencing hotel management practices.

The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity are two important statistics used in the context of factor analysis to assess the suitability of data for this statistical method (Williams et al., 2010). The KMO value is 0.850, which is very good since KMO values range between 0 and 1, with values closer to 1 indicating that correlation patterns between variables are relatively compact, and therefore factor analysis should yield distinct and reliable factors (Williams et al., 2010; García-Santillán et al., 2013). A KMO value of 0.850 suggests that the data is suitable for factor analysis. This test examines the hypothesis that your correlation matrix is the identity matrix, indicating that your variables are uncorrelated and unsuitable for factor analysis. In your case, Bartlett's test has an approximate chi-square value of 702.739, with 105 degrees of freedom and a significance level (Sig.) of 0.000. This highly significant result ( $p$ -value  $< 0.05$ ) rejects the null hypothesis, indicating that the variables are correlated, and the data is suitable for factor analysis.

Advanced statistical techniques, such as regression modeling or Structural Equation Modeling (SEM) in SmartPLS, were applied to examine relationships between variables and test hypotheses, providing valuable insights into the complex interactions of factors within the hotel industry. Various assessment parameters were considered, including Cronbach's alpha, composite reliability, Average Variance Extracted (AVE), Fornell-Larcker criterion, and Standardized Root Mean Square Residual (SRMR). These parameters ensured the reliability and validity of the data and analysis results. The predictive power of the model ( $R^2$ ) for economic stability is 0.496, suggesting that nearly 50% of the variance in economic stability can be explained by the independent variables (biodiversity, climate and environment, economy, social environment). Other reliability values will be presented in the results chapter tables.

### **Results and discussion**

In this chapter, we will analyze and interpret the findings from the study on hotel management in Serbia. The chapter is organized to provide information about three key aspects of analysis: first, the results of descriptive analysis, second, the results of factor analysis, and finally, the results of structural modeling. Table 1 shows the

means and standard deviations for each individual item, as well as the Cronbach's alpha coefficients.

**Table 1.** Descriptive values of items and reliability values

Items	M	sd	$\alpha$
Food waste contributes to a significant increase in greenhouse gas emissions	3.54	0.804	0.801
Food waste has a serious impact on air quality due to the decomposition process and methane generation	4.58	0.822	0.811
Reducing food waste could significantly reduce water consumption in agriculture	3.62	0.690	0.823
Food waste results in significant economic losses due to unused resources in food production.”	3.35	0.594	0.865
Reducing food waste can contribute to lower operating costs for businesses in the food industry	4.27	0.829	0.838
More efficient household food management can contribute to saving money and reducing living costs	4.15	0.673	0.861
Food waste contributes to the reduction of biodiversity due to the excessive use of land for agriculture	4.66	0.877	0.961
Reducing food waste can have a positive impact on the conservation of natural habitats and wildlife	4.22	0.504	0.822
Increasing efficiency in food production and distribution can reduce pressure on biodiversity	3.09	0.082	0.827
Food waste contributes to social injustice because while some people waste food, others struggle with hunger	4.01	0.747	0.847
Reducing food waste can improve economic efficiency and reduce the cost of living for consumers	3.51	0.736	0.813
Greater awareness and education about reducing food waste can have a positive impact on social responsibility and sustainability	3.34	0.735	0.844
Large amounts of food waste in the hotel industry directly affect the profitability and economic efficiency of hotels	3.34	0.661	0.873
Food waste in hotels adds to operational costs and can negatively impact guest service prices	3.20	0.663	0.887
Effective management of food waste in the hotel industry can significantly contribute to the sustainability and long-term economic stability of the sector	3.05	0.874	0.814

\*M-arithmetic mean; sd – standard deviation,  $\alpha$  – Cronbach alpha

Source: Authors.

Items with higher mean scores (above 4.0) typically discuss the serious impact of food waste on air quality, its contribution to social injustice, and the benefits of reducing food waste in terms of conservation, economic efficiency, and operational costs in the food industry. These high scores indicate a strong agreement or concern among respondents about these specific aspects of food waste. Items with lower mean scores (close to or below 3.5) are likely to address with indirect consequences of food waste, such as its impact on economic stability in specific sectors such as hotels or the broader implications for biodiversity and food production efficiency. The relatively narrow range of standard deviations (mostly between 0.5 and 0.9) across all items suggests

that respondents' opinions are generally consistent, indicating that while there are differences in the level of concern or agreement for each statement, these differences are not extremely wide. Cronbach's alpha values, mostly above 0.8 for each item, suggest a high level of reliability in the responses, indicating that the items together constitute a consistent measure of attitudes towards food waste and its impacts.

Exploratory factor analysis with Promax rotation revealed a total of five factors, which are shown in Table 2.

**Table 2.** Results of EFA (Exploratory Factor Analysis).

Total Variance Explained							
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings <sup>a</sup>
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
Climate and Environment	4.861	32.409	32.409	4.861	32.409	32.409	3.709
Economy	1.800	11.998	44.407	1.800	11.998	44.407	2.745
Biodiversity	1.084	7.228	51.636	1.084	7.228	51.636	2.902
Social Environment	1.019	6.792	58.428	1.019	6.792	58.428	1.766
Economic Stability	1.848	5.653	64.081	.848	5.653	64.081	2.325

*Source:* Authors.

In the analysis of Principal Component Analysis (PCA) results, it is evident that the data represent a different structure concerning explained variance. Initially, the eigenvalues from PCA indicate a clear hierarchy in the importance of components, with the first component standing out as the most significant, explaining over 32% of the variance in the dataset. The data reveal that the first three components together explain just over half of the total variance (51.636%). This cumulative contribution highlights the interplay and combined significance of these top components in understanding the essence of the dataset. After rotation, the contribution of the first component slightly decreases, while the role of the third becomes more pronounced. The cumulative percentage of variance explained by the components, especially noticeable when considering the first five or six components, is significant. These components together account for approximately 64% to 69% of the total variance.

Table 3 gives an insight into the reliability and validity values of all study factors. After examining the metrics of reliability and validity, it is found that the constructs differ in their internal consistency but generally show adequate reliability.

**Table 3.** Construct Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Biodiversity	0.787	0.704	0.736	0.785
Climate and Environment	0.709	0.727	0.835	0.728
Economic Stability	0.762	0.892	0.814	0.896
Economy	0.822	0.779	0.834	0.730
Social Environment	0.746	0.871	0.765	0.821

Source: Authors.

Cronbach's alpha for the constructs ranges from 0.787 (Biodiversity) to 0.822 (Economy), with Social Environment (0.746), Climate and Environment (0.709) and Economic Stability (0.762) also showing strong values. While the alpha values for biodiversity and the social environment are slightly below the generally accepted threshold, they still suggest a moderate level of internal consistency, which can be considered acceptable in research contexts.

The values of rho\_A closely mirror the Cronbach's Alpha results, enhancing the internal consistency of the constructs. The composite reliability for all constructs exceeds the acceptable threshold of 0.7, emphasizing the overall reliability of the measurement model.

Regarding construct validity, all values of the extracted average variance (AVE) surpass the reference value of 0.5, indicating that most constructs explain more than half of the variance in their indicators. Specifically, the Economy factor shows the highest AVE at 0.730, followed by Climate and Environment with 0.728, suggesting strong convergent validity for these constructs.

The construct with the most significant impact on Economic Stability is the Social Environment, which not only exhibits a strong and statistically significant path coefficient but also demonstrates satisfactory measures of reliability and validity. Although Biodiversity, Climate and Environment, and the Economy show positive relationships with Economic Stability, they are not statistically significant, implying that their direct impact may be limited within the scope of this study.

In the analysis of structural equation modeling using SmartPLS, the assessment of discriminant validity using the Fornell-Larcker Criterion was presented as part of the research on the determinants of economic stability (Table 4).

**Table 4.** Discriminant Validity: Fornell-Larcker Criterion

	Biodiversity	Climate and Environment	Economic Stability	Economy	Social Environment
Biodiversity	0.796				
Climate and Environment	0.723	0.793			

	Biodiversity	Climate and Environment	Economic Stability	Economy	Social Environment
Economic Stability	0.714	0.819	0.772		
Economy	0.780	0.764	0.745	0.794	
Social Environment	0.789	0.806	0.812	0.812	0.722

Source: Authors.

Using the Fornell-Larcker criterion, discriminant validity within the model has been confirmed. The square roots of the average variance extracted (AVE) for each construct (Biodiversity, Climate and Environment, Economic Stability, Economy, Social Environment) were compared to the correlations between the constructs. The values on the diagonal, representing the square root of AVE, were greater than the values off the diagonal in the corresponding rows and columns. This indicates that each construct has more variance with its indicators than with other constructs, satisfying the conditions of discriminant validity.

Composite reliability for each construct was found to be above the generally accepted threshold of 0.7, indicating a reliable measure. The t-statistics associated with these reliabilities were significantly large (all exceeded the value of 22), and the p-values were at the 0.000 level, indicating that the construct reliabilities were statistically significant (Table 5).

**Table 5.** Composite Reliability

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ( O/STDEV )	P Values
Biodiversity	0.735	0.730	0.033	22.256	0.000
Climate and Environment	0.835	0.831	0.025	33.888	0.000
Economic Stability	0.816	0.814	0.026	31.209	0.000
Economy	0.833	0.826	0.033	25.593	0.000
Social Environment	0.766	0.763	0.031	24.851	0.000

Source: Authors.

Confidence intervals for composite reliability estimates, both standard and bias-corrected, did not include the critical lower threshold of 0.7, further confirming the reliability of our constructs. The small bias observed in the bias-corrected intervals did not significantly change our confidence in these estimates (Tables 6 and 7).

**Table 6.** Confidence Intervals and Confidence Intervals Bias Corrected

	Confidence Intervals				Confidence Intervals Bias Corrected			
	Original Sample (O)	Sample Mean (M)	2.5%	97.5%	Original Sample (O)	Sample Mean (M)	2.5%	97.5%
Biodiversity	0.735	0.730	0.658	0.790	0.735	0.730	-0.005	0.667
Climate and Environment	0.835	0.831	0.777	0.874	0.835	0.831	-0.004	0.783
Economic Stability	0.816	0.814	0.759	0.861	0.816	0.814	-0.002	0.761
Economy	0.833	0.826	0.748	0.873	0.833	0.826	-0.007	0.763

Source: Authors.

Model fit was assessed using multiple indices, indicating acceptable fit. The results presented in Table 7 detail the fit of two different models within structural equation models: the Saturated Model and the Estimated Model. It is interesting to note that both models show identical values across all the evaluated measures, which indicates a consistent level of adaptation of the model in relation to the considered parameters. Specifically, the SRMR (Standardized Root Mean Square Residual) values are extremely low, exactly 0.001 for both models, implying an excellent fit. This measure, which evaluates the average difference between observed and predicted correlations, in this case indicates an almost perfect correlation, given that values below 0.08 generally signal a good fit. Likewise,  $d_{ULS}$  (Unweighted Least Squares discrepancy) values are equal for both models and amount to 0.032. These values, which are well below any conventional thresholds, suggest that the discrepancy between observed and model-predicted covariances is minimal, further indicating the effectiveness of both models. Additionally,  $d_G$  (Geodesic discrepancy) shows values of 0.073 for both models, providing further evidence of good model fit. This result, which relies on the geodesic discrepancy as a measure of fit, confirms that both models adequately reflect the structure of the data. Chi-Square values of 2.537, equal for both models, further support this interpretation. In the context of the Chi-Square test, lower values are preferred, and the results obtained are in line with expectations for high-quality models. Finally, the NFI (Normed Fit Index) values of 0.915, identical for both models, exceed the conventional threshold of 0.90, which categorizes them as models with good fit. This indicates that both models fit the structure of the data effectively compared to the null model which assumes no correlations between the variables.

**Table 7.** Fit Summary

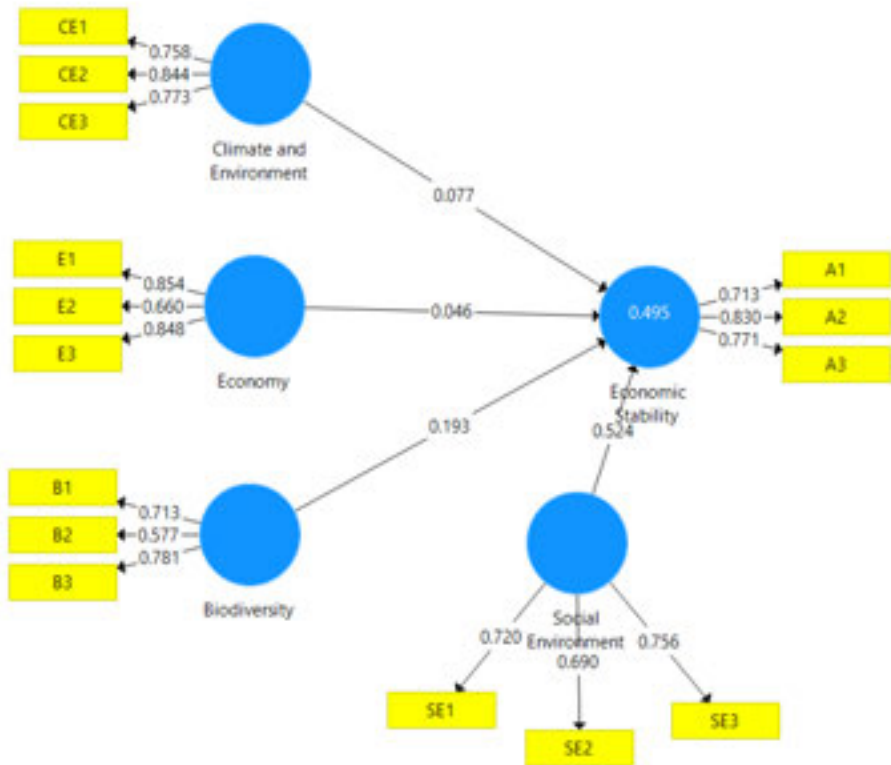
Indicators of model fit	Saturated Model	Estimated Model
SRMR	0.001	0.001
$d_{ULS}$	0.032	0.032
$d_G$	0.073	0.073
Chi-Square	2.537	2.537
NFI	0.915	0.915

Source: Authors.



Model shows good discriminant validity and reliability in all constructs, with the measurement model providing a strong foundation for assessing various factors influencing economic stability. While fit indices indicate satisfactory model fit, they also suggest that future research can explore potential improvements to enhance the model. Figure 2 and Table 8 show the path coefficient model of results from the SmartPLS analysis, focusing on the impact of various factors on Economic Stability.

**Figure 2.** Graphic representation of the structural modeling equation with the average load.



**Table 8.** Path coefficients

	Estimate	Sample mean	sd	t Statistics ( O/STDEV )	p
Biodiversity ->Economic Stability	0.193	0.191	0.110	1.766	0.077
Climate and Environment -> Economic Stability	0.077	0.084	0.075	1.026	0.305
Economy -> Economic Stability	0.046	0.054	0.067	0.695	0.487
Social Environment -> Economic Stability	0.524	0.526	0.091	5.732	0.000

\*Note: sd-standard deviation; p –statistical significance

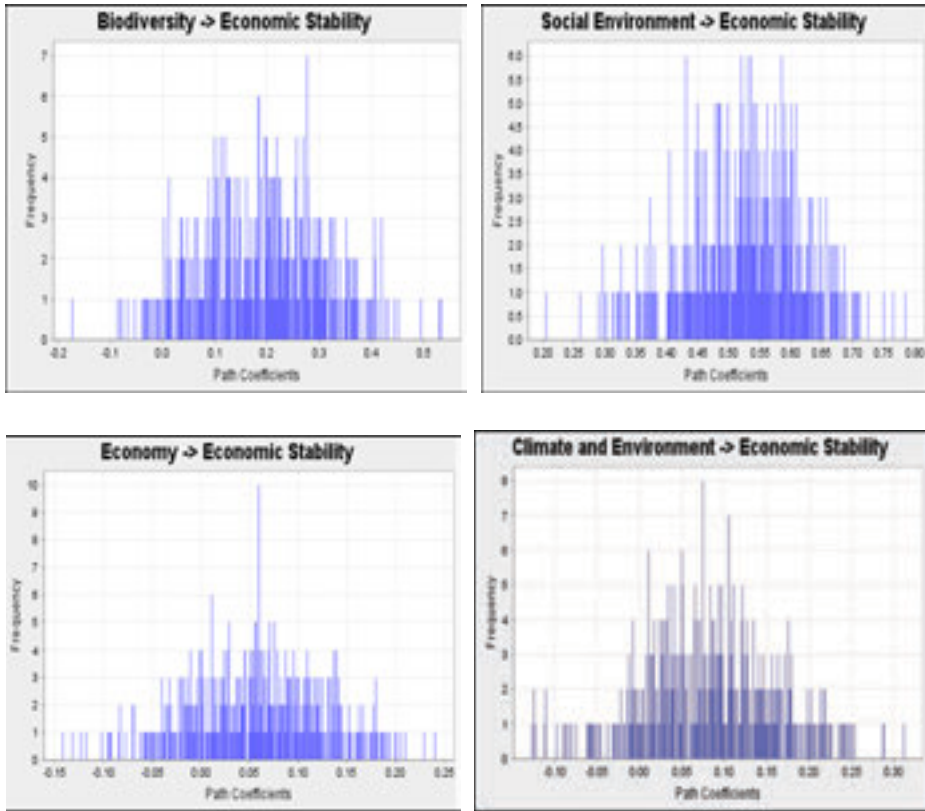
Source: Authors.

It has been determined that the path coefficient from biodiversity to economic stability is 0.193, indicating a positive relationship between these two constructs. Although this suggests that greater biodiversity may contribute to improved economic stability, the relationship is not strong, and with a p-value of 0.077, it fails to reach conventional levels of statistical significance ( $p < 0.05$ ). This implies that while there may be a positive trend, the evidence is not strong enough to confirm a definitive impact of biodiversity on economic stability within this study. Similarly, the impact of climate and the environment on economic stability yielded a path coefficient of 0.077. This result also points in a positive direction, but the relationship is even weaker than that of biodiversity and is not statistically significant ( $p = 0.305$ ). This finding suggests that any direct influence of climate and environmental factors on economic stability is minimal and not strongly supported by the data at hand.

The direct impact of the economy on economic stability was surprisingly weak, with a path coefficient of 0.046 and a p-value of 0.487. This suggests that there is no significant direct relationship between the general economic factors measured in this study and the construct of economic stability as defined by our model. Contrary to these findings, the social environment showed a strong and statistically significant influence on economic stability, with a path coefficient of 0.524 and a p-value of 0.000. This result is robust and implies a significant positive impact of social factors in the environment on economic stability. Such a strong connection underscores the importance of social structures and systems in supporting economic stability.

The histograms provided represent the initial distribution of path coefficient estimates for the relationships between biodiversity, social environment, economy, climate and environment, and economic stability within the Structural Equation Model. Each histogram visualizes the frequency distribution of initial path coefficient estimates obtained from the PLS analysis.

**Figure 3-6.** Histograms of the starting distribution



Source: Authors.

For the relationship between Biodiversity and Economic Stability, the distribution for bootstrapping is centered slightly above zero, predominantly between 0.1 and 0.3. This implies a general trend towards a positive impact of biodiversity on Economic Stability. However, the spread of the distribution towards negative values suggests some variability in the samples that were generated, indicating that the positive relationship is present but not highly consistent across all estimates.

In contrast, the Social Environment shows a pronounced positive effect on Economic Stability, with a distribution that leans towards higher values, mainly in the range of 0.4 to 0.8. This strong positive relationship indicates a robust and consistent impact of Social Environmental factors on Economic Stability, as consistently high initial estimates support statistical significance and potential substantive relevance of this path.

The distribution of path coefficients for the impact of the Economy on Economic Stability is tightly clustered around zero, with most values lying in the positive spectrum but close to zero. The narrowness of the distribution suggests a positive but weak relationship. The presence of some values in the negative range suggests that

the impact of the economy on economic stability, while generally positive, is not as strongly supported or as strong as the impact of the social environment.

The relationship between Climate and the Environment and Economic Stability is also predominantly positive, with initial estimates concentrated between 0 and 0.3. Despite the overall positive trend, the spread of values towards zero and into the negative range implies a degree of uncertainty, suggesting that while there is a positive connection, the relationship may not be strong or consistent across different samples.

Current findings offer valuable insights, with the construct of the Social Environment, in particular, demonstrating a significant and strong impact on Economic Stability. Statistical evaluations support the essential conclusions drawn from the analysis and underscore the importance of social factors in the context of Economic Stability. These results should inform both academic discourse on this topic and policy considerations aimed at strengthening economic resilience.

While hypotheses 1, 2, and 3 were not confirmed because their p-values exceeded the conventional significance level of 0.05, hypothesis 4 was strongly confirmed as its p-value was very low (0.00). These findings suggest that the Social Environment indeed has a significant positive impact on Economic Stability, while other factors (Biodiversity, Climate and the Environment, Economy) did not exhibit statistically significant relationships in this analysis.

### **Conclusion with limitations and future implications**

Food waste in Serbia represents a significant economic challenge. Not only does it lead to losses in the food production sector, but it also contributes to economic inefficiency. Particularly in the hotel industry, poor food waste management can have a negative impact on the profitability and long-term economic stability of hotels. Therefore, it is essential to adopt sustainable waste management practices to mitigate the adverse effects on the growth and development of the hospitality sector.

This study investigated these issues through a survey conducted among 136 managers at all levels working in various cities across the Republic of Serbia, including mountain hotels. The research was carried out in 2023. The aim was to gain a deeper understanding of the complex relationships between food waste and economic stability. We used factor analysis to extract latent variables or factors from the dataset, such as Biodiversity, Climate, Environment, and Economic and Social surroundings. In addition to factor analysis, advanced statistical techniques were used, including Structural Equation Modeling (SEM) using SmartPLS software. We analyzed path coefficients, means, standard deviations, t-values, p-values, Cronbach's Alpha, Composite Reliability, Average Variance Extracted (AVE), Fornell-Larcker Criterion, and Standardized Root Mean Residual (SRMR). These data helped us assess the reliability, validity, and significance of our structural model.

The results of the descriptive analysis showed that participants recognized the significant environmental consequences of food waste, giving high ratings to items related to the impact of food waste on air quality and biodiversity. Potential economic benefits of more efficient food management were also highlighted. However, items related to social issues, such as the impact of food on social injustice, received moderate ratings. This indicates the multifaceted nature of the food waste problem and the need for solutions that encompass both ecological and economic aspects.

In the statistical analysis conducted for this study, hypotheses formulated to examine the influence of various factors on economic stability were assessed. Hypothesis 1, which posited a relationship between Biodiversity and Economic Stability, did not receive statistical confirmation (estimate = 0.193,  $p = 0.077$ ). Similarly, Hypothesis 2 (Climate and Environment  $\rightarrow$  Economic Stability) was not supported, as the  $p$ -value was 0.077. Furthermore, Hypothesis 3 (Economy  $\rightarrow$  Economic Stability) was not confirmed in the analysis, as the estimate was 0.046 and did not reach statistical significance. However, in complete contrast, Hypothesis 4 (Social Environment  $\rightarrow$  Economic Stability) was strongly supported by the analysis, revealing a significant positive relationship between the Social Environment and Economic Stability (estimate = 0.524,  $p = 0.000$ ).

#### *Limitations*

The research was conducted in specific cities in Serbia and in several hotels in mountainous areas. This may limit the scope of sample representativeness since not all parts of the country were included. Although the results can be applied to these specific locations, it is necessary to be cautious about general conclusions that apply to the entire country. In Serbia, it is important to note that the structure of job positions in the hotel sector can vary from one hotel or location to another. Not all hotels have a standardized structure with managers at all levels. Instead, some positions may encompass not only managers but also department or sector heads. This can vary depending on the size and organizational structure of a specific hotel. Such diversity in the structure of job positions in the hotel sector can further impact the way different business functions are managed and their responsibilities. Therefore, when analyzing research and directing future activities, it is important to keep this diversity in mind and adapt the approach in line with the specific organizational model and business structures in different hotels in Serbia.

#### *Theoretical implications*

This study has significant theoretical implications across multiple aspects. Firstly, it complements the existing body of literature on the impact of food waste on the economy and the hospitality industry, providing fresh insights and knowledge into these intricate relationships. This contribution to the literature is pivotal for advancing the theoretical understanding of the issue.

Secondly, the research adopts a multidisciplinary approach by integrating elements of ecology, economics, and hospitality. This holistic approach contributes to the theoretical synthesis of diverse disciplines and enables a deeper comprehension of their interactions.

Thirdly, the findings of this research are not solely of theoretical relevance but can also be directly applied in practice. They offer guidelines for the development of strategies to reduce food waste in the hospitality sector and optimize economic stability within that industry, bridging the gap between theoretical knowledge and practical utility. Furthermore, this study underscores the importance of addressing food waste from an economic perspective, which can raise awareness and significance of this issue among decision-makers, businesses, and society at large.

Lastly, the research results provide a theoretical framework for future studies in this field. Identifying the factors influencing economic stability concerning food waste can inspire further research and investigations. In summary, the theoretical significance of this research lies in its ability to deepen the understanding of the complex relationships between food waste, economics, and the hospitality sector, offering new theoretical perspectives and practical implications.

#### *Practical implications with a proposal for corrective measures*

For the hospitality sector, the research findings underscore the importance of reducing food waste to improve economic stability. Hotels are advised to consider strategies for waste reduction, such as better inventory management, staff education, and collaboration with organizations involved in food redistribution. Reducing food waste can lower operational costs and enhance profitability. Preserving biodiversity and reducing environmental impact are crucial factors for long-term ecological sustainability. Hoteliers are encouraged to adopt environmentally friendly practices, including resource conservation, support for local ecosystems, and the reduction of greenhouse gas emissions. For economic decision-makers, the research indicates that reducing food waste can have a positive impact on economic stability. This can spur the development of policies and initiatives that support food waste reduction within a broader economic context. Raising awareness about the issue of food waste and its implications can have a significant influence. Hotels, consumers, and organizations are recommended to collaborate on education and information dissemination to promote responsibility and sustainable practices. The practical implications of this research emphasize the importance of reducing food waste as a key factor for economic stability, environmental sustainability, and social responsibility. A collective effort among different stakeholders is recommended to achieve positive outcomes in all of these areas.

In the context of researching the impact of food waste on economic stability, there are several key steps and activities that can be taken to reduce negative impacts and improve efficiency in the food sector. Conducting a food waste audit involves analyzing and tracking food waste from its source to the point of disposal. The primary focus during this process includes quantifying the amount of food being wasted and the number of people visiting restaurants. This way, management can identify the major sources of food waste. Monitoring is done through two methods - food logging that tracks the type of food being wasted, reasons for it, and the quantity, and traffic log that takes into account the restaurant's traffic, weather changes, and other relevant information

for future planning. Avoiding the habit of wasting ingredients before they are prepared is also crucial. This involves assessing food inventory to better understand how long it takes to use up stored food materials in the restaurant. This helps in reducing unnecessary ordering and the loss of perishable ingredients. Additionally, restaurant staff should receive waste management training through appropriate training, allowing them to develop effective strategies for managing these challenges. Creating a food waste management plan is also essential. Restaurants face the issue of leftover food when waiters serve portions that cannot be fully consumed by guests. This problem can be addressed by improving the accuracy of customer orders. Customers can also be encouraged to take leftover food home or donate it to others. Furthermore, forming food waste management teams is essential for effectively addressing these issues. Restaurant staff should work as a team while implementing food waste management strategies, with sensitivity to the problems of poor food waste management in restaurants. Team members should be educated about methods of monitoring, storing, and recycling food waste. New staff should always be familiar with the food waste management policy in the restaurant before integrating into the teams.

Ultimately, composting food waste represents a sustainable practice that hotels and restaurants can adopt to reduce negative impacts on the environment. This practice requires appropriate composting equipment and can contribute to reducing the amount of food waste ending up in landfills. All of these activities and strategies contribute to reducing food waste, which has a positive impact on the economic stability and sustainability of hotels and restaurants.

The conducted research provides valuable insights into the issue of food waste and its impact on economic stability, especially in the context of hotels and restaurants in Serbia. However, this research opens the door for further research and the improvement of food waste management strategies. Future research can focus on the implementation and evaluation of proposed food waste management strategies to better understand their effectiveness and applicability in different situations. Additionally, research can further analyze the factors influencing consumer decisions regarding food leftovers and ways to efficiently utilize them. Furthermore, future research can focus on monitoring the long-term effects of applied strategies on the economic stability of hotels and restaurants, as well as their environmental impact. This would allow for a deeper understanding of the long-term benefits of sustainable food waste management. Through further research, we could also explore best practices in other countries and apply them in the local context, taking into account the specificities of the food market and consumer needs in Serbia.

### **Conflict of interests**

The authors declare no conflict of interest.

## References

1. Aamir, M., Ahmad, H., Javaid, Q., & Hasan, S. M. (2018). Waste not, want not: a case study on food waste in restaurants of Lahore, Pakistan. *Journal of Food Products Marketing*, 24(5), 591-610. <https://doi.org/10.1080/10454446.2018.1472695>
2. Abeliotis, K., Lasaridi, K., Costarelli, V., & Chroni, C. (2015). The implications of food waste generation on climate change: The case of Greece. *Sustainable Production and Consumption*, 3, 8–14. <https://doi.org/10.1016/j.spc.2015.06.006>
3. Ai, N., & Zheng, J. (2019). Community-based food waste modeling and planning framework for urban regions. *Journal of Agricultural and Food Systems, Community Development*, 9(1), 39-58. <https://doi.org/10.5304/jafscd.2019.091.009>
4. Al-Maliky, S. J. B., & ElKhayat, Z. Q. (2012). Kitchen Food Waste Inventory for Residential Areas in Baghdad City. *Modern Applied Science*, 6(8), p45. <https://doi.org/10.5539/mas.v6n8p45>
5. Berkowitz, S., Marquart, L., Mykerezzi, E., Degeneffe, D., & Reicks, M. (2016). Reduced portion entrees in a worksite and restaurant setting: impact on food consumption and waste. *Public Health Nutrition*, 19(16), 3048-3054. <https://doi.org/10.1017/s1368980016001348>
6. Bugarčić, J., Cvijanović, D., Vukolić, D., Zrnić, M., & Gajić, T. (2023). Gastronomy as an effective tool for rural prosperity - Evidence from rural settlements in Republic of Serbia. *Economics of Agriculture*, 70(1), 169–183. <https://doi.org/10.59267/ekoPolj2301169B>
7. Camilleri-Fenech, M., Sola, J. O. i, Farreny, R., & Durany, X.G. (2020). A snapshot of solid waste generation in the hospitality industry. The case of a five-star hotel on the island of Malta. *Sustainable Production and Consumption*, 21, 104-119. <https://doi.org/10.1016/j.spc.2019.11.003>
8. Chakona, G., & Shackleton, C. M. (2017). Local setting influences the quantity of household food waste in mid-sized South African towns. *PLOS ONE*, 12(12), e0189407. <https://doi.org/10.1371/journal.pone.0189407>
9. Chen, H.S., & Jai, T.-M. (2018). Waste less, enjoy more: forming a messaging campaign and reducing food waste in restaurants. *Journal of Quality Assurance in Hospitality & Tourism*, 19(4), 495-520. <https://doi.org/10.1080/1528008x.2018.1483282>
10. Collison, R., & Colwill, J.S. (1987). Food waste in public houses and restaurants and customer attitudes. *International Journal of Hospitality Management*, 6(3), 163-167. [https://doi.org/10.1016/0278-4319\(87\)90050-8](https://doi.org/10.1016/0278-4319(87)90050-8)
11. Corrado, S., & Sala, S. (2018). Food waste accounting along global and European food supply chains: state of the art and outlook. *Waste Management*, 79, 120-131. <https://doi.org/10.1016/j.wasman.2018.07.032>



12. Dusmanescu, D., Andrei, J., Popescu, G. H., Nica, E., & Panait, M. (2016). Heuristic methodology for estimating the liquid biofuel potential of a region. *Energies*, 9(9), 703.
13. Eriksson, M., Persson Osowski, C., Bjorkman, J., Hansson, E., Malefors, C., Eriksson, E., & Ghosh, R. (2018). The tree structure d a general framework for food waste quantification in food services. *Resources, Conservation and Recycling*, 130, 140-151. <https://doi.org/10.1016/j.resconrec.2017.11.030>
14. FAO. (2020). *The State of Food Security and Nutrition in the World*. Food and Agriculture Organization of the United Nations. <https://doi.org/10.4060/ca9692en>
15. Gajić, T., Minasyan, L. A., Petrović, M. D., Bakhtin, V. A., Kaneeva, A. V., & Wiegel, N. L. (2023a). Travelers' (in)resilience to environmental risks emphasized in the media and their redirecting to medical destinations: Enhancing sustainability. *Sustainability*, 15(21), 15297. <https://doi.org/10.3390/su152115297>
16. Gajić, T., Rajčić, J. P., Blešić, I., Aleksić, M., Petrović, M. D., Radovanović, M. M., Vuković, D. B., Šikimić, V., Pivac, T., Kostić, M., et al. (2022). Factors that influence sustainable selection and reselection intentions regarding soluble/instant coffee—The case of Serbian consumers. *Sustainability*, 14(17), 10701. <https://doi.org/10.3390/su141710701>
17. Gajić, T., Vukolić, D., Zrnić, M., & Dávid, L. D. (2023b). The quality of hotel service as a factor of achieving loyalty among visitors. *Hotel and Tourism Management*, 11(1), 67-77. <https://doi.org/10.5937/menhottur2301067G>
18. García-Santillán, A., Venegas-Martinez, F., & Escalera, M. E. (2013). Attitude toward Statistic in College Students (An Empirical Study in Public University). *Journal of Statistical and Econometric Methods*, 2(1), 43-60.
19. Halloran, A., Clement, J., Kornum, N., Bucatariu, C., & Magid, J. (2014). Addressing food waste reduction in Denmark. *Food Policy*, 49, 294-301. <https://doi.org/10.1016/j.foodpol.2014.09.005>
20. Hennchen, B. (2019). Knowing the kitchen: applying practice theory to issues of food waste in the food service sector. *Journal of Cleaner Production*, 225, 675-683. <https://doi.org/10.1016/j.jclepro.2019.03.293>
21. Hersey, P., & Blanchard, K. (2013). The Hersey-Blanchard situational leadership theory. Retrieved from <http://www.leadership-central.com/situational-leadership-theory.html#axzz3Yjy8dmy3>
22. Juvan, E., Grün, B., & Dolnicar, S. (2018). Biting Off More Than They Can Chew: Food Waste at Hotel Breakfast Buffets. *Journal of Travel Research*, 57(2), 232–242. <https://doi.org/10.1177/0047287516688321>
23. Kasavan, S., Mohamed, A. F., & Halim, S. A. (2017). Sustainable food waste management in hotels: case study Langkawi Unesco Global Geopark. *Planning Malaysia*, 15. <https://doi.org/10.21837/pm.v15i4.317>

24. Kim, M.J., & Hall, C.M. (2019). Can climate change awareness predict pro-environmental practices in restaurants? Comparing high and low dining expenditure. *Sustainability*, 11(23), 6777. <https://doi.org/10.3390/su11236777>
25. Kim, M.J., Hall, C.M., & Kim, D.-K. (2019). Predicting environmentally friendly eating out behavior by value-attitude-behavior theory: does being vegetarian reduce food waste? *Journal of Sustainable Tourism*, 28(6), 797-815. <https://doi.org/10.1080/09669582.2019.1705461>
26. McAdams, B., von Massow, M., Gallant, M., & Hayhoe, M. A. (2019). A cross-industry evaluation of food waste in restaurants. *Journal of Foodservice Business Research*, 22(5), 449-466. <https://doi.org/10.1080/15378020.2019.1637220>
27. Mekoth, N., & Thomson, A. R. (2018). Food preferences and culture: The influence of nationality and religion among tourists visiting Goa. *Tourism Culture & Communication*, 18(3), 191-204. <https://doi.org/10.3727/109830418X15319363084472>
28. Nahman, A., de Lange, W., Oelofse, S., & Godfrey, L. (2012). The costs of household food waste in South Africa. *Waste Management*, 32(11), 2147–2153. <https://doi.org/10.1016/j.wasman.2012.04.012>
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. Nicholes, M. J., Quested, T. E., Reynolds, C., Gillick, S., & Parry, A. D. (2019). Surely you don't eat parsnip skins? Categorizing the edibility of food waste. *Resources, Conservation and Recycling*, 147, 179–188. <https://doi.org/10.1016/j.resconrec.2019.03.004>
31. Oberlin, A. S. (2013). Characterization of Household Waste in Kinondoni Municipality, Dar Es Salaam. *Academic Journal of Interdisciplinary Studies*. <https://doi.org/10.5901/ajis.2013.v2n13p35>
32. Petrović, M., Milovanović, I., Gajić, T., Kholina, V. N., Vujičić, M., Blešić, I., Đoković, F., Radovanović, M., Čurčić, N., Rahmat, A. F., Muzdybayeva, K., Kubesova, G., Koshkimbayeva, U., & Dávid, L. D. (2023). The degree of environmental risk and attractiveness as a criterion for visiting a tourist destination. *Sustainability*, 15, 14215. <https://doi.org/10.3390/su151914215>
33. Sima, V., & Gheorghe, I. G. (2014). Analyze of environmental performance in Romania based on environmental performance index. Annals of the „Constantin Brâncuși” University of Târgu Jiu. *Economy Series*, 3, 101-104.
34. Sima, V., & Gheorghe, I. G. (2017). A multicriterial analysis of national competitiveness: Evidences for a resilient economy. *Industrija*, 45(2), 45-64.
35. Strotmann, C., Gobel, C., Friedrich, S., Kreyenschmidt, J., Ritter, G., Teitscheid, P., (2017). A participatory approach to minimizing food waste in the food industry—a manual for managers. *Sustainability*, 9(1), 66. <https://doi.org/10.3390/su9010066>

36. Suthar, S., & Singh, P. (2015). Household solid waste generation and composition in different family size and socio-economic groups: A case study. *Sustainable Cities and Society*, 14, 56–63. <https://doi.org/10.1016/j.scs.2014.07.004>
37. Tajfel, H., & Turner, J.C. (2004). The social identity theory of intergroup behavior. In: Jost, J.T., Sidanius, J. (Eds.), *Key Readings in Social Psychology. Political Psychology: Key Readings*. Psychology Press, pp. 276e293. <https://doi.org/10.4324/9780203505984-16>
38. Tatano, F., Caramiello, C., Paolini, T., Tripolone, L. (2017). Generation and collection of restaurant waste: characterization and evaluation at a case study in Italy. *Waste Management*, 61, 423–442. <https://doi.org/10.1016/j.wasman.2017.01.020>
39. Thanh, N. P., Matsui, Y., & Fujiwara, T. (2010). Household solid waste generation and characteristic in a Mekong Delta city, Vietnam. *Journal of Environmental Management*, 91(11), 2307–2321. <https://doi.org/10.1016/j.jenvman.2010.06.016>
40. Thyberg, K. L., & Tonjes, D. J. (2016). Drivers of food waste and their implications for sustainable policy development. *Resources, Conservation and Recycling*, 106, 110-123. <https://doi.org/10.1016/j.resconrec.2015.11.016>
41. Vukolić, D., Gajić, T., & Popović, A. (2022). The influence of the names of the dishes in the menu on the choice in Serbian restaurants. *BIZINFO, Journal of Economics, Management and Informatics, Blace*, 13(1), 25-32. <https://doi.org/10.5937/bizinfo2201025V>
42. Vukolić, D., Gajić, T., Petrović, M. D., Bugarčić, J., Spasojević, A., Veljović, S., Vuksanović, N., Bugarčić, M., Zrnić, M., Knežević, S., Rakić, S. R., Drašković, B. D., & Petrović, T. (2023). Development of the concept of sustainable agro-tourism destinations—Exploring the motivations of Serbian gastro-tourists. *Sustainability*, 15, 2839. <https://doi.org/10.3390/su15032839>
43. Wang, Q., Awasthi, M. K., Ren, X., Zhao, J., Wang, M., Chen, H., & Zhang, Z. (2018). Recent advances in composting of organic and hazardous waste: A road map to safer environment. *Biosynthetic Technology and Environmental Challenges*, 307-329. [https://doi.org/10.1007/978-981-10-7434-9\\_17](https://doi.org/10.1007/978-981-10-7434-9_17)
44. Williams, B., Onsmann, A., & Brown, T. (2010). Exploratory factor analysis: A five-step guide for novices. *Australasian journal of paramedicine*, 8, 1-13.

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## PROFITABILITY OF ORGANIC FARMING OF SPELT IN THE CLIMATE CONDITIONS OF SERBIA

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### ABSTRACT

This research focuses on assessing the general profitability of organically produced spelt. Spelt is an ancient grain that has experienced a resurgence in Serbia in the late seventies of the previous century, due to its exceptional nutritional value and high compatibility with organic farming. Field experiments were conducted in northern Serbia over four years, applying further financial analysis. The main goal of the research is to identify and quantify the costs, benefits, and general profitability of organic production of spelt in the climatic conditions of Serbia. Results indicate that organically produced spelt is economically profitable, primarily due to its significantly higher market price compared to conventionally produced spelt. Given climate change concerns, promoting the cultivation of climate-resilient crops, like spelt, becomes crucial. Organic spelt cultivation could play a significant role in adapting crops to climate change, emphasizing the need for activities that mitigate negative environmental impacts.

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## Introduction

Spelt (*Triticum spelta*) is an ancient species of wheat, originally grown in the Nile Valley back in 4,000 BC. It was known to the Romans and it was also grown for a long time in Germany, the Alpine region, and parts of the Pannonian Plain. As the Pannonian Plain became populated, Hungarian tribes continued to grow spelt (Kiš et al., 2016; Medović et al., 2021). However, spelt was almost disappeared over time and it was kept only in gene banks worldwide. It was rediscovered in the 1970s, due to rise in environmental awareness and increase in consumption of organically produced food (Campbell, 2010).

Today, spelt is gaining an increase in market share as people recognize its multiple worth. The morphological structure of the crop is such that it cannot prevail in soils containing heavy metals, therefore it is ideal for system of organic farming (Yonkova et al., 2016, Biel et al., 2016). Meanwhile, the thick grain membrane (husk) protects spelt from insects, but also pesticides, and other toxic substances (Deng et al., 2005). Spelt grain and flour attract potential consumers by its rich flavor (sweet and nutty), adequate and pleasant texture of derived bakery products, and well-balanced nutritional values (Wójtowicz et al., 2020). Its use is currently widespread, among other things because spelt contains less gluten than some other cereals (Frakolaki et al., 2018). So good nutritional quality recommends the spelt grain in food industry (specifically in bakery, pasta and confectioners' production, or beverage industry), (Chetrariu, Dabija, 2021), or as a animal feed (especially in growing horses), (Fayt et al., 2008), while straw and husks could be used for animal bedding in stables (Riedel et al., 2023).

Spelt grain has ideal combination of protein, carbohydrates, fats, minerals, vitamins, and fiber (Sinkovič et al., 2023). Compared to common wheat, it may have a higher content of protein and fiber, as well certain oligo-minerals and micro elements (e.g. phosphorus), or vitamins (e.g.  $\beta$ -carotene and retinol), (Escarnot et al., 2012; Huertas García et al., 2023).

Spelt fiber is readily soluble in water and this property enhances the resorption of nutrients by the body (Krahl et al., 2010). From the aspect of health, relative to bread wheat, spelt contains much more essential amino acids: leucine, methionine, and phenylalanine (Ranhotra et al., 1995; Rakszegi et al., 2023). Phenylalanine produces dopamine, and noradrenaline and adrenaline. Under certain conditions, deficit of dopamine may lead to Parkinson's disease, while noradrenaline and adrenaline control blood sugar, or their deficit could lead in severe depression (Jankovic et al., 2015). Spelt is rich in tryptophan, which supports the synthesis of serotonin, hormone that affects mood and mental balance (Munoz Insa et al., 2016).

Spelt grain abounds in minerals, microelements, and vitamins, and contains much more vitamin B1, vitamin B2, and niacin than common wheat. Selenium content is also high (Zuk Golaszewska et al., 2022). Consumption of spelt protects the human body from disease and boosts immunity. In some countries, like Germany, spelt is part of therapy for chronic infections such as herpes and AIDS, bone and nervous system ailments

(Parkinson's and Alzheimer's disease, or arthritis), cancer, as it effects the prolonged influence of antibiotics (Wójtowicz et al., 2020).

Although the spelt farming in Serbia is quit a limited, it has recently been expanding due to the exceptional nutritional value of the grain and its suitability for organic production (in organic system of production, it is grown at less than 200 ha, while the largest areas are in Vojvodina), (Golijan et al., 2019). Previously, spelt had not been included in seed production in Serbia. However, scientific institutions, such as the Institute of Field and Vegetable Crops from Novi Sad, or Maize institute from Zemun polje recognized its significance and proceeded to multiply seeds to promote spelt farming (Jankovic et al., 2015; Lazarević et al., 2022). Limited areas under spelt are usually linked for high costs of husks dehulling from the grain, as the processing lines for that purposes are great investment for the majority of farms, that could lead to the zone of unprofitability (Kolankowska et al., 2023; Sinkovic et al., 2023).

Crop farming in Serbia directly depends on climate conditions, as it is largely rainfed (Daničić et al., 2021). On the other side, temporal and spatial distribution of rainfalls is uneven, especially during the growing season, generating semi-favorable conditions for crop production and high yield uncertainty (Zubović et al., 2018). Apart from erratic rainfall, climate in Serbia involves high summer air temperatures and frequent heat waves, while in general air temperatures exhibit an upward trend. In addition, in Serbia may be expected more frequent occurrence of heavy rainfalls and extreme heat, or drought (Bonacci, 2019; Pecelj et al., 2020). So, mentioned climate conditions have in certain extent negative impact on plant production, while given climate predictions points out that crop productivity will continue to reduce, especially in production of spring crops (Iglesias et al., 2012; Milošević et al., 2015). Given that one of the ways for adapting to the impact of climate change on crop farming is adequate selection of crops and varieties tolerant to high temperatures and drought, there is believe that organic farming in Serbia should be given serious consideration (Jovanovic and Stikic, 2012; Djekic et al., 2021), especially in case of spelt varieties.

Appliance of organic farming allows farmers to benefit from several economic and social advantages over conventional farming. Usual conventional crop production system currently involves highly intensive activities based on high-energy inputs, mainly harmful to the environment. Practicing organic farming offers much shallower environmental footprint due to absence of synthetic agro-chemicals, while its efficiency could vary in line to used management choices (Gomiero et al., 2011). As in case of spelt wheat, the adequate variety represents key factor for efficient organic production, while its current cultivars do not fit assumed production and market requirements of organic agriculture (Konvalina et al., 2009). Oftentimes farmers involve in organic crop production old varieties of cereals, as they are more resistant to diseases, or they require lower fertilization, contrary to expected lower yields. So, the basic criteria for varieties selection is their fitting to local climate (heat waves and drought, frosts, hail or wind, and water-logging), plant yield capacity and stability, well-rooting, level of required macro and micro nutrient, tolerance to diseases, pests and weeds, etc. (Lammerts van Bueren et al., 2011; Rawat et al., 2021).

Differing results in profitable organic farming derived as combination of yield oscillations, cut in input costs, and level of subsidies and price premiums. Like in other grains production, the costs of agro-chemicals (fertilizers, growth stimulators or pesticides) are significantly lower in spelt organic contrary to conventional production (McBride et al., 2015). Additionally, mentioned production is pressed by higher costs of seed, more intensive tilling and land cultivation (higher fuel costs), labor intensive approach (e.g. making the organic fertilizers, performing the intensive weed and pest control, etc.), affecting the overall profitability of organic cereals growing. Providing the sustainable profitability in crop growing is difficult task, both in organic and non-organic farming. Meanwhile, the costs in grain (spelt) organic production are more often higher, while the yields are potentially lower in conventional farming, where the expected higher prices for organic agro-food products could make profitability more challenging (McBride et al., 2015; Simin et al., 2019).

The main purpose of paper is to identify and quantify the general costs, benefits, and profitability of organic spelt farming in climate conditions of Serbia. The emphasis in this research is based on appliance of common economic method and the use of real data. Although the potential limitation is in observed production period, it could serve for perceiving the profitability potential of this line of crop production, as well as derived results could apply to similar geographic and climate areas, or by production technology similar crops.

### **Materials and methods**

This section mainly includes several details about the study area, used spelt variety, performed organic farming practices, available climate parameters and soil type, and the used methodological approach.

#### *Study area and used variety*

The research is focused on organic spelt production. The study area is in the north of Serbia - the Province of Vojvodina, specifically location is in Ada municipality (Figure 1.). The study period covers four years (2010/11-2013/14.). Location has been chosen based on assumption that Vojvodina is a Serbia's leader in field crop farming, attracting the majority of spelt organic production, so it could be adequate represent of available climate conditions, performed practices and profitability linked to spelt production. To assess the economic feasibility of organic spelt production in real-time, evaluation parameters were also projected in 2023. based on the occurred inflation rate.

Organic farming is performed at the fields (on several plots) of the agricultural company Bio Farma doo, that is generally specialized in crop, mainly grains production. The available soil is highly fertile (carbonate chernozem type, on a loess plateau). The observed climate parameters involve amount of overall precipitation (rainfalls), mean daily or monthly air temperature, and potential evapotranspiration (ET<sub>o</sub>).

**Figure 1.** Location of study area and photos of the organic production and harvesting of spelt in a fields of Bio Farma doo in Ada during the study period



Source: photos: Nandor Terek; map: [http://commons.wikimedia.org/wiki/File:Municipalities\\_of\\_Serbia\\_Map-sr.svg#/media/File:Municipalities\\_of\\_Serbia\\_Map-sr.svg](http://commons.wikimedia.org/wiki/File:Municipalities_of_Serbia_Map-sr.svg#/media/File:Municipalities_of_Serbia_Map-sr.svg)

The data for daily precipitation during the study period (2010/11-2013/14.) were collected from a rain-gauge station installed in the Halas Jožef field in Ada. The other meteorological data and ETo, were taken from the Republic Hydrometeorological Service of Serbia (RHSS) for the weather station at Palić, as a representative for the study area. ETo was calculated according to Penman-Monteith method (Allen et al., 1998). The studied crop was spelt, specifically Nirvana cultivar, as its suitable for growing in system of organic agriculture, as well as its highly tolerant to low winter temperatures (NSS, 2023).

### *Organic farming*

The transition to organic crop management at Bio Farma doo was initiated in 2005-2006., while actual organic farming has begun (upon certification) in the spring of 2008. Spelt was grown during the study period at 10 ha plot, pursuant to the Serbian Organic Farming Law (Official Gazette of Republic of Serbia no. 30/10 and 17/19). The crop preceding spelt in the first and fourth year (2010/2011. and 2013/14.) was maize, while in the second and third year (2011/12. and 2012/13.) was soybean. The spelt, Nirvana cultivar, was sown in the late October, while it was harvested in mid-July of following year. Firstly, land tilling is made with tractor Belarus 820 in two passes. Prior to sowing, the soil was disked by New Holland tractor and large disc harrow, while field preparation for sowing was done by the New Holland tractor and seedbed conditioner (4 m wide). The used crop density was 500-550 germinating grains per m<sup>2</sup>. The crop was harvested by a New Holland harvester equipped with a straw shredder. Organic fertilizer was applied using a Torpedo tractor and depositor, while biostimulators was applied by Torpedo tractor and adequate atomizer. Irrigation system was not implemented. In the first year the crop was not fertilized, while in the second

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year Guanito (6N - 15P2O5 - 3 K2O) pelleted fertilizer was used (250 kg/ha), or in the third and fourth year Itaipolino (12N-5P2O5-15K2O) pelleted fertilizer (250 kg/ha) was applied prior to plots preparation for sowing. In spring, as side-dressing was used Itaipolino (3N - 3P2O5 - 3 K2O, in norm of 150 kg/ha) or Dix fertilizers (10N, in norm 250 kg/ha). In the third year of observed period biostimulators Humus (1.5 l/ha) and Green Shield (2.1 l/ha) were also applied.

#### *Economic evaluation parameters*

The profitability assessment of applied organic management in spelt production involves financial analysis in line to commonly used analytical calculations based on variable costs (contribution margin), (Kresovic et al., 2014; Đuričin et al., 2018; Jeločnik et al., 2021). Contribution margin represents the overall economic benefit derived from certain production line (Kendall et al., 2007). It shows the difference between overall income and overall expenses (mainly variable costs) gained in observed production, in this case spelt organic growing. Basically, fixed costs and taxes was not included in calculation. Income represents the expression of achieved yields and current market prices of certain crop, while the total income is increased for assigned incentives for organic crop production (Subić et al., 2021). Starting from 2013. the Ministry of Agriculture, Forestry and Water-management has been started to subsidies the organic crop producers per hectare, determining the level of incentives for each production year (previously sum of subsidies in organic crop production was equal to sum given for conventional crop production). Up today incentives have showed upward trend. Made expenses (overall variable costs) covers the value of used inputs (in line to prices at local market in certain year). They include the costs of using machinery, labor, fuel, seed and agro-chemicals (fertilizers, pesticides and biostimulators). The costs for used mechanization were calculated according to pricelists of the Cooperative Union of Vojvodina for observed years. All mentioned were used to calculate income and variable costs (contribution margin) for the organic production of spelt. Norm of used inputs were obtained from the producers' internal documentation.

Further, future values of costs and incomes were projected to examine the economic feasibility of organic spelt production in real-time (Table 3.). They represent the all values at a specific moment, in this case in 2023., increased for a given inflation rate. Estimation of production cost and prices for 2023. was performed using the formula that considers the future value of money, while the inflation rate is used instead of interest rate (Ruiz Menjivar et al., 2015):

$$RtV = BV * (1 + IR)^t \quad (1)$$

Where:

RtV = real-time values,

BV = basic values for the observed period,

IR = inflation rate, and

t = number of periods (years) until the moment in the future (selected year).

For basic values, average cost and price values were used, while for the inflation rate, the annual inflation rate in the Republic of Serbia for the year 2023. was used, amounting to 7.6% (CEKOS IN, 2023). The number of periods (years) until the determined future moment was set at 9 years, representing the number of periods from 2014., for which there is real data, to 2023, the year for which the values are projected. The projection of income and cost values in real-time is based on price projections, while the yield is based on the average value achieved during the period 2011-2014. Future yield values are not projected since the research indicates the achievable production quantity under existing agroecological conditions. Incentives for 2023. are determined by the Ministry.

## Results with Discussion

### *Climate conditions*

The average annual air temperature for the past 50 years (1960/61-2010/11.) in the study area (weather station at Palić) is 10.8 C, while the average annual precipitation is 565 mm (Table 1.). Like for winter wheat, the growing season of spelt is from October to June, and it is characterized by average air temperature (1960/61-2010/11.) of 8.0 C and average precipitation of 405 mm. To better illustrate the trends of main climate parameters (air temperature and precipitation), in Table 1. are shown the average values for the first 30 years (1960/61-1990/91.), the following 20 years (1991/92-2010/11.), and each observed year in study period (study years represents hydrological years or vegetation period linked to organic spelt production, from October to November).

**Table 1.** Main climate parameters of northern Serbia (Palić weather station) for certain years and growing season (October-June)

Period	T (in C)		P (in mm)		ETo (in mm)		ETo - P (in mm)					
	Hydr. year	Oct-Jun	Hydr. Year	Oct-Jun	Hydr. Year	Oct-Jun	Hydr. year	Oct-Jun				
1960/61-1990/91.	10.5	7.6	539	395	854	497	315	103				
1991/92-2010/11.	11.4	8.5	605	420	914	534	309	114				
2010/11.	12.3	8.9	508	382	827	488	319	106				
2011/12.	12.8	9	342	295	825	470	483	176				
2012/13.	12.3	9	729	574	941	522	212	-52				
2013/14.	12.8	8.3	758	444	850	514	92	69				
2010/11-2013/14.	12.6	8.8	584	424	861	499	277	75				
Mean air temperature (in C)												
Period	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1960/61-1990/91.	11	5.2	0.7	-1.6	1.1	5.6	11.1	16.3	19.4	21	20.2	16.5
2010/11.	9.3	9	0.4	0.4	0.4	6.7	13.9	17.8	22.2	22.5	24.1	21.2
2011/12.	11.2	3.2	3.8	1.6	-4	8.5	14	18.6	24.3	26.4	25.9	20.6
2012/13.	12.7	8.4	0	1.8	3.8	5.6	14.1	18.2	16.5	25.3	24.7	16.5
2013/14.	14.4	8.6	2	3.1	5.1	9.9	13.3	16.0	20.4	22.3	21.0	17.4
2010/11-2013/14.	11.9	7.3	1.5	1.7	1.3	7.7	13.8	17.7	20.9	24.1	23.9	18.9
Precipitation (in mm)												
Period	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1960/61-1990/91.	28	46	46	36	31	34	43	55	74	57	54	36

Period	T (in C)			P (in mm)			ETo (in mm)			ETo - P (in mm)		
	Hydr. year	Oct-Jun		Hydr. Year	Oct-Jun		Hydr. Year	Oct-Jun		Hydr. year	Oct-Jun	
2010/11.	54	49	65	35	25	58	3	65	28	82	15	29
2011/12.	36	0	44	33	35	10	59	57	23	29	4	14
2012/13.	77	41	71	49	67	86	50	82	52	24	62	70
2013/14.	70	0	3	32	22	51	25	193	50	103	97	114
2010/11-2013/14.	59	23	46	37	37	51	34	99	38	60	44	57

Source: RHSS, 2023.

Note: Air temperatures (T), annual and seasonal (Oct-Jun), overall precipitation (P), and potential evapotranspiration (ETo)

Air temperature over the past 50 years exhibits an upward trend (Table 1.). In the previous four years, the average annual temperatures have risen by as much as 2.1 C, while during the growing season of spelt (October-June) by 1.2 C, relative to the period 1960/61-1990/91. Average annual temperatures in observed period (2010/11-2013/14.) varied from 12.3 C to 12.8 C. The warmest hydrological years were 2011/12. and 2013/14., with an average annual temperature of 12.8 C. The warmest growing seasons (October-June), with an average temperature of 9.0 C, were recorded in 2011/12. and 2012/13. (Table 1.).

Annual overall precipitation in observed period varied from 342 mm to 758 mm, where the first two observed years were drier than normal (1960/61-1990/91.), while the last two observed years were above the normal (Table 1.). The least precipitation (342 mm) was recorded in hydrological year 2011/12., when is registered for 37% less rainfall than normal. The rainiest year was 2013/14. with 758 mm, or for 41% more rainfall than normal. The driest growing season (October-June) was in 2011/12., with only 295 mm of rainfall, or for 25% less than normal. The optimal spelt yield may be obtained in regions with overall rainfalls in range 650-750 mm, with rainfall distribution in line to crop requirements for water in individual growing stages (Vojnov et al., 2020).

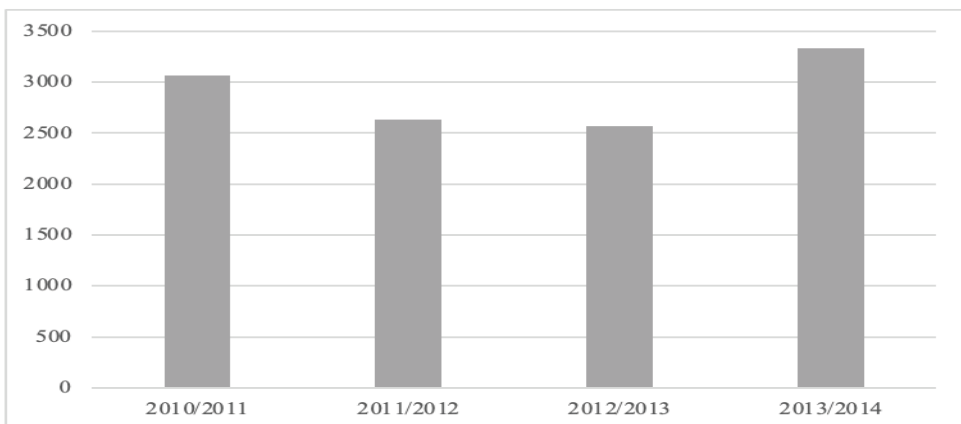
The sum of annual potential evapotranspiration (ETo) in observed hydrological years was in average 861 mm, while in the spelt growing season (October-June) was 499 mm. These values were close to the 30-year average (1960/61-1990/91.), (Table 1.). In the study years (2010/11-2013/14.), the annual ETo was higher than the annual precipitation. Water deficit for the studied crop was from 92 mm (in 2013/14.) to 483 mm (in 2011/12.). Determined water deficit (overall and by separate parts of growing season) is in line to certain findings for Serbia and wheat growing (Jeločnik et al., 2019), while mentioned impose the implementation of irrigation in cereal production. In general, high yield variability is the main feature of rainfed crop production in Serbia (Matović et al., 2013), while level of temperature and crops' drought tolerance is among the major criteria in selection the species, varieties, or hybrids, in organic and conventional farming.

Given that average annual and seasonal climate parameters are insufficient for assessment of rainfed farming, which also requires temperature and rainfall distribution in shorter intervals over the growing season, in Table 1. is also shown the mean monthly air temperatures and precipitation. In the study period, the coldest was in February (in average 0.1 C), while the warmest was in July (in average 24.4 C). The largest rainfalls were recorded in May (in average 99 mm), while the lowest were in November, where without rain were in two observed years (2011 and 2013.). There were also recorded occurrence of moderate spring frosts that haven't affects the gained yields.

#### *Organic spelt wheat grain yields*

In Figure 2. are shown the obtained yields of organic spelt within the study period. In average, the yield of organic spelt (Nirvana cultivar) over the observed period was 2.9 t/ha. The entire year 2011/2012., as well as growing season (October-June) in mentioned year was extremely dry, affected by the lowest annual (342 mm) or seasonal precipitation (295 mm) and the highest annual average temperature (12.8 C). Occurred extreme drought in observed area, results in unusually high-water deficit (ETo-P) of 176 mm (Table 1.). In such circumstances, gained yields were lower compared to previous year, when the overall precipitation within the growing season was 382 mm, with average temperature of 8.9 C. So, the yield reduction in 2011/2012. compared to 2010/2011. was 14.3%. Mentioned was not only the result of hot and dry summer in 2012. (June – precipitation 23 mm, mean temperature 24.3 C), but also the extremely dry conditions during the period when the soil cultivation and sowing was performed (September and October of 2011. had rainfalls of 21 mm, or 11 mm), (Table 1.). In such weather conditions, without implemented irrigation, sprouting and initial stages of plant growth was hindered, while there comes to acceleration in ripening. So, having in mind that almost every fifth year in Serbia is characterized by very dry weather (Gocic, Amiri, 2023), negative weather impacts on gained crop yields could be, among all, exceeded by irrigation.

**Figure 2.** Yields of organic spelt (in kg, period 2010-2014)



Source: Bio Farma, 2023.

*Economic assessment of organic spelt production*

The economic assessment of the profitability (contribution margin) of organic spelt farming encompasses analytical calculations based on variable costs. The gross profit was calculated as the difference between total incomes (including subsidies) and variable costs derived from organic spelt growing, where the variable costs involve costs of mechanization use, fuel, seed, and agro-chemicals (sum of costs of pesticides, growth stimulators, fertilizers, etc.), (Table 2.).

**Table 2.** The economic assessment of the profitability of organic spelt farming

Period	2011.	2012.	2013.	2014.	Average
Mechanization (EUR/ha)	163	153	165	180	165
Fuel (EUR/ha)	72	72	74	101	80
Seed (EUR/ha)	116	124	142	139	130
Agro-chemicals (EUR/ha)	80	255	267	361	241
<b>Total variable costs (EUR/ha)</b>	<b>431</b>	<b>604</b>	<b>648</b>	<b>781</b>	<b>616</b>
Yield (t/ha)	3.07	2.63	2.57	3.33	2.90
Price (EUR/kg)	0.54	0.50	0.61	0.53	0.55
<b>Income (EUR/ha)</b>	<b>1,658</b>	<b>1,315</b>	<b>1,568</b>	<b>1,765</b>	<b>1,581</b>
Subsidies (EUR/ha)	162	123	110	139	134
<b>Total income (EUR/ha)</b>	<b>1,820</b>	<b>1,438</b>	<b>1,678</b>	<b>1,904</b>	<b>1,714</b>
<b>Contribution margin (EUR/ha)</b>	<b>1,389</b>	<b>834</b>	<b>1,030</b>	<b>1,123</b>	<b>1,098</b>

*Source:* According to authors' calculation.

In economic theory, to labor may be given two opposite views. In line to organization of activities at the agricultural holding, labor costs can be seen as fixed or variable. Usually, as variable costs are assumed if they involve external labor (Subić et al., 2022).

In average, over the study period the sum of variable costs was 616 EUR/ha. Analysis shows that the costs of used agrochemicals have the highest share within the overall variable costs (about 39%), while they have gradually increase, and in average amounts 241 EUR/ha (Table 2.). In addition, costs of mechanization (in average 165 EUR/ha) have also significant share in the structure of overall variable costs (about 27%). Increase in costs of organic agro-chemicals was due to rise in their price at international level (they are mostly imported products). Seed and fuel costs in average for observed period were 130 EUR/ha and 80 EUR/ha, while they have share of 21% and 13%, respectively.

Yasin et al. (2014) have been reported higher profitability of organic crop management than conventional. In performed research, the profitability (i.e. contribution margin) of organic spelt farming derived from the higher overall income, due to relatively stable yields and price, and increase in subsidies in observed period. The average yield was 2.9 t/ha, while the average price was 0.55 EUR/kg (Table 2.). From the aspect of dynamics, rise in organic spelt wheat's yield (up to natural capacity of used variety), price and national support have led to consistent rise in overall incomes, while the total income increased faster than the total variable costs, resulting in better farm

profitability (contribution margin) of organic spelt growing. This way was made the general preconditions for more intensive enlargement of this line of production at national level.

Meanwhile, the economic feasibility of organic spelt production (Table 3.) has been confirmed in real-time. The projected values of costs and prices, with unchanged yields, result in a profit margin 72% higher in 2023. compared to the average profit margin for the period 2011-2014. From a dynamic perspective, with unchanged yields, total income exceeds total costs. The significant increase in total income is largely due to a significant increase in national incentive for organic crop production in 2023. compared to its value in observed period 2011-2014.

**Table 3.** Estimated assessment of the profitability of organic spelt farming (in 2023.)

Period	Average (2011-2014.)	2023.
Mechanization (EUR/ha)	165	319
Fuel (EUR/ha)	80	155
Seed (EUR/ha)	130	251
Agro-chemicals (EUR/ha)	241	466
<b>Total variable cost (EUR/ha)</b>	616	1.191
Yield (t/ha)	2,9	2,9
Price (EUR/kg)	0,55	1,1
Income (EUR/ha)	1.581	3.084
Subsidies (EUR/ha)	134	538
<b>Total income (EUR/ha)</b>	1.714	3622
<b>Contribution margin (EUR/ha)</b>	<b>1.098</b>	<b>1.893</b>

*Source:* Authors' calculations based on available data

Derived profitability of spelt organic production is usually the result of obtained market price, where compared to common (bread) wheat its market price could be up to three times higher. Despite the more expressed energy efficiency, or health and environmental impact in organic agriculture (including the spelt production), (Smith et al., 2015; Takač et al., 2022) the negative side organic production arises from lower yields (Gabriel et al., 2013) that is commonly compensated by higher food-product's prices (Singh and Grover, 2011; Cristache et al., 2018).

The research is in line with general knowledge, emphasizing how pricing, yields stability, national support, or cost control determine the profitability in conventional or organic farming. It has noted that Vojnov et al. (2020) obtained similar yields in spelt organic production in several locations in the north of Serbia. Since the yields in rainfed organic grains production usually lag behind up to 20-30% compared to yields gained in conventional production (Mäder et al., 2002), the gap in derived profitability cannot be explained by yields, its mainly caused by better prices (demand pressure) and stronger national support. For example, the conventionally grown spelt yield in Italy, under rainfed conditions, peaks 3.1 t/ha (hulled grain yield was 2.8 t/ha), (Troccoli and Codianni, 2005), while in Poland it reaches around 2.6 t/ha (Sulewska et al., 2008). In research study, the reached average yield is in line to yields usually gained in organic

spelt wheat, around 3 t/ha (Moudrý et al., 2011). On the other side, in some experimental conditions gained yields, depending to intensity of certain production condition, have been varied from around 4 t/ha (Dorval et al., 2015; Wang et al., 2021) to over the 7 t/ha (Pospisil et al., 2012).

Some research results (Novković et al., 2020), show that in northern Serbia conventional spelt growing has better profitability contrary to common wheat, although it reaches 50% smaller yields, as its price is up to 5 times higher, while production costs are for up to 40% lower. So, knowing that spelt is well-adapted to producing in several environmental conditions, in optimal conditions due to climate, soil, used agrotechnical measures, organization of production, etc. under some circumstances it could gain similar yields to common wheat (Jablonskytė Raščė et al., 2013). Like in grains production, there could come to certain gaps in produced volume of other crops (vegetables, pulses, fodder crops, oilseeds, or tuber crops, and fruits) grown in organic or conventional system of production (depend on observed crop and region) they could differ in extreme situation in range from 70 to over 80% (De Ponti et al., 2012).

Besides, there could be implemented certain production mechanisms in organic crop management that will provide further yields stability if occurs the lack of applied irrigation towards the exposed level of water deficit in some crop development stages within the growing seasons. As were previously mentioned yield oscillations is common issue in rainfed crop production, where the crops tolerance to high temperature and drought is mainly desired. Besides, activities that are increasing the drought tolerance of grown crop involve maintaining the higher level of soil water-holding capacity (Wells et al., 2000), or higher level of soil organic carbon (SOC), (Iizumi and Wagai, 2019). Then, some experimental measurements have shown much more available water in soil by practicing organic than conventional pulses growing. In same manner, crop resilience to drought in organic crop management is more affected by presence of mycorrhiza (Ortiz et al., 2015).

### **Conclusions with recommendations**

Policymakers, together with national association of organic producers can have a much more expressed impact on spreading the areas under the organic spelt. It could be done through various support mechanisms (especially to farmers that are in transition period), such are introduction of new and rising the level of practiced direct payments and indirect subsidies (e.g., grants for organic certification, low-interest loans for used inputs, certain forms of tax breaks, etc.). Furthermore, it should be allocated more funds for research (to scientific institutions) and knowledge transfer or training programs for farmers (primarily to extension services), that are mainly linked to organic spelt farming techniques, pest and disease, or soil improvement management. Policy makers should support initiation of collaboration between research institutions, farmers, and private enterprises, due to development and implementation of innovative technology and organic growing practices (specifically for spelt). Additionally, there has to be established close connection between policy makers and national association of organic

producers, and other stakeholders, as are retailers, food processors, restaurants, etc. in order to rise the demand for organic spelt (due to rise in awareness to consumers related to benefits of organic spelt) and further to provide stable farmers' incomes and market stability. Then has to be well-maintained and in some parts adjusted existing system of (re)certification towards the spelt growing.

Although is mainly the producers' decision, towards the expected profit and existing market demand, policy makers could have to adopt current land use policies in a way to prioritize organic farming practices and reallocate some suitable land areas to organic spelt growing. Mentioned could involve protecting available agricultural land from urban encroachment, or promoting the conversion of conventional to organic farms. Policy makers should also develop and support policies that address the issues and challenges of current climate change trends in agriculture, where one segment may be through organic spelt growing practices. At the end, by previously mentioned they could affect promotion of sustainable agriculture, enhancing food security, environmental conservation, as well as fostering health life at local population. Unfortunately, there is still not in operation the marketing information system for organic products and inputs at national level, whose establishment will surely facilitate dynamics of current production and consumption of organic agro-food products (Kovačević, 2021).

Considering observed farm and performed economic assessment, it could be assumed profitable (based on contribution margin) spelt organic production in Serbia (in rainfed conditions), as the total incomes are over the total variable costs. Considering the granted state subsidies, actual profitability could be even higher. Applied calculation method could be used in other production lines, or production systems, as well as different geographic regions, or alternative growing periods, etc. It is expected in Serbia that current state support together with rise in farms' and consumers' awareness towards the general economic and health benefits will encourage large-scale organic farming in upcoming period. This would be extremely important not only for Serbia, but the entire West Balkans where the agriculture is among the most important economic activities that affects national GDPs, while by mentioned trend will be activated the additional creation of value added in agriculture.

Given the current climate changes and upward trends in average temperatures, heatwave and drought frequency and intensity, generally higher drought tolerance of organic crops and wider implementation of irrigation could also support the increase of areas under the system of organic management. Future research could involve a comparative analysis of gained climate and economic results with those obtained in upcoming four years period (e.g. 2024-2027), or at other location, with assumption of *ceteris paribus*. Further, future comparative analysis could include deeper examination of climate conditions, achieved yields, etc., trying to discover whether the previous elements determining the profitability in spelt production have been changed in the meantime.



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## Conflict of interests

The authors declare no conflict of interest.

## References

1. Allen, R., Pereira, L., Raes, D., & Smith, M. (1998). Crop evapotranspiration. Guidelines for computing crop water requirements. FAO Irrigation and Drainage Paper, no. 56, FAO, Rome, Italy, retrieved at: [https://appgeodb.nancy.inra.fr/biljou/pdf/Allen\\_FAO1998.pdf](https://appgeodb.nancy.inra.fr/biljou/pdf/Allen_FAO1998.pdf), 23<sup>rd</sup> November 2023.
2. Biel, W., Stankowski, S., Jaroszevska, A., Pużyński, S., & Boško, P. (2016). The influence of selected agronomic factors on the chemical composition of spelt wheat (*Triticum aestivum* ssp. *spelta* L.) grain. *Journal of integrative agriculture*, 15(8), 1763-1769, doi: [https://doi.org/10.1016/S2095-3119\(15\)61211-4](https://doi.org/10.1016/S2095-3119(15)61211-4)
3. Bio Farma (2023). Data related to organic spelt production. Internal data gained upon request, Bio Farma doo, Ada, Serbia.
4. Bonacci, O. (2019). Air temperature and precipitation analyses on a small Mediterranean island: The case of the remote island of Lastovo (Adriatic sea, Croatia). *Acta Hydrotechnica*, 32(57), 135-150, doi: <https://doi.org/10.15292/acta.hydro.2019.10>.
5. Campbell, K. (2010). Spelt: Agronomy, genetics, and breeding. *Plant Breed Reviews*, 15, 187-213.
6. CEKOS IN. (2023). Indeksi potrošačkih cena u Srbiji - 2023. godina [In English: Business entity for publishing activities and economic consulting Ltd., CEKOS IN. (2023). Consumer Price Indices in 2023]. Retrieved from: <http://www.cekos.rs/indeksi-potrošackih-cena-u-2023-godini>, (February, 5 2023).
7. Chetrariu, A., & Dabija, A. (2021). Quality characteristics of spelt pasta enriched with spent grain. *Agronomy*, 11(9), 1824, doi: <https://doi.org/10.3390/agronomy11091824>
8. Cristache, S., Vuță, M., Marin, E., Cioacă, S., & Vuță, M. (2018). Organic versus conventional farming: A paradigm for the sustainable development of the European countries. *Sustainability*, 10, 4279, doi: <https://doi.org/10.3390/su10114279>.

9. Daničić, M., Pejić, B., Mačkić, K., Lalić, B., Maksimović, I., & Putnik Delić, M. (2021). The predicted impact of climate change on maize production in Northern Serbia. *Maydica*, 65(3), 1-10.
10. De Ponti, T., Rijk, B., & Van Ittersum, K. (2012). The crop yield gap between organic and conventional agriculture. *Agricultural Systems*, 108, 1-9, doi: <https://doi.org/10.1016/j.agsy.2011.12.004>.
11. Deng, X. P., Shan, L., Inanaga, S., & Inoue, M. (2005). Water-saving approaches for improving wheat production. *Journal of the Science of Food and Agriculture*, 85(8), 1379-1388, doi: <https://doi.org/10.1002/jsfa.2101>
12. Djekic, I., Kovačević, D., & Dolijanović, Ž. (2021). Impact of climate change on crop production in Serbia. In: Filho, W., Luetz, J., Ayal, D. (eds.) *Handbook of Climate Change Management: Research, Leadership, Transformation*, Springer International Publishing, Cham, Switzerland, pp. 779-796.
13. Dorval, I., Vanasse, A., Pageau, D., & Dion, Y. (2015). Seeding rate and cultivar effects on yield, yield components and grain quality of spring spelt in eastern Canada. *Canadian Journal of Plant Science*, 95(5), 841-849, doi: <https://doi.org/10.4141/cjps-2014-439>.
14. Đuričin, S., Beraha, I., & Bodroža, D. (2018). Alternatives for exiting the loss zone for mediumsized agricultural enterprises in the Republic of Serbia. *Economics of Agriculture*, 65(1), 391-411, doi: 10.5937/ekoPolj1801391D.
15. Escarnot, E., Jacquemin, J., Agneessens, R., & Paquot, M. (2012). Comparative study of the content and profiles of macronutrients in spelt and wheat, a review. *Biotechnologie, Agronomie, Societe et Environnement*, 16(2), 243-256.
16. Fayt, J., Dotreppe, O., Hornick, J., & Istasse, L. (2008). Spelt, an ancient cereal and first pressure linseed oil as ingredients of compound feedstuffs for modern horse feeding. *Journal of animal physiology and animal nutrition*, 92(3), 303-309, doi: <https://doi.org/10.1111/j.1439-0396.2007.00772.x>
17. Frakolaki, G., Giannou, V., Topakas, E., & Tzia, C. (2018). Chemical characterization and breadmaking potential of spelt versus wheat flour. *Journal of Cereal Science*, 79, 50-56, doi: <https://doi.org/10.1016/j.jcs.2017.08.023>.
18. Gabriel, D., Sait, S., Kunin, W., & Benton, T. (2013). Food production vs. biodiversity: Comparing organic and conventional agriculture. *Journal of Applied Ecology*, 50(2), 355-364, doi: <https://doi.org/10.1111/1365-2664.12035>.
19. Gocic, M., & Amiri, M. (2023). Analysis of Spatial Variability and Patterns of Drought: A Case Study for Serbia. In: Singh et al. (eds.) *Integrated Drought Management – vol. 2*, pp. 31-42, CRC Press, Boca Raton, USA.

20. Golijan, J., Kolarić, L., Popović, A., & Živanović, L. (2019). Proizvodnja organskog krupnika (*Triticum spelta* L.) u Srbiji. Selekcija i semenarstvo, 25(1), 23-32, doi: 10.5937/SelSem1901023G.
21. Gomiero, T., Pimentel, D., & Paoletti, M. (2011). Environmental Impact of Different Agricultural Management Practices: Conventional vs. Organic Agriculture. *Critical Reviews in Plant Sciences*, 30(1-2), 95-124, doi: <https://doi.org/10.1080/07352689.2011.554355>.
22. Huertas García, A., Tabbita, F., Alvarez, J., Sillero, J., Ibba, M., Rakszegi, M., & Guzmán, C. (2023). Genetic variability for grain components related to nutritional quality in spelt and common wheat. *Journal of Agricultural and Food Chemistry*, 71(28), 10598-10606, doi: <https://doi.org/10.1021/acs.jafc.3c02365>
23. Iglesias, A., Garrote, L., Quiroga, S., & Moneo, M. (2012). A regional comparison of the effects of climate change on agricultural crops in Europe. *Climatic Change*, 112, 29-46, doi: <https://doi.org/10.1007/s10584-011-0338-8>.
24. Iizumi, T., & Wagai, R. (2019). Leveraging drought risk reduction for sustainable food, soil and climate via soil organic carbon sequestration. *Scientific Reports*, 9(1), 19744, doi: <https://doi.org/10.1038/s41598-019-55835-y>.
25. Jablonskytė Raščė, D., Maikštėnienė, S., & Mankevičienė, A. (2013). Evaluation of productivity and quality of common wheat (*Triticum aestivum* L.) and spelt (*Triticum spelta* L.) in relation to nutrition conditions. *Zemdirbyste-Agriculture*, 100(1), 45-56, doi: 10.13080/z-a.2013.100.007.
26. Jankovic, S., Ikanovic, J., Popovic, V., Rakic, S., Pavlovic, S., Ugrenovic, V., Simic, D., Doncic, D. (2015). Morphological and Productive Traits of Spelt Wheat (*Triticum spelta* L.), *Agriculture & Forestry*, 61(2), 173-182, doi: 10.17707/AgricultForest.61.2.15.
27. Jeločnik, M., Subić, J., & Nastić, L. (2021). Upravljanje troškovima na poljoprivrednim gazdinstvima (Cost management at the agricultural holdings). Institute of agricultural economics, Belgrade, Serbia.
28. Jeločnik, M., Zubović, J., & Zdravković, A. (2019). Estimating impact of weather factors on wheat yields by using panel model approach: The case of Serbia. *Agricultural water management*, 221, 493-501, doi: <https://doi.org/10.1016/j.agwat.2019.05.015>.
29. Jovanovic, Z., & Stikic, R. (2012). Strategies for improving water productivity and quality of agricultural crops in an era of climate change. In: Lee, T. (ed.) *Irrigation systems and practices in challenging environments*, IntechOpen, Rijeka, Croatia, pp. 77-102.

30. Kendall, C., DeJonge, A., & Kaleita, K. (2007). Simulating the effect of spatially variable irrigation on corn yield, costs, and revenue in Iowa. *Agricultural Water Management*, 92(1-2), 99-109, doi: <https://doi.org/10.1016/j.agwat.2007.05.008>.
31. Kiš, D., Kalambura, S., Marić, S., Guberac, V., Jovičić, N., Guberac, S., & Slipčević, D. (2016). Spelt (*Triticum spelta* L.): Healthy food. *Works of the Faculty of Agriculture, University of Sarajevo*, 61(66/1), 156-159.
32. Kolankowska, E., Choszcz, D., & Furyk Grabowska, K. (2023). An Analysis of the Spelt Dehulling Process in a Cylinder Separator. *Agricultural Engineering*, 27(1), 349-365, doi: 10.2478/agriceng-2023-0025.
33. Konvalina, P., Stehno, Y., & Moudrý, J. (2009). The critical point of conventionally bred soft wheat varieties in organic farming systems. *Agronomy Research*, 7(2), 801-810.
34. Kovačević, V. (2021). Analysis of current state and limiting factors for the development of organic sector in Serbia. *Western Balkan Journal of Agricultural Economics and Rural Development*, 3(1), 23-33, doi: 10.5937/WBJAE2101023K.
35. Krahl, M., Zarnkow, M., Back, W., & Becker, T. (2010). Determination of the influence of malting parameters on the water-extractable arabinoxylan content of wheat (*Triticum aestivum*), rye (*Secale cereale*), and spelt wheat (*Triticum aestivum* spp. *spelta*). *Journal of the American Society of Brewing Chemists*, 68(1), 34-40, doi: <https://doi.org/10.1094/ASBCJ-2009-1126-01>
36. Kresovic, B., Matovic, G., Gregoric, E., Djuricin, S., & Bodroza, D. (2014). Irrigation as a climate change impact mitigation measure: Agronomic and economic assessment of maize production in Serbia. *Agricultural Water Management*, 139, 7-16, doi: <https://doi.org/10.1016/j.agwat.2014.03.006>.
37. Lammerts van Bueren, E., Jones, S., Tamm, L., Murphy, K., Myers, J., Leifert, C., & Messmer, M. (2011). The need to breed crop varieties suitable for organic farming, using wheat, tomato and broccoli as examples: A review. *NJAS: Wageningen Journal of Life Sciences*, 58(3-4), 193-205, doi: <https://doi.org/10.1016/j.njas.2010.04.001>.
38. Lazarević, T., Petrović, T., Todorović, G., Sečanski, M., Golijan Pantović, J., & Lekić, S. (2022). Seed Vigour of Spelt Produced at the Maize Research Institute, Zemun Polje. *Journal of Agricultural Sciences*, 67(4), 355-366, doi: <https://doi.org/10.2298/JAS2204355L>.
39. Matović, G., Gregorić, E., & Glamčlija, Đ. (2013). Crop production and drought in Serbia in light of climate change. In: Redzepagic, S., Simoes, M. (eds.) *Agriculture in Serbia and Portugal: Recent Developments and Economic Policy Implications*, Faculty of Economics, University of Coimbra, Coimbra, Portugal, pp. 264-286.

40. McBride, D., Greene, C., Foreman, L., & Ali, M. (2015). The Profit Potential of Certified Organic Field Crop Production. Economic Research Report, no. 188, Economic Research Service, USDA, Washington, USA, retrieved at: <http://www.ers.usda.gov/media/1875181/err188.pdf>, 11<sup>th</sup> November 2023.
41. Medović, A., Marjanović Jeromela, A., & Mikić, A. (2021). An update to the La Tène plant economy in northern Serbia. *Ratarstvo i povrtarstvo*, 58(2), 53-65, doi: 10.5937/ratpov58-33250.
42. Milošević, D., Savić, S., Stojanović, V., & Popov Raljić, J. (2015). Effects of precipitation and temperatures on crop yield variability in Vojvodina (Serbia). *Italian Journal of agrometeorology*, 20(3), 35-46.
43. Moudrý, J., Konvalina, P., Stehno, Z., Capouchová, I., & Jan Moudrý, JrJ. (2011). Ancient wheat species can extend biodiversity of cultivated crops. *Scientific Research and Essay*, 6(20), 4273-4280.
44. Munoz Insa, A., Gastl, M., & Becker, T. (2016). Variation of sunstruck flavor-related substances in malted barley, triticale and spelt. *European Food Research and Technology*, 242, 11-23, <https://doi.org/10.1007/s00217-015-2513-z>
45. Novković, N., Filipović, J., Vukelić, N., Filipović, V., Vučurović, V., & Ivanišević, D. (2020). Economic and health aspects of spelt production and processing in AP Vojvodina. *Ekonomija: Teorija i praksa*, 13(1), 62-74, doi: 10.5937/etp2001062N.
46. NSS (2023). Nirvana. Portal of NS Seme doo (NSS), Novi Sad, Serbia, retrieved at: <https://nsseme.com/aktuelno/saveti-strucnjaka/nirvana-sorta-spelta-psenice-pogodna-za-gajenje-organskoj-proizvodnji/>, 15<sup>th</sup> November 2023.
47. Ortiz, N., Armada, E., Duque, E., Roldán, A., & Azcón, R. (2015). Contribution of arbuscular mycorrhizal fungi and/or bacteria to enhancing plant drought tolerance under natural soil conditions: effectiveness of autochthonous or allochthonous strains. *Journal of plant physiology*, 174, 87-96, doi: <https://doi.org/10.1016/j.jplph.2014.08.019>.
48. Pecelj, M., Lukić, M., Filipović, D., Protić, B., & Bogdanović, U. (2020). Analysis of the Universal Thermal Climate Index during heat waves in Serbia. *Natural Hazards and Earth System Sciences*, 20(7), 2021-2036, doi: <https://doi.org/10.5194/nhess-20-2021-2020>.
49. Pospisil, S., Pospisil, A., Svecnjak, M., & Matotan, Z. (2012). Influence of crop management upon the agronomic traits of spelt (*Triticum spelta* L.). *Plant, soil and environment*, 57(9), 435-440.
50. Rakszegi, M., Tóth, V., & Mikó, P. (2023). The place of spelt wheat among plant protein sources. *Journal of Cereal Science*, 114, 103813, doi: <https://doi.org/10.1016/j.jcs.2023.103813>

51. Ranhotra, G., Gelroth, J., Glaser, B., & Lorenz, K. (1995). Baking and nutritional qualities of a spelt wheat sample. *LWT-Food Science and Technology*, 28(1), 118-122, [https://doi.org/10.1016/S0023-6438\(95\)80022-0](https://doi.org/10.1016/S0023-6438(95)80022-0)
52. Rawat, L., Bisht, T., & Naithani, D. (2021). Plant disease management in organic farming system: Strategies and challenges. In: Singh, K., Jahagirdar, S., Sarma, B. (eds.) *Emerging Trends in Plant Pathology*, Springer, Singapore, pp. 611-642, doi: [https://doi.org/10.1007/978-981-15-6275-4\\_27](https://doi.org/10.1007/978-981-15-6275-4_27).
53. RHSS (2023). Hydrometeorological parameters from weather station Palić for observed period. Data upon request, Republic Hydrometeorological Service of Serbia (RHSS), Belgrade, Serbia.
54. Riedel, A., Pieper, L., Lautner, M., Leiding, C., Jung, M., & Schulze, M. (2023). Comparison of deep-litter bedding materials and analysis of semen traits in Piétrain boars: A randomized controlled field study. *Animal Reproduction Science*, 259, 107379, doi: <https://doi.org/10.1016/j.anireprosci.2023.107379>
55. Ruiz Menjivar, J., Gillen, M., & Gutter, M. (2015). Time Value of Money. In: Chaffin, C. (edt.) *Financial Planning Competency Handbook*, Wiley, New Jersey, USA, pp. 97-105, <https://doi.org/10.1002/9781119642473.ch11>
56. Simin, M., Trbić, D., Petrović, M., & Komaromi, B. (2019). Prices of organic products in the Republic of Serbia. *Western Balkan Journal of Agricultural Economics and Rural Development*, 1(2), 93-100, doi: 10.5937/WBJAE1902093T.
57. Singh, I., & Grover, D. (2011). Economic Viability of Organic Farming: An Empirical Experience of Wheat Cultivation in Punjab. *Agricultural Economics Research Review*, 24(2), 275-281.
58. Sinkovič, L., Rakszegi, M., Pipan, B., & Meglič, V. (2023). Compositional Traits of Grains and Groats of Barley, Oat and Spelt Grown at Organic and Conventional Fields. *Foods*, 12(5), 1054, doi: <https://doi.org/10.3390/foods12051054>
59. Sinkovic, L., Tóth, V., Rakszegi, M., & Pipan, B. (2023). Elemental composition and nutritional characteristics of spelt flours and wholemeals. *Journal of Elementology*, 28(1), 27-39, doi: 10.5601/jelem.2022.27.4.2358.
60. Smith, L., Williams, A., & Pearce, B. (2015). The energy efficiency of organic agriculture: A review. *Renewable Agriculture and Food Systems*, 30(3), 280-301, doi: <https://doi.org/10.1017/S1742170513000471>.
61. Subić, J., Jeločnik, M., Kovačević, V., Grujić Vučkovski, B. (2022). Estimation of Economic Effects of Processing of Organic Products in the case of Family Farms. In: Gostin et al. (eds.) *Course for trainers: Entrepreneurial innovation in agri-food science*. Alexandru Ioan Cuza University of Iasi, Romania, Institute of Agricultural Economy, Belgrade, pp. 175-195.

62. Subić, J., Jeločnik, M., Nastić, L., Vasile, J. (2021). Economic Effects of Plum Plantation Establishment. In: Subic et al. (eds.) Sustainable agriculture and rural development, Institute of Agricultural Economics, Belgrade, Serbia, pp. 149-162.
63. Sulewska, H., Koziara, W., Panasiewicz, K., & Ptaszyńska, G. (2008). Yielding of two spelt varieties depending on sowing date and sowing rate in central Wielkopolska conditions. *Journal of Research and Applications Agricultural Engineering*, 53(4), 85-91.
64. Takač, V., Viola T., Marianna R., Péter M., Mikić, S., & Mirosavljević, M. (2022). The Influence of Farming Systems, Genotype and Their Interaction on Bioactive Compound, Protein and Starch Content of Bread and Spelt Wheat. *Foods*, 11(24), 4028, doi: <https://doi.org/10.3390/foods11244028>.
65. Troccoli, A., & Codianni, P. (2005). Appropriate seeding rate for einkorn, emmer, and spelt grown under rainfed condition in southern Italy. *European Journal of Agronomy*, 22(3), 293-300, doi: <https://doi.org/10.1016/j.eja.2004.04.003>.
66. Vojnov, B., Manojlovic, M., Latkovic, D., Milosev, D., Dolijanovic, Ž., Simic, M., Babec, B., & Seremesic, S. (2020). Grain yield, yield components and protein content of organic spelt wheat (*Triticum spelta*L.) grown in different agro-ecological conditions of northern Serbia. *Ratarstvo i povrtarstvo*, 57(1), 1-7, doi: 10.5937/ratpov57-23867.
67. Vojnov, B., Manojlović, M., Latković, D., Milošev, D., Dolijanović, T., Simić, M., Babec, B., & Šeremešić, S. (2020). Grain yield, yield components and protein content of organic spelt wheat (*Triticum spelta* L.) grown in different agro-ecological conditions of northern Serbia. *Ratarstvo & Povrtarstvo*, 57(1), 1-7, doi: 10.5937/ratpov57-23867.
68. Wang, J., Baranski, M., Korkut, R., Kalee, H., Wood, L., Bilsborrow, P., & Volakakis, N. (2021). Performance of modern and traditional spelt wheat (*Triticum spelta*) varieties in rain-fed and irrigated, organic and conventional production systems in a semi-arid environment: Results from exploratory field experiments in Crete, Greece. *Agronomy*, 11(5), 890, doi: <https://doi.org/10.3390/agronomy11050890>.
69. Wells, A., Chan, K., & Cornish, P. (2000). Comparison of conventional and alternative vegetable farming systems on the properties of a yellow earth in New South Wales. *Agriculture, Ecosystems and Environment*, 80(1-2), 47-60, doi: [https://doi.org/10.1016/S0167-8809\(00\)00133-X](https://doi.org/10.1016/S0167-8809(00)00133-X).
70. Wójtowicz, A., Oniszcuk, A., Kasprzak, K., Olech, M., Mitrus, M., & Oniszcuk, T. (2020). Chemical composition and selected quality characteristics of new types of precooked wheat and spelt pasta products. *Food Chemistry*, 309, 125673, doi: <https://doi.org/10.1016/j.foodchem.2019.125673>.

71. Wójtowicz, A., Oniszczyk, A., Kasprzak, K., Olech, M., Mitrus, M., & Oniszczyk, T. (2020). Chemical composition and selected quality characteristics of new types of precooked wheat and spelt pasta products. *Food chemistry*, 309, 125673, doi: <https://doi.org/10.1016/j.foodchem.2019.125673>.
72. Yasin, A., Ashfaq, M., Adil, A., & Bakhsh, K. (2014). Profit efficiency of organic vs conventional wheat production in rice-wheat zone of Punjab, Pakistan. *Journal of Agricultural Research*, 52(3), 439-452.
73. Yonkova, G., Gancheva, A., & Kazalov, V. (2016). Comparative Characteristics Between Cultures: Common Wheat, Einkorn and Spelt. *New Knowledge Journal of Science*, 5(3), 38-42.
74. Zubović, J., Jeločnik, M., Zdravković, A., Subić, J., & Radovanović, S. (2018). Using Spatial and Seasonal Panel Model to Determine Impact of Climatic Factors on Maize Yields in Serbia. *Romanian biotechnological letters*, 23(2), 13383-13393.
75. Zuk Golaszewska, K., Majewska, K., Tyburski, J., & Golaszewski, J. (2022). Nutritional properties of organic spelt wheats in different growth stages and the resulting flours. *Journal of Elementology*, 27(3), 645-662, doi: 10.5601/jelem.2022.27.1.2267.





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# APPLICATION OF FUZZY METRICS IN CLUSTERING PROBLEMS OF AGRICULTURAL CROP VARIETIES

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## ABSTRACT

The problem of image-based detection of the variety of beans, using artificial intelligence, is currently dealt with by scientists of various profiles. The idea of this paper is to show the possibility of applying different types of distances, primarily those that are fuzzy metrics, in clustering models in order to improve existing models and obtain more accurate results. The paper presents the method of variable neighborhood search, which uses both standard and fuzzy t-metrics and dual fuzzy s-metrics characterized by appropriate parameters. By varying those parameters of the fuzzy metric as well as the parameters of the metaheuristic used, we have shown how it is possible to improve the clustering results. The obtained results were compared with existing ones from the literature. The criterion function used in clustering is a fuzzy metric, which is proven in the paper.

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## Introduction

When it comes to agricultural products, the dry bean (*Phaseolus vulgaris* L.) is the most important and the most produced (Fabaceae - Leguminosae) legume worldwide. The United Nations General Assembly declared 2016 the International Year of Brewing with the role “Nutritious grains for a secure future” considering that this group of crops is the

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source protein and high energy food. The most widespread legumes or grain legumes in the world are beans, dry peas and lentils, and in Serbia beans are indisputable (Vasić et al., 2019). The taste of beans and dishes made from them are so popular that many peoples consider them to be its national dish. In terms of its nutrition, it is one of the richest sources vegetable proteins, and often the only one for the poor population of the planet. Except tall their protein content is high and their quality is high, and their composition is also high usability in the human body can be a substitute for meat (Tepić et al., 2007). Starchy food is important, and thus energy food, which is also significant for the poor segment of the population. For a modern, urban man oriented towards life with little physical activity, it is especially important as source of dietary fibers, ballast substances, also necessary in the diet (Costa et al., 2006), as well as antioxidant substances (Karadžić Banjac et al., 2019). In addition to the chemical composition, an important role is played in assessing the quality of bean grains there is also a cooking time. Apart from food, beans are also used for other purposes, such as example for wastewater treatment (Šćiban et al., 2010).

In modern agriculture where special attention is paid to sustainability and economics of leguminous production, and thus beans, occupy an important a valued place primarily because of its ability to interact with bacteria of the *Rhizobium* sp. they fix nitrogen from the air and thereby increase soil fertility. That's right additional food is also provided to plants in combined crops with legumes.

Beans can be successfully grown together with other crops, as they tolerate it well shade, and the microclimate that prevails during the gathering is very pleasing to him. Apart from that the advantage is the short growing season of modern varieties, which in our climatic conditions, enables the cultivation of beans as a second crop. But the short growing season of beans, as well as being in the field in the hottest time of the year makes the production of beans very intensive and risky. All agrotechnical measures must be not only adequate but also timely because every day of delay means a lot. This could be mitigated by providing better conditions for the growth and development of bean crops. Adequate nutrition, achieving the optimal composition of plants, irrigation and crop protection should be highlighted here. Unfortunately, protection against predominant diseases and pests in our country is usually insufficient effective, late, inadequate and too late, both due to inadequate choice of variety, establishment and care of crops, i.e. prevention, as well as due to poor information about the occurrence of the disease and pests and how to protect them.

It occupies a special role in the agriculture. It is sensitive to climate change and this can be mitigated by breeding the seed variety. Finding the best seed, not only for this variety, but also for plant varieties with similar problems, is a challenge for agriculture (Wakchaure et al., 2023). The reason lies in the fact that with such varieties, without breeding and finding a new variety that would be more resistant to climate changes, even if all conditions are met, the quality of production cannot be increased. Namely, seeds of lower quality in production will lead to a lower quantity, even if all the conditions for cultivation are provided. Dry beans are native to the Americas, while there is genetic diversity around the world (Koklu et al., 2020).

You can see how the production of beans in the world is moving in Figure 1. The biggest producer is Asia with 43.9%, than America with 31.9%, Africa 21.6%, Europe 2.3% and Oceania 0.3%.

**Figure 1.** Production/Yield quantities of Beans, dry in World + (Total) 1994 – 2022



Source: downloaded from <https://www.fao.org/faostat/en/#data/QCL/visualize>

Analysis and classification (Halder et al., 2023) of dry bean genotypes, which are very common in Turkey and around the world, constitute one of the main processes in crop production. Characteristics of dry beans determined by physical dimensions, such as appearance, size, color, interior and variety increase market value. Identification of bean varieties helps farmers to use seeds for planting and marketing. Manual classification and sorting of bean varieties is a long, inefficient and painstaking job. The problem of detecting the variety of beans based on an image, using artificial intelligence, is one of the current ones that scientists of various profiles deal with. For these reasons, it is good to apply artificial intelligence techniques and use its power, in order not only to facilitate this process and similar ones, but also to speed up development (Shukla et al., 2023). In the last few years, the application of artificial intelligence to various problems in agriculture is current, from image processing problems, up to prediction and optimization.

The idea of this paper is to show through a concrete example the application of mathematical models that can improve and speed up the solution of this problem. The work is divided into several sections. The next section will deal with the description of the distances used in the clustering procedure presented in this paper, as well as their applications not only in genetics and agricultural sciences, but also in other applied sciences where problems of a similar nature have arisen. In the first subsection, the definition of the fuzzy metric and the proven claim that the function that is used as a criterion function and whose arguments of the fuzzy metric are also fuzzy metrics are proven. We will also show how we used the variable environment method applied

to this problem. In the Data Description section, the data that were used, what they represent and how the final conclusions were obtained based on them will be shown. The conclusions will be discussed in more detail in that section.

## Materials and methods

### Materials

In order to perform the analysis and classification of bean genotypes, we will consider its characteristics determined by physical dimensions (appearance, size, color, interior and variety), which we can examine using appropriate sample images. That's why the so-called are used in image analysis. shape descriptors (area and perimeter of the shape) of which we use some of them, such as the 16 features listed below.

In this research, Koklu et al., 2020 set up a camera and recorded the types of beans. The camera was connected to a computer and the image was converted into a signal using MATLAB R2016a. In total, 13,611 dry bean samples were obtained from 236 images. A detailed description of each attribute (features vectors) with which the grains are described can be seen at <https://archive.ics.uci.edu/dataset/602/dry+bean+dataset>.

The types of beans considered are Seker, Barbunya, Bombay, Cali, Derosan, Horoz and Sira.

### Fuzzy metric

The concept of distance in different sciences and applications can be interpreted in different ways. Mathematically, the distance is a non-negative symmetric function that assigns a non-negative number to each pair of elements (their order is not important) of a set (objects), and assigns 0 to two of the same elements. It can also be interpreted as the similarity or difference of two objects, and often and belonging to a group. We will use this feature of the distance in this paper for the clustering procedure.

The distance defined over a nonempty set  $U$  encompasses a wide family of mappings  $d$  from  $U^2$  to  $[0, +\infty)$ . Depending on the research needs,  $d$  is required to have some important properties. Thus, the distance  $d : U^2 \rightarrow [0, \infty)$  that satisfies the conditions:

- 1)  $d(\eta, \zeta) = 0 \Leftrightarrow \eta = \zeta$ ;
- 2)  $d(\eta, \zeta) = d(\zeta, \eta)$ ;
- 3)  $d(\eta, \psi) \leq d(\eta, \zeta) + d(\zeta, \psi)$ .

is called *metric* and  $(U, d)$  is called *metric space* (m.s). If  $U = R$  (real set) the usual Euclidean distance  $d(u, v) = |u - v|$  is a metric.

It can be noticed that the distance between two object does not have to be a non-negative real number, but it can be taken to be, for example, a fuzzy set. Such generalization of distances is very useful in applications.

In order to define the notions the fuzzy  $S$ -metric and the fuzzy  $T$ -metric, the triangular norm (shorter  $t$ -norm) and triangular conorm (shorter  $t$ -conorm) are used (more details, for example, in book Klir et al., 1995).

The function  $T: [0,1]^2 \rightarrow [0,1]$  ( $S: [0,1]^2 \rightarrow [0,1]$ ) is  $t$ -norm ( $t$ -conorm) if it satisfies: associativity, commutativity, monotonicity and 1 (0) is neutral element.

The most widely used  $t$ -norms are:  $T_M(a,b) = \min\{a,b\}$  and  $T_P(a,b) = ab$  and their dual conorms:  $S_M(a,b) = \max\{a,b\}$  and  $S_P(a,b) = a + b - ab$ .

Let  $g: [0,1] \rightarrow [0,1]$  be an increasing continuous mapping such that  $g(0) = 0$  and  $g(1) = 1$ . We will say  $g \in G$ . It is easy to show that with

$$T_g(u_1, u_2) = u_1 \otimes u_2 = g^{-1}(g(u_1)g(u_2))$$

a  $t$ -norm is defines the so called *pseudo multiplication* generated by  $g$ .

We will give the definition of fuzzy metrics and some examples that we use in this paper (more details, for example, in the papers Gregori et al., 2011, Ralević et al., 2019, Ralević et al., 2022).

**Definition 1.** Let  $U$  be a non-empty set, and  $T$  ( $S$ ) a continuous  $t$ -norm ( $t$ -conorm). A fuzzy set  $\mathbf{t}$  ( $\mathbf{s}$ ) defined on  $U \times U \times (0, +\infty)$  is called a *fuzzy  $T$ -metric* (shortly f.T.m.) (*fuzzy  $S$ -metric* (shortly f.S.m.)) if the following conditions for all  $\eta, \zeta, \psi \in U, \alpha, \beta > 0$ , hold:

$$1) \mathbf{t}(\eta, \zeta, \alpha) \in (0, 1] \quad (\mathbf{s}(\eta, \zeta, \alpha) \in [0, 1]);$$

$$2) \mathbf{t}(\eta, \zeta, \alpha) = 1 \Leftrightarrow \eta = \zeta \quad (\mathbf{s}(\eta, \zeta, \alpha) = 0 \Leftrightarrow \eta = \zeta);$$

$$3) \mathbf{t}(\eta, \zeta, \alpha) = \mathbf{t}(\zeta, \eta, \alpha) \quad (\mathbf{s}(\eta, \zeta, \alpha) = \mathbf{s}(\zeta, \eta, \alpha));$$

$$4) T(\mathbf{t}(\eta, \zeta, \alpha), \mathbf{t}(\zeta, \psi, \beta)) \leq \mathbf{t}(\eta, \psi, \alpha + \beta)$$

$$(\mathbf{S}(\mathbf{s}(\eta, \zeta, \alpha), \mathbf{s}(\zeta, \psi, \beta)) \geq \mathbf{s}(\eta, \psi, \alpha + \beta))$$

$$5) \mathbf{t}(\eta, \zeta, \_): (0, +\infty) \rightarrow [0, 1] \quad (\mathbf{s}(\eta, \zeta, \_): (0, +\infty) \rightarrow [0, 1]) \text{ is a continuous function.}$$

**Example 1.** The mapping  $\mathbf{t}_p : U \times U \times (0, +\infty) \rightarrow (0, 1]$ ,  $U \subseteq R_0^+$ , defined by

$$\mathbf{t}_p(\eta, \varsigma) = \frac{\left(\frac{\eta^p + \varsigma^p}{2}\right)^{1/p} + L}{\max\{\eta, \varsigma\} + L},$$

$L > 0, p \geq 1$  is a f.T.m. with respect to  $T_p$  (see Milosavljević et al., 2023) and its dual (with respect to standard fuzzy complement)

$$\mathbf{s}_p(\eta, \varsigma) = 1 - \mathbf{t}_p(\eta, \varsigma) = \frac{\max\{\eta, \varsigma\} - \left(\frac{\eta^p + \varsigma^p}{2}\right)^{1/p}}{\max\{\eta, \varsigma\} + L}$$

is a f.S.m. with respect to  $S_p$ .

Specially,  $\mathbf{t}_1(\eta, \varsigma) = \frac{\frac{\eta + \varsigma}{2} + L}{\max\{\eta, \varsigma\} + L}$ ,  $\mathbf{s}_1(\eta, \varsigma) = 1 - \mathbf{t}_1(\eta, \varsigma) = \frac{|\eta - \varsigma|}{\max\{\eta, \varsigma\} + L}$

**Example 2.** The mapping  $\Delta : U \times U \times (0, +\infty) \rightarrow (0, 1]$ ,  $U \subseteq R_0^+$ , defined by

$$\Delta(\eta, \varsigma) = \frac{\min\{\eta, \varsigma\} + L}{\max\{\eta, \varsigma\} + L},$$

$L > 0$ , is a f.T.m. with respect to  $T_p$  and its dual (with respect to standard fuzzy complement)

$$\Sigma(\eta, \varsigma) = 1 - \Delta(\eta, \varsigma) = \frac{|\eta - \varsigma|}{\max\{\eta, \varsigma\} + L}$$

is a f.S.m. with respect to  $S_p$ .

**Example 3.** If  $(U, d)$  is a m.s., then the mapping  $\tau_{h(t)} : U^2 \times R^+ \rightarrow R$  defined by

$$\tau_{h(t)}(\eta, \varsigma, t) = \frac{h(t)}{h(t) + d(\eta, \varsigma)}$$

is a f.T.m. with respect to the  $T_p$  and its dual (with respect to the standard fuzzy complement) is a f.S.m. with respect to  $S_p$ .

$$\sigma_{h(t)}(\eta, \zeta, t) = 1 - \tau_{h(t)}(\eta, \zeta, t) = \frac{d(\eta, \zeta)}{h(t) + d(\eta, \zeta)}$$

The results for the special case, when function  $h(t)=L$ ,  $L = const$  and  $d(\eta, \zeta) = |\eta - \zeta|$ , are shown in Table 2.

**Theorem 1.** Let  $g \in G$  and  $g_j \in G, j \in J = \{1, \dots, n\}$ . If  $\mathbf{d}_j : U_j \times U_j \rightarrow (0, 1]$ ,  $j \in J$  are f.T.m.s with respect to t-norms  $T_j, j \in J$  generated by  $g_j \in G$ , respectively, then the mapping  $\mathbf{d} : U^2 \rightarrow [0, 1]$ ,  $U = U_1 \times \dots \times U_n$  given by

$$\mathbf{d}(\eta, \zeta, \alpha) = g^{-1} \left( g_1(\mathbf{d}_1(\eta_1, \zeta_1, \alpha)) \cdot g_2(\mathbf{d}_2(\eta_2, \zeta_2, \alpha)) \cdot \dots \cdot g_n(\mathbf{d}_n(\eta_n, \zeta_n, \alpha)) \right),$$

$\eta = (\eta_1, \dots, \eta_n)$ ,  $\zeta = (\zeta_1, \dots, \zeta_n)$ , is a f.T.m. with respect to triangular norm  $T$  generated by  $g \in G$ .

Proof.

1.  $\mathbf{d}_j(\eta_j, \zeta_j, \alpha) \in (0, 1], j \in J \Rightarrow g_j(\mathbf{d}_j(\eta_j, \zeta_j, \alpha)) \in (0, 1], j \in J \Rightarrow$

$$g_1(\mathbf{d}_1(\eta_1, \zeta_1, \alpha)) \cdot g_2(\mathbf{d}_2(\eta_2, \zeta_2, \alpha)) \cdot \dots \cdot g_n(\mathbf{d}_n(\eta_n, \zeta_n, \alpha)) \in (0, 1] \Rightarrow$$

$$\mathbf{d}(\eta, \zeta, \alpha) \in (0, 1]$$

2.  $\eta = \zeta \Leftrightarrow \eta_j = \zeta_j, j \in J \Leftrightarrow$

$$\mathbf{d}_j(\eta_j, \zeta_j) = 1, j \in J \Rightarrow \mathbf{d}(\eta, \zeta, \alpha) = g^{-1}(g_1(1) \cdot g_2(1) \cdot \dots \cdot g_n(1)) = g^{-1}(1 \cdot \dots \cdot 1) = 1.$$

How  $g \in G$  and  $g^{-1}(a) = 1 \Leftrightarrow a = 1$ , then

$$a_1, \dots, a_n \in [0, 1], a_1 \cdot \dots \cdot a_n = 1 \Leftrightarrow a_1 = 1 \wedge \dots \wedge a_n = 1, \text{ and then}$$

$$\mathbf{d}(\eta, \zeta, \alpha) = g^{-1} \left( g_1(\mathbf{d}_1(\eta_1, \zeta_1, \alpha)) \cdot g_2(\mathbf{d}_2(\eta_2, \zeta_2, \alpha)) \cdot \dots \cdot g_n(\mathbf{d}_n(\eta_n, \zeta_n, \alpha)) \right) = 1$$

$$\Leftrightarrow g_1(\mathbf{d}_1(\eta_1, \zeta_1, \alpha)) = g_2(\mathbf{d}_2(\eta_2, \zeta_2, \alpha)) = \dots = g_n(\mathbf{d}_n(\eta_n, \zeta_n, \alpha)) = 1$$

$$\Leftrightarrow \mathbf{d}_1(\eta_1, \zeta_1, \alpha) = \mathbf{d}_2(\eta_2, \zeta_2, \alpha) = \dots = \mathbf{d}_n(\eta_n, \zeta_n, \alpha) = 1$$

$$\Leftrightarrow \eta_j = \zeta_j, j \in J \Leftrightarrow \eta = \zeta.$$

3.  $\mathbf{d}(\eta, \zeta, \alpha) = g^{-1} \left( g_1(\mathbf{d}_1(\eta_1, \zeta_1, \alpha)) \cdot g_2(\mathbf{d}_2(\eta_2, \zeta_2, \alpha)) \cdot \dots \cdot g_n(\mathbf{d}_n(\eta_n, \zeta_n, \alpha)) \right)$

$$= g^{-1} \left( g_1(\mathbf{d}_1(\zeta_1, \eta_1, \alpha)) \cdot g_2(\mathbf{d}_2(\zeta_2, \eta_2, \alpha)) \cdot \dots \cdot g_n(\mathbf{d}_n(\zeta_n, \eta_n, \alpha)) \right) = \mathbf{d}(\zeta, \eta, \alpha)$$



4. From the fourth axiom for  $\mathbf{d}_j, j \in J$

$$\begin{aligned}
 & \mathbf{d}(\eta, \zeta, \alpha + \beta) = \\
 & g^{-1} \left( g_1(\mathbf{d}_1(\eta_1, \zeta_1, \alpha + \beta)) \cdot g_2(\mathbf{d}_2(\eta_2, \zeta_2, \alpha + \beta)) \cdot \dots \cdot g_n(\mathbf{d}_n(\eta_n, \zeta_n, \alpha + \beta)) \right) \\
 & \geq g^{-1} \left( g_1(T_1(\mathbf{d}_1(\eta_1, \psi_1, \alpha), \mathbf{d}_1(\psi_1, \zeta_1, \beta))) \cdot \dots \cdot g_n(T_n(\mathbf{d}_n(\eta_n, \psi_n, \alpha), \mathbf{d}_n(\psi_n, \zeta_n, \beta))) \right) \\
 & = g^{-1} \left( g_1(\mathbf{d}_1(\eta_1, \psi_1, \alpha)) \cdot g_1(\mathbf{d}_1(\psi_1, \zeta_1, \beta)) \cdot \dots \cdot g_n(\mathbf{d}_n(\eta_n, \psi_n, \alpha)) \cdot g_n(\mathbf{d}_n(\psi_n, \zeta_n, \beta)) \right) \\
 & = g^{-1} \left( g_1(\mathbf{d}_1(\eta_1, \psi_1, \alpha)) \cdot \dots \cdot g_n(\mathbf{d}_n(\eta_n, \psi_n, \alpha)) \cdot g_1(\mathbf{d}_1(\psi_1, \zeta_1, \beta)) \cdot \dots \cdot g_n(\mathbf{d}_n(\psi_n, \zeta_n, \beta)) \right) \\
 & = g^{-1} \left( g \circ g^{-1} \left( g_1(\mathbf{d}_1(\eta_1, \psi_1, \alpha)) \cdot \dots \cdot g_n(\mathbf{d}_n(\eta_n, \psi_n, \alpha)) \right) \right. \\
 & \cdot \left. g \circ g^{-1} \left( g_1(\mathbf{d}_1(\psi_1, \zeta_1, \beta)) \cdot \dots \cdot g_n(\mathbf{d}_n(\psi_n, \zeta_n, \beta)) \right) \right) \\
 & = g^{-1} \left( g(\mathbf{d}(\eta, \psi, \alpha)) \cdot g(\mathbf{d}(\psi, \zeta, \beta)) \right) \\
 & = \mathbf{d}(\eta, \psi, \alpha) \otimes \mathbf{d}(\psi, \zeta, \beta).
 \end{aligned}$$

5) From continuity of metrics  $\mathbf{d}_j, j \in J$  and mapp  $g$ , follows continuity of

$$\mathbf{d}(\eta, \zeta, \_): (0, +\infty) \rightarrow [0, 1] . \quad \square$$

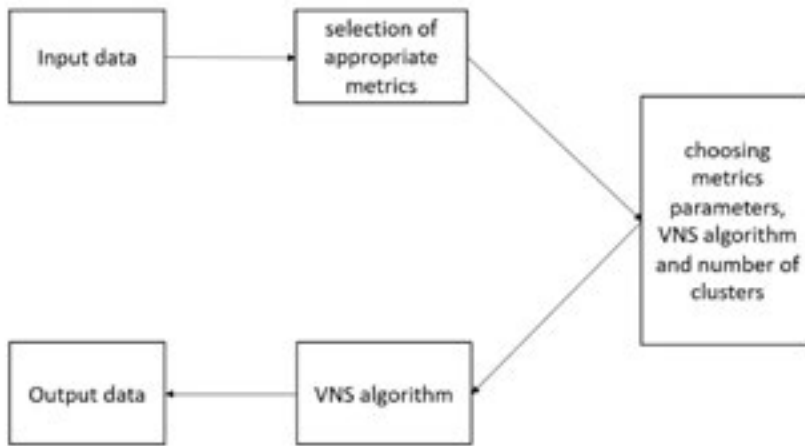
Note that we will use the distance determined in this way as a measure of the object's belonging to a cluster.

### Variable neighborhood search

The variable neighborhood search (VNS) is a metaheuristic that was mathematically founded by Mladenović et al., 1997. It is based on a single solution and a search of its environments. The systematic use of multiple environments increases the efficiency of the search. VNS (Hansen et al., 2001.) relies on three simple facts:

- 1) The local optimum in relation to one environment does not have to be the optimum in relation to another
- 2) The global optimum is local in relation to each environment
- 3) For most problems, the local optimums in relation to various environments are relatively close.

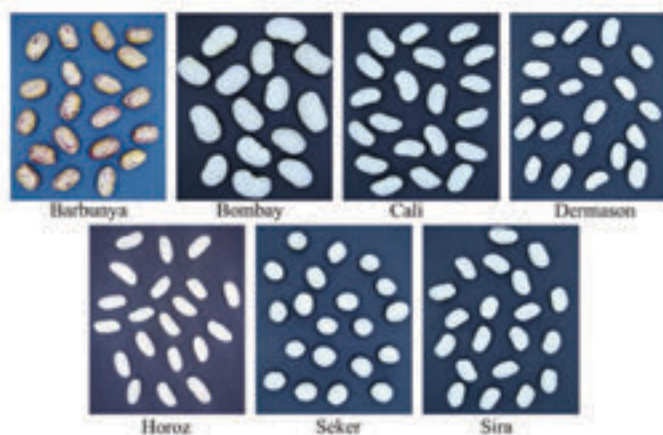
In this work, we applied this method in order to better cluster dry bean varieties. You can see the description of the algorithm in Figure 2.

**Figure 2.** Description of the step-by-step algorithm applied for clustering.

Source: Authors' figure

## Results

We downloaded the data used in this work from the website <https://archive.ics.uci.edu/dataset/602/dry+bean+dataset> (Dry Bean Dataset. (2020). UCI Machine Learning Repository. <https://doi.org/10.24432/C50S4B>). This database contains 7 different types of dry beans, where characteristics such as shape, type and structure are taken into account according to the market situation. For the classification model, 13,611 grains were used, 7 different registered dry grains (Figure 3.) were recorded with high-resolution cameras (more details in the paper Koklu et al., 2020. Images subjected to this kind of computer processing and segmentation, from which 16 characteristics were obtained for each grain, were used in the analysis of our proposed model.

**Figure 3.** Sample of taken dry bean images.

Source: Koklu et al., 2020

If we look at the descriptive statistics of the characteristic vectors of the beans (Table 1.) we can notice large changes in mean values, median, standard deviation and variance. These were some of the reasons why we do not use some of those values for centroids in our algorithm. Candidates for centroids in our algorithm are values from the database.

**Table 1.** Descriptive statistics feature vectors

Feature vectors	Mean	Median	Std. Deviation	Variance
1	53048.28	44652	29324.1	8.6E+08
2	855.2835	794.941	214.2897	45920.07
3	320.1419	296.8834	85.69419	7343.494
4	202.2707	192.4317	44.97009	2022.309
5	1.5832	1.5511	0.24668	0.061
6	0.7509	0.7644	0.092	0.008
7	53768.2	45178	29774.92	8.87E+08
8	253.0642	238.438	59.17712	3501.932
9	0.7497	0.7599	0.04909	0.002
10	0.9871	0.9883	0.00466	0
11	0.8733	0.8832	0.05952	0.004
12	0.7999	0.8013	0.06171	0.004
13	0.0066	0.0066	0.00113	0
14	0.0017	0.0017	0.0006	0
15	0.6436	0.642	0.099	0.01
16	0.9951	0.9964	0.00437	0

*Source:* Authors' calculations

The results we obtained compared with the results obtained in the work of Koklu et al., 2020 are shown in Table 2. The input data is the feature vector data of the publicly available database that we used. By metrics and their selection (Figure 2.), we mean the metrics presented in the methodology of this work. The output of the algorithm is the percentage of successful clustering of bean varieties. Since we obtained a unique best performance for changing the parameters of various phase metrics, we put it in Table 2. in bold. You can see how the performance values moved by varying certain parameters. We varied the parameter  $p$ , while the parameter  $K$  was 1.

**Table 2.** Results classification.

Name of methods	Accuracy (%)
MLP (Koklu et al., 2020,)	91.73
SVM (Koklu et al., 2020,)	93.13
DT (Koklu et al., 2020,)	87.92
kNN (Koklu et al., 2020,)	92.52
VNS metric $\Delta$	96.01

Name of methods	Accuracy (%)
VNS metric $s_1$	95.71
VNS metric $s_2$	94.22
VNS metric $s_3$	<b>96.12</b>
VNS metric $t_1$	95.71
VNS metric $t_2$	94.22
VNS metric $t_3$	<b>96.12</b>
VNS metric $\Sigma$	96.01
VNS euclidean distance	93.98
VNS special case metric $\tau$	95.02
VNS special case metric $\sigma$	95.02

Source: Autor's and Koklu et al., 2020, calculations.

## Discussions

In this paper, we have shown on one example, by changing only some values of the distance parameters, how the success of the clustering algorithm can be improved by using different distances. In comparison with the results obtained by Koklu et al., 2020 the success of some other clustering techniques and our VNS proposed model, we see that the success rates are also different. Our proposed model further performs better in all applications. Details of the results can be seen in Table 2. The application of each of the proposed metrics performed better than the performance of the model in Koklu et al., 2020. One can also see how the performance results change when the metrics and their parameters are changed. The best score is marked in bold in Table 2. Success in this case means how many bean varieties are distributed in those cluster groups to which it really belongs in reality. The percentage of that success is shown in the Table 2.

The proposed model has a wide application in agricultural problems. In addition to this problem, clustering methods can also solve the problems of detecting diseases that attack vegetables and fruits. Also, by analyzing the image in similar ways, we can detect the stages of fruit development. These are just some of the problems.

## Conclusions

The proposed model showed better performance compared to others in Koklu et al., 2020. The entire work, which relies on the results presented in the work of other scientists, opens up possibilities for further research, and some of them are the possibilities of image processing in different ways, the possibility of improving and combining existing methods, as well as finding adequate distances that would lead to a more accurate model.

Khan et al. 2023 did similar research. They proposed other classifiers. They proposed an algorithm that reduces oversampling deviations and found better classifiers in that sense. Our results perform with higher accuracy. Dogan et al. 2023 in his study presents different proposals for finding classifiers. With him, the number of them has been

reduced to 14. He combines various methods to achieve better precision. Taspinar et. al. 2022. in his work, he studies the classification of beans using deep learning techniques.

Diseases are an inevitable part of this topic. They limit the maximum yields. Little work is done in this field, especially to determine the degree of crop damage. The modeling that I deal with in this paper can be applied to these problems as well. Image processing is applicable to any type of images with minor modifications and refinements of the algorithm. Problems similar to this one were investigated by Hashemi-Beni et al. 2020. In their work, they propose a model that uses deep learning methods in precise agriculture. It especially deals with the problem of weeds and crop damage. He included a large number of paintings in his studio. Similar to these studies can be seen in Kumar et al. 2023. This paper deals with the sampling of vegetable leaves. Image processing uses different machine learning processes, using different classifiers.

Our future research will expand in these directions.

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### Conflict of interests

The authors declare no conflict of interest.

### References

1. de Almeida Costa, G. E., da Silva Queiroz-Monici, K., Reis, S. M. P. M., & de Oliveira, A. C. (2006). Chemical composition, dietary fibre and resistant starch contents of raw and cooked pea, common bean, chickpea and lentil legumes. *Food chemistry*, 94(3), 327-330.
2. Dogan, M., Taspinar, Y. S., Cinar, I., Kursun, R., Ozkan, I. A., & Koklu, M. (2023). Dry bean cultivars classification using deep cnn features and salp swarm algorithm based extreme learning machine. *Computers and Electronics in Agriculture*, 204, 107575.
3. Gregori, V., Morillas, S., & Sapena, A. (2011). Examples of fuzzy metrics and applications. *Fuzzy sets and systems*, (170), 95-111.
4. Halder, S., Bhattacharya, S., Roy, M. B., & Roy, P. K. (2023). Application of fuzzy C-means clustering and fuzzy EDAS to assess groundwater irrigation suitability and prioritization for agricultural development in a complex hydrogeological basin. *Environmental Science and Pollution Research*, 30(20), 57529-57557.
5. Hansen, P., & Mladenović, N. (2001). Variable neighborhood search: Principles and applications. *European journal of operational research*, 130(3), 449-467.

6. Hashemi-Beni, L., & Gebrehiwot, A. (2020). Deep learning for remote sensing image classification for agriculture applications. *The International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences*, 51-54. <https://doi.org/10.1016/j.fss.2010.10.019>
7. Karadžić Banjac, M., Kovačević, S., Tepić Horecki, A., Šumić, Z., Vakula, A., Podunavac Kuzmanović, S., & Jevrić, L. (2019). Toward consistent discrimination of common 742 BILJNI LEKAR / PLANT DOCTOR, 49, 6/2021 bean (*Phaseolus vulgaris* L.) based on grain coat color, phytochemical composition, and antioxidant activity. *J Food Process Preserv.* 2019; 43: e14246.
8. Khan, M. S., Nath, T. D., Hossain, M. M., Mukherjee, A., Hasnath, H. B., Meem, T. M., & Khan, U. (2023). Comparison of multiclass classification techniques using dry bean dataset. *International Journal of Cognitive Computing in Engineering*, 4, 6-20.
9. Klir, G.J., & Yuan, B. (1995). *Fuzzy sets and fuzzy logic, theory and applications*. Prentice Hall, New Jersey.
10. Koklu, M., & Ozkan, I. A. (2020). Multiclass classification of dry beans using computer vision and machine learning techniques. *Computers and Electronics in Agriculture*, 174, 105507.
11. Kumar, C., & Kumar, V. (2023, March). Vegetable plant leaf image classification using machine learning models. In *Proceedings of Third International Conference on Advances in Computer Engineering and Communication Systems: ICACECS 2022* (pp. 31-45). Singapore: Springer Nature Singapore.
12. Milosavljević, N. S., & Ralević, N. M. (2023). Fuzzy methaheuristic model for copy-move forgery detection on images. *Multimedia Tools and Applications*, DOI: 10.1007/s11042-023-17053-7
13. Mladenović, N., & Hansen, P. (1997). Variable neighborhood search. *Computers & operations research*, 24(11), 1097-1100.
14. Ralević, N. M., Delić, M., & Nedović, Lj. (2022). Aggregation of fuzzy metrics and its application in image segmentation. *Iranian journal of fuzzy systems* 19(3), 19-37. DOI: <https://doi.org/10.22111/ijfs.2022.6941>
15. Ralević, N. M., Karaklić, D., & Pištinjat, N. (2019). Fuzzy metric and its applications in removing the image noise. *Soft Computing* 23(22), 12049–12061. DOI: 10.1007/s00500-019-03762-5, <http://link.springer.de/link/service/journals/00500/index.htm>
16. Ralević, N., & Paunović, M. (2021). Applications of the Fuzzy Metrics in Image Denoising and Segmentation. *Tehnički vjesnik - Technical Gazette* 28(3), 819-826. DOI: <https://doi.org/10.17559/TV-20200305075136>
17. Šćiban, M. B., Vasić, M. A., Prodanović, J. M., Antov, M. G., & Klačnja, M. T. (2010). The investigation of coagulation activity of natural coagulants extracted from different strains of common bean. *APTEFF*, 41, 141- 147.

18. Shukla, M. K., & Sharma, P. (2023). Fuzzy k-means and principal component analysis for classifying soil properties for efficient farm management and maintaining soil health. *Sustainability*, 15(17), 13144.
19. Taspinar, Y. S., Dogan, M., Cinar, I., Kursun, R., Ozkan, I. A., & Koklu, M. (2022). Computer vision classification of dry beans (*Phaseolus vulgaris* L.) based on deep transfer learning techniques. *European Food Research and Technology*, 248, 2707–2725. <https://doi.org/10.1007/s00217-022-04080-1>
20. Tepić, A., Vujičić, B., Vasić, M., & Lučić A. (2007). Amino acids and phytic acid in some Serbian varieties of dry beans (*Phaseolus vulgaris*); *Proc. of the 2nd Internat. Cong. on Food and Nutrition*, 24-26 October 2007, Istanbul, Turkey, 180-182.
21. Vasić, M., Malidža, G, & Rajković, M. (2019). Prinos pasulja u združenoj setvi sa kukuruzom tolerantnim na cikoksidim. Zbornik radova 1, *XXIV Savetovanje o biotehnologiji sa međunarodnim učešćem, Čačak*, 15-16 mart 2019., 141-148. [in English: Vasić, M., Malidža, G, & Rajković, M. (2019). Yield of beans in joint sowing with maize tolerant to cycoksidim. *Proceedings 1, XXIV Conference on Biotechnology with International Participation, Čačak*, March 15-16, 2019, 141-148.]
22. Wakchaure, M., Patle, B. K., & Mahindrakar, A. K. (2023). Application of AI techniques and robotics in agriculture: A review. *Artificial Intelligence in the Life Sciences*, 100057.

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# KEY FACTORS OF PROMOTING INNOVATIVE PERFORMANCE IN AGRIBUSINESS SMEs: PROJECT AN EMPIRICAL METHOD

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## ABSTRACT

The main goal of the research is to determine the effects of the selected factors (organization culture, organization learning, market orientation and innovation culture) on the innovation performance of small and medium-sized enterprises in agribusiness. The Structural Equation Modeling method was used to test the research hypotheses. The results showed that the selected factors are significant determinants of innovative performance. In addition, the relationship between organizational culture and innovation performance, as well as organizational learning and innovation performance, was found to be fully mediated, and the relationship between market orientation and innovation performance was found to be partially mediated by innovation culture. Small and medium-sized businesses should be empowered in the globalized and fiercely competitive market of today by fostering product innovation, investing in the development of human resources and technology, and broadening their market reach. These initiatives are essential to enhancing their marketing plans and successfully taking on competitors.

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## Introduction

Developing countries are increasingly relying on the SME sector for their economic growth and development, following the lead of established countries. At the start of the twenty-first century, the Republic of Serbia underwent institutional reforms that significantly advanced the establishment of a framework for promoting and assisting the growth of SMEs and improved the business environment (Kostadinović and

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Stanković, 2021). Serbian agriculture has the potential to significantly contribute to the nation's economic development with proper strategic planning (Dašić et al., 2022). The formulation and execution of economic policy present a challenging task for those responsible for fostering a highly competitive national economy and agriculture (Dimovski et al., 2022). According to the data of the Statistical Office of the Republic of Serbia, in Serbia, in 2022, out of a total of 108.305 enterprises, there were 12.540 small (11.6%) and 2.913 medium-sized (27.27%). In Serbia, over 25% of the workforce works directly in agriculture, producing agricultural goods and then processing them to make food items. Another 10% of the population is indirectly employed in agriculture. In 2017, 12.823 active enterprises were registered in the agribusiness industry, of which 1.249 were small and 350 were medium-sized, according to APR data (Fren, 2020).

For small and medium-sized businesses to grow or remain competitive, innovation is essential. How inventive these businesses can be largely depends on how capable and imaginative their entrepreneurs are. However, based on the review of the relevant literature, as far as the authors are aware, there is still not enough research that deals with the factors that determine the innovative performance of small and medium-sized enterprises in agribusiness that operate on the territory of Serbia. Bearing this in mind, the subject of the research is key factors promoting innovative performance in agribusiness SMEs, by applying the empirical method, i.e., structural equation modeling. According to the subject, the main goal of the research is to determine the effects of the key factors on the innovation performance of micro, small and medium-sized enterprises in agribusiness.

### Literature Review

Nowadays, in the emerging information economy, creativity and innovation are critical organizational competencies (Kostadinović and Stanković, 2021a). The idea of innovation has been closely associated with economic ideology over time, as nations have embraced it as a means of overcoming economic obstacles and gaining a competitive edge in the global market (Drejer, 2004). According to Tellis et al. (2012), innovation can take place in platforms, business models, component or design technologies, goods or processes, and more. Innovation is a tool that promotes industrial leadership since it increases productivity (Adner & Kapoor, 2010). The subject of why businesses innovate is one that comes up frequently.

Innovation performance is one of innovation's main results (Robertson et al., 2023). According to Edquist et al. (2018), an ideal definition of innovation performance would take into account both linear and holistic methods, as well as all factors that influence the creation and spread of inventions that improve inventive company performance or achieve commercial success. Innovation performance, as it relates to organizations, is the ability to successfully implement creative ideas (Zhang et al., 2023). Innovation performance is the culmination of several driving forces and encompasses all innovations' accomplishments and outcomes. Organizational innovation performance is influenced by numerous influencing factors, such as organizational culture.

The innovation culture inside an organization is mostly driven by its organizational culture (Halim et al., 2019). An inventive organization is one where the proprietor is willing to experiment with new ideas and has the skills, knowledge, and resources needed to develop and carry out creative projects. Since innovation requires an environment that supports creative endeavors (Kaasa & Vadi, 2010), small and medium-sized enterprises should be given the chance to explore and experiment in order to produce innovative products and services (Halim et al., 2019). Dobni (2008) proposes four dimensions of organizational culture: intention, infrastructure, influence and implementation for innovation.

The typical habits, actions, and representations that all members of an organization share make up its culture (Davies and Buisine, 2018; Latinović et al., 2023). Every organization has an organizational culture, what matters is whether it was developed deliberately or consciously (Krušković et al., 2023). Furthermore, different organizational cultures have different effects on how employees behave and perform within the organization (Žikić and Valjević, 2021). Since organizations that instill organizational culture can have beneficial incremental and radical changes in their operations, an organization should have a set of shared behaviors, ideas, beliefs, and experiences in order to achieve innovative performance (O’Cass and Viet Ngo, 2007).

Given the importance of continuous, both formal and informal, learning in a well-structured system within the organization, employees in the organization should share a similar belief in promoting innovation (Achdiat et al., 2023). According to López et al. (2004), organizational learning is a combination of four processes: distribution, interpretation, acquisition, and organizational memory. Organizations that prioritize organizational learning must first gather data, then analyze it to fully comprehend its significance and turn it into knowledge. Organizational learning is encouraged by innovation cultures (Ilić et al., 2023; Krušković et al., 2022).

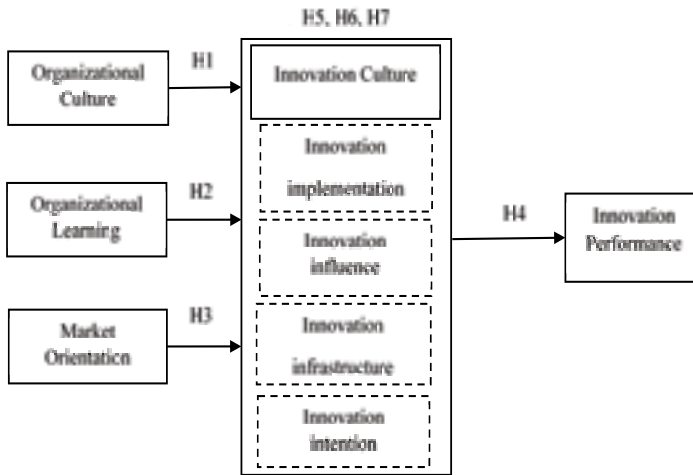
Any organization’s performance depends on its market orientation, which prioritizes responsiveness, coordination, and awareness of its customers and competitors (Pérez-González, 2017). Innovation and market orientation are closely related fields, and market-oriented organizations frequently use innovative policies (O’Cass and Viet Ngo, 2007). Market orientation and organizational innovation have a statistically significant association, according to research findings by Šlogar (2021).

## **Methodology**

### **Research model**

Planned research examines how organizational culture (OC), organizational learning (OL), and market orientation (MO), through innovation culture (IC), influence innovation performance (IP) (Figure 1). This is done by following the methodology used in the studies by Halim et al. (2019), Hanifah et al. (2019), and Kusnandar et al. (2023).

Figure 1. Research model



Source: Authors' presentation, based on Halim et al. (2019), Hanifah et al. (2019), and Kusnandar et al. (2023) methodology

The research objectives and subject, together with previous studies on the topic, were taken into consideration when defining the following research hypotheses:

H1: Innovation culture is significantly affected by organizational culture.

H2: Innovation culture is significantly affected by organizational learning.

H3: Innovation culture is significantly affected by market orientation.

H4: Innovation performance is significantly affected by innovation culture.

H5: The relationship between organizational culture and innovation performance is significantly mediated by innovation culture.

H6: The relationship between organizational learning and innovation performance is significantly mediated by innovation culture.

H7: The relationship between market orientation and innovation performance is significantly mediated by innovation culture.

### Sample

According to Creswell et al. (2011), empirical research employs a quantitative technique to test and generalize the preliminary findings. The sample includes owners /managers of small and medium-sized agribusiness enterprises operating on the territory of Serbia. Since enterprises in Serbia, according to the Law on Accounting, are classified as micro (up to 10 employees), small (up to 50 employees), medium (up to 250 employees), and large-sized, the sample only consists of enterprises with more than ten and fewer

than 250 employees. Data were collected through self-administered questionnaires distributed to small and medium-sized agribusiness enterprises in Serbia. Because the data in this research reflect the phenomenon of the individual's situation and behavior, wherein the organizational environment is assumed to be constant at different times, a cross-sectional design was employed in this study. The survey, including the pilot test, was carried out between March and November 2023. There were 281 questionnaires gathered, and upon reviewing the irregularities, all 281 respondents were included in the further analysis.

According to the data shown in Table 1, the sample had the most respondents with a higher school or faculty diploma (59.8%) and the least with a master's or PhD degree (10.3%). The sample includes 68% of small and 32% of medium-sized agricultural enterprises. Observed according to activity, the largest percentage of companies are engaged in the production of food of plant origin (45.2%), followed by companies engaged in the production of food of animal origin (37.4%), the production of mixed food (11.7%), and the smallest companies whose activity is service activities in agriculture (5.7%). In addition, the largest percentage of companies have been operating for more than 10 years (41.6%) and the smallest for up to 3 years (6.8%). As far as market coverage is concerned, the largest percentage of companies participate in the regional market (47.7%), followed by the national market (26%), slightly less in the local market (25.6%), and the least in the international market (0.7%).

**Table 2.** Socio-demographic characteristics of the research sample

Characteristics	Indicator	Percent
Education	Medium	29.9
	Higher/High	59.8
	Master/PhD	10.3
Enterprise size	Small	68.0
	Medium	32.0
Activity	Service activities in agriculture	5.7
	Production of food of animal origin	37.4
	Production of plant-based food	45.2
	Production of mixed food	11.7
Length of business	Up to 3	6.8
	4-6	18.9
	6-8	17.4
	8-10	15.3
	10+	41.6
Market Coverage	Local	25.6
	Regional	47.7
	National	26.0
	International	0.7

*Source:* Authors' own calculations

## Measures

Six components made up the questionnaire that was created for the study. The demographics of the respondents were covered in the first section of the questionnaire (education level, size of company, activity, length of operation, and market penetration). The questionnaire (Appendix 1) was divided into six sections: part II asked business owners and managers about their perceptions of organizational culture; part III asked them about their perceptions of organizational learning; part IV asked them about their perceptions of market orientation; part V asked them about their perceptions of innovative culture; and part VI asked them about their perceptions of innovative performance. A five-point Likert scale was used to rate the items (1 - strongly disagree and 5 - strongly agree). A cover letter outlining the goals of the study and the meaning of the variables included in it was also sent with the questionnaire. Furthermore, participants were notified that the survey was anonymous and that an aggregate of the findings would be displayed.

The instrument for measuring organizational culture consisted of three attitudes, taken from Denison et al. (2006). In the research, the construct of organizational culture was observed as a first-order construct. The organizational learning measurement instrument consisted of 3 items, created by García-Morales et al. (2008). The scale for measuring market orientation consisted of four items, taken from Mac and Evangelista (2016). This construct is also seen as a first-order construct. The scale for measuring innovative performance consisted of three items taken from Zhang and Li (2010). In the research, this construct was viewed as a first-order construct. The innovation culture construct was viewed as a second-order construct. The instrument for measuring this construct consisted of 12 items, taken from Dobni (2008). Items are divided into 4 dimensions of 3 items each: innovation intention (InnInt), innovation infrastructure (InnInfr), innovation influence (InnInfl) and innovation implementation (InnImpl) (Appendix 2).

## Analysis

The structural equation modeling method was used to evaluate the causal link between the variables included in the study. A multivariate statistical technique called structural equation modeling (SEM) includes estimating the parameters of a system of simultaneous equations. As noted by Bollen (1989), a few generalized frameworks that comprise SEM are factor, regression, and pathway analysis, as well as simultaneous econometric equations and latent growth curve models. Three tendencies may be seen in the development of SEM, according to Bollen et al. (2022). The first two trends involved combining popular statistical techniques into a single model and generalizing them. The third development was the spread of SEM across various fields. This made it easier to see how many conventional models fit under a broader model, which in turn made it possible to create new hybrid models. SEM is used to evaluate a system of linear equations to test the research “causal” model fit. Visualizing the proposed model or drawing a “path diagram” based on existing information and/or ideas is therefore the first step. Rectangles in path diagrams indicate variables that are directly measured or

observed, while circles or ovals usually indicate latent or unobserved constructions that are defined by measured variables. Double-headed arrows show correlations between variables, while unidirectional arrows show causal routes, where one variable directly affects another. Some people think “arc” is a better word than “causal path” (Stein et al., 2012). Measurement and structural models are the two submodels that make up SEM. According to Bollen (1989), the measurement model consists of the following equations:

$$x = \Lambda_x \xi + \varepsilon$$

$$y = \Lambda_y \eta + \varepsilon$$

In which:  $x$  and  $y$  represent latent variable observable indicators;  $\Lambda$  represent factor loadings;  $\xi$  and  $\eta$  represent latent variables;  $\delta$  and  $\varepsilon$  represent error.

The structural model, according to Bollen (1989), consists of the following equation:

$$\eta = \alpha + B\eta + \Gamma\xi + \zeta$$

In which:  $\eta$  is a vector with  $m \times 1$  latent endogenous variables;  $\alpha$  is a vector of intercept terms with  $m \times 1$ ;  $\xi$  is a vector with  $n \times 1$  latent exogenous variables;  $B$  is an  $m \times m$  matrix coefficient that gives the effect of endogenous variables ( $\eta$ ) on each other;  $\Gamma$  is an  $m \times n$  matrix coefficient that gives the influence of exogenous ( $\xi$ ) on endogenous variables ( $\eta$ ); The  $m \times 1$  disturbance vector, denoted by  $\zeta$ , contains the segments of the  $\eta$ 's that are described.

Based on the approach proposed by Anderson and Gerbing (1988), the paper first evaluated the measurement model (validity and reliability) and then the structural model (testing the relationship between research variables). Factor loadings, composite reliability (CR), and average variance extracted (AVE) should all be taken into account when evaluating convergent validity, as suggested by Hair et al. (2014). De Vellis (2003) states that the lower acceptance threshold for factor loading and AVE is 0.5, while for CR and Crombach's alpha ( $C\alpha$ ), it is 0.7. Discriminant validity was interpreted in accordance with Fornell and Larcker (1981), as well as Farrell and Rudd (2009), who propose that the AVE values of the square root ( $\sqrt[2]{AVE}$ ) of each of the concepts in a pair are bigger than the correlation between concepts. The coefficient of determination ( $R^2$ ) value was used to assess the structural model. According to Cohen (1988), a substantial model is indicated by an  $R^2$  value greater than 0.26. The path coefficient ( $\beta$ ) was used to determine the impacts' magnitude.

Mediation analysis examines hypothesized causal links in which one variable affects a second variable, which in turn affects a third variable. This is also referred to as an indirect effect on occasion (Blair, w.d.). According to Edwards and Lambert (2007), partial mediation occurs when the relationship between two variables may be explained by both direct and indirect association, but full mediation occurs when the mediator

variable fully explains the relationship between two variables (indirect association). The Bootstrap technique was used to perform mediation analysis. A statistical method called bootstrap resamples a single dataset to produce several simulated samples (Stanković et al., 2023). The approach suggested by Hair et al. (2016) was applied for the mediation analysis. This approach looks at the direct impacts in the presence of intermediaries after looking at the indirect effects first.

Data processing was done using IBM SPSS 21 statistical software and IBM SPSS Amos Graphics.

## **Results**

### **Requirements of the SEM model**

Lee et al. (2010) state that the common method variance bias test (CMV), multicollinearity concerns not being present, and the adequacy of the research sample are requirements for structural equation modeling. Hoelter (1983) recommends a minimum sample size of 200. In this research, the sample included 281 respondents. Results of the VIF (variance inflation factor) test below 3 (range from 1.766 to 2.483) show that there is no multicollinearity problem. To look at CMV, the Harman's single-factor test was employed. Eight factors were extracted from the exploratory factor analysis that had a characteristic root larger than 1. According to Podsakoff et al. (2012), the first factor shouldn't account for more than half of the variance in the whole. The findings show that there was no problem with CMV, as the first construct explained 38.302% of the total variation.

### **Measurement Model**

As indicated by the results displayed in Table 2, the factor loadings ranged from 0.794 to 0.914 for the construct organization culture, 0.780 to 0.881 for the construct organization learning, from 0.702 to 0.760 for the construct market orientation, from 0.926 to 0.972 for the construct innovation performance, and from 0.67 to 0.858 for the innovation culture construct, respectively. The value of the  $C\alpha$  coefficient for the organization culture construct is 0.896, the CR value is 0.898, and the AVE value is 0.746. For the organization learning construct, the  $C\alpha$  coefficient is 0.859, the CR value is 0.861, and the AVE value is 0.674. For the market orientation construct, the  $C\alpha$  coefficient is 0.837, the CR value is 0.839, and the AVE value is 0.565. The value of the  $C\alpha$  coefficient for the innovation performance construct is 0.965, the CR value is 0.966, and the AVE value is 0.903. For the innovation culture construct, the  $C\alpha$  coefficient is 0.852, the CR value is 0.849, and the AVE value is 0.587. The results showed that the convergent validity criteria were satisfied.

**Table 2.** Measurement model evaluation

1 <sup>st</sup> order construct	2 <sup>st</sup> order construct	Item	Factor loading	Ca	CR	AVE
Organization culture		OC1	.794	.896	.898	.746
		OC2	.914			
		OC3	.879			
Organizational learning		OL1	.780	.859	.861	.674
		OL2	.881			
		OL3	.799			
Market orientation		MO1	.702	.837	.839	.565
		MO2	.771			
		MO3	.760			
		MO4	.772			
Innovation performance		IP1	.926	.965	.966	.903
		IP2	.972			
		IP3	.953			
	Innovation culture	Innovation implementation	.670	.852	.849	.587
		Innovation influence	.858			
		Innovation infrastructure	.810			
		Innovation intention	.712			

Source: Authors' own calculations

The measurement model demonstrated adequate discriminant validity, according to the test results of discriminant validity, since the square root of the AVE is greater than the correlations between all pairs of constructs (Table 3).

**Table 3.** Discriminant Validity

Construct	OC	OL	MO	IC	IP
OC	.864*				
OL	.626	.821*			
MO	.371	.393	.752*		
IC	.634	.592	.517	.950*	
IP	.145	.179	.323	.243	.766*

Note: \* -  $\sqrt{AVE}$

Source: Authors' own calculations

The results of the confirmatory analysis, interpreted according to the suggestions of Byrne (1998) as well as Hu and Bentler (1999), showed that the measurement model fit well (Table 1).

**Table 4.** Fit indices of measurement model

	$\chi^2/df$	NFI	TLI	CFI	RMSEA	SRMR
Fit indices	1,729	.942	.969	.975	.051	.055
Recommended values	$\leq 3$	$\geq .90$	$\geq .90$	$\geq .90$	$\leq .08$	$\leq .08$

Source: Authors' own calculations



### Structural Model

The value of the coefficient of determination was 0.534 for the construct innovation culture, i.e., 0.567 for the construct innovation performance. The obtained results indicated a substantial model. The results showed a positive and significant influence of organizational culture on innovation culture ( $\beta = 0.371$ ;  $p < 0.001$ ), a positive and significant influence of organizational learning on innovation culture ( $\beta = 0.247$ ;  $p < 0.001$ ), a positive and significant influence of market orientation on innovation culture ( $\beta = 0.290$ ;  $p < 0.001$ ), and positive and significant impacts of innovation culture on innovation performance ( $\beta = 0.258$ ;  $p < 0.001$ ) (Table 5 and Figure 2).

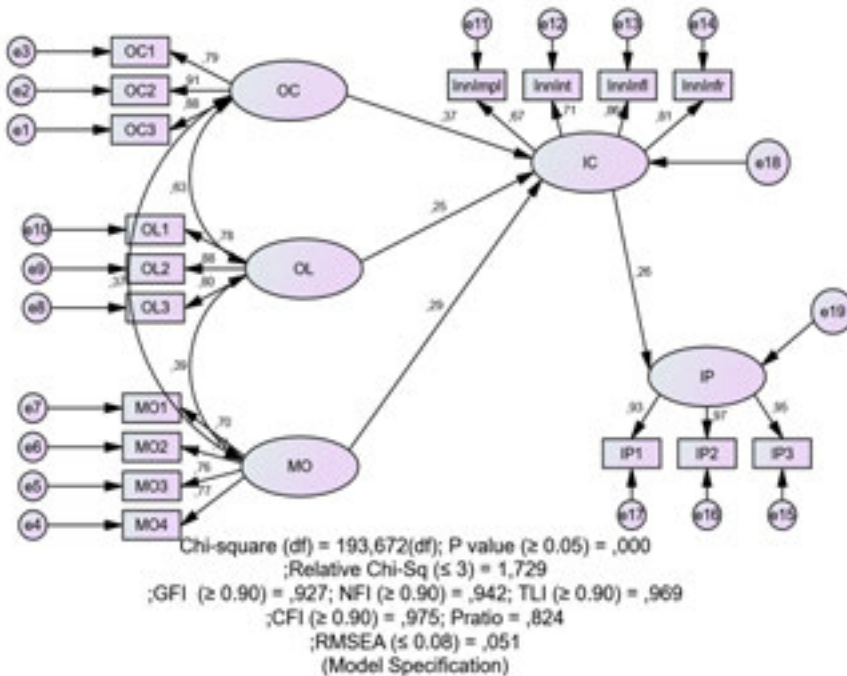
**Table 5.** Structural model evaluation

Hypotheses	Paths	$\beta$	S.E.	t	R <sup>2</sup>	Decision
H1	OC→IC	.371	.064	5.131*	R <sup>2</sup> <sub>IC</sub> = .534	Supported
H2	OL→IC	.247	.066	3.330*		Supported
H3	MO→IC	.290	.064	4.660*		Supported
H4	IC→IP	.258	.077	4.067*	R <sup>2</sup> <sub>IP</sub> = .567	Supported

Note: \* -  $p < 0.001$

Source: Authors' own calculations

**Figure 2.** Structural model



Source: Authors' presentation

## Mediation analysis

To assess the mediating role of innovation culture in the relationship between organizational culture, organizational learning and market orientation, on the one hand, and innovation performance, on the other hand, three mediation analyses were applied by first examining indirect and then direct effects (in the presence of mediators) (Table 5). The first mediation analysis assessed the role of innovation culture as a mediator of the relationship between organizational culture and innovation performance. In the first phase of the mediation analysis, the indirect influence of organizational culture on innovation performance, via innovation culture, was assessed. The obtained results showed that this influence is significant ( $\beta = 0.162$ ;  $p < 0.05$ ). In the second phase, the direct influence of organizational culture on innovation performance was examined in the presence of innovation culture as a mediator. The results showed that this influence was not significant ( $\beta = -0.017$ ;  $p > 0.05$ ), which indicated full mediation. The second mediation analysis assessed the role of innovation culture as a mediator of the relationship between organizational learning and innovation performance. In the first phase of the mediation analysis, the indirect influence of organizational learning on innovation performance, via innovation culture, was assessed. The obtained results showed that this influence is significant ( $\beta = 0.125$ ;  $p < 0.05$ ). In the second phase, the direct influence of organizational learning on innovation performance was examined in the presence of innovation culture as a mediator. The results showed that this influence was not significant ( $\beta = 0.057$ ;  $p > 0.05$ ). These results indicated full mediation. The third mediation analysis assessed the role of innovation culture as a mediator of the relationship between market orientation and innovation performance. In the first phase of the mediation analysis, the indirect influence of market orientation on innovation performance, via innovation culture, was assessed. The obtained results showed that this influence is significant ( $\beta = 0.155$ ;  $p < 0.05$ ). In the second phase, the direct influence of market orientation on innovation performance was examined in the presence of innovation culture as a mediator. The results showed that this influence was significant ( $\beta = 0.267$ ;  $p < 0.05$ ). These results indicated partial mediation.

**Table 6.** Results of mediation analysis

Hypotheses	Paths	Indirect effect	Direct effect	Decision
H5	OC→IC→IP	.162*	-.017	Full mediation
H6	OL→IC→IP	.125*	.057	Full mediation
H7	MO→IC→IP	.155*	.267*	Partial mediation

Note:  $p < 0.01$

Source: Authors' own calculations

## Discussions

According to the results of the research, organizational culture has a significant impact on innovation culture. Such results are consistent with the results of earlier research, which also indicate the importance of this factor for improving innovation culture (Sharifirad and Ataei, 2012; Halim et al., 2019; Zhang et al., 2023). The obtained results indicate a significant positive relationship between organizational learning and innovation culture, which is in accordance with the results of earlier studies by Škerlavaj et al. (2010). Similarly, Halim et al. (2019) obtained results according to which two (information acquisition and behavioral and cognitive learning) out of three organizational learnings positively and significantly influence organizational culture. The results of the current research indicate a positive and significant relationship between market orientation and organizational culture. Similarly, Halim et al. (2019) found a positive and significant relationship between market orientation towards competition and innovation culture. Kusnandar et al. (2023) report positive and significant effects of market orientation on innovation.

The current research findings indicate that innovation performance is positively and significantly impacted by innovation culture. Similar findings were reached by Hanifah et al. (2019) and Liu et al. (2021), who found that innovation culture significantly and positively affects innovation performance.

The current research findings demonstrate the important moderating role that creative culture plays in the interaction between market orientation, organizational learning, organizational culture, and innovation performance. As far as the authors are aware, the results obtained, which were based on a study of the pertinent literature, cannot be compared with the findings of other studies because this link has not been thoroughly examined in previous research. Nonetheless, important role for organizational culture as a mediator can be inferred given the positive and significant correlations that have been shown between innovative performance and organizational learning, organizational culture, and market orientation. In particular, the findings of the Lee et al. (2008) study showed a strong and favorable correlation between organizational learning and organizational culture and innovation performance. Furthermore, as per the results of the aforementioned investigation, varying degrees of organizational culture and learning exert a differential impact on innovation. The study by Škerlavaj et al. (2010) found that organizational learning promotes innovation both directly and indirectly through organizational culture. Innovation culture is a key moderator of the relationship between organizational learning and inventive performance characteristics, according to data obtained by Ghasemzadeh et al. (2019). Market orientation has a significant and direct impact on innovative performance in Chinese manufacturing organizations, according to Zhang and Duan's (2010) findings.

## Conclusions

The main goal of this paper was to determine the effects of key factors (organizational culture, organizational learning, market orientation and innovation culture) on the innovative performance of small and medium-sized enterprises in agribusiness. The results showed a significant impact of organizational culture, organizational learning and market orientation on innovation culture, as well as significant positive impacts of innovation culture on innovation performance, which is why it was concluded that hypotheses H1, H2, H3 and H4 are accepted. In addition, the research results showed that organizational culture is a significant mediator of the relationship between organizational culture, organizational learning and market orientation, on the one hand, and innovation culture, on the other hand, which is why it was concluded that hypotheses H5, H6 and H7 are accepted.

Increasing the innovative performance of small and medium-sized enterprises in agribusiness requires a combination of internal characteristics of the enterprise. The main implication of this paper is that, although SMEs might not require large resources for innovation, organizational culture, organizational learning, market orientation, and innovative culture are necessary conditions for attaining innovation performance. Furthermore, because it examines the role of organizational culture as a mediator in the relationship between organizational culture, learning, and market orientation and innovation performance, this paper can add to the body of literature on innovation issues pertaining to small and medium-sized enterprises.

There are certain limitations to this study. It could be argued that the study's reliance on a single respondent (SME owners) is a weakness, since bias can occur. According to the results of the Harman's test, bias is not a problem, but this does not mean that such a possibility does not exist. The fact that the research only looks at four agribusiness-related activities could be another limitation. Additional activities like retail trading, plant cultivation, animal husbandry, mixed farming, hunting, and fishing may be included in future studies. Future research should look at how other factors, such as government support or innovation strategy, affect the innovation performance of agribusiness SMEs.

The results of this paper contribute to the understanding of how selected factors influence innovation performance and provide organizations with useful advice on how to create management environments that encourage innovation. Finally, achieving innovative performance is a difficult task without a proper plan or roadmap that outlines and practices it.

## Conflict of interests

The authors declare no conflict of interest.

## References

1. Achdiat, I., Mulyani, S., Azis, Y., & Sukmadilaga, C. (2023). Roles of organizational learning culture in promoting innovation. *The Learning Organization*, 30(1), 76-92. <https://doi.org/10.1108/TLO-01-2021-0013>
2. Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal*, 31(3), 306-333. <https://doi.org/10.1002/smj.821>
3. Anderson, J. C., & Gerbing, D. W. (1988). Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach. *Psychological Bulletin*, 103(3), 411 – 442. <https://doi.org/10.1037/0033-2909.103.3.411>
4. Blair, A. (w.d.). Chapter 14: Mediation and Moderation. University of Illinois at Chicago Retrieved from <https://ademos.people.uic.edu/Chapter14.html> (January 12, 2024).
5. Bollen, K. (1989). *Structural equations with latent variables*. John Wiley & Sons, New York.
6. Bollen, K.A., Fisher, Z., Lilly, A., Brehm, C., Luo, L., Martinez, A., & Ye, A. (2022). Fifty years of structural equation modeling: A history of generalization, unification, and diffusion. *Social Science Research*, 107:102769. <https://doi.org/10.1016%2Fj.ssresearch.2022.102769>
7. Byrne, B. M. (1998). *Structural Equation Modeling with Lisrel, Prelis, and Simplis. Basic Concepts, Applications, and Programming*. 1st ed. New York: Psychology Press.
8. Chen-Kuo Lee, C.-K., Tan, B., & Chiu, J.-Z. The impact of organisational culture and learning on innovation performance. *International Journal of Innovation and Learning*, 5(4), 413-428. <http://dx.doi.org/10.1504/IJIL.2008.017561>
9. Cohen, J. (1988). *Statistical Power Analysis for the Behavioural Science*. 2nd ed. Lawrence Erlbaum Associates, Hillsdale, NJ.
10. Creswell, J. W., Klassen, A. C., Plano Clark, V. L., & Smith, K. C. (2011). *Best Practices for Mixed Methods Research in the Health Sciences*. National Institutes of Health, Bethesda (MD).
11. 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>
12. Davies, M., & Buisine, S. (2018). *Innovation Culture in Organizations*. In book: Science, Technology and Innovation Culture, ch 6, vol. 3, pp.101-115. <http://dx.doi.org/10.1002/9781119549666.ch6>
13. De Vellis, R. F. (2003). *Scale Development: Theory and Applications*. 2nd ed. Thousand Oaks, CA: Sage Publications.
14. Denison, D. R., Janovics, J., Young, J., & Cho, H. J. (2006). *Diagnosing organizational cultures: Validating a model and method*. Denison Consulting Group.

15. Dimovski, J., Krstić, B., & Radivojević, V. (2022). Ensuring the improvement of agricultural competitiveness through the human resource development. *Economics of Agriculture*, 69(4), 1017–1029. <https://doi.org/10.5937/ekoPolj2204017D>
16. Dobni, C. B. (2008). Measuring innovation culture in organizations. The development of a generalized innovation culture construct using exploratory factor analysis. *European Journal of Innovation Management*, 11(4), 539-559. <https://doi.org/10.1108/14601060810911156>
17. Drejer, I. (2004). Identifying innovation in surveys of services: a Schumpeterian perspective. *Research Policy*, 33(3), 551-562. <https://doi.org/10.1016/j.respol.2003.07.004>
18. Edquist, C., Zabala-Iturriagagoitia, J. M., Barbero, J., & Zofio, J. L. (2018). On the meaning of innovation performance: Is the synthetic indicator of the Innovation Union Scoreboard flawed? *Research Evaluation*, 27(3), 196-211, <https://doi.org/10.1093/reseval/rvy011>
19. Edwards, J. R., & Lambert, L. S. (2007). Methods for Integrating Moderation and Mediation: A General Analytical Framework Using Moderated Path Analysis. *Psychological Methods*, 12(1), 1 – 22. <https://psycnet.apa.org/doi/10.1037/1082-989X.12.1.1>
20. Farrell, A. M., & Rudd, J. M. (2009). Factor Analysis and Discriminant Validity: A Brief Review of Some Practical Issues. In: Dewi, T. (ed.): *ANZMAC 2009 Conference Proceedings*. Melbourne: ANZMAC.
21. Fornell, C., & Larcker, D. F. (1981). Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics. *Journal of Marketing Research*, 18(3), 382–388. <https://doi.org/10.1177/002224378101800313>
22. Fren. (2020). *Analiza perspektivnih zanimanja u sektoru Agrobiznisa*. Ministarstvo prosvete, nauke i tehnološkog razvoja. Retrieved from <http://noks.mpn.gov.rs/wp-content/uploads/2017/07/Analiza-perspektivnih-zanimanja-u-sektoru-agrobiznisa.pdf> (January 18, 2024).
23. García-Morales, V. J., Matías-Reche, F., & Hurtado-Torres, N. (2008). Influence of transformational leadership on organizational innovation and performance depending on the level of organizational learning in the pharmaceutical sector. *Journal of Organizational Change Management*, 21(2), 188-212. <https://doi.org/10.1108/09534810810856435>
24. Ghasemzadeh, P., Nazari, J.A., Farzaneh, M., & Mehralian, G. (2019). Moderating role of innovation culture in the relationship between organizational learning and innovation performance. *The Learning Organization*, 26(3), 289-303. <https://doi.org/10.1108/TLO-08-2018-0139>
25. Hair Jr, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review*, 26(2), 106-121. <https://doi.org/10.1108/EBR-10-2013-0128>
26. Hair, J. F. J., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2016). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. 2nd ed. New York, NY: SAGE Publications.

27. Halim, H. A., Ahmad, N. H., & Ramayah, T. (2019). Sustaining the Innovation Culture in SMEs: The Importance of Organisational Culture, Organisational Learning and Market Orientation. *Asian Journal of Business Research*, 9(2), 14-33. <http://dx.doi.org/10.14707/ajbr.190059>
28. Hanifah, H., Halim, H. A., Ahmad, N. H., & Vafaei-Zadeh, A. (2019). Emanating the key factors of innovation performance: leveraging on the innovation culture among SMEs in Malaysia. *Journal of Asia Business Studies*, 13(4), 559-587. <https://doi.org/10.1108/JABS-04-2018-0130>
29. Hoelter, J. W. (1983). The Analysis of Covariance Structures: Goodness-of-Fit Indices. *Sociological Methods & Research*, 11(3), 325 – 344. <https://doi.org/10.1177/0049124183011003003>
30. Hu, L.-T., & Bentler, P. M. (1999). Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria versus New Alternatives. *Structural Equation Modeling. A Multidisciplinary Journal*, 6(1), 1 – 55. <https://doi.org/10.1080/10705519909540118>
31. Ilic, B., Stankovic, S., & Al Salaimh, S. (2023). Analysis of employee competencies and the role of new technologies. In Proceeding LINK IT & EdTech International Scientific Conference, Belgrade, (pp.47-48).
32. Kaasa, A., & Vadi, M. (2010). How does the culture contribute to innovation? Evidence from European Countries. *Economics of Innovation and New Technology*, 19(7), 583-604. <https://doi.org/10.1080/10438590902987222>
33. Kostadinović, I., & Stanković, S. (2021). Comparative Analysis of the Development of the Small and Medium Enterprises Sector in the Republic of Serbia and the European Union. In proceedings 7th International Scientific-Business Conference – LIMEN 2021, (pp. 1-11). <https://doi.org/10.31410/LIMEN.2021.1>
34. Kostadinović, I., & Stanković, S. (2021a). Organizational Learning and Innovation in the Tourism Industry as a Basis for Creating Value for Tourists. *Economic Themes*, 59(1), 153-172. <https://doi.org/10.2478/ethemes-2021-0009>
35. Krušković, T., Ilić, B., & Anđelić, S. (2022). Research and development of human resource management in Serbian organizations. In Proceedings of 4th Virtual International Conference Path to a Knowledge Society-Managing Risks and Innovation PaKSoM 2022, (pp. 183-189).
36. Krušković, T., Ilić, B., & Anđelić, S. (2023). Attracting And Retaining Employees As A Result Of Effective Employer Brand Management. *International Journal for Quality Research*, 17(4), 1195–1206. <http://dx.doi.org/10.24874/IJQR17.04-14>
37. Kusnandar, Setyowati, N., & Wida Riptanti, E. (2023). Creating an innovative culture in agribusiness of micro, small and medium-sized enterprises. *Agricultural and Resource Economics: International Scientific E-Journal*, 9(2), 205-222. <http://dx.doi.org/10.22004/ag.econ.337441>
38. Latinović, B., Ostojić, B., & Bugarčić, M. (2023). Analysis Of Attitudes Towards Social-Economic And Marketing Factors On The Growth Of Organic Production. *Economics of Agriculture*, 70(3), 725–735. <https://doi.org/10.59267/ekoPolj2303725L>

39. Lee, C.-K., Tan, B., & Chiu, J.-Z. (2008). The impact of organisational culture and learning on innovation performance. *International Journal of Innovation and Learning*, 5(4), 413-428. <https://doi.org/10.1504/IJIL.2008.017561>
40. Lee, V.-H., Ooi, K.-B., Tan, B.-I., & Chong, A. Y.-L. (2010). A Structural Analysis of the Relationship between TQM Practices and Product Innovation. *Asian Journal of Technology Innovation*, 18(1), 73–96. <https://doi.org/10.1080/19761597.2010.9668683>
41. Liu, S.-M., Hu, R., & Kang, T.-W. (2021). The Effects of Absorptive Capability and Innovative Culture on Innovation Performance: Evidence from Chinese High-Tech Firms. *Journal of Asian Finance, Economics and Business*, 8(3), 1153–1162. doi: 10.13106/jafeb.2021.vol8.no3.1153
42. López, S. P., Peón, J.M. M., & Ordás, C. J. V. (2004). Managing knowledge: the link between culture and organizational learning. *Journal of Knowledge Management*, 8(6), 93-104. <https://doi.org/10.1108/13673270410567657>
43. Mac, L., & Evangelista, F. (2016). The Relative Impact of Market Orientation and Entrepreneurship on Export Performance: Do We Really Know Enough? *Journal of Global Marketing*, 29(5), 266-281. <https://doi.org/10.1080/08911762.2016.1196285>
44. O’Cass, A., & Viet Ngo, L. (2007). Market orientation versus innovative culture: two routes to superior Brand performance. *European Journal of Marketing*, 41(7/8), 868-887. <https://doi.org/10.1108/03090560710752438>
45. Pérez-González, D., Trigueros-Preciado, S., & Popa, S. (2017). Social media technologies’ use for the competitive information and knowledge sharing, and its effects on industrial SMEs’ innovation. *Information Systems Management*, 34(3), 291–301. <https://doi.org/10.1080/10580530.2017.1330007>
46. Podsakoff, P. M., Mackenzie, S. B., & Podsakoff, N. P. (2012). Sources of Method Bias in Social Science Research and Recommendations on How to Control It. *Annual Reviews*, 63, 539 – 569. <http://dx.doi.org/10.1146/annurev-psych-120710-100452>
47. Robertson, J., Caruana, A., & Ferreira, C. (2023). Innovation performance: The effect of knowledge-based dynamic capabilities in cross-country innovation ecosystems. *International Business Review*, 32(2): 101866. <https://doi.org/10.1016/j.ibusrev.2021.101866>
48. Sharifirad, S. M., & Ataei, V. (2012). Organizational culture and innovation culture: exploring the relationships between constructs. *Leadership & Organization Development Journal*, 33(5), 494-517. <https://doi.org/10.1108/01437731211241274>
49. Stanković, S., Jovanović, V., & Cogoljević, M. (2023). Business Sustainability Factors of Mining Companies Based on SEM Model. *Ekonomický časopis/Journal of Economics*, 71(6/7), 458-486. <https://doi.org/10.31577/ekoncas.2023.06-07.04>
50. Stein, C. M., Morris, N. J., & Nock, N. L. (2012). Structural Equation Modeling. In: Elston, R. C., Satagopan, M. J., & Sun, S. (eds.), *Statistical Human Genetics: Methods and Protocols, Methods in Molecular Biology* (pp. 495-512). Springer Science+Business Media.



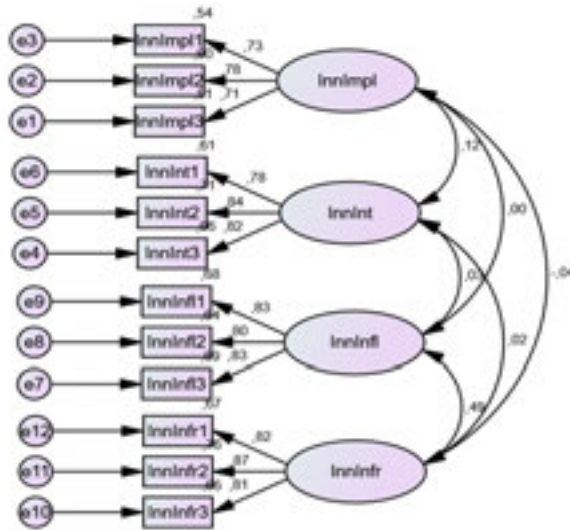
51. Škerlavaj, M., Song, J. H., & Lee, Y. (2010). Organizational learning culture, innovative culture and innovations in South Korean firms. *Expert Systems with Applications*, 37(9), 6390-6403. <https://doi.org/10.1016/j.eswa.2010.02.080>
52. Šlogar, H. (2021). Relationship between market orientation and innovativeness in companies. *International Review*, 3-4, 21-29. <https://doi.org/10.5937/intrev2103021S>
53. Tellis, G. J., Chandy, R. K., & Prabhu, J. C. (2012). Key questions on innovation in the B2B context. In G. L. Lilien, & R. Grewal (Eds.), *Handbook of business-to-business marketing* (pp. 582–595). Cheltenham, UK: Edward Elgar Publishing.
54. Zhang, W., Zeng, X., Liang, H., Xue, Y., & Cao, X. (2023). Understanding How Organizational Culture Affects Innovation Performance: A Management Context Perspective. *Sustainability*, 15(8): 6644. <https://doi.org/10.3390/su15086644>
55. Zhang, Y., & Li, H. (2010). Innovation Search of New Ventures in a Technology Cluster: The Role of Ties with Service Intermediaries. *Strategic Management Journal*, 31(2), 88–109. <https://doi.org/10.1002/smj.806>
56. Žikić, S., & Valjević, M. (2021). Organizaciona kultura kao važan faktor upravljanja krizom preduzeća u uslovima pandemije Kovida 19. *Društveni horizonti*, 1(1), 59-75.

## Appendix 1 / Questionnaire

Constructs and items	Source	
<b>Organization culture</b>		
We are able to meet short-term demands without compromising our long-term vision	Denison et al., 2006	
There is widespread agreement about goals		
Most employees are highly involved in their work.		
<b>Organization learning</b>		
The organization has acquired and used much new and relevant knowledge that has provided competitive advantage	García -Morales et al., 2008	
The organization's members have acquired critical capacities and skills that have provided competitive advantage		
Organizational improvements have been influenced fundamentally by new knowledge entering the organization		
<b>Market orientation</b>		
Strategy for competitive advantage is based on our understanding of customers' needs	Mac and Evangelista, 2016	
We rapidly respond to competitive actions that threaten us		
We freely communicate information about our successful and unsuccessful customer experiences across all business functions		
Measure customer satisfaction systematically and frequently		
<b>Innovation culture</b>		
<i>Innovation implementation (dimension)</i>		
We can quickly facilitate changes to our products and services based on client or competitive reaction	Dobni, 2008	
We are quick to turnaround ideas into marketable products/services		
There is an understanding that mistakes will occur or an opportunity will not transpire as expected		
<i>Innovation influence (dimension)</i>		
We take time to understand our competitive environment to the point where we can anticipate industry shifts		
When I find out something important about a customer or competitor that may affect others in the organization, I know what to do with that information		
I actively search for new ideas and innovations at all stages of product/service development		
<i>Innovation intention (dimension)</i>		
My contributions are valued by my fellow employees		
There is trust and mutual respect currently between management and employees		
Innovation is a core value in this organization		
<i>Innovation infrastructure (dimension)</i>		
There is an expectation to develop new skills, capabilities and knowledge that is directed toward supporting innovation in this organization		
I view uncertainty as opportunity, and not as a risk		
Innovation in our organization is more likely to succeed if employees are allowed to be unique and express this uniqueness in their daily activities		

Constructs and items	Source
<i>Innovation performance</i>	Zhang and Li, 2010
The new products developed by our organization are of high quality	
Our organization has a relatively short development cycle for innovative products	

**Appendix 2 / Confirmatory factor analysis of the innovation culture measurement instrument**



Chi-square (df) = 53,374(df); P value ( $\geq 0.05$ ) = ,275;  
 Relative Chi-Sq ( $\leq 3$ ) = 1,112;  
 GFI ( $\geq 0.90$ ) = ,971; NFI ( $\geq 0.90$ ) = ,965; TLI ( $\geq 0.90$ ) = ,995;  
 CFI ( $\geq 0.90$ ) = ,996; Pratio = ,727;  
 RMSEA ( $\leq 0.08$ ) = ,020  
 (Model Specification)

$$InnImpl = (InnImpl1 + InnImpl2 + InnImpl3)/3$$

$$InnInt = (InnInt1 + InnInt2 + InnInt3)/3$$

$$InnInfl = (InnInfl1 + InnInfl2 + InnInfl3)/3$$

$$InnInfr = (InnInfr1 + InnInfr2 + InnInfr3)/3$$

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# THE ECONOMIC DEVELOPMENT EFFECTS ON FRESHWATER ABSTRACTION FROM THE EUROPEAN PERSPECTIVE

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## ABSTRACT

Water scarcity is a growing concern across the globe due to climate change and demands for increased economic development. This paper analyses the relationship between economic development and freshwater abstraction in order to investigate its European impact. The analysis focuses on a total of 19 European countries, including 18 EU member states and one candidate, from 2007 to 2018. Using a panel dataset, the impact of a diverse selection of indicators of economic development (per capita GDP, the Human Development Index - HDI, water productivity and volume of international trade) on freshwater abstraction, our analysis finds that all explanatory variables are significant for cross-country variations except for international trade. To maintain scope, the analysis is limited to economic-development indicators themselves, excluding the effects of climate change and the availability of water resources.

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## Introduction

Although freshwater is a basic human right, it is still inaccessible to a significant share of the global population, with 2.5 billion lacking basic sanitation due to water scarcity and nearly one million annual deaths due to water pollution (Mekonnen, Hoekstra, 2016; WHO, 2021). Moreover, while freshwater resources account for only roughly 2% of all water on the planet, the high demand for them could lead to a 40% drop in the global water-supply by 2030 (Sachidananda *et al.*, 2016). Economic expansion, climate change, population growth, changes in land use and urban expansion are all both rapidly depleting water reserves and increasing water pollution levels (Roson, Damania 2017; Zhang *et al.*, 2017, Djuričin *et al.*, 2016).

Many regions throughout the globe suffer from insufficient available water resources to meet demand (Hervás-Gámez, Delgado-Ramos, 2019). Over the last 50 years, global freshwater use have increased by more than 40% (Gerverni *et al.*, 2020). To exacerbate matters, climate may lead to more severe water scarcity. The impacts of climate-related risks to health, food security, water supply and economic growth are expected to increase with a global warming temperature shift of 1.5°C and intensify further at 2°C (Masson-Delmotte *et al.*, 2018). Water scarcity is of particular concern, along with other limited natural resources such as fertile land, with a variety of ecosystems significantly affecting human well-being (Dantas *et al.*, 2021).

As an important resource used in production, water is indispensable for socioeconomic development (Beecher, 2020), due to its direct and indirect contributions to economic activity across sectors (Distefanoa, Kellyb, 2017). Playing a fundamental role in the world economy, agriculture is one of the most vulnerable sectors to water scarcity (Musolino *et al.*, 2018), with most freshwater generally used for agricultural purposes, followed by industry and households (Wu *et al.* 2019). Water scarcity will also likely affect both industries and households due to electricity shortages from reduced hydroelectric energy production (Koch, Vögele, 2009). To address this issue, sustainability must entail financially feasible development that is able to maximize income by exploiting available water resources (Aznar-Sanchez *et al.*, 2018).

The relationship between economic development and water use has attracted increasing attention to become a common research topic. According to Aznar-Sanchez *et al.* (2018), the number of published articles examining the impact of economic development on water use has steadily increased over the past 30 years. From a systematic review and bibliometric analysis of a sample of 1022 published articles, 45% was found to have focused on the economic impact on water use, in which the majority of individual studies originated from the United States (23.5%), Australia (13.6%) and China (8.1%).

Although Europe as a whole is generally considered to possess sufficient water resources, water scarcity and droughts are an increasingly common and widespread phenomenon (Rey *et al.*, 2019). Except for Eastern Europe, annual renewable freshwater resources per capita have been declining over the last 30 years (European Environment Agency – EEA 2021). Water scarcity and droughts in Europe may currently affect over 100

million people and approximately one third of the European continent (Hervás-Gámez, Delgado-Ramos, 2019). It is calculated most European Mediterranean countries will have less freshwater by 2050 than was available in 1990 and at least 11% of the population of Europe will face water stress (Lavrnić *et al.*, 2017).

Considering the critical nature of water scarcity, there is still a surprising research gap in assessing the impact of economic development on water in Europe. To address the gap, this paper investigates the impact of economic development on freshwater abstraction in Europe. Our analysis focuses on a total of 19 European countries, including 18 EU member states (Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, France, Hungary, Latvia, Lithuania, Malta, the Netherlands, Poland, Romania, Slovakia, Slovenia and Spain) and one candidate country (Serbia) from 2007 to 2018. Other European countries were not included as no data was readily available. To answer the main research question: “Does significant relationship between economic development and freshwater abstraction exist in the European countries selected?”, a panel dataset was used that includes economic development indicators (per capita GDP, the Human Development Index - HDI, water productivity and volume of international trade) and freshwater abstraction according to source per capita - m<sup>3</sup> per capita.

### Literature overview

Most literature examining the relationship between economic growth and the environment has focused on pollution as a function of income, which has led to criticism that such studies ignore the natural resource component of environmental quality (Arrow *et al.*, 1995). When it comes to studies examining use of natural resources, most have focused on deforestation (Culas, 2007), with only a few addressing other forms, including energy (Suri, Chapman, 1998) and water. These studies tend to equate resource use to pollution as an indicator of environmental quality.

Several characteristics distinguish natural resources from pollution in terms of their relationship to income, particularly for resources not generally traded internationally in large quantities such as water. These include: (1) limited supplies resulting in maximum amounts of use; (2) the role of natural endowments in influencing access to and demand for many resources; (3) unlike pollution which is an undesirable by-product of the production or consumption of other goods, natural resources generally yield a positive market price as goods; (4) the direct economic costs associated with the extraction and acquisition of resources; and (5) reduction is not necessarily desirable beyond a certain level (Katz, 2015).

There is a general consensus that water scarcity will likely increase significantly in the coming decades, causing problems for food security, environmental sustainability and economic development (Alcamo *et al.*, 2007; Hoekstra, 2014). Nevertheless, relatively little literature has addressed the relationship between income and water use at a state or national level. In the main, published studies provide evidence that national per capita water withdrawals appear to follow an inverted U or Environmental Kuznets

Curve (EKC) in relation to per capita income. In the early stages of economic growth, degradation and pollution increase, but do so only above a certain level of per capita income (as subject to the indicator); conversely, the trend reverses at high-income levels whereby economic growth leads to environmental improvement (Stern, 2004).

There is a general result of indicated EKCs when analysing water abstraction and its economic effects. Rock (1998) produced the first study on water income based on international cross-sectional data on water abstraction, finding per capita water withdrawal and consumption to follow an inverted-U path consistent with the EKC hypothesis. More importantly, however, is that Rock included explanatory variables other than income in his regression model - such as dummy variables for geographic regions, measures of agricultural water efficiency and trade openness. However, Gleick (2003) found no relationship between national per capita water withdrawals and income datasets. Goklany (2002) presented a qualitative assessment of water use, showing that per capita agricultural water withdrawal in the United States appears to have an inverted-U shape. Jia et al. (2006) also found an EKC for industrial water use for most OECD countries, with Bhattarai (2004) finding an EKC for irrigated land in tropical countries. Cole (2004) analysed the relationship between per capita water consumption and income using a panel data for 40 countries which confirmed a statistically significant inverted U-shaped relationship between water consumption and income. Furthermore, Barbier (2004) also found a concave relationship between growth and water use rates. Hoehn and Adanu (2008) tested an inverted-U relationship between water use and income using the International Hydrological Program (IHP) database with data from 32 countries for an interval of years of 1970, 1980 and 1990. Their dependent variable was water withdrawal and consumption, using the independent variables of: 1) economic size, 2) capital intensity, 3) trade openness, 4) income (and its squared term), 5) temperature (and its squared term), 6) precipitation and 7) climate dummies. Under a generalized least-squares estimation, capital intensity, trade openness and income all were indicated to potentially have negative effects on water use, while economic size tended to increase use which provides no support for an EKC.

The majority of existing quantitative studies on the water-income nexus have only incorporated income as an explanatory variable to assess the significance of correlation between water use and economic growth. Many additional variables have frequently been omitted from these reduced models intentionally because they were considered endogenous to economic growth. Therefore, analysts need to develop a comprehensive model that integrates all variables pertinent to isolating the effects of income (Katz, 2015).

Trade openness is an indicator of the water-trade nexus, whose work began with the observation that trade can “save” the importing country’s local water resources (Allan, 1993). The introduction of the concept of virtual water (VW) has been used to account for the water contained in traded goods outside national borders but excludes domestic consumption. It has led to extensive work on trade-based global water savings (GWS) (Chapagain *et al.*, 2006). Hoekstra and Chapagain (2007) transformed the VW concept into a water footprint (WF) to indicate the amount of water required to produce either

a product or service. Through another application of VW, Chapagain and Hoekstra (2008) indicated that international trade in crops accounts for 61% of global VW trade, with trade in livestock and livestock products representing 17% and trade in industrial products making up 22%. In total, 16% of the water used in the world for agricultural and industrial production is exported as VW.

Trade liberalization itself, however, has varied but beneficial effects on water scarcity. Dang *et al.* (2016) presented a theoretical model of trade and domestic water resources that demonstrates the conditions under which trade liberalization affects water use. Reimer (2014) also demonstrated that trade liberalization could be neutral from a water-resource perspective as well as improve welfare and allow markets to better cope with shocks. Moreover, Berrittella *et al.* (2008) showed the effects of trade liberalization to likely be non-linear – i.e., reducing water use in water-scarce countries while increasing it in water-rich countries. Further to this finding, Liu *et al.* (2014) concluded that international trade buffers the impact of projected future irrigation shortages. Ultimately, Konar *et al.* (2016) found that free trade under a changing climate may also lead to higher GWS. Nevertheless, Hoekstra (2009) suggested that the export of water-intensive goods does increase water consumption and water scarcity in the exporting country.

Water productivity (WP) is the physical or economic output per unit of water use (Cai, Rosegrant, 2003). It indicates economic output generated per m<sup>3</sup> of freshwater withdrawn (in EUR per m<sup>3</sup> or PPS per m<sup>3</sup>). Physical WP is the ratio between agricultural production by mass with the amount of water consumed, whereas the monetary value generated per unit of water consumed determines economic WP (Brauman, 2013; Ali, Talukder, 2008). It is found that growing more food with less water may help achieve more agricultural benefits (Molden, 2010). WP itself reflects the ability to produce more food and higher income, while also improving livelihoods and increasing environmental benefits at a lower social and environmental cost per unit of water consumed. Such outcomes of correlated increased WP and reduced water consumption have been confirmed over multiple studies (Zheng *et al.*, 2018; Kresovic *et al.*, 2014; Fraiture, Wichelns, 2010). In addition, higher WP may reduce the need for additional water resources (Rosegrant *et al.*, 2002). In industrialized countries, the gains from high WP are limited (Viala, 2008). Provided that the water is used efficiently, improved WP in agriculture allows for more water to be available for other competing sectors (Descheemaeker *et al.*, 2013). Therefore, increasing water productivity is an important response to decreased water scarcity, including the maintaining of sufficient water levels in rivers to maintain ecosystems and meet the growing needs of both urban areas and industry (Hengsdijk *et al.*, 2006).

Finally, as a summary measure of human development taking into account average performance in key dimensions (a long and healthy life, knowledge and an adequate standard of living) (UNDP 2021), the HDI may be used to measure these variables to indicate a country's ability to adapt to water stress (Brown and Matlock 2011). Lawrence *et al.* (2002) found a strong positive correlation between the HDI and water capacity. In support, Sušnik and Zaag (2017) also found a strong positive correlation



between access to clean water (as a percentage of the total population) and the HDI. Desai (1995) claims that whether a country withdraws 20% or 60% of its internal water resources annually depends strongly on the geophysical conditions but has virtually no direct impact on human development.

To the best of the authors' knowledge, a panel-data empirical analysis on the impact of economic development on freshwater abstraction has yet to be carried out for European countries, apart for research for Spain and France.

### Materials and methods

In this paper, the following panel model specification was applied for estimation:

$$\overline{fw}_{i,t} = x'_{i,t}\beta + u_{i,t}, \quad i = 1, \dots, N, \quad t = 1, \dots, T \quad (1)$$

where  $\overline{fw}_{i,t}$  is the total freshwater abstraction by source per capita - m<sup>3</sup> per capita in country  $i$  at time  $t$ ,  $x'_{i,t}$  is a vector of explanatory variables and  $u_{i,t}$  is a disturbance term. The total freshwater abstraction includes water withdrawn permanently or temporarily from a freshwater source. Mine and drainage water, as well as that abstracted from precipitation, are included, while water used for hydropower generation (in-situ use) is excluded (Eurostat).

Following the discussion in the research background, the explanatory variables include:

$\overline{gdp\_pc}_{i,t}$  - GDP per capita in current USD

$\overline{trade}_{i,t}$  - international trade (sum of import and export) as a percentage of GDP

$\overline{wp}_{i,t}$  - water productivity, measured as economic output produced per m<sup>3</sup> of freshwater abstracted, in constant 2010 EUR at 2010 exchange rates

$\overline{hdi}_{i,t}$  - Human Development Index

We estimate the empirical model using an unbalanced panel dataset for 19 European countries, comprised of 18 EU Member States and one candidate country, from 2007 to 2018. Several datasets were combined to estimate the impact of economic development on freshwater withdrawals. The data on GDP per capita and international trade were obtained from the World Bank's WDI database, while the data on the Human Development Index were retrieved from the UNDP. The data on freshwater and water productivity come from the Eurostat database. The incompleteness of cross-country data on freshwater and water productivity limited the selection of countries to 19 for which at least ¾ of the observations are available within the timeframe observed to prevent major imbalances in the panel dataset. Ultimately, 221 observations were included.

In the estimation, typical problems were taken into account that characterize the econometric estimation of panel models and that reduce the efficiency of basic OLS

estimation, such as panel heterogeneity and cross-sectional dependence, as well as the correlation and heteroscedasticity of residuals. The assumption of panel heterogeneity implies that the disturbance term  $\overline{u_{i,t}}$  consists of the time-invariant individual effect of country  $\overline{v_i}$  and IID random error  $\varepsilon_{i,t}$ ,  $\overline{u_{i,t}} = \overline{v_i} + \varepsilon_{i,t}$ . The presence of cross-sectional dependence, correlation and heteroscedasticity necessitates the covariance matrix of the residuals  $E[uu']$  to be a block matrix:

$$\Omega_{uu} = \begin{bmatrix} \sigma_1^2 \Omega_{11} & \dots & \sigma_{1N} \Omega_{1N} \\ \dots & \ddots & \dots \\ \sigma_{N1} \Omega_{N1} & \dots & \sigma_N^2 \Omega_{NN} \end{bmatrix}$$

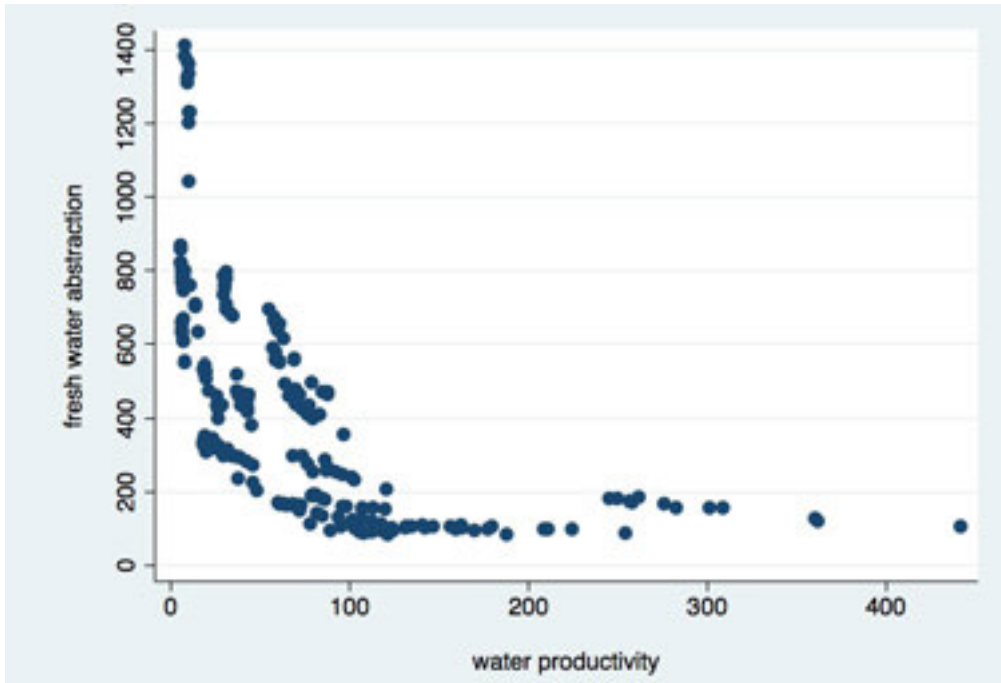
where  $\sigma_i^2$  is the heteroskedastic variance of the disturbances,  $\Omega_{ii}$  is a matrix of autocorrelations, and  $\sigma_{ij} \Omega_{ij}$  is a matrix of cross-sectional correlations. Since basic OLS estimation requires the assumptions that all  $\sigma_i^2$  are equal, all  $\Omega_{ii}$  are identical matrices and all  $\sigma_{ij} \Omega_{ij}$  are zeros, it is clear that neglecting these aspects may lead to unreliable estimates if the OLS is applied without the appropriate corrections.

Finally, an additional econometric problem that particularly relates to the specification of the model has been taken into consideration; namely, water productivity is most likely endogenous to water extraction. This arises from water productivity being calculated as economic output per m<sup>3</sup> of freshwater withdrawn, which in turn implies a likely simultaneity of freshwater withdrawn per capita and water productivity. Similar to other econometric problems, the presence of endogeneity in the model reduces the reliability of a simple OLS estimation.

Therefore, tests were first performed for cross-sectional dependence, correlation and heteroscedasticity to check whether these problems are relevant to the model, as well as the Hausman test to decide whether we should use a fixed or random effects estimator. Thereafter, to address all the econometric issues discussed as well as check the robustness of the estimation results, the model was evaluated using several estimators as proposed in the literature.

Before estimating the model, a graphic examination using scatter plots was performed on the relationships between the dependent variable and each explanatory variable to check whether all relationships are linear. Since the scatterplot of freshwater abstraction and water productivity indicates the presence of very strong non-linear relationships between these two variables, as shown in Figure 1 in the Appendix, the squared value of water productivity as an explanatory variable was also included.

**Figure 1.** The relation between freshwater abstraction and water productivity



*Source:* Authors

## Results

To test for the presence of cross-sectional dependence, correlation and heteroskedasticity of the residuals, the following residual tests were applied:

- Heteroskedasticity: the Modified Wald test for heteroskedasticity (Greene, 2000). Under the null that all residual variances of all panels are equal, the Modified Wald test statistics is Chi-squared distributed.
- Autocorrelation: the Wooldridge test for serial correlation in panel data (Wooldridge, 2002). Under the null that the residuals within the panel are not autocorrelated at the first lag, the Wooldridge test statistics is F distributed.
- Cross-sectional dependence: Pesaran's test of cross-sectional independence (Pesaran, 2004). Under the null that the residuals are not cross-sectional dependent, the Pesaran test statistics is z distributed.

The results of testing, presented in Table 1, clearly reject nulls in all three tests applied, thereby implying that issues of cross-sectional dependence, correlation and heteroskedasticity of the residuals should not be neglected in model estimation.

**Table 1.** Residual tests

Test	Statistics	P-value
Modified Wald test for heteroskedasticity	$\chi^2(19) = 12674.61$	0.0000
Wooldridge test for serial correlation in panel data	$F(1, 18) = 102.165$	0.0000
Pesaran's test of cross sectional independence	$z = 7.748$	0.0000

*Source:* Authors

Further, the Hausman specification test (Hausman, 1978) was performed to test null that the Random Effect (RE) estimator is efficient against the alternative of the RE as inconsistent. The computed Hausman statistics ( $\chi^2(3) = 8.8$ , P-value = 0.032) suggest the rejection of null, making Fixed Effects estimation more appropriate.

It is typical to address endogeneity through using an estimator based on the instrumental variable approach (IV). However, in order to achieve a more efficient estimation with an IV estimator compared to OLS, the instruments must be sufficiently adequate / relevant (i.e., correlated with the instrumented variables) and valid (i.e., not correlated with the disturbance term). If there is no clear choice of instruments from the explanatory variables, the first lags of the explanatory ones may be used, as they are not correlated with contemporaneous disturbances but likely with the current values of the instrumented explanatory variables. For our research, the linear and quadratic terms of water productivity are instrumented by both their own first lags and those of the other explanatory variables. The validity of the instruments is tested using the Kleibergen-Paap rk Wald F test (Kleibergen, Paap, 2006) and the Hansen J test (Hansen et al., 1996). The Kleibergen-Paap rk Wald F test of weak identification indicates whether the instruments are relevant, whereas the Hansen J test indicates instrument validity. The calculated values of the two statistics and the respective critical values confirm the instruments to be appropriate.

Since the results of the residual test clearly indicate the presence of cross-sectional dependence, correlation and heteroskedasticity, three different estimators are used for the model (including the squared water productivity). Firstly, the Fixed Effects (FE) estimator, as implied by the Hausman test, is applied to control for individual effects. However, since the FE estimator is essentially an OLS estimator applied to data transformed by removing fixed effects, it is not robust for cross-sectional dependence, correlation and heteroskedasticity. Two additional estimators, therefore, are also applied: Feasible Generalized Least Squares (GLS) and Panel-Corrected Standard Errors (PCSE) - both of which are robust to cross-sectional dependence, correlation and heteroskedasticity. Finally, Two-Stage LS estimators are also applied to deal with the endogeneity arising from the simultaneous dependence between water productivity and freshwater withdrawals. The results of the estimations are presented in Table 2.

**Table 2.** The model's estimation results

	FE	FGLS	PCSE	IV TSLS
wp	-6.3817***	-5.3583***	-6.1680***	-6.1594***
	(0.4519)	(0.3732)	(0.6814)	(1.0247)
wp_sq	0.0095***	0.0089***	0.0099***	0.00972***
	(0.0008)	(0.0009)	(0.0013)	(0.0020)
hdi	1589.6417***	863.0137***	996.6999*	1697.968**
	(393.4906)	(279.8742)	(545.0999)	(823.9513)
gdp_pc	0.0065***	0.0033***	0.0048***	0.0063***
	(0.0017)	(0.0007)	(0.0016)	(0.0017)
trade	-0.5761	0.2067	0.3461	-0.4793
	(0.3649)	(0.1461)	(0.2246)	(0.8081)
_cons	-658.5154**	-127.6685	-205.8569	
	(303.7843)	(228.7309)	(435.2034)	
No. of Obs.	221	221	221	202
R-Squared	0.56		0.65	0.55

*Dependent variable: Freshwater*

*Fixed effects are removed in IV TSLS estimation*

*Levels of significance: \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$*

*R-Squared is not possible to compute for FGLS*

Apart from international trade, the estimation results clearly demonstrate all explanatory variables to be significant in explaining cross-country variation in freshwater. The estimated relationship between water productivity and freshwater is non-linear, as indicated by the scatter plot, which is a highly robust result in terms of the significance, direction and magnitude of the estimated regression coefficients. A one-unit change in water productivity leads to a per capita decrease in freshwater withdrawal between 5.4 and 6.4 m<sup>3</sup>; nonetheless, this negative linear effect is partially offset by the positive non-linear effects. The estimated impact of the HDI on freshwater is both positive and significant, suggesting better living standards coincide with an increased ability to extract more freshwater. Still, the magnitude of this effect cannot be accurately assessed due to the considerable variation in the estimated regression coefficients with respect to the estimators used. Finally, the estimation results also indicate a positive and robust influence of GDP per capita on freshwater intake. Accordingly, a change in GDP per capita of USD 1000 leads to a corresponding change in the freshwater intake of between 3.3 and 6.5 m<sup>3</sup>. In sum, the explanatory power of the model may be considered satisfactory as it is estimated at 56%, 65% and 55% for IV, FE and PCSE regression, respectively. (Note: It is not possible to estimate the R-squared when FGLS is applied.)

## Discussions

Confirming others' results (El Khanji, Hudson, 2016), our estimation results indicate a significant positive impact of economic growth on water consumption, which suggests development to be likely influenced by water-resource management. As a country grows in wealth, it tends to use water more intensively – especially for non-agricultural purposes. Yet, since the existence of the inverted U relationship between water use and economic growth according to the EKC theory was not the subject of our analysis, our conclusions may only echo those already found in the literature showing trends change in favour of improving environmental conditions when economic growth is high.

When considering the relationship between trade openness and water use, the breadth of research has produced varied results. While some studies have argued for trade openness as a significant factor for water conservation (Hoehn, Adanu, 2008), others have yielded either neutral effects (Reimer, 2014) or a non-linear correlation between the two variables (Berrittella *et al.*, 2008). One possible reason could be the structure of the individual countries researched.

Regarding the relationship between water productivity and water use, our result is consistent with other studies in the literature which also concluded that increasing water productivity reduces per capita water withdrawals (Zheng *et al.*, 2018; Kresovic *et al.*, 2014). The non-linear negative relationship between water productivity and water withdrawal suggests that the rates of decline in water withdrawal have the potential to lower with additional growth in water productivity. The finding that the decline in water withdrawal weakens as water productivity increases is consistent with the conclusion of Viala (2008). There is the potential to increase physical and economic water productivity, but it would require policies and actions that take into account the complexity of achieving these gains. Moreover, the areas posed to benefit from the highest potential gains in improved WP are those which have extremely low yields and which rely on rain-fed agricultural systems.

Our research finding of a strong positive correlation between the HDI and freshwater use also confirms the conclusions of Lawrence *et al.* (2002). Our results, however, differ from the findings of Neumayer (2001), Sušnik and Zaag (2017), who all concluded there to be no direct correlation between resource exploitation and environmental degradation with human development.

## Conclusion

Using country-level panel data from 19 European countries from 2007 to 2018, this paper has examined the relationship between its selected indicators of economic development (GDP per capita, the Human Development Index - HDI, water productivity and volume of international trade) and freshwater abstraction. With the exception of the volume of international trade, our analysis confirms research elsewhere in the literature and indicates all explanatory variables to be significant in explaining cross-country variation in freshwater abstraction.

According to Eurostat methodology, the main issue associated with using total freshwater abstraction as an indicator of water consumption is that it fails to distinguish between freshwater abstraction from surface and groundwater. Since the Eurostat database for water abstraction statistics aggregates nationally, it does not account for regional and seasonal changes throughout the year for areas which may be under the influence river basins, which may suffer from varying degrees of water scarcity in summer, or which may experience drastic contrasts in temperature. The indicator also does not distinguish between abstracted water that is returned to the catchment after use and appropriate treatment or when it is used for irrigation purposes and undergoes natural evaporation. For a more detailed analysis, separate data on water abstraction from groundwater, surface water and regional allocation should be considered, but these data are not readily available.

Furthermore, as the impact of climate change has not been assessed here; rather, our analysis is limited solely to economic development indicators. An important extension of this study would be to consider the impact of climate change on water abstraction, especially within a country or countries facing moderate or severe water scarcity.

Bearing in mind the impact of economic development on water abstraction, European countries must learn to adapt to any and all successful water conservation strategies. Economic and population growth, cultural challenges, changes in trade controls and the responses throughout the industrial sector to water scarcity shall all be the main factors influencing the future of water demand (Ercin, Hoekstra 2016). One possible solution is to reduce water demand by increasing water prices (Lavrić *et al.*, 2017). In addition, the reuse of wastewater can be a suitable strategy to prevent further problems with water demand (Tchobanoglous, 2021). Technological changes in the productivity of water use could significantly slow down the increase in water withdrawals in all sectors (Alcamo *et al.*, 2007). These measures may also all have impact on freshwater abstraction to economic development as has been presented here.

This paper is a starting point to better understand the relationship between economic development and water abstraction in Europe. Further research should examine economic-development forecasts as well as the measures used to reduce freshwater abstraction by country. This paper may assist national decision-makers in Europe to identify priorities and further measures to provide sufficient freshwater of adequate quantity and quality for all.

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### **Conflict of interests**

The authors declare no conflict of interest.

## References

1. Alcamo, J. Florke, M., & Marker, M. (2007). Future long-term changes in global water resources driven by socio-economic and climatic changes. *Hydrological Sciences Journal* 52 (2): 247–275.
2. Ali, M.H. & Talukder, M.S.U. (2008). Increasing water productivity in crop production-A synthesis. *Agricultural water management*, 95 (11), 1201-1213.
3. Allan, J.A. (1993). Fortunately there are substitutes for water otherwise our hydro-political futures would be impossible. In *Priorities for water resources allocation and management*, ODA, London, 1993: 13-26
4. Arrow, K., Bolin, B., Costanza, R., Dasgupta, P., Folke, C., Holling, C.S., Jansson, B.O., Levin, S., Maler, K.G., Perrings, C., & Pimentel, D. (1995). Economic growth, carrying capacity, and the environment. *Ecological Economics*, 15 (2), 91-95.
5. Aznar-Sanchez, J.A., Belmonte-Urena, L.J., Velasco-Munoz J.F. & Manzano-Agugliaro, F. (2018). Economic analysis of sustainable water use: A review of worldwide research. *Journal of Cleaner Production*, 198, 1120-1132.
6. Barbier, E.B. (2004). Water and Economic Growth. *Economic Record*, 80 (248), 1-16.
7. Beecher, J.A. (2020). Policy note: a universal equity–efficiency model for pricing water. *Water Economics and Policy*, 6 (03), 2071001.
8. Berrittella, M., Rehdanz, K., Tol, R., & Zhang, J. (2008). The impact of trade liberalization on water use: a computable general equilibrium analysis. *Journal of Economic Integration*, 23(3), 631-655.
9. Bhattarai, M., (2004). Irrigation Kuznets curve governance and dynamics of irrigation development: A global cross-country analysis from 1972 to 1991. International Water Management Institute Colombo, Sri Lanka.
10. Brauman, K.A., Siebert, S. & Foley, J.A. (2013). Improvements in crop water productivity increase water sustainability and food security—a global analysis. *Environmental Research Letters*, 8 (2), 024030.
11. Brown, A. & Matlock, M.D. (2011). A review of water scarcity indices and methodologies. *White paper*, 106 (1), 19.
12. Cai, X. & Rosegrant, M.W. (2003). World water productivity: current situation and future options. In *Water productivity in agriculture: Limits and opportunities for improvement*, Kijne, J.W. Barker, R. and Molden, D. (eds.), 163-178. Sri Lanka: International Water Management Institute (IWMI).
13. Chapagain, A.K, Hoekstra, A., Savenije, H. (2006). Water saving through international trade of agricultural products. *Hydrology and Earth System Sciences*, 10, 455–468.



14. Chapagain, A.K. & Hoekstra, A.Y. (2008). The global component of freshwater demand and supply: an assessment of virtual water flows between nations as a result of trade in agricultural and industrial products. *Water international*, 33 (1), 19-32.
15. Chen, Z., Ngo, H., Guo, W. & Eslamian, S. (2015). *Water shortages, urban water reuse handbook* (1st ed.). CRC Press.
16. Cole, M.A. (2004). Economic growth and water use. *Applied Economics Letters*, 11, 1-4.
17. Culas, R.J. (2007). Deforestation and the environmental Kuznets curve: An institutional perspective. *Ecological Economics*, 61, 429-437.
18. Cvijanović, D., Trandafilović, S., & Imamović, N. (2013). Marketing concept in terms of agricultural enterprises development in transitional countries. *Economics of Agriculture*, 60(1), 113-122.
19. Dang, Q., Konar, M., Reimer, J.J., Baldassarre, G.D., Lin, X. & Zeng, R. (2016). A theoretical model of water and trade. *Advances in Water Resources*, 89, 32-41.
20. Dantas, I.R.M., Delzeit, R. & Klepper, G. (2021). Economic research on the global allocation of scarce Water resources needs better data. *Water Economics and Policy*, 7(03), 1-33.
21. Desai, M. (1995). Greening of the HDI? *Accounting for Change*. A McGillivray (ed.), 21-36. London: New Economics Foundation.
22. Descheemaeker, K., Bunting, S.W., Bindraban, P., Muthuri, C., Molden, D., Beveridge, M., Brakel, M., Herrero, M., Clement, F., Boelee, E. & Jarviset, D. I. (2013). Increasing water productivity in agriculture. In *Managing Water and Agroecosystems for Food Security*, Boelee, E. (ed.), 10, 104-123. Wallingford, UK: CAB International.
23. Distefanoa, T. & Kellyb, C. (2017). Are we in deep water? Water scarcity and its limits to economic growth. *Ecological Economics*, 142, 130–147.
24. Djuričin, S., Savić, S., Bodroza, D., Cvijanović, G., Djordjević, S. (2016). Climate change impacts on agricultural water management: Challenge for increasing crop productivity in Serbia, *Economic of Agriculture*, 63 (4), 1333-1346
25. Domanović, V., Vujičić, M. & Ristić, L. (2018). Profitability of food industry companies in the Republic of Serbia, *Economic of Agriculture*, 65(1), 11-32. doi:10.5937/ekoPolj1801011D
26. ElKhanji, S. & Hudson, J. (2016). Water utilization and water quality in endogenous economic growth. *Environment and Development Economics*, 21(5), 626-648.
27. Ercin, A.E. & Hoekstra, A.Y. (2016). Water footprint scenarios for 2050: A global analysis. *Environment international*, 64, 71-82.
28. European Environment Agency – EEA (2021). Use of freshwater resources in Europe. <https://www.eea.europa.eu/data-and-maps/indicators/use-of-freshwater-resources-3/assessment-4> [accessed on May 21, 2021]

29. Fraiture, C. & Wichelns, D. (2010). Satisfying future water demands for agriculture. *Agricultural Water Management*, 97 (4), 502-511.
30. Gerverni, M., Avelino, A.F.T. & Dall'erba, S. (2020). Drivers of water use in the agricultural sector of the European union 27. *Environmental Science & Technology*, 54, 9191–9199.
31. Gleick, P.H. (2003). Water use. *Annual Review of Environment and Resources*, 28, 275-314.
32. Goklany, I.M. (2002). Comparing 20th century trends in U.S. and global agricultural water and land use. *Water International*, 27(3), 321-329.
33. Greene, W (2000). *Econometric Analysis*. 4th Edition, Prentice Hall, Englewood Cliffs.
34. Hansen, L.P., Heaton, J. & Yaron, A. (1996). Finite sample properties of some alternative GMM estimators. *Journal of Business and Economic Statistics*, 14 (3), 262-280.
35. Hausman, J.A. (1978). Specification tests in econometrics. *Econometrica*, 46, 1251-1271.
36. Hengsdijk, H., Krogt, W., Verhaeghe, R.J. & Bindraban, P.S. (2006). Consequences of supply and demand management options for integrated water resources management in the Jabotabek- Citarum region Indonesia. *International Journal of River Basin Management*, 4(4), 283-290.
37. Hervás-Gámez, C. & Delgado-Ramos, F. (2019). Drought management planning policy: From Europe to Spain. *Sustainability*, 11 (7), 1862.
38. Hjalager, A. M. & Richards, G. (2003). *Tourism and gastronomy*. Routledge, London.
39. Hoehn, J.P. & Adanu, K. (2008). Do growth, investment, and trade encourage water use or water conservation? *Letters in Spatial and Resource Sciences*, 1, 127-146.
40. Hoekstra, A.Y. & Chapagain, A.K. (2007). Water footprints of nations: water use by people as a function of their consumption pattern. *Water Resources Management*, 21, 35-48.
41. Hoekstra, A.Y. (2009). Water security of nations: how international trade affects national water scarcity and dependency. *Threats to global water security*, 27-36.
42. Hoekstra, A.Y. (2014). Water scarcity challenges to business. *Nature Climate Change*, 4 (5), 318-320.
43. Jia, S., Yang, H., Zhang, S., Wang, L. & Xia, J. (2006). Industrial water use Kuznets curve: evidence from industrialized countries and implications for developing countries. *Journal of Water Resources Planning and Management*, 132 (3), 183-191.
44. Katz, D. (2015). Water use and economic growth: Reconsidering the environmental Kuznets curve relationship. *Journal of Cleaner Production*, 88, 205–213.
45. Kleibergen, F. & Paap, R. (2006). Generalized reduced rank tests using the singular value decomposition. *Journal of Econometrics*, 133, 97-126.

46. Koch, H. & Vögele, V. (2009). Dynamic modelling of water demand, water availability and adaptation strategies for power plants to global change. *Ecological Economics*, 68 (7), 2031-2039.
47. Konar, M., Reimer, J.J., Hussein, Z. & Hanasaki, N. (2016). The water footprint of staple crop trade under climate and policy scenarios. *Environmental Research Letters*, 11 (3), 035006.
48. Kresovic, B., Matovic, G., Gregoric, E., Djuricin, S. & Bodroza, D. (2014). Irrigation as a climate change impact mitigation measure: An agronomic and economic assessment of maize production in Serbia. *Agricultural Water Management*, 139, 7-16.
49. Lavrnić, S, Zapater-Pereyra, M. & Mancini, M.L. (2017). Water scarcity and wastewater reuse standards in Southern Europe: focus on agriculture. *Water, Air, & Soil Pollution*, 228, 1-12.
50. Lawrence, P., Meigh, J., Sullivan, C. (2002). The water poverty index: An international comparison Keele. *Economics research papers*, Keele, Department of Economics University of Keele
51. Li, X., Kang, S., Zhang, X., Li, F. & Lu, H. (2018). Deficit irrigation provokes more pronounced responses of maize photosynthesis and water productivity to elevated CO<sub>2</sub>. *Agricultural Water Management*, 195, 71-83.
52. Liu, J., Hertel, T.W., Taheripour, F., Zhu, T. & Ringler, C. (2014). International trade buffers the impact of future irrigation shortfalls, *Global Environmental Change*, 29, 22-31.
53. Masson-Delmotte, V.P., Zhai, H.O., Roberts, P.D., Skea, J., Shukla, P.R., Pirani, A., Moufouma-Okia, W., Péan, C., Pidcock, R., Connors, S., Matthews, J.B.R., Chen, Y., Zhou, X., Gomis, M.I., Lonnoy, E., Maycock, T., Tignor, M. & Waterfield, T. (2018). IPCC, 2018: Global Warming of 1.5 C. An IPCC Special Report on the impacts of global warming of 1.5 C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. *Sustainable Development, and Efforts to Eradicate Poverty*, 616.
54. Mekonnen, M.M.& Hoekstra, A.Y. (2016). Four billion people facing severe water scarcity. *Science Advances*, 2 (2), e1500323.
55. Mićović, A. (2017). Tourism Development and Evolution of Tourism Related Rules, *2<sup>nd</sup> International Scientific Conference – Thematic Proceedings II*, Faculty of Hotel Management and Tourism, Vrnjačka Banja, 181-202. Retrieved from [http://www.hit-vb.kg.ac.rs/conference/images/thematic\\_proceedings/2017\\_II.pdf](http://www.hit-vb.kg.ac.rs/conference/images/thematic_proceedings/2017_II.pdf)
56. Molden, D., Oweis, T., Steduto, P., Bindraban, P., Hanjra, M.A. & Kijne, J. (2010). Improving agricultural water productivity: Between optimism and caution. *Agricultural Water Management*, 97, 528-535.

57. Musolino, D.A., Massarutto, A. & Carli, A. (2018). Does drought always cause economic losses in agriculture? An empirical investigation on the distributive effects of drought events in some areas of Southern Europe. *Science of The Total Environment*, 633, 1560-1570.
58. Neumayer, E. (2001). The human development index & sustainability — a constructive proposal. *Ecological Economics*, 39(1), 101-114.
59. Pesaran, M.H. (2004). General diagnostic tests for cross section dependence in panels. Cambridge Working Papers in Economics 0435 University of Cambridge.
60. Reimer, JJ (2014). Water in the international economy. *Journal of International Agricultural Trade and Development*, 9, 21-52.
61. Rey, D., Pérez-Blanco, C.D., Escrivá-Bou, A., Girard, C., Ted, I.E. & Veldkamp, T. (2019). Role of economic instruments in water allocation reform: Lessons from Europe. *International Journal of Water Resources Development*, 35 (2), 206-239.
62. Rock, M.T. (1998). Freshwater Use, Freshwater Scarcity, and Socioeconomic Development. *The Journal of Environment & Development*, 7(3), 278–301.
63. Rosegrant, M., Cai, R.X. & Cline, S. (2002). World water and food to 2025. Dealing with Scarcity. International Food Policy Research Institute, Washington DC.
64. Roson, R. & Damania, R. (2017). The macroeconomic impact of future water scarcity: An assessment of alternative scenarios. *Journal of Policy Modeling*, 39 (6), 1141-1162.
65. Sachidananda, M., Webb, D.P. & Rahimifard, S. (2016). A concept of water usage efficiency to support water reduction in manufacturing industry. *Sustainability*, 8 (12), 1222.
66. Stern, D.I. (2004). The environmental Kuznets curve. In *Companion to Environmental Studies*, 49-54. Routledge
67. Stošić, L. & Stošić, I. (2013). Diffusion of innovation in modern school. *International Journal of Cognitive Research in Science, Engineering And Education (IJCRSEE)*, 1(1), 12-24.
68. Suri, V. & Chapman, D. (1998). Economic growth, trade and energy: Implications for the environmental. *Ecological Economics*, 25(2), 195-208.
69. Sušnik, J. & Zaag, P. (2017). Correlation and causation between the UN Human Development Index and national and personal wealth and resource exploitation. *Economic Research-Ekonomska Istraživanja*, 30 (1), 1705-1723.
70. Tchobanoglous, G., Kenny, J. & Leverenz, H. (2021). Rationale for constant flow to optimize wastewater treatment and advanced water treatment performance for potable reuse applications. *Water Environment Research*, 93 (8), 1231-1242.
71. The Food and Agriculture Organization of the United Nations (FAO). Retrieved from <http://www.fao.org> (July 31, 2018)

72. United Nations Development Programme (2021). Human Development report. <http://hdr.undp.org/en/content/human-development-index-hdi> [accessed on May 21, 2021]
73. Viala, E. (2008). Water for food, water for life a comprehensive assessment of water management in agriculture. *Irrigation and Drainage Systems*, 22, 127-129.
74. WHO (2021). Progress on household drinking water, sanitation and hygiene 2000–2020: Five years into the SDGs. WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP).
75. Wooldridge, J.M. (2002). Econometric analysis of cross section and panel data. Cambridge MA MIT Press.
76. Wu, X.D., Guo, J.L., Li, C.H., Shao, L., Han, M.Y. & Chen, G.Q. (2019). Global socio-hydrology: An overview of virtual water use by the world economy from source of exploitation to sink of final consumption. *Journal of Hydrology*, 573, 794-810.
77. Zhang, Y., Zhang, Y., Shi, K., & Yao, X. (2017). Research development, current hotspots, and future directions of water research based on MODIS images: A critical review with a bibliometric analysis. *Environmental Science and Pollution Research*, 24, 15226e15239.
78. Zheng, H., Bian, Q., Yin, Y., Ying, H., Yang, Q. & Cui, Z. (2018). Closing water productivity gaps to achieve food and water security for a global maize supply. *Scientific Reports*, 8 (1), 14762.

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# IMPACT OF DIGITAL MARKETING ON THE PERFORMANCE OF COMPANIES IN THE AGRICULTURAL SECTOR OF SERBIA

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## ABSTRACT

This paper explores the impact of digital marketing on the business operations of companies in the agricultural sector of Serbia. Accordingly, the research objective is to determine critical success factors of digital marketing channels in companies within this sector. Given the stated research objective, the following general hypothesis has been formulated: digital marketing channels such as effective presence on social media, website quality, online sales and search engine optimization have a significant positive impact on the business performance of companies in the agricultural sector in Serbia. Successful implementation of these types of digital marketing channels by companies is expected to lead to increased visibility, engagement of the target audience, and improved sales. Consequently, the results of empirical research provide more insightful perspectives on the state of this field, identifying specific aspects of digital marketing that significantly contribute to the business performance of companies in the agricultural sector of Serbia.

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## Introduction

Agriculture, much like various other sectors in the modern world, has undergone significant transformations due to the adoption of intensification technologies, the globalization of agri-food markets, and the financialization of both production and

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consumption (Ioris, 2018). These profound changes have reshaped the landscape of agricultural practices, introducing new dynamics and challenges that require a multifaceted approach to address. The integration of advanced technologies, the interconnectedness of global agri-food markets, and the increased financial aspects influencing production and consumption have collectively contributed to the evolution of agriculture into a more complex and interconnected system.

The agricultural production market in Serbia is undergoing rapid transformations as it adapts to global trends, particularly the dynamics of the Internet economy (Ljutić et al., 2016). This shift signifies a profound change in the way agricultural products are produced, marketed, and consumed. With the advent of digital technologies and the growing influence of the Internet, the traditional methods of agricultural commerce are evolving to align with the demands of a more interconnected and technologically driven marketplace. This adaptation to global trends not only reshapes the landscape of agricultural practices but also opens up new opportunities and challenges for stakeholders within the Serbian agricultural sector.

All categories of companies in the agricultural sector of Serbia (micro, small, medium, and large) are most prevalent, in terms of quantity, in the Belgrade region, followed by the Vojvodina region, then the Šumadija and Western Serbia region, and finally in the South and East Serbia region (Dimitrijević et al., 2021). Regarding their impact on economic development, evaluated through GDP, employment figures, and turnover, the scenario remains consistent. The most advanced enterprises are concentrated in the Belgrade region, whereas the least developed ones are situated in the South and East Serbia region (Dimitrijević et al., 2021). Unfortunately, the link between primary agriculture and other sectors such as processing industry, trade, tourism, education, and more is currently weak (Aničić & Paraušić, 2020).

Research on digital marketing in developing countries, particularly concerning agricultural products, is still in need of enhancement, particularly when viewed from the consumer's perspective (Fitriana et al., 2024). There exists a gap in understanding the dynamics of digital marketing's impact on consumer behavior and preferences within these regions. A comprehensive exploration of how digital marketing strategies influence consumers in the context of agricultural products is essential for uncovering nuanced insights. Bridging this gap in research will contribute valuable knowledge that can inform effective digital marketing strategies tailored to the unique characteristics and needs of consumers in developing economies.

It is evident that digital transformation has become indispensable in modern business, especially in the agro-industry facing a dynamic market and the need for a more efficient marketing approach. This paper aims to explore the complex dynamics of digital marketing, with a particular focus on key channels such as social media presence, website quality, online sales, and search engine optimization (SEO). The introduction of digital marketing strategies in the agro-sector requires a holistic approach, encompassing an analysis of market trends, technological innovations, and specificities

of the agro-industry. We assume that the successful implementation of these strategies has the potential to significantly enhance the company's visibility, increase audience engagement, attract new customers, and result in sales growth.

Extensive evidence suggests that engaging in e-commerce provides a significant opportunity for reducing costs and enhancing demand (Zeng et al., 2017). The transformative impact of e-commerce extends beyond mere financial considerations, touching upon various facets of business operations. This digital avenue not only offers the potential for streamlining costs associated with traditional business processes but also serves as a dynamic platform for augmenting customer demand. The utilization of e-commerce introduces efficiencies that extend across the entire supply chain, influencing procurement, production, distribution, and customer engagement.

Within the dynamic trade of agro-products in Serbia, digital marketing represents a crucial factor for companies aiming to achieve sustainable growth. Global trends, rapid technological advancements, and the evolution of consumer habits dictate the need for adapting traditional marketing approaches. The agro-sector, as a vital part of Serbia's economic structure, faces challenges and opportunities arising from digitization. With the ubiquity of the internet and widespread availability of mobile devices, consumers increasingly rely on digital channels for product information and purchase decision-making.

### **Literature review**

The process of digitization has the potential to bring about fundamental transformations in the relationships among various stakeholders in the agricultural value chain (Kosior, 2018). This includes altering the dynamics between technology providers, input suppliers, farms, traders, processing units, retailers, and consumers. As digitization advances, it introduces novel opportunities and efficiencies, reshaping how information is shared, transactions are conducted, and decisions are made across the entire agricultural ecosystem. This digital revolution is poised to impact each stage of the value chain, promoting collaboration, transparency, and innovation for sustainable agricultural practices. Namely, digital technology helps SME's move faster and more competitive in national and international context. The effective free market is basic point of SME's (Munandar & Firmansyah, 2018). Digital technology serves as a catalyst for Small and Medium Enterprises (SMEs), enabling them to operate more swiftly and compete effectively on both national and international fronts. The efficient functioning of a free market is foundational for SMEs, and digital advancements play a pivotal role in ensuring their agility, adaptability, and competitiveness.

In modern agricultural practice, digitization plays a key role in achieving success and sustainability. Access to the Internet is a vital factor for the digitization of agriculture, enabling the connection of farmers with other actors in the sector and the use of digital technologies (Petrović et al., 2023). Digitization of agriculture brings significant effects, contributing to economic, social and environmental sustainability (Petrović et al., 2022). Influencer marketing, through social networks such as Facebook, Instagram,



YouTube, provides farmers with the opportunity to promote products and brands, as well as gain knowledge about new technologies (Mandušić et al., 2023).

The digital economy, serving as a pivotal force driving innovation, competitiveness, and growth, is increasingly essential for advancing economic development further (Spalević et al., 2018). Companies like “My Food” utilizing online technologies, particularly highlight the significance of online marketing as an integral component of their digital marketing strategy (Zogović, 2017). Utilizing a variety of digital platforms is crucial for agricultural businesses aiming to boost visibility, engage with target audiences, and establish a robust online presence (Brits, 2016). This multifaceted approach involves utilizing social media platforms, content marketing strategies, and other digital channels. Social media platforms provide a dynamic space for connecting with audiences, sharing updates, and fostering community engagement. Concurrently, strategic content marketing helps convey the brand’s story, expertise, and values. By integrating these efforts across diverse digital channels, agricultural businesses can effectively build and reinforce their brand presence in the competitive online landscape.

In the context of agriculture, education and training are key to success. Work to reduce migration, especially among young people, requires strengthening the marketing and promotion of villages and tourism (Blanuša et al., 2021). Research shows that digital marketing capabilities positively influence the market performance of small and medium-sized enterprises in the agro-industry (Phiri, 2020, a). In “Empowering Agribusiness with Digital Innovation for Emerging Market” (Srinivasan, 2018) the focus lies on leveraging digital innovation to empower agribusinesses in emerging markets. The chapter delves into strategic marketing issues within these markets, offering insights and solutions to enhance the role of digital innovation in agribusiness operations. Srinivasan’s work contributes valuable perspectives on navigating challenges and harnessing opportunities in the evolving landscape of agribusiness within emerging markets.

Digital transformation in agriculture also plays a key role in the global context. A digital marketing strategy can be aimed at the company’s strategic goals, enabling business development (Hall, 2023). Digital marketing has developed into an integral component of all marketing campaigns, becoming a key success factor (Bojkić et al., 2016). In the face of globalization changes and heightened demand for agricultural products, digital marketing is emerging as a sustainable means to enhance competitiveness in agriculture (Bose & Kiran, 2021).

The adoption of contemporary digital marketing technologies has the potential to expedite the product distribution process and enhance the efficiency of the distribution system in agricultural enterprises (Nezamova & Olentsova, 2021). The suitability of emerging technologies (cloud technologies, big data, artificial intelligence, robotics, open interfaces (API), biometrics, distributed registries, mobile contactless technologies) employed by agribusiness representatives is examined (Korobeynikova et al., 2018). For example, the examination of the suitability of emerging technologies for agribusiness encompasses a comprehensive evaluation of various cutting-edge tools

and cloud technologies offer scalable and flexible computing resources, facilitating efficient data storage and processing.

Digital marketplaces serve as crucial institutions, harnessing digital technology to facilitate trade services between buyers and sellers (Clasen & Mueller, 2006). The analysis of digital marketing resources and capabilities highlights their strategic importance in navigating a challenging digital environment (Day, 2011). The emphasis is on recognizing the prerequisites essential for the progress of mobile marketing in agricultural businesses (Shvydenko, 2014). Namely, Shvydenko (2014) explores the economic and organizational factors that serve as prerequisites for the successful implementation of mobile marketing strategies in the agricultural sector. The article likely provides valuable insights into the intersection of mobile technology and marketing strategies specific to agricultural contexts.

Digital marketing presents both challenges and opportunities in rural areas. Studies indicate that it is more effective than traditional methods, and users in these areas are more receptive to its adoption (Ravi & Rajasekaran, 2023). As the global population continues to grow, the agri-food sector faces increasing pressure, making digital marketing essential for exploring innovative solutions to meet the rising demand for food (Bowen & Morris, 2019). Given the accessibility of digital technology, enterprises have the chance to collect market and consumer information, adjusting their tools in response to shifts in consumer behavior (Borisova et al., 2020). Improving e-business and e-marketing in agribusiness requires adapting business and marketing strategies in light of digital transformation (Stojoska, 2023). In these circumstances, e-commerce has become a viable solution for linking agribusinesses with consumers within the food marketing system (Carpio & Lange, 2015). E-commerce provides a platform for these entities to engage, facilitate transactions, and streamline the distribution of agricultural products to consumers in a more direct and efficient manner. This approach allows for improved accessibility and convenience in the food supply chain.

Digital marketing holds a crucial position in addressing the objectives and key success indicators of the agricultural sector (Singh et al., 2020). Acknowledging the strategic importance of digital marketing resources and capabilities is crucial in the face of this challenging digital environment (Phiri, 2020, b). Recognizing the pivotal role that digital marketing plays is crucial for navigating and succeeding in the dynamic landscape of the online world. By harnessing relevant resources and developing robust capabilities in digital marketing, businesses can effectively adapt to the ever-evolving digital environment, ensuring their competitiveness and relevance in the modern market.

### **Materials and methods**

The research methodology of this paper is based on: 1) desk research of existing literature and 2) empirical research on a sample of 116 companies in the agricultural sector of Serbia, which were surveyed in the period September - October 2023. The first step includes a thorough analysis of the relevant literature related to the impact of

digital marketing on the business operations of companies in the agricultural sector. This literature review presents a theoretical framework for formulating a general hypothesis and identifying the key variables of digital marketing that were investigated in the empirical part.

Empirical research was conducted by surveying 116 companies in the agricultural sector in Serbia. The survey is focused on collecting data on current digital marketing strategies, level of presence on social networks, quality of websites, volume of online sales, application of SEO techniques, as well as other digital marketing variables. The data was collected through an online survey during September and October 2023. For the analysis of empirical data, factor analysis was used, which enables the identification of key factors and mutual connections between different aspects of digital marketing and business performance of companies in the agricultural sector of Serbia.

This statistical technique provides a systematic approach to understanding the complexity of factors that influence the success of digital marketing strategies in the specific context of agro-industry in Serbia. The survey was designed with the aim of covering various aspects of digital marketing, including specific challenges and opportunities that appear in the business of companies in the agricultural sector of Serbia. The questions were structured to obtain quantitative data, allowing precise analysis and quantification of responses.

A sample of 116 companies was selected taking into account: diversity of company size (small companies: 65%, medium: 33%, large: 2%), geographical distribution (The Belgrade region, Vojvodina region, and the Šumadija and Western Serbia region constitute 81% of the selected sample) and type of production (plant-based food production: 43%, animal food production: 32%, mixed food production: 13%, service activities in agriculture: 12%). This contributes to the representativeness of the sample and the validity of the results of empirical research for wider business contexts in the agricultural sector. After data collection, a factor analysis was conducted, which was used to identify key factors associated with the success of digital marketing strategies.

Consequently, this analysis enables the grouping of digital marketing variables into relevant factors, thus facilitating the interpretation of the complexity of interactions among the various elements of digital marketing. Accordingly, reliable and relevant information is provided that provides a thorough insight into the impact of digital marketing variables on the business operations of companies in the agricultural sector of Serbia.

## **Results and Discussion**

The examination of the impact of digital marketing on the performance of companies in the agricultural sector of Serbia reveals insightful results, marking a significant stride in understanding the dynamics of contemporary business strategies. The research focuses on dissecting various facets of digital marketing channels, including: social media presence,

- website quality,
- content marketing,
- SEO,
- online advertising and influencer marketing, among others.

It is anticipated that the successful utilization of these digital marketing channels will result in enhanced visibility for these companies, increased engagement with their target audience, and ultimately, improved sales. By effectively leveraging these channels, companies in the agricultural sector in Serbia can expect to achieve substantial growth and success in their endeavors.

Through empirical data and factor analysis, the study aims to unravel the nuanced relationships between these digital marketing variables and the overall performance of agribusinesses. The subsequent discussion delves into the implications of the findings, shedding light on how these insights can inform strategic decisions and shape the future landscape of digital marketing in the agricultural sector of Serbia.

The question: “How does your company conduct digital marketing (please check the appropriate options)?” yielded the following results:

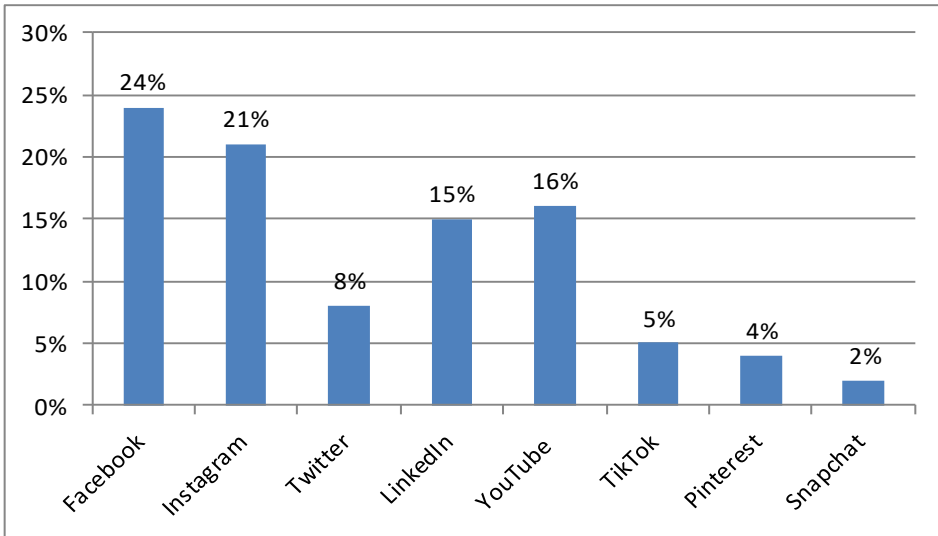
- Independently - without engaging professional agencies: 51%;
- In collaboration with an internal team and professional agencies: 34%;
- Exclusively using professional digital marketing agencies: 12%;
- We have no activities in the field of digital marketing: 3%.

The survey results indicate diverse approaches to digital marketing among the companies surveyed. A significant portion opts for independent management of digital marketing without involving external agencies, showcasing a preference for in-house strategies.

Another notable approach is collaborative efforts, with companies working alongside both internal teams and professional agencies to navigate the complexities of digital marketing. Additionally, a noteworthy percentage exclusively relies on professional digital marketing agencies, demonstrating a preference for outsourcing expertise in this field.

A small percentage of companies reported having no activities in the realm of digital marketing, suggesting a limited or non-existent presence in this aspect of business promotion. The structure of social media usage by companies in the agricultural sector of Serbia is illustrated in Graph 1.

**Graph 1.** Structure of social media usage by companies in the agricultural sector of Serbia



Source: Author’s research

In the survey research, digital marketing variables were rated on a scale from 1 (minimum value) to 5 (maximum value) based on their impact on the performance of companies in the agricultural sector of Serbia (Table 1). This served as the starting point for obtaining empirical data, i.e., ratings for individual variables, which constitute the input for factor analysis.

**Table 1.** Selected variables of digital marketing that may impact the business operations of companies in the agricultural sector of Serbia

Serial number	Variables of digital marketing
1	Presence on social media
2	Website quality
3	Content marketing
4	SEO (search engine optimization)
5	Online advertising
6	Email marketing
7	Influencer marketing
8	Content on YouTube and other video platforms
9	Online sales
10	Mobile marketing
11	Website and social media analytics
12	Online reputation and review management
13	Interactive content
14	Chatbots and customer support automation
15	Customized content for targeted segments

Source: Author’s research

A factorial simplicity index is constructed using the quartimax transformational criteria proposed by Carroll, Wrigley, Neuhaus, and Saunders (Kaiser, 1974). This index can be applied to each row individually as well as to a factor pattern matrix as a whole and the index ranges from zero to one, indicating the level of simplicity (Kaiser, 1974). This criterion is proposed as a test measure to assess the quality of the correlation matrix in factor analysis. Table 2 shows the scale for the evaluation of levels MSA criterion (measure of sampling adequacy).

**Table 2.** Scale for the evaluation of levels MSA criterion

MSA $\geq$ 0,9	marvelous	( <i>desirable value</i> )
MSA $\geq$ 0,8	meritorious	( <i>very good</i> )
MSA $\geq$ 0,7	middling	( <i>quite good</i> )
MSA $\geq$ 0,6	mediocre	( <i>mediocre</i> )
MSA $\geq$ 0,5	miserable	( <i>very bad</i> )
MSA $<$ 0,5	unacceptable	( <i>non-desirable value</i> )

Source: Kaiser, 1974;

The scale serves as a guideline for researchers to assess the adequacy of their sample size and correlation matrix in the context of factor analysis, helping them determine the suitability of their data for extracting meaningful factors. This evaluation is crucial for ensuring the reliability and validity of the factor analysis results. Table 3 presents the empirical values of the so-called Kaiser-Meyer-Olkin (KMO) criteria and Bartlett's test. They represent a valuable basis for assessing the representativeness of the selected sample in terms of the application of statistical factor analysis. As already stated the value of this criterion ranges between 0 and 1, where higher values indicate better convenience of the sample. In this case, a value of 0.817 is considered high, indicating an adequate sample for factor analysis. This high value suggests that the variables in the sample share enough common variance, which is crucial for successful factor analysis.

**Table 3.** Values of Keiser-Mayer-Olkin's criterion and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.817
Bartlett's Test of Sphericity	Approx. Chi-Square	578.431
	Df	141
	Sig.	.000

Source: Author's research

Bartlett's test tests the hypothesis "Variables are uncorrelated" and estimates the probability of rejecting that hypothesis. In this case, a low p-value (Sig. = .000) indicates a significant correlation between the variables. The chi-square value (578.431) and the number of degrees of freedom (141) indicate that the results are statistically significant, rejecting the hypothesis of non-correlation of the variables. Accordingly, it can be concluded that there is a statistically significant correlation between the relevant variables of digital marketing in the companies in the agricultural sector of Serbia that are included in the sample. The conducted tests show that the selected sample is suitable for factor analysis. This is supported by the high value of KMO criteria, while on the other hand,

Bartlett's test values show that there is a statistically significant correlation between digital marketing variables, which additionally justifies further analysis of factors that influence the performance of companies in the agricultural sector of Serbia. Table 4 illustrates the factors influencing the impact of digital marketing on the performance of companies in the agricultural sector of Serbia: variable coverage and % variance.

**Table 4.** Factors influencing the impact of digital marketing on the performance of companies in the agricultural sector of Serbia: variable coverage and % variance

Number of factors	Name of the extracted factor	Variable coverage	Percentage of variance
1	Social Presence and Online Marketing	Presence on social media, website quality, content marketing, SEO, online advertising, influencer marketing, and other aspects of digital marketing related to the online presence of the company	41.426
2	Mobile Marketing	Mobile advertising and customized applications for mobile devices	14.025
3	Interactive Content and Support	Interactive content (such as quizzes, surveys, contests) and customer support through chatbots and automation	9.098
4	Analytics and Optimization	Website and social media analytics, as well as optimization through tracking the success of marketing activities	8.625
5	Online Sales and Reputation	Online sales (e-commerce, electronic ordering) and management of online reputation and reviews	6.599
6	Video Content and Marketing	Content on YouTube and other video platforms, as well as marketing activities related to the video format	6.051
7	Customized Content for Segments	Customized content for targeted segments, personalization, and directing content to specific user groups	4.195
8	Email Marketing	Email marketing and communication via electronic mail	3.323

*Source:* Author's research

The research is based on the following general hypothesis: digital marketing channels such as effective presence on social media, website quality, online sales, and SEO (search engine optimization) have a significant positive impact on the business performance of companies in the agricultural sector in Serbia. Companies that successfully implement these types of digital marketing achieve greater visibility, engagement of the target audience, and increased sales. This hypothesis assumes that the specified digital marketing channels are particularly relevant to the agricultural sector in Serbia and that their effective implementation can have a positive impact on the business operations of companies in that sector.

The first extracted factor contributes with 41.426% to the variance, representing the highest share among all considered factors of digital marketing. The second extracted factor contributes with 14.025% to the variance (cumulatively, the first two factors explain 55.451% of the variance). The third extracted factor has a share of 9.098% in the variance, and cumulatively, the first three factors explain 64.549% of the variance. The fourth extracted factor contributes with 8.625% to the variance (cumulatively, the first four factors explain 73.174% of the variance). The fifth extracted factor contributes with 6.599% of the variance, and cumulatively, the first five factors explain 80.024% of the variance. As evident in Table 4, subsequent factors of digital marketing after the fifth progressively have diminishing shares in the variance.

Factor analysis has revealed that the variables of digital marketing, based on their inherent connections and influence on the performance of companies in the agricultural sector of Serbia, are grouped into the following factors (Table 4).

- The first extracted factor (41.426% variance) - “Social Presence and Online Marketing” encompasses variables related to social media presence, website quality, content marketing, SEO, online advertising, influencer marketing, and other aspects of digital marketing related to the online presence of companies.
- The second extracted factor (14.025% variance) - “Mobile Marketing” includes variables related to mobile advertising and customized applications for mobile devices.
- The third extracted factor (9.098% variance) - “Interactive Content and Support” includes variables related to interactive content (such as quizzes, surveys, contests) and customer support through chatbots and automation.
- The fourth extracted factor (8.625% variance) - “Analytics and Optimization” encompasses variables related to website and social media analytics, as well as optimization through tracking the success of marketing activities.

After the fourth factor, other factors have a smaller share in the variance and can mostly be named based on the specific variables present in those factors.

- The fifth extracted factor (6.599% variance) - “Online Sales and Reputation” contains variables related to online sales (e-commerce, electronic ordering) and management of online reputation and reviews.
- The sixth extracted factor (6.051% variance) - “Video Content and Marketing” includes variables related to content on YouTube and other video platforms, as well as marketing activities related to the video format.
- The seventh extracted factor (4.195% variance) - “Customized Content for Segments” contains variables related to customized content for targeted segments, including personalization and directing content to specific user groups.
- The eighth extracted factor (3.323% variance) - “Email Marketing” focuses on variables related to email marketing and communication via electronic mail.



The first extracted factor “Social Presence and Online Marketing” contributes to the variance by 41.426%. The research has led to a redefinition of the initial general hypothesis: Digital marketing channels, including presence on social media, website quality, content marketing, SEO, online advertising, influencer marketing, and other aspects related to the online presence of the company, largely determine the performance of companies in the agricultural sector of Serbia. The study’s findings underscore the significance of the first extracted factor, “Social Presence and Online Marketing” which strongly influences the variance by contributing 41.426%. This notable contribution has prompted a reconsideration of the initial general hypothesis, indicating that digital marketing channels, encompassing elements such as social media presence, website quality, content marketing, SEO, online advertising, and influencer marketing, play a pivotal role in determining the overall performance of companies in the agricultural sector of Serbia. The substantial impact of these factors highlights the importance of a robust online presence for businesses within this sector, aligning with the dynamic landscape of digital marketing. The results of ratings on the impact of digital marketing on the performance of companies in the agricultural sector of Serbia provide insight into the overall trend in this industry (Table 5).

**Table 5.** Average ratings of the impact of digital marketing on company performance, on a scale from 1 to 5

Company performance in the agricultural sector of Serbia	Average rating (on a scale of 1 to 5)
• Increase in sales	4.6
• Increase in brand awareness	4.3
• Increase in customer loyalty	4.1
• Improvement in customer engagement	3.8
• Increase in conversions	3.6
• Enhancement of targeting and segmentation	3.4
• Increase in competitive advantage	3.3
• Improvement in brand reputation	3.0

*Source:* Author’s research

The results indicate that digital marketing can have the greatest impact on increasing sales and brand awareness, aligning with broader trends in digital transformation and the increasing use of digital channels for product promotion and sales.

It is also noteworthy that improving customer loyalty receives a high rating, suggesting that digital marketing can be an effective tool for building long-term relationships with customers and maintaining their loyalty to the brand. This is particularly important in the agricultural sector, where there is the potential for repeat purchases and long-term collaboration with consumers. On the other hand, ratings for improving brand reputation, competitive advantage, and targeting/segmentation are somewhat lower. These results suggest that digital marketing may have a slightly smaller but still significant impact on these aspects. Careful planning, strategy and implementation are needed to achieve the maximum effect in these areas.

## Conclusions

The research examined the impact of digital marketing on the performance of companies in the agricultural sector of Serbia, focusing on key channels such as social media presence, website quality, online sales, and search engine optimization. The first extracted factor, "Social Presence and Online Marketing," contributes to the variance by 41.426%, indicating a significant influence of digital marketing channels on the performance of agricultural companies.

The findings led to a redefinition of the initial general hypothesis, emphasizing the crucial role of digital channels, including social media presence, website quality, content marketing, SEO, online advertising, influencer marketing, and other aspects related to the online presence of the company. The substantial contribution of the first extracted factor underscores the importance of a robust online presence for businesses in the agricultural sector, aligning with the dynamic landscape of digital marketing.

The results of ratings on the impact of digital marketing on the performance of companies in the agricultural sector of Serbia provide insight into the overall trend in this industry. The results indicate that digital marketing can have the greatest impact on increasing sales and brand awareness, aligning with broader trends in digital transformation and the increasing use of digital channels for product promotion and sales.

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## Conflict of interests

The authors declare no conflict of interest.

## References

1. Aničić, J., & Paraušić, V. (2020). Trends in development of Serbian agriculture after the economic crisis in 2008. *Western Balkan Journal of Agricultural Economics and Rural Development*, 2(2), 111-122. doi: <https://doi.org/10.5937/WBJAE2002111A>
2. Blanuša, A., Petrović, S., & Stevanović, M. (2021). The place and importance of agriculture in the economic system of the Republic of Serbia from 2000 to 2021. *Ecologica*, 28(104), 581-590. <https://doi.org/10.18485/ecologica.2021.28.104.13>
3. Bojkić, V., Vrbančić, M., Žibrin, D., & Čut, M. (2016). Digital marketing in agricultural sector. *ENTRENOVA-ENTERprise REsearch INNOVation*, 2(1), 419-424. Available at SSRN: <https://ssrn.com/abstract=3282288>
4. Borisova, L. V., Baranova, I. V., & Bruzhukova, O. V. (2020, May). Digital Marketing: Drivers for the Development of the Russian Agricultural Sector. In 2nd International Scientific and Practical Conference "Modern Management Trends

- and the Digital Economy: from Regional Development to Global Economic Growth”(MTDE 2020), Atlantis Press, (pp. 177-181). <https://doi.org/10.2991/aebmr.k.200502.028>
5. Bose, S. C., & Kiran, R. (2021). Digital marketing: a sustainable way to thrive in competition of agriculture marketing. *Bioinformatics for agriculture: High-throughput approaches*, 135-144. Available at [https://link.springer.com/chapter/10.1007/978-981-33-4791-5\\_8](https://link.springer.com/chapter/10.1007/978-981-33-4791-5_8)
  6. Bowen, R., & Morris, W. (2019). The digital divide: Implications for agribusiness and entrepreneurship. Lessons from Wales. *Journal of Rural Studies*, 72, 75-84. <https://doi.org/10.1016/j.jrurstud.2019.10.031>
  7. Brits, M. (2016). Online media and agriculture: building your brand through digital platforms. *FarmBiz*, 2 (11), 6-9. Available at <https://hdl.handle.net/10520/EJC196701>
  8. Carpio, C. E., & Lange, K. Y. (2015). Trends in e-commerce for the food marketing system. *CABI Reviews*, (2015), 1-8. <https://doi.org/10.1079/PAVSNNR2015100>
  9. Clasen, M., & Mueller, R. A. (2006). Success factors of agribusiness digital marketplaces. *Electronic Markets*, 16(4), 349-360. <https://doi.org/10.1080/10196780600999809>
  10. Day, G. S., (2011). Closing the Marketing Capabilities Gap. *Journal of Marketing*, Volume 17, pp. 183-195. <https://doi.org/10.1509/jmkg.75.4.183>
  11. Dimitrijević, M., Ristić, L., & Stojković, D. (2021). Značaj malih i srednjih preduzeća u razvoju agrarnog sektora Republike Srbije. *Agroekonomika* 50 (90), 29-40. [in English: Dimitrijević, M., Ristić, L., & Stojković, D. (2021). The significance of small and medium-sized enterprises in the development of the agrarian sector of the Republic of Serbia. *Agroeconomics*, 50(90), 29-40.].
  12. Hall, S. (2023). B2B digital marketing strategy: how to use new frameworks and models to achieve growth. Kogan Page Publishers.
  13. Fitriana, W., Azriani, Z., & Hariance, R. (2024). Utilization of Digital Marketing in Food Agricultural Business. In International Conference on Entrepreneurship, Leadership and Business Innovation (ICELBI 2022), Atlantis Press, (pp. 688-698). [https://doi.org/10.2991/978-94-6463-350-4\\_68](https://doi.org/10.2991/978-94-6463-350-4_68)
  14. Ioris, A. A. (2018). The politics of agribusiness and the business of sustainability. *Sustainability*, 10(5), 1648. <https://doi.org/10.3390/su10051648>
  15. Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, 39, 31–36.
  16. Korobeynikova, O., Korobeynikov, D., & Dugina, T. (2018). Issues on diffusion of digital payment innovations in agribusiness in Russia. In International scientific and practical conference” Agro-SMART-Smart solutions for agriculture”(Agro-SMART 2018) (pp. 378-382). Atlantis Press. <https://doi.org/10.2991/agrosmart-18.2018.71>

17. Kosior, K. (2018). Digital transformation in the agri-food sector—opportunities and challenges. *Roczniki (Annals)*, 20 (2), 98-104, <https://doi.org/105604/01.3001.0011.8122>
18. Ljutić, B. Ž., Đurđević, D., Đorđević, Z., & Damjanovic, A. (2016). Serbian large agribusiness corporations knocking at the door of e-agribusiness revolution. *AGRIS on-line Papers in Economics and Informatics*, 8(2), 57-65. <https://doi.org/10.22004/ag.econ.241370>
19. Mandušić, D., Katalinić, V., & Blašković, L. (2023). Influencer marketing as an excellent way to promote an agricultural product. *Obrazovanje za poduzetništvo-E4E: znanstveno stručni časopis o obrazovanju za poduzetništvo*, 13(1-2), 168-180. [in English: Mandušić, D., Katalinić, V., & Blašković, L. (2023). Influencer marketing as an excellent way to promote an agricultural product. *Education for Entrepreneurship-E4E: a scientific and professional journal on entrepreneurship education*, 13(1-2), 168-180.]. <https://doi.org/10.38190/ope.13.1-2.13>
20. Munandar, J. M., & Firmansyah, D. (2018). The role of digital marketing in improving SME's product competitiveness in the ASEAN Economic Community (AEC)(Case study in Indonesia). *Journal of Administrative and Business Studies*, 4(4), 206-218. Available at SSRN: <https://ssrn.com/abstract=3744796>
21. Nezamova, O., & Olentsova, J. (2021). The role of digital marketing in improving the efficiency of the product distribution system of agricultural enterprises in the Krasnoyarsk Region. In *E3S Web of Conferences* (Vol. 247, p. 01027). EDP Sciences. <https://doi.org/10.1051/e3sconf/202124701027>
22. Petrović, D. Č., Stanimirović, P. Z., & Vratonjić, G. A. M. (2022). The importance of digital transformation projects in agriculture and the challenges of their justification assessment. *Tehnika*, 77(6), 767-773. <https://doi.org/10.5937/tehnika2206767P>
23. Petrović, D., Stanimirović, P., & Vratonjić Gligorijević, A. (2023). Izazovi u upravljanju projektima digitalizacije u poljoprivredi. [in English: Petrović, D., Stanimirović, P., & Vratonjić Gligorijević, A. (2023). Challenges in managing digitalization projects in agriculture.]. Available at <https://symorg.fon.bg.ac.rs/wp-content/uploads/2023/06/Odrzivo-upravljanje-poslovanje-Inovacije-softver-i-komunikacije-naslovna-i-sadržaj.pdf>.
24. Phiri, M. (2020a). Impact of digital marketing capabilities on market performance of small to medium enterprise agro-processors in Harare, Zimbabwe. *Business: Theory and Practice*, 21(2), 746-757. <https://doi.org/10.3846/btp.2020.12149>
25. Phiri, M. (2020b). Exploring digital marketing resources, capabilities and market performance of small to medium agro-processors. A conceptual model. *Journal of Business and Retail Management Research*, 14(2), 1-14. Available at [https://www.jbrmr.com/cdn/issue\\_file/2020-05-03-13-39-59-PM.pdf#page=8](https://www.jbrmr.com/cdn/issue_file/2020-05-03-13-39-59-PM.pdf#page=8)
26. Ravi, S., & Rajasekaran, S. R. C. (2023). A perspective of digital marketing in rural areas: A literature review. *International Journal of Professional Business Review*, 8(4), e01388-e01388. <https://doi.org/10.26668/businessreview/2023.v8i4.1388>

27. Spalević, Ž., Vićentijević, K., & Ateljević, M. (2018). Legal and economic analyzing the development of the digital economy. *Business Trends*, 6(1), 29-37. Available at <https://scindeks-clanci.ceon.rs/data/pdf/2334-816X/2018/2334-816X1801029S.pdf>
28. Shvydenko, O. M. (2014). Prerequisites for the development of mobile marketing in agricultural enterprises. *Ekonomika APK*, (11), 114-119.
29. Singh, V., Huseynov, R., & Jhaji, S. (2020). Role of digital marketing for smart agriculture: Their implications, practices and future direction. *Economic Agents*, 167-202.
30. Stojoska, S. (2023). Influence of internal and external factors on the introduction of e-business and e-marketing in agribusiness (Doctoral dissertation, Faculty of Agricultural Sciences and Food-Skopje).
31. Zeng, Y., Jia, F., Wan, L., & Guo, H. (2017). E-commerce in agri-food sector: a systematic literature review. *International Food and Agribusiness Management Review*, 20(4), 439-460. <https://doi.org/10.22434/IFAMR2016.0156>
32. Zogović, K. (2017). Mjerenje konverzija, tagovanje i remarketing u funkciji poboljšanja marketinga preduzeća „Moja hrana”. *LIMESplus*, (3), 125-139. [in English: Zogović, K. (2017). Measurement of conversions, tagging, and remarketing for the purpose of improving marketing at the company „My Food”. *LIMESplus*, (3), 125-139.]. Available at <https://www.cceol.com/search/article-detail?id=672514>

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# LOCAL SELF-GOVERNMENT AS THE BASIS FOR THE AGRICULTURAL DEVELOPMENT AND THE AGRARIAN POLICY IMPLEMENTATION IN THE REPUBLIC OF SERBIA

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## ABSTRACT

The development of modern democratic states implies respect for the principle of subsidiarity, which means bringing down decisions and their execution to the local level. The decisions regarding the use of agrarian potential in the Republic of Serbia are still under the jurisdiction of the central government authorities, which contributes inadequately to the overall stability and development of agriculture in modern geopolitical correlations. The goal of this paper is to point out to the necessity of understanding the need to enable as much as possible the authorities at the local self-government level of the Republic of Serbia to implement the strategic goals of agrarian policy while improving permanently their agricultural capacities. Based on the research on the opinions of relevant state and local authorities and on empirical and theoretical arguments, the authors support this claim and provide a new perspective for the content of agrarian policy, as well as the development of the rich agricultural potential that the Republic of Serbia has at its disposal.

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## Introduction

Realization of basic human needs at the level closest to the citizens is an epithet of highly developed democratic states of the world. In the political system of the Republic of Serbia, this has certainly been attributed to the local self-government. Local self-government is the right of citizens to directly and through freely elected

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representatives manage public affairs of immediate, common and general interest of the local population, as well as the right and obligation of local self-government bodies to, in accordance with the law, plan, arrange and manage public affairs that are within their jurisdiction and of interest to the local population (Law on Local Self-Government, Article 2). Investing in the agricultural potential of the Republic of Serbia should have a strategic approach, but not only in terms of administration, but also in terms of the implementation of legislation and agrarian policy measures.

It is self-understood that such an approach must be defined at the state level, but the implementation of measures should be delegated to local administrative units that are under the supervision of bodies of the Ministry of Agriculture of the Republic of Serbia. In this regard, and with the aim of raising the level of education of citizens about the necessity of improving awareness regarding the strengthening and development of the agricultural potential that is given to us as a natural resource, it is necessary to place special emphasis on the organizational and developmental instruments of agrarian policy. A key role in the creation and implementation of agrarian policy instruments should be given to local administrative units, where there would also be institutions that would deal with development and advisory consulting in the field of agriculture. In the last decade, the agrarian policy of the Republic of Serbia has had a progressive image, but there is still an insufficiently developed mechanism for implementing the policy into practice and achieving production that creates a mercantilist agrarian position of the state, for which objectively there are resources (Voza & Fedajev, 2020; Blanuša, et al., 2021).

Agrarian policy instruments that could be considered as organizational and developmental ones are:

1. agricultural education,
2. agricultural advisory services and
3. scientific research work in the field of agriculture (Đurić, 2021).

Agricultural education in the Republic of Serbia is implemented at the high school and higher education level. However, it is necessary to intervene here and introduce a new element into the Law on the Basics of the Education and Training System. Namely, this new element implies that children even from preschool age should be educated about the necessity of protecting the existing agricultural potential which the Republic Serbia has at its disposal. This intervention in the legislation of the Republic of Serbia is also necessary because it creates in children from early childhood a sense of commitment to healthy agricultural production and the creation of a value system in which the resources available to the Republic of Serbia, first and foremost the area of arable agricultural land, are placed on a high pedestal. Having in mind exactly these potentials of the Republic of Serbia, there is a necessity to delegate the implementation of organizational and development instruments of agrarian policy to local administrative units. Each local self-government, depending on geographical position of its local

administrative unit, should carry out the process of educating children from an early age, and through the regular school system and in that way create awareness among children to nurture the natural resources we enjoy. A prerequisite for improving the results of agricultural development instruments is a change in the way of managing, implementing and monitoring local agricultural policy and rural development policy (Blanuša, et al., 2022).

The agricultural advisory services, which have been considered as the second instrument for the improvement of the implementation of agrarian policy in the Republic of Serbia, could achieve enviable results and contribute both in terms of creation and implementation of the policy of spreading social awareness of the importance and the priority of creating a new society. These services have been known for organizing numerous workshops for the youngest, permanently educating advisers, providing field work of advisers, as well as assistance in registering agricultural holdings and realizing the benefits guaranteed to farmers by the Government of the Republic of Serbia. The third instrument for the improvement of the implementation of agricultural policy instruments in the Republic of Serbia is reflected by the cooperation of science and practice, that is, modern society imposes the tendencies of a healthy life, and that trend includes academic intervention in agricultural production. In contrast to agricultural consultancy, which can be organized as a public service, but also in the form of private consulting agencies, institutions engaged in scientific and research work, due to the importance and risks they carry, are as a rule financed by the state (Đurić, 2021).

### **Participation of local self-government in the implementation of agrarian policy measures**

The Constitution of the Republic of Serbia (2006), contains a more modern, necessary and significantly more advanced arrangement of local self-government than the one that existed in the previous Constitution from 1990. This can be seen first of all by the fact that the Constitution (2006) guarantees the right of citizens to local self-government (Article 176) and establishes that the state power is limited by the right of citizens to local self-government (and territorial autonomy) and that this right is subject only to the supervision of constitutionality and legality (Article 12) (Milosavljević, 2009). Furthermore, the Constitution of the Republic of Serbia (2006) guarantees the right of citizens to local self-government, and thus it recognizes and confirms the legal identity of local administrative units (Constitution of the Republic of Serbia, Article 176).

It is from this legal basis that we derive the thesis that the implementation of agrarian policy on the territory of the Republic of Serbia should be the responsibility of local self-governments, and that their work should be subject to the supervision of the line ministry. As regulators of democracy in the modern political sense, democratic principles are defined that categorize the political system as democratic. These are regulators on the basis of which the overall work of institutions is evaluated and their degree of success is measured (Živković et al., 2019; Ljubojević, Petrović, 2019). The development of agricultural potential is directly conditioned by the development of the



political system of the Republic of Serbia, because the national policy is the creator of all policies within a country. It follows from this that there is an interest, and in accordance with the developed democratic political systems in Europe, for agrarian potential and agrarian policy to be exclusively managed on the level of local self-government, that is, by the decentralized units of government.

Agricultural consultancy, as an instrument of agrarian policy, gives the best effects precisely in the geographic area it is most familiar with, thus connecting education, science and the resources available to the local community. The Republic of Serbia is still going through a transition in defining all policies of national development, the truth is much less than before, but this transition process is still ongoing. Each phase of the transition has been characterized by certain social and economic phenomena that generated certain negative impact on economic development, and therefore on agricultural development (Mihajlović, Marković, 2004). In order to increase awareness about the importance of promoting and implementing agrarian policy, it is necessary to approach each geographic area in accordance with the characteristics of its locality in the Republic of Serbia. Starting from the fact that the development potentials are different in certain regions of the country, the construction of the advisory system should be selective. This approach implies that the advisory system should be created, first of all, in accordance with the specificities and development needs of the areas that have the greatest development potentials. In that way, the principle of rational spending of budget funds would be respected, while different types of support would be provided for areas with the lowest level of development potential (Đurić, 2020). At the moment, such local initiatives are not sufficiently present.

Local self-government does not have sufficient readiness or capacity to act in the process of implementing agrarian policy. It has been known that local initiatives have been primarily present in the segment of improving the situation in the field of physical, i.e. communal infrastructure (water supply and sewerage network), energy (electricity, gas) and road infrastructure (Paraušić et al., 2022). In the Republic of Serbia, there is a large number of distinctly rural areas, which could be developed in an adequately controlled manner only with the involvement of local scientific and educational institutions. For this reason, the rural development policy supports building the capacity of local communities to determine and implement local development plans. The network for supporting rural development through regional and district centers should form the basis for the establishment and efficient functioning of local action groups, which would take care of determining and implementing the development strategies of the local community (Popović et al., 2011).

In this sense, for the development of agrarian potential in the Republic of Serbia, it is necessary that businesses that are registered in the territory of a certain local administrative unit opt for inclusion in the process of improving and creating local economic and agrarian development. As claimed by Janković-Milić et al. (2014), the representatives of business community have the opportunity to be involved in certain local self-government bodies and to give their opinion on aspects of the local economic

development. An example of local self-government bodies are local employment councils. According to the positive practice of the Republic of Serbia, local employment councils gather representatives of local self-governments, national employment service, entrepreneurs, centres for social work, representative syndicates and non-governmental organizations. However, it has to be pointed out that these institutional forms have been established with the aim of improving functioning of specific segments of the local economic framework (e.g. employment, education, etc.). It means that the role of these business community representatives has been limited to initiatives of already adopted measures referring to a single particular area. Nevertheless, this type of the involvement of business community in local initiatives could open another chapter in the use of local potentials. For example, the representatives of business community stationed in certain local administrative unit could contribute to the development of local rural tourism. Having in mind that tourism plays an increasingly important role in the economy of the Republic of Serbia, the development of local rural tourism could contribute significantly to employment and improving the social, cultural and natural environment of local communities (Cizler, 2013). The interest of every country is modernization and monitoring the trends of more developed countries, which is also discussed in the Report on progress in achieving the goals of sustainable development by 2030 in the Republic of Serbia (Babović, 2020).

### **Agrarian potential of the Republic of Serbia**

In the Republic of Serbia, there are 5.06 million hectares of agricultural land. At this moment it has to be stressed that only 71% of agricultural land is used intensively, in the form of arable land, orchards and vineyards. It means that 29% of agricultural land is natural grassland consisting of meadows and pastures. The dominant part of agricultural land, amounting to 3.3 million hectares or 65%, is in the form of arable land. It has to be pointed out that about 7% of arable land is not in the use, i.e. it remains in the form of uncultivated land (Ljubojević et al., 2022).

When describing the rural areas of Serbia, it can be stated that there is a large concentration of natural resources such as agricultural land, forests, water, with preserved ecosystems and biodiversity. Also, important advantages of rural areas are being recognized in the wealth of cultural resources, as well as the preserved traditions of the people who live in these areas (Pavlović et al., 2021; Cvijanović et al., 2022). However, each of local rural areas has its own peculiarities and characteristics. That is why it is important that the implementation of the agrarian development policy is entrusted to the greatest extent to local self-governments. In general, many of development policy tasks are legally entrusted to the authorities of local administrative units as parts of the local self-government system, but the results based on entrusting them with these tasks are not enough visible. This mostly refers to forestry, agriculture, water management and other areas of importance for the accelerated development of Serbian agrarian potential.

In order to compare the level of economic development of different areas in the Republic of Serbia, the European NUTS (Nomenclature of Territorial Units for

<http://ea.bg.ac.rs>

Statistics) classification of regions has been implemented. NUTS 1 are regions having three million to seven million inhabitants; NUTS 2 are regions within NUTS 1 regions having 800,000 to 3,000,000 inhabitants (Eurostat, 2018). In the Republic of Serbia, Serbia North and Serbia South have been considered as NUTS 1 Regions. Within NUTS 1 Serbia North Region are the following NUTS 2 Regions: The Region of Belgrade and the Region of Vojvodina. Within NUTS 1 Serbia South Region are NUTS 2 Regions: The Region of Šumadija and Western Serbia, the Region of Southern and Eastern Serbia and the Region of Kosovo and Metohija.

With the data from Table 1, we can statistically explain the impact of the agricultural potential in the regions at the NUTS 1 level in the Republic of Serbia, divided into the north of the country and its south, and to highlight how much agricultural land is used both by family holdings and by legal entities and entrepreneurs. It is clear that the region of Southern Serbia is in a significantly less favorable position than the region of Northern Serbia when it comes to the size of agricultural holdings and the level of utilization of agricultural potential.

Table 2 clearly shows how important it is for agrarian policy to observe statistical data at the level of the NUTS 2 statistical regions of the Republic of Serbia. The data on the used agricultural land in the period from 2017 to 2019 show this. In the mentioned table, it is easy to recognize which part of the country has the least developed agricultural potential, that is the region of Southern and Eastern Serbia. Also, it can be seen which is the region with the greatest agricultural potential. Namely, according to the data on the number and size of agricultural land, the Region of Vojvodina leads the way, on the territory of which nearly 35% of the agricultural land of the Republic of Serbia is located. Table 2 also shows how important it is to implement agricultural policy measures in order to improve the use of agricultural land, precisely in the region of Vojvodina. It is a region where the size of used agricultural land decreased in the last year of the observed period. The shortcomings in the implementation of the agrarian policy measures in this region could be partly attributed to the ineffectiveness of local authorities. Unfortunately, there are quite a lot of paradoxes in the implementation of agrarian policy in local self-governments: from an inefficient workforce to large imports of agricultural products to the domestic market. Even in the territory of Vojvodina, the area of land under irrigation systems has decreased. In many agricultural branches, exports to foreign countries have stopped and now the products are sold at much lower prices, suffocating small farmers along the way, and because of all this, the villages become only sad witnesses of some old times and former life, where much more attention was paid to agriculture than it is today (Kokeza, 2013).

**Table 1.** Land, livestock, workforce and standard value of farm production according to legal status and size of used agricultural land

Period	2021						
Indicator							
Territory – NUTS	SIZE of UAL	Legal status	Used agricultural land [Hectare]	Holdings [number]	Cattle [number]	Yearly working unit [number]	Economic size of holding (SO) [millions of euros]
REPUBLIC OF SERBIA	TOTAL	Total	3475894	564541	1933840	645733.12	4879
		Family holding	2916125	562895	1651568	627406.28	4221
		Legal entity	557866	1373	276370	17576.92	646
		Entrepreneur	1903	272	5902	749.92	12
SERBIA – NORTH	Total	Total	1719899	157103	784606	163381.75	2321
		Family holding	1287300	156138	562421	148957.4	1760
		Legal entity	431356	853	221200	14118.23	557
		Entrepreneur	1242	112	985	306.12	4
SERBIA – SOUTH	Total	Total	1755995	407438	1149234	482351.37	2558
		Family holding	1628826	406758	1089147	478448.88	2461
		Legal entity	126509	520	55170	3458.69	89
		Entrepreneur	660	161	4917	443.8	8

Source: Statistical Office of Serbia Metadata

**Table 2.:** Used agricultural land by regions, in hectares

Used agricultural land		
	Total	Arable land
<b>Republic of Serbia</b>		
2017.	3438130	2594980
2018.	3486908	2582909
2019.	3481567	2578898
<b>Region of Belgrade</b>		
2017.	148640	119335
2018.	147330	114699
2019.	150642	119148
<b>Region of Vojvodina</b>		
2017.	1554354	1438183
2018.	1594311	1453032
2019.	1549861	1432382
<b>Region of Šumadija and Western Serbia</b>		
2017.	1012041	554558
2018.	1000063	529800

Used agricultural land		
2019.	1034697	542111
Region of Southern and Eastern Serbia		
2017.	723094	488947
2018.	745203	485378
2019.	746367	485257

*Source:* Statistical Office of Serbia Metadata

### **The potential of local self-government as the bearer of agricultural policy implementation**

Local self-government is one of the most important parts of a political system (Lapčević, Rapačić, 2023). Such is the case in the Republic of Serbia. Although we are aware of the numerous shortcomings of local self-government in Serbia, we must nevertheless mention that it can be the driving force behind effective agrarian policy through many activities and changes that are needed and expected on the soil of the country in which we live. In order for agrarian policy to be effective and preferably economical, we must tackle the numerous challenges that await us on the difficult path of establishing a successful agrarian policy.

Agrarian policy can be best defined and determined as a consciously directed action of the state government that should be implemented in the food sector in order to achieve production results that are in line with the social belief of what an ideal agrarian system should look like (Ljubojević et al., 2022). Agrarian policy, and especially its food system, should have as its main goal the adequate food for the entire population, cheap food as a form of satisfying basic human needs, availability of food throughout the year regardless of the season, then health-safe food that must constantly be under by the control of appropriate state institutions, as well as the appropriate way e for people living in villages and engaged in agriculture in its primary form.

We must agree that today we cannot talk about a developed, democratic state without mentioning local self-government as an important part of its political system (Bird, 2000). As much as the state has to deal with agrarian policy, it also has to deal with public policy that occurs in the form of satisfying the interests and needs of citizens living in smaller, local communities. Among others, agrarian policy is certainly one of the most important state policies that are also carried out at the local level. That is why it is important that agrarian policy, due to the very principle of subsidiarity, is realized at the local level through original and entrusted tasks that the state entrusts to local self-government.

Although many believe that the state should not interfere in the affairs of the agrarian system, considering that there is no need for such a thing and that these problems can be solved at a lower organizational level, nevertheless it is believed that the state, i.e. its government, has very significant role in regulating the agrarian policy (Ljubojević et al., 2022). Also, there are numerous reasons for state intervention, especially when

it comes to food production. The areas in which this intervention is necessary relate mostly to food security, protection of the income of agricultural producers, increasing the efficiency of agricultural production, food safety and numerous other, increasingly prevalent, environmental problems.

The most important issue is the question of the competence of local authorities, because in order to successfully carry out tasks from the original scope of cities and municipalities, it is necessary that those who manage local administrative units be competent in performing their own community tasks. Good management, in addition to transparency in work and responsibility, also implies that local authorities rationally use available resources and provide public services in accordance with the principles of efficiency, effectiveness and economizing behavior (Begovic et al., 2006). Local authorities would have to possess numerous abilities to harmonize the various demands and interests of their citizens, and to successfully coordinate all activities of local services and institutions.

Although we talk about the necessity of the existence of a relationship between agrarian policy and local self-government, we must primarily understand the importance of the state in determining and implementing agrarian policy. On that side, the state nurtures the three most important concepts of agrarian policy. These are: protectionist, liberal and the concept of sustainable development of agriculture. The protectionist concept characterizes the protective position of the state in order to develop and protect domestic agriculture from foreign competition. The liberal concept is the complete opposite of the previously mentioned concept, and it is characterized by the free formation of prices of agricultural and food products on the market, liberalized imports, that is, completely free operation of market mechanisms in the sphere of agriculture. The concept of sustainable development of agriculture aims at the modern development of this economic activity and within it the focus is on the development of multifunctional agriculture, on rural development and development of agriculture based on respect for environmental protection (Radović, 2021). In this way, we see all the need and necessity of interference and cooperation of the state and local authorities when it comes to agricultural affairs, that is, agrarian policy.

Local authorities are the ones who should primarily participate in the process of attracting capital and other production factors. Local agricultural policy will depend on their efficiency. And therefore, the policy of local economic development should be understood as the growth of the capacity of the local economy to create wealth for the population that makes up a local community, and thus to improve their quality of life through an increase in employment, real earnings, the value of personal property, the volume and quality of public services and the like (Begović et.al., 2006). That is why it is considered that economic development in local community does not arise by itself. Therefore, it is necessary to reach an agreement on a common strategy for the development of the agrarian policy of all local administrative units in the Republic of Serbia and for the entire communities to actively participate in the implementation, that is, the realization of the aforementioned strategy.

## **Research on the perspectives of the development of agrarian policy in the Republic of Serbia and its local administrative units**

Research on the perspectives on the development of agrarian policy in the Republic of Serbia and its local administrative units has been conducted in November and December 2023. Three relevant representatives from the Ministry of Local Government and Rural Development of the Republic of Serbia and eight representatives from local administrative units (four of them from the municipalities situated in NUTS 2 Region of Vojvodina and four of them situated in the municipalities situated in the NUTS 2 Region of Southern and Eastern Serbia) were interviewed to obtain answers on the following questions:

- How do you think the state could assist local administrative units to implement successfully agrarian policy measures?
- In your opinion, what should be the ways to strengthen the functioning of rural areas in the implementation of the agrarian policy?
- How do you find the importance of the cooperation of local authorities with the business community situated in the territory of certain local administrative unit?
- Do you think that the harmonization of agrarian policy instruments of the Republic of Serbia with the relevant instruments applied in the European Union could improve the role of self-government in agrarian development?

These semi-structured interviews were realized by phone and recorded with the permission of the respondents. The obtained answers were analyzed and systematized according to their relevance.

All respondents stressed that there are a number of priorities the state should implement with the help of local authorities. They described their attitudes regarding the relationship of the activities of the agrarian policy makers and local authorities. According to their opinion, to the greatest extent, these activities are aimed at further improving the management of local economic development through the planning and implementation of public and agrarian policies, numerous programs and mechanisms, including business advice and branding. The representatives of the Ministry of Local Government and Rural Development argued that special attention should be paid to the improvement of existing legal frameworks that are important for local economic development and the implementation of agrarian policy, and what is most important, which refers to proposing some new legal solutions with the aim of developing the full agricultural potential.

The respondents from local administrative units believe that the great success of the state and local self-government would be in more frequent intensification of the permanent cooperation of cities and municipalities with local business representatives. According to the view of the respondents from the municipalities situated in NUTS 2 Region of

Southern and Eastern Serbia, the result of these activities should be constant support to the local self-government in the optimization of local administrative procedures towards the economy and citizens. They argued that in today's political system of the Republic of Serbia, there are shortcomings related to the readiness of local authorities to face the growing agrarian policy and its needs. That is why they believe that the accelerated development of the capacity of cities and municipalities for the application of the rules on the allocation of state aid and the necessity of adequate harmonization of state aid with local development policy is necessary. On the other hand, the respondents from the municipalities situated in the NUTS 2 Region of Vojvodina claimed that it would be particularly significant to provide further support to local self-government units in the development and implementation of annual programs for the protection, arrangement and use of agricultural land, the organization of local programs aimed at supporting agriculture and rural development, and strengthening the capacities of cities and municipalities as a service to potential users for the implementation of agricultural policy.

The answers to the question how and in what way to strengthen the agrarian policy in the local administrative units, more precisely how to strengthen the functioning of rural areas in the implementation of the agrarian policy were concentrated on the problem of the depopulation of rural areas. The respondents stressed that the main goals are aimed at effectively keeping the population in rural areas and providing that population with an equivalent quality of life as in the city. They claimed that since local self-government in rural areas in Serbia is still poorly developed, it is necessary to enable the potential unhindered settlement of rural areas by the urban population, if the disposition for such a thing exists among the urban population. In that respect they stressed that financial aid from the state and the development of competition can greatly contribute to the strengthening of agrarian policy in local communities.

Analyzing the answers of the respondents to the question of harmonizing agrarian policy of the Republic of Serbia to the agrarian policy of the European Union, it could be concluded that the prevailing opinion is that such harmonization is yet to be pursued. The representatives of the Ministry of Local Government and Rural Development considered that one of the more ideal scenarios for the efficient development of agrarian policy in the state and local self-government would be the entry of Serbia into the European Union and the respect of its basic principles and values aimed at the development of agrarian potential. However, the respondents think that there is still a great struggle ahead in the process as many necessary conditions must be met for such a scenario. Above all, they mentioned that the necessity to harmonize agrarian policy of the Republic of Serbia with the EU's agrarian policy is just one step to the entry of the Republic of Serbia to the European Union. Yet, in order for Serbia to harmonize its agricultural policy with the EU policy, it must meet certain standards that have long been established as the basic criteria for joining the European Union. Primarily, they stressed the creation and functioning of a market economy that should be able to integrate into the market economies of the EU member states. At the same time, they were worried about the ability of the state to deal with strong competition so that the



state's economy is not destroyed by the invasion of imported goods at the moment of joining the great free market. They concluded that, among other things, fulfilling the criteria for the state to adapt to the whole set of EU rules and practices, which are known under the collective name of *acquis communautaire*, means that the obligation of all countries that want to join the EU is to unconditionally accept everything that the European Union asks of them.

### Conclusion

The development of agriculture as a vital branch of the overall economy of the Republic of Serbia is conditioned by internal and external factors that have a direct impact on the overall political and strategic approach to agrarian development. For local self-government in Serbia, it is necessary to be freed from the political factor and to be supported by the Government of the Republic of Serbia through various aid mechanisms and thus to gain a legislative framework, viewed through the exclusively strategic intention of developing the entire agrarian sector of the country. The strategy, in this case, implies returning to the natural resource as undoubtedly the greatest potential, inalienable, inexhaustible, and always reliable.

The fact that only 80 years ago Serbia was a country for more than 85% of the population engaged in agriculture shows that its potential is inexhaustible and immeasurable. The industrialization policy implemented during the period of socialism from the end of the Second World War to the 1990s, accompanied with neglecting the agrarian development, has led to the devastation of large number of agricultural holdings and to the depopulation of rural areas. The last few decades of political and economic transition were characterized by further neglect of agricultural development. That is why it is necessary to establish a more efficient institutional and organizational framework for local self-government, as well as to strengthen local administrative capacities. At this moment, it represents a huge challenge for local self-government because it has to provide the most favorable financial conditions that will enable them to become competitors with other European developed countries with such a developed agrarian policy and agriculture. At the same time, numerous obstacles for the expansion of the local agricultural system must be removed through the introduction of incentive measures for producers in this sector and the provision of support for relevant research and development activities in this area. In that respect, the encouraging of local administrative units in their goals of improving the development of agrarian sector and enabling rural population to stay and work on their land is of primary importance for the state agrarian policy makers.

It could be concluded that it is necessary to establish a more efficient institutional and organizational framework, as well as to strengthen local administrative capacities of the Republic of Serbia. At this moment, those goals represent a huge challenge for the state because it has to provide the most favorable financial conditions that will enable rural communities to become competitors with the farmers of European developed countries with such a developed agrarian policy and agriculture. At the same time, numerous

obstacles for the expansion of the local agricultural system must be removed through the introduction of incentive measures for producers in this sector and the provision of support for relevant research and development activities in this area.

### Conflict of interests

The authors declare no conflict of interest.

### References

1. Babović, M. (2020). *Progress report on the implementation of sustainable development goals by 2030 in the Republic of Serbia*. Statistical Office of the Republic of Serbia, Belgrade
2. Begović B., Vacić Z., Matković G., Mijatović B. (2006) *Local Economic Development*, Center for Liberal Democratic Development, Belgrade
3. Bird, C. (2000). The Possibility of Self-Government. *The American Political Science Review*, 94(3), 563–577. doi: <https://doi.org/10.2307/2585831>
4. Blanuša, A., Petrović, S., Stevanović, M. (2021). The place and importance of agriculture in the economic system of the Republic of Serbia from 2000 to 2021, *ECOLOGICA*, 28(104), 581-590.  
a. doi: <https://doi.org/10.18485/ecologica.2021.28.104.13>
5. Blanuša, A., Petrović, S., Žikić, S., Trifunović, D. (2022). The influence of local self-government on sustainable development of agricultural potential, *ECOLOGICA*, 29(105), 1-7.  
a. doi: <https://doi.org/10.18485/ecologica.2022.29.105.1>
6. Borović, S., Stojanović, K., & Cvijanović, D. (2022). The future of rural tourism in the Republic of Serbia. *Economics of Agriculture*, 69(3), 925–938. doi: <https://doi.org/10.5937/ekoPolj2203925B>
7. Cizler, J. (2013). Opportunities for the sustainable development of rural areas in Serbia. *Problemy Ekorozwoju–Problems of Sustainable Development*, 8(2), 85-91. Retrieved from: <https://bibliotekanauki.pl/articles/371206> (December 25, 2023)
8. Ustav Republike Srbije („Službeni glasnik RS“ br. 98/2006 i 115/20121) [*in English*: Constitution of the Republic of Serbia (“Official Gazette of RS”, no. 98/2006 and 115/2021)]
9. Đurić, K. (2020). *Stanje i perspektive poljoprivrednog savetodavstva u Republici Srbiji*. Poljoprivredni fakultet, Univerzitet u Novom Sadu, Novi Sad [*in English*: Đurić, K. (2020). *State and Perspectives of Agricultural Consulting of the Republic of Serbia*, Faculty of Agriculture, University of Novi Sad, Novi Sad]
10. Đurić, K. (2021). *Agrarian policy*, Faculty of Agriculture, University of Novi Sad, Novi Sad
11. Eurostat (2021) *Population Density by NUTS 2 Region* Retrieved from: <https://data.europa.eu/data/datasets/qegn3fjf0sqo7qpan8t9g?locale=en> (November 22, 2023)

12. Janković Milić, V. Stanković, J., & Marinkovic, S. (2014). The capacity of local governments to improve business environment: Evidence from Serbia. *Proceedings of Rijeka Faculty of Economics, Journal of Economics and Business*, 32(2), 233-254. Retrieved from: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2554337](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2554337) (December 24, 2023)
13. Kokeza, G. (2013). Regionalni razvoj - uslov bržeg oporavka privrede Srbije. *Ekonomski vidici* 18(2-3), 209-220. [in English: Kokeza, G. (2013). Regional development – condition for faster economic recovery, *Economic Perspectives*, 18(2-3), 209-220].
14. Lapčević, M., & Rapajić, M. (2023). On local self-government and its constitutional position in Serbia. *Law – Theory and Practice*], 40(4), 112–137. doi: <https://doi.org/10.5937/ptp2304112L>
15. Zakon o lokalnoj samoupravi („Službeni glasnik RS“), br. 129/2007, 83/2014 – dr. zakoni, 101/2006 – dr. zakoni. 47/2018 i 111/2021 – dr. zakoni [in English: Law on Local Self-Government (“Official Gazette of RS”), no. 129/2007,83/2014 - other laws, 101/2016 - other laws, 47/2018 and 111/2021 - other laws]
16. Ljubojević, R., Petrović, S. (2019). Ključni faktori koji utiču na razvoj političkog sistema Republike Srbije, *Srpska politička misao*, 65(3), 217-232. [in English: Ljubojević, R., Petrović, S. (2019). Key factors that influence the development of political system of the Republic of Serbia, *Serbian Political Thought*, 65(3), 217-232]. doi: <https://doi.org/10.22182/spm.6532019.9>
17. Ljubojević, R., Blanuša, A., Petrović, S. (2022). Agrarian strategy and policy of the Republic of Serbia. *Economics of Agriculture*, 69(3), 897-909. doi:<https://doi.org/10.5937/ekoPolj2203897L>
18. Mihajlović, L. B., & Marković, K. (2004). Poljoprivredno savetodavstvo kao faktor agrarnog razvoja u zemljama u tranziciji. *Ekonomika poljoprivrede*, 51(3-4), 119-126 [in English: Agricultural consulting as a factor of agrarian development in the transition countries, *Economics of Agriculture*, 51(3-4), 119-126].
19. Milosavljević, B. (2009). *Sistem lokalne samouprave u Srbiji*, Stalna konferencija gradova i opština, Beograd [in English: Milosavljević, B. (2009). *The System of Local Self-Government in Serbia*, Permanent Conference of Cities and Municipalities, Belgrade]
20. Paraušić, V., Kostić, Z., Subić, J. (2023). Local development initiatives in Serbia’s rural communities as prerequisite for the leader implementation: Agricultural advisors’ perceptions, *Economics of Agriculture*, 70(1), 117-130. doi: <https://doi.org/10.59267/ekoPolj2301117P>
21. Pavlović, M. M., Popović, J., & Turnjanin, D. (2021). Development of small and medium enterprises in Serbia. *Oditor*, 7(2), 47-64. <https://doi.org/10.5937/Oditor2102047P>
22. Popović, V., Katić, B., & Savić, M. (2011). Ruralni razvoj u Srbiji i lokalne zajednice, *Ekonomika poljoprivrede*, 58(1), 33-44. [in English: Popović, V., Katić, B., & Savić, M. (2011). Rural Development in Serbia and Local Communities. *Economics of Agriculture*, 58(1), 33-44].

23. Radović G. (2021). Agrarni budžet i agrarna politika u funkciji razvoja poljoprivrede i ruralnog razvoja u Republici Srbiji. *Agrarna politika i ruralni razvoj*, Centar za razvoj agrara, Cetinje, 131-172. [in English: Radović G. (2021). Agrarian budget and agrarian policy in the function of agricultural development and rural development in the Republic of Serbia. *Agrarian Policy and Rural Development*. Center for Agrarian Development, Cetinje, 131-172].
24. Voza, D. ., & Fedajev, A. . (2020). Strategic approach to the development of ecotourism in Bor District, Serbia. *Hotel and Tourism Management*, 8(2), 89–100. <https://doi.org/10.5937/menhottur2002089V>
25. Živković, A., Pantić, N., & Rosić, M. (2019). Fiscal sustainability of the macroeconomic system of European Union members. *Oditor*, 5(2), 32-41. <https://doi.org/10.5937/Oditor1902033Z>



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# CULTURAL TOURISM IN RURAL AREAS: MAPPING RESEARCH TRENDS THROUGH BIBLIOMETRIC AND CONTENT ANALYSIS

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## ABSTRACT

The main objective of this paper is to perform a detailed analysis of the scientific literature on cultural tourism in rural areas through a bibliometric study of the papers indexed in the Web of Science database. The bibliometric analysis was carried out using performance analysis and science mapping techniques. Authors' keywords and KeyWords Plus were analyzed using RapidMiner software, and VOSviewer software was employed to create category maps and visualize the evolution of keywords. Content analysis of influential publications was used to show the evolution of knowledge and discover the most current issues. The results show the evolution of publications on cultural tourism in rural areas and identify the most influential journals, articles, authors, institutions and countries, as well as the most important research topics in the field. The paper concludes with recommendations for future bibliometric studies and offers guidelines for further research on cultural tourism in rural areas.

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## Introduction

Culture and tourism share an inseparable relationship, one that has been steadily intensifying as tourists increasingly prioritize authentic and unforgettable cultural experiences. TripAdvisor searches up to October 31, 2022, reveal the importance of cultural tourism, with 25% directly involving cultural activities like museum visits and events. Another 25% indirectly relate to cultural tourism, reflecting tourists' strong interest in cultural experiences (World Tourism Organization, 2023). In 2022, the

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worldwide cultural tourism market was valued at USD 5,321.7 million. It is projected to grow to USD 11,900 million by 2029, with a compound annual growth rate (CAGR) of 14.4% anticipated during the forecast period (Business Research Insights, 2024). The increasing development of cultural destinations, driven by initiatives such as the promotion of rural tourism and the revival of domestic tourism, will lead to significant revenue growth in cultural tourism over the next decade (Future Market Insights, 2023).

The role of cultural tourism and its subgenre heritage tourism in rural development has become increasingly important in the academic literature, as these types of tourism improve the economy and quality of life of rural communities (Ancuța & Jucu, 2023; Anderson, 2014; Aznar & Hoefnagels, 2019). In general, Dimitrijević et al. (2022) emphasize that the promotion of tourism in rural areas not only diversifies the local economy but also stimulates growth in various economic sectors and creates employment opportunities. Cultural tourism, characterized by engaging with local traditions, attending cultural events and visiting museums proves to be an important driver for rural development. While heritage tourism is tied to specific places (e.g., places associated with significant historical events), cultural tourism prioritizes immersive experiences over physical locations (Leask, 2022). Taken together, these dimensions of cultural and heritage tourism offer multiple opportunities for rural areas to capitalize on their unique cultural assets and improve socio-economic conditions. This paper attempts to deepen the scientific discourse on cultural tourism in rural areas through a comprehensive bibliometric analysis, highlighting the main trends, research gaps and new perspectives in this field. Furthermore, the study aims to enrich understanding and contribute to the advancement of scholarship in this important area of research.

### **Materials and methods**

In order to identify and analyse the scientific production on the topic of cultural tourism in rural areas, a bibliometric analysis and a content analysis were carried out. Bibliometric analysis is a widely used method for analysing scientific data (Donthu et al., 2021), which allows researchers to “evaluate the performance of the research and publication of individuals and/or institutions, and/or map the structure and dynamics of science” (Koseoglu et al., 2016, p. 181). This analysis is widely used in the literature to examine the scientific production in different areas of tourism, such as agritourism (e.g., Dimitrovski et al., 2019), sustainable tourism (e.g., Niñerola et al., 2019), food tourism (e.g., Naruetharadhol & Gebombut, 2020), world heritage tourism (e.g., Zhang et al., 2022), etc.

According to Baker et al. (2021), bibliometric analysis “involves applying quantitative tools to bibliographic data” (p. 1028). Based on objective criteria for the analysis and classification of publications (such as the number of publications and citations and the repetition of keywords), it provides a categorized representation of documents (such as scientific papers in journals, books, chapters, and conference proceedings) in the field under consideration. Zupic and Čater (2015) point out that bibliometric analysis complements the literature review method and increases the objectivity of this

method. The methodology employed in this study follows the framework proposed by Meneghello (2021, p. 3) and consists of three main phases: 1. definition of the data set, 2. bibliometric analysis and 3. content analysis.

### *Definition of the data set*

The data available in scientific databases such as Web of Science, Scopus and Google Scholar are usually used as input data for bibliometric analyses. While the use of the latter database is questionable, as it also contains unreliable publications (Delgado López-Cózar, 2014), the first two databases are the most widely used and recognised in the scientific community (Garrigos-Simon et al., 2018). The data for this study were collected from the Web of Science Core Collection in January 2024. A query, shown in Table 1, yielded a total of 1,677 results distributed across Web of Science categories such as Environmental Studies (16%), Hospitality Leisure Sport Tourism (14%), Environmental Sciences (14%) and Green Sustainable Science Technology (11%). Documents from various other fields (e.g. Geography, Architecture, Economics, etc.) account for less than 10%. The results obtained were filtered according to the criteria listed in Table 1 in order to be suitable for achieving the set objectives. After filtering the results, a total of 150 documents were included in the further analyses.

**Table 1.** Search strategy in the Web of Science database

<b>Query</b>	TS=(“cultural tourism” OR “heritage tourism” OR “cultural heritage”) AND TS=(rural)
<b>Web of Science category</b>	Hospitality Leisure Sport Tourism
<b>Document type</b>	Article
<b>Publication year</b>	≤ 2023
<b>Language</b>	English
<b>Search date</b>	January 2024

*Source:* Authors

Although conference papers are often included in bibliometric analysis (e.g., Khan et al., 2021; Qiu et al., 2022), they were not used in this study. A previous analysis of papers published at conferences on cultural tourism in rural areas found that of the 32 papers available in the Web of Science database, 15 conference papers were without citations. Of the remaining 17 papers published at conferences in Macedonia, Malaysia, Iceland, etc., only five papers had more than 10 citations. Considering the years of publication, this distribution of citations according to Niñerola et al. (2019) indicates that the research topic is not of sufficient scientific interest, so these papers are not included in further analysis.

### *Bibliometric analysis*

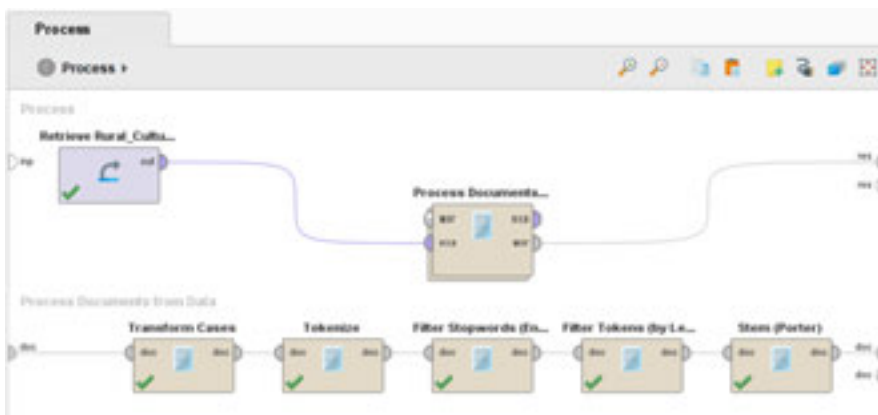
The two main techniques for conducting bibliometric analysis are performance analysis and science mapping (Donthu et al., 2021). Performance analysis is descriptive in nature, and authors Donthu et al. believe that it can be somewhat identified with the profile of



participants presented in empirical research. According to these authors, performance analysis is used to analytically examine and present the performance of journals, authors, countries, and institutions in the observed field. The authors also point out that when conducting a performance analysis, it is appropriate to use publication-related metrics, citation-related metrics and metrics related to publications and citations. In this study, publication-related metrics (such as the total number of publications, the number of contributing authors, the number of single-author publications, and the number of co-author publications) and citation-related metrics (the total number and the average number of citations) were used.

Science mapping, on the other hand, “analyzes the relationships between research constituents and a field’s intellectual structure” (Baker et al., 2021, p. 1028). As explained by Donthu et al. (2021), various techniques are used in science mapping. First, citation analysis was used. According to Mulet-Forteza (2018), citation analysis is one of the most commonly used methods to identify important papers in a scientific field. In addition to this analysis, as recommended by several authors (e.g., Freire & Veríssimo, 2020; Donthu et al., 2021), a keyword analysis was also used to fully understand the research streams and gain a detailed insight into the most important research topics. To avoid getting a list of keywords in which many terms have the same meaning, the text mining software RapidMiner 9.10 was used to find the steam (root) of the keywords and thus identify the most important ones. Following the methodology presented by Seočanac and Dimitrovski (2022), the standard text processing procedure (Figure 1) was applied to both the keywords identified by the authors and the keywords generated with KeyWords Plus. Zhang et al. (2015) recommend the use of KeyWords Plus in bibliometric analysis due to the large number of terms that provide a summary of the main and secondary topics of the research, i.e., a better insight into the field under consideration. To ensure that the most important keywords, i.e., topics, are visible, a word cloud is created from keywords that occur in at least five documents.

**Figure 1.** Text processing procedure



Source: Authors

Additionally, the bibliometric software VOSviewer version 1.16.20 (van Eck & Waltman, 2014) was used to create category maps of keywords that provide insight into the focus of research interest in cultural tourism in rural areas during the observed period. The normalization method was used to form the network: the association strength. Each keyword in the network is represented by a node, where the size of the node depends on the weighting factor of the keyword, i.e., the number of repetitions of the concept in the articles (the higher the number of repetitions, the larger the node). The nodes are connected by lines whose thickness indicates how often related words occur together in the articles (the thicker the line, the higher the number of common repetitions). The distance between the nodes indicates how strong the relationship between the terms is (the closer the nodes are to each other, the stronger the relationship between the two terms, i.e., they occur together more frequently in the articles compared to other terms). Each term is color-coded to indicate the group (cluster) to which it belongs. In this case, the clusters are colored according to the average year of the publications in which the term appears.

### *Content analysis*

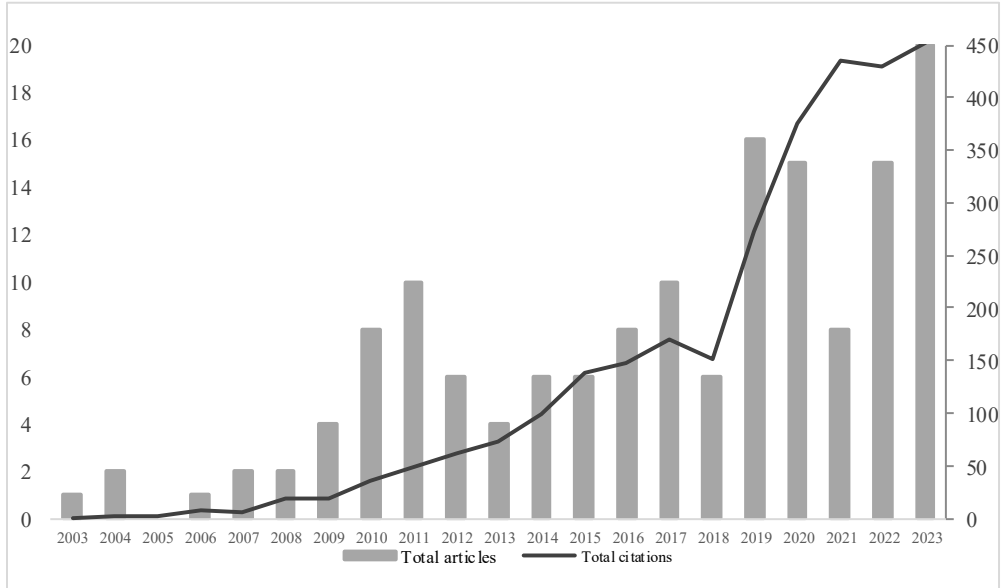
Another qualitative analysis recommended by Freire and Veríssimo (2020) is content analysis. Based on the previously created category maps and the identified clusters, a content analysis of the articles in each cluster was carried out to obtain an overview of the main topics in the field of cultural tourism in rural areas over the years. The main objective is to recognise the evolution of research interest and to identify the most topical issues. The content analysis was conducted by reviewing the abstracts and available articles for each cluster.

### **Results and discussion**

The first scientific paper found in the Web of Science on the subject of cultural tourism in rural areas was published in 2003 in *Annals of Tourism Research* under the title “Cultural rural tourism: Evidence from Canada” by MacDonald and Jolliffe. Since this pioneering work, the number of publications on cultural tourism in rural areas has slowly increased. In the ten years following the first publication, the number of publications increased slightly, reaching a peak in 2011. After that, the number of published papers suddenly declined. A significant increase in the number of publications was recorded in 2019, when 16 scientific papers were published, and this level was maintained in 2020. After a sudden drop in 2021, the number of published papers reached a second peak in 2023 with 20 scientific papers on this topic. This distribution of the number of published papers supports Price’s law that the available information doubles 10-15 years after the start of research on a particular topic (Price, 1956). Looking at the distribution of publications in Figure 2, it is clear that research on cultural tourism in rural areas has left the first phase, which consists of the first publications on the subject, and is now in the second phase of development, i.e., the phase of exponential research growth. According to Durán-Sánchez et al. (2020), this phase is followed by a phase of linear growth, characterized by a slowdown in the growth of the number

of publications and an overview of the knowledge gained in the first two phases. The current distribution of publications shows that the topic of cultural heritage tourism is relatively new and is far from being complete.

**Figure 2.** Number of publications on rural cultural tourism and citations by observed years



Source: Authors

### Performance analysis

#### Journals

The articles on cultural tourism in rural areas were published in 46 different journals (Table 2). Of the 46 journals, 41.30% published only one article on the observed topic, while 21.74% published more than five articles. These results indicate that articles on cultural tourism in rural areas are mainly published in non-specialised journals.

**Table 2.** Journal productivity

Number of published papers per journal	Number of journals	Percentage
1	19	41.30%
2	5	10.87%
3	8	17.39%
4	4	8.70%
5 or more	10	21.74%
<b>Total</b>	<b>46</b>	<b>100.00%</b>

Source: Authors

Table 3 shows that the most productive journal and leader in this field is the Journal of Heritage Tourism, which published 15 scientific papers on cultural tourism in rural areas, followed by the Journal of Sustainable Tourism, which published 14 papers. The journal Tourism Management achieved the highest number of citations with 643 citations for 9 published articles.

**Table 3.** Number of papers and citations by journals

Journal	Number of papers	Number of citations
Journal of Heritage Tourism	15	123
Journal of Sustainable Tourism	14	499
Tourism Management	9	643
Tourism and Hospitality Research	8	102
Journal of Tourism and Cultural Change	7	173
Tourism Geographies	7	151
Current Issues in Tourism	6	255
Almatourism – Journal of Tourism Culture and Territorial Development	5	22
Pasos Revista de Turismo y Patrimonio Cultural	5	2
Tourism Management Perspectives	5	78

*Source:* Authors

A total of 362 authors were identified in the observed articles. Based on the author's contribution to the observed topic, Crane (1969) proposes the following classification: high producers (more than 10 papers), moderate producers (5-9 papers), aspirants (2-4 papers) and transients (only 1 paper). The results show that the highest percentage of authors belong to the last category – transients (87% of authors), while the remaining 13% belong to aspirants. Based on the results obtained, there are no high or moderate producers on the topic of cultural tourism in rural areas. Table 4 shows the five most prolific authors of articles on cultural tourism in rural areas. Professor Geoff Wall from the University of Waterloo in Canada is the author with the most citations and articles on cultural tourism in rural areas.

**Table 4.** The most productive authors

Author	Country	Number of papers	Number of citations
Wall, G.	Canada	4	150
Lenao, M.	Botswana; Finland	3	46
Okolo-Obasi, E. N.	Nigeria	3	89
Su, M. M.	China	3	134
Uduji, J. I.	Nigeria	3	89

*Source:* Authors

Of the total number of articles, 20%, i.e., 30 articles, were written by a single author, while the remaining 80% are the result of the collaboration of several authors (Table 5). Most articles have three authors, while the fewest have eight authors.

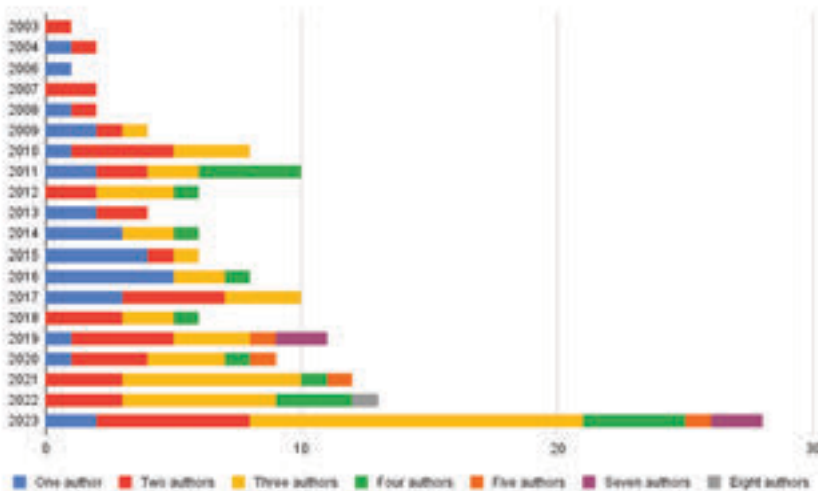
**Table 5.** Co-author analysis

Number of authors per paper	Number of papers	Percentage
1	30	20%
2	43	28.67%
3	51	34%
4	17	11.33%
5	4	2.67%
6	4	2.67%
8	1	0.67%

Source: Authors

Figure 3 shows that the number of authors increases in the course of the development cycle of the observed thematic area. In the first five years, papers are mainly authored by one or two authors, after which papers are published that are the result of collaboration between more than two authors.

**Figure 3.** Number of authors by years



Source: Authors

*Institutions and countries*

The most productive institutions are the universities. The most productive universities are the University of Waterloo in Canada (five published papers), followed by the University of Botswana (four papers). The articles on cultural tourism in rural areas were published by authors from 49 different countries, which shows that it is a popular topic worldwide. As shown in Table 6, China is the country with the most publications in this thematic area.

**Table 6.** Author's countries of affiliation

Country	Number of papers	Number of citations
China	28	716
USA	25	531
Spain	15	218
Australia	13	306
Italy	12	164
England	11	334
Canada	10	501
Portugal	6	100
Mexico	5	51
South Africa	5	30

Source: Authors

### *Citation analysis*

Table 7 shows that only six papers have more than 100 citations, while 25 have no citations. Niñerola et al. (2019) give two possible explanations for the lack of citations: either the research topic is not of sufficient scientific interest or the article has only recently been published. A review of the articles without citations revealed that 19 of 25 papers were published in 2022 and 2023, which corresponds to the second explanation given by Niñerola et al.

**Table 7.** Citation of papers (all databases)

Number of citations	Number of papers	Percentage of papers
≥ 100	6	4%
50–99	8	5.33%
25–49	20	13.33%
5–24	60	40%
1–4	31	20.67%
No citations	25	16.67%
<b>Total</b>	150	100%

Source: Authors

Table 8 shows the articles with the highest number of citations and their characteristics. The paper with the highest number of citations (212) is the paper entitled “Cultural rural tourism – Evidence from Canada”, authored by MacDonald and Jolliffe (2003). The paper with the highest number of citations per year (14.54) is the paper written by Jimura (2011) “The impact of world heritage site designation on local communities – A case study of Ogimachi, Shirakawa-mura, Japan”.

**Table 8.** Articles with the highest number of citations

Article title	Author/s	Journal	TC	TC/Y
Cultural rural tourism – Evidence from Canada	MacDonald and Jolliffe (2003)	Annals of Tourism Research	212	10.10
The impact of world heritage site designation on local communities – A case study of Ogimachi, Shirakawa-mura, Japan	Jimura (2011)	Tourism Management	189	14.54
Community, governments and external capitals in China’s rural cultural tourism: A comparative study of two adjacent villages	Ying and Zhou (2007)	Tourism Management	155	9.12
Assessing the sustainability of agritourism in the US: A comparison between agritourism and other farm entrepreneurial ventures	Barbieri (2013)	Journal of Sustainable Tourism	138	12.55
Braveheart-ed Ned Kelly: Historic films, heritage tourism and destination image	Frost (2006)	Tourism Management	124	6.89

Abbreviations: TC – Total citations; TC/Y – Total citations/years

Source: Authors

### Keyword analysis

After processing the keywords, a list of 573 keywords was obtained. In order to highlight the most important keywords, i.e., topics, a word cloud is created from 71 keywords that occur in at least five documents (Figure 4). In addition to the words representing the observed theme (such as heritage, culture, tourism and rural), the most frequently used keywords are development, community, sustainability, experience, authenticity, attitude and conservation.

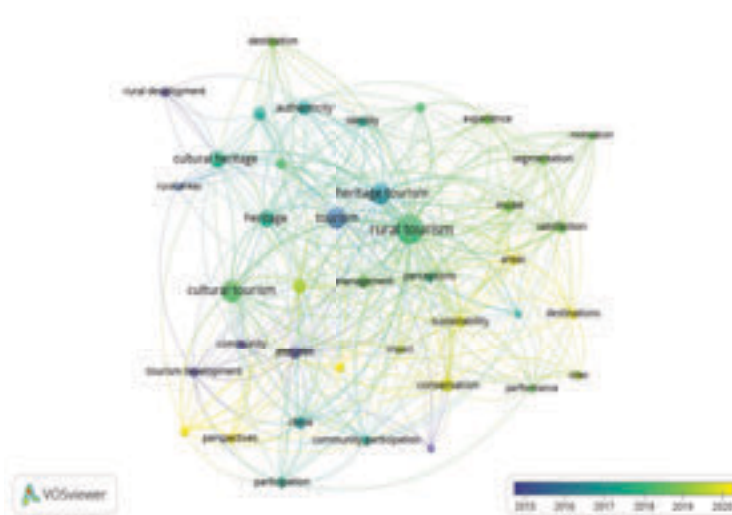
**Figure 4.** Word cloud of keywords that occur in at least five articles



Source: Authors

With the VOSviewer software, it is possible to see the trend of keywords by observed years, i.e., the evolution of the observed area. Figure 5 and Table 9 show that in the first publications, the authors focused on tourism and rural development before the interest in authenticity and sustainable development increased. In the more recent publications, the focus shifts to experience and empowerment. The detailed literature review on the identified topics is presented in the following part of the article.

**Figure 5.** Keyword trend



Source: Authors

**Table 9.** Keyword clusters by average year of publication

Clusters	Items	Colour	Avg. pub. year
Cluster 1	Attitudes, community, culture, development, rural, tourism development	Purple	2015
Cluster 2	Heritage tourism, rural areas, tourism	Blue	2016
Cluster 3	Authenticity, China, community participation, destination image, identity, participation, sustainable tourism	Turquoise	2017
Cluster 4	Cultural heritage, cultural tourism, heritage, perceptions, rural tourism, sustainable development	Green	2018
Cluster 5	Destination, ecotourism, experience, impact, management, model, motivation, performance, satisfaction, segmentation, sites	Lime green	2019
Cluster 6	Areas, community-based tourism, conservation, destinations, empowerment, perspectives, sustainability	Yellow	2020

Source: Authors



## *Content analysis*

### *Cluster 1: Cultural tourism as a catalyst for rural development*

Tourism is seen as an important tool for rural development, especially in regions with declining traditional industries. MacDonald and Jolliffe (2003) present a framework for the development of a region in Canada that focuses on cultural rural tourism and emphasizes the value of preserving local culture. Community-based partnerships, particularly through cooperatives, are seen as effective in this context. Ankomah and Larson (2008) proposed a tripartite alliance for the development of cultural tourism products to alleviate rural poverty. Anderson (2014) examined the impact of cultural tourism on well-being in rural Kilimanjaro and found that cultural tourism significantly enhances community well-being by providing a reliable source of income, promoting social progress and improving access to education and health facilities. However, it highlights the need for targeted training programs at the community level to address limited skills and negative attitudes towards the tourism industry. Overall, Cluster 1 advocates for a holistic and collaborative approach to rural development that combines cultural preservation, community engagement and tourism development.

### *Cluster 2: Impacts and challenges of heritage tourism in rural areas*

The studies in Cluster 2 highlight the most important aspects of the impacts and challenges of heritage tourism and tourism in general in rural areas. McMorran (2008) argues that cultural heritage is primarily used for economic benefit rather than for ideological reasons. Kausar and Nishikawa (2010) focused on the challenges faced by developing countries and emphasized the need for linkages between tourism and local economies. Fonseca and Ramos (2012) examine the potential of heritage tourism in peripheral areas, identify barriers and emphasize the importance of effective collaboration and strategic planning. Ming et al. (2015) emphasize the transformative impact of tourism on livelihoods in rural areas and warn that overdependence can increase long-term risks to communities and jeopardize their long-term sustainability. Huang et al. (2016) identified the motivations of visitors to heritage sites, focusing on learning and recreation. Taken together, these findings highlight the multifaceted nature of heritage tourism and the need for a balanced and sustainable approach to tourism development.

### *Cluster 3: Factors influencing destination image of rural tourism destinations*

The studies in Cluster 3 shed light on the various aspects that shape destination image of rural tourism destinations. The study by Frost (2006) examines the impact of historical films on heritage tourism and deals with questions of authenticity and destination image using the example of “Ned Kelly”. Royo-Vela’s (2009) study conceptualizes excursions to rural cultural destinations in Spain as a popular form of tourism and identifies key variables that shape the image of the destination. Fountain and Mackay (2017) observe the evolving form and identity of a festival over time, reflecting the dynamic interplay of local initiatives and global influences. Implicit power relations in tourism development are revealed in the study conducted in China by Xue and Kerstetter

(2017), who call for a reassessment of power structures to improve community-business relations. Guizzardi et al. (2021) explore how sustainability drives tourism demand in small areas by identifying key indicators and demonstrating their impact on destination image and satisfaction. Cheng et al. (2023) emphasize the complicated relationship between perceived authenticity, destination image, satisfaction and loyalty, with visitors expectations playing a moderating role. In summary, these studies highlight the importance of perceived authenticity, sustainability, power dynamics and evolving place identities in shaping the tourist experience and image of rural destinations.

#### *Cluster 4: Cultural tourism for sustainable rural development*

The studies that form cluster 4 emphasize the central role of sustainable development in rural areas and underline the need for strategic management. Sasidharan and Hall (2007) highlight the potential of cultural tourism initiatives to revitalize rural economies, but emphasize the need for sustainable development practices based on the engagement and empowerment of local communities. Kastenholz et al. (2018) identify clusters of tourists with different impacts on environmental, cultural and economic aspects of rural areas. Xu and Sun (2019) emphasize the direct contribution of local farmers to sustainable rural tourism, with coping behavior influencing the sustainable development of rural tourism. Qu and Cheer (2020) explore the transformative potential of bottom-up events in revitalization and sustainable development in rural communities. The study emphasizes the critical role of community engagement for sustainable success. Muangasame and Tan (2022) present a unique phygital strategy for rural cultural heritage tourism based on local engagement, digitalization and innovative partnerships. Taken together, these studies provide valuable insights into the various dimensions of cultural tourism for sustainable rural development and emphasize the importance of community engagement and innovative approaches for long-term success.

#### *Cluster 5: Improving tourism experiences in cultural rural destinations*

Li et al. (2019) develop a conceptual model to understand the relationships between quality-related factors and travel intentions or attitudes to sustain rural tourism. The results show the crucial mediating role of perceived value and point to management implications for improving tourism in rural cultural destinations. Fraiz et al. (2020) focus on active tourism and identify three distinct groups in the Spanish market. Each group has unique motivations and preferences in terms of pull factors. In particular, the authors emphasize that the segment of people interested in culture could be a good target group for rural destinations. Kim et al. (2021) explore the economic potential of experiential offerings in rural heritage destinations and emphasize the importance of emotional and cognitive aspects in experiential consumption. Chirieleison et al. (2021) investigate the influence of destination certifications and labels on the perception and satisfaction of tourists in Italian villages. The study suggests that knowledge of labels can represent a significant competitive advantage, affecting authenticity, personal engagement and overall satisfaction in the tourism development of historic villages. Katelieva and Muhar (2022) have shown that the inclusion of intangible

cultural heritage in the tourism offer in rural Austria contributes to sustainable tourism development by providing shared benefits and protecting cultural heritage. Overall, these studies contribute to the understanding of factors influencing tourism experiences in cultural rural destinations and provide valuable insights for effective rural destination management and sustainable development.

*Cluster 6: Empowerment in rural areas through cultural tourism*

Overall, the studies shed light on various dimensions of empowerment in rural areas through tourism. In Nigeria, the impact of social responsibility initiatives of multinational oil companies on the empowerment of women in rural areas through agrotourism is examined (Uduji et al., 2020). In China, the engagement of Hui ethnic women in cultural tourism (embroidery) is examined, highlighting economic and multidimensional empowerment at different levels (Ming et al., 2020). The case of Egypt highlights the tensions in tourism development policies, where local communities seek to protect their identity, leading to potential disempowerment (Asham et al., 2022). Guo et al. (2023) highlight the widespread gender inequality in rural China by drawing on theories of empowerment and sustainable development to assess women's perceptions, and they demonstrate the significant role of tourism cooperatives in empowering women, improving participation in tourism, and promoting sustainable tourism development. These findings emphasize the need for inclusive and community-oriented approaches to rural tourism planning and development that take into account cultural and gender dynamics to achieve sustainable and equitable outcomes.

## **Conclusions**

The bibliometric and content analysis carried out on cultural tourism in rural areas leads to the conclusion that this is a relatively young research topic for which there is a need and sufficient scope for new studies. Based on the subject matter of the observed papers, three important areas can be identified: Sustainability, Experience and Empowerment. Through empirical research and the use of quantitative and qualitative methods, as well as a combination of both, the authors have attempted to identify and propose solutions for the conservation and sustainable management of cultural heritage in rural areas, as well as improving the experience of tourists and empowering local people, especially women. Considering that the current issues related to cultural tourism in rural areas have been identified, researchers in this field can use the results of this study to make a decision about their research topic. The identification of the most current issues in cultural tourism in rural areas through a bibliometric and content analysis, which to the author's knowledge has not been done before, can be considered as a theoretical contribution of this paper. In addition, this study can be useful for researchers in other fields who can apply the same methodology to other areas. The results of this study also have practical benefits for rural areas wishing to develop cultural tourism. Firstly, they can be encouraged to take the initiative and involve local communities and other stakeholders in heritage protection activities. Secondly, they can use the lessons learned by the authors of the sixth cluster to strengthen local community participation. Thirdly,

they can be encouraged to improve the tourism offer (e.g., by offering authentic activities such as storytelling about authentic local lifestyles, etc.) to enhance tourists' experiences and satisfaction.

Suggestions for future studies can be made in two directions. First, future studies wishing to conduct a bibliometric analysis of cultural tourism in rural areas are advised to use studies indexed in other databases (such as Scopus) in order to increase the sample of observed papers and the reliability of the results, which could be considered a limitation of the present study. It is also interesting to perform a bibliographic coupling analysis in future studies to discover possible connections between documents, journals, authors, organisations or countries. The second suggestion is addressed to the authors of future studies on cultural tourism in rural areas. When reviewing the identified papers, it became clear that most studies are based on case studies or research in specific locations, which prevents generalisation and broader application of the findings. Future studies should aim to develop research models that are at least applicable to the same type of heritage resource (e.g., historic houses). From the identification of keywords, it can also be concluded that the most important theories on the observed topic are not included. Therefore, future studies should consider theories such as Stakeholder theory (to identify key stakeholders), Social exchange theory (to understand locals' attitudes), Consumer culture theory (to understand tourists' behaviour), and Transformative learning theory (to understand the significant cognitive, emotional, and attitudinal changes that tourists undergo as a result of their cultural rural tourism experiences).

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### Conflict of interests

The authors declare no conflict of interest.

### References

1. Ancuța, C., & Jucu, I. S. (2023). Sustainable rural development through local cultural heritage capitalization – Analyzing the cultural tourism potential in rural Romanian areas: A case study of Hărman commune of Brașov region in Romania. *Land*, 12(7), 1297. <https://doi.org/10.3390/land12071297>
2. Anderson, W. (2014). Cultural tourism and poverty alleviation in rural Kilimanjaro, Tanzania. *Journal of Tourism and Cultural Change*, 13(3), 208–224. <https://doi.org/10.1080/14766825.2014.935387>

3. Ankomah, P., & Larson, T. (2008). Creativity in cultural tourism: The case for rural development in Sub-Saharan Africa. *Tourism Review International*, 12(3), 171–186.
4. Asham, M. K., Katô, K., & Doering, A. (2022). Disempowering minority communities: Tourism development in the Siwa Oasis, Egypt. *Tourism Planning & Development*, 20(4), 660–681. <https://doi.org/10.1080/21568316.2022.2050420>
5. Aznar, M. & Hoefnagels, H. (2019). Empowering small rural communities through heritage tourism. In P. L. Pearce & H. Oktadiana (Eds.), *Delivering Tourism Intelligence (Bridging Tourism Theory and Practice, Vol. 11)*, (pp. 49–60). Emerald Publishing Limited. <https://doi.org/10.1108/S2042-144320190000011005>
6. Baker, H. K., Kumar, S., & Pandey, N. (2021). Forty years of the Journal of Futures Markets: A bibliometric overview. *Journal of Futures Markets*, 41(7), 1027–1054. <https://doi.org/10.1002/fut.22211>
7. Barbieri, C. (2013). Assessing the sustainability of agritourism in the US: A comparison between agritourism and other farm entrepreneurial ventures. *Journal of Sustainable Tourism*, 21(2), 252–270. <https://doi.org/10.1080/09669582.2012.685174>
8. Business Research Insights. (2024). *Cultural tourism market overview*. Retrieved from <https://www.businessresearchinsights.com/market-reports/cultural-tourism-market-107478> (January 4, 2024).
9. Cheng, X., Chi, X., & Han, H. (2023). Perceived authenticity and the heritage tourism experience: The case of Emperor Qinshihuang’s Mausoleum Site Museum. *Asia Pacific Journal of Tourism Research*, 28(6), 503–520. <https://doi.org/10.1080/10941665.2023.2245504>
10. Chirieleison, C., Montrone, A., & Scrucca, L. (2021). Destination labels for historic villages: The impact on perception, experience, and satisfaction. *Tourism and Hospitality Research*, 22(2), 164–179. <https://doi.org/10.1177/14673584211020788>
11. Crane, D. (1969). Social structure in a group of scientists: A test of the “invisible college”. *American Sociological Review*, 34(3), 335–352.
12. Delgado López-Cózar, E., Robinson-García, N., & Torres-Salinas, D. (2014). The Google scholar experiment: How to index false papers and manipulate bibliometric indicators. *Journal of the Association for Information Science and Technology*, 65(3), 446–454. <https://doi.org/10.1002/asi.23056>
13. Dimitrijević, M., Ristić, L., & Bošković, N. (2022). Rural tourism as a driver of the economic and rural development in the Republic of Serbia. *Hotel and Tourism Management*, 10(1), 79–90. <https://doi.org/10.5937/menhottur2201079D>
14. Dimitrovski, D., Leković, M., & Joukes, V. (2019). A bibliometric analysis of Crossref agritourism literature indexed in Web of Science. *Hotel and Tourism Management*, 7(2), 25–37. <https://doi.org/10.5937/menhottur1902025D>

15. Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
16. Durán-Sánchez, A., Álvarez-García, J., González-Vázquez, E., & del Río-Rama, M. D. L. C. (2020). Wastewater management: Bibliometric analysis of scientific literature. *Water*, 12(11), 2963. <https://doi.org/10.3390/w12112963>
17. Fonseca, F. P., & Ramos, R. A. R. (2012). Heritage tourism in peripheral areas: Development strategies and constraints. *Tourism Geographies*, 14(3), 467–493. <https://doi.org/10.1080/14616688.2011.610147>
18. Fountain, J., & Mackay, M. (2017). Creating an eventful rural place: Akaroa's French Festival. *International Journal of Event and Festival Management*, 8(1), 84–98. <https://doi.org/10.1108/ijefm-06-2016-0043>
19. Fraiz, J. A., De Carlos, P., & Araújo, N. (2020). Disclosing homogeneity within heterogeneity: A segmentation of Spanish active tourism based on motivational pull factors. *Journal of Outdoor Recreation and Tourism*, 30, 100294. <https://doi.org/10.1016/j.jort.2020.100294>
20. Freire, R. R., & Verissimo, J. M. C. (2020). Mapping co-creation and co-destruction in tourism: A bibliographic coupling analysis. *Anatolia*, 32(2), 207–217. <https://doi.org/10.1080/13032917.2020.1855594>
21. Frost, W. (2006). Braveheart-ed Ned Kelly: Historic films, heritage tourism and destination image. *Tourism Management*, 27(2), 247–254. <https://doi.org/10.1016/j.tourman.2004.09.006>
22. Future Market Insights (2023). *Cultural tourism market*. Retrieved from <https://www.futuremarketinsights.com/reports/cultural-tourism-market> (January 4, 2024).
23. Garrigos-Simon, F., Narangajavana-Kaosiri, Y., & Lengua-Lengua, I. (2018). Tourism and sustainability: A Bibliometric and visualization analysis. *Sustainability*, 10(6), 1976. <https://doi.org/10.3390/su10061976>
24. Guizzardi, A., Stacchini, A., & Costa, M. (2021). Can sustainability drive tourism development in small rural areas? Evidences from the Adriatic. *Journal of Sustainable Tourism*, 30(6), 1280–1300. <https://doi.org/10.1080/09669582.2021.1931256>
25. Guo, Q., Yang, X., & Hui, C. (2023). The influence of women's empowerment on tourism involvement and sustainable tourism development: The moderating role of tourism cooperatives. *Asia Pacific Journal of Tourism Research*, 28(10), 1130–1146. <https://doi.org/10.1080/10941665.2023.2289401>
26. Huang, W., Beeco, J. A., Hallo, J. C., & Norman, W. C. (2016). Bundling attractions for rural tourism development. *Journal of Sustainable Tourism*, 24(10), 1387–1402. <https://doi.org/10.1080/09669582.2015.1115510>

27. Jimura, T. (2011). The impact of world heritage site designation on local communities – A case study of Ogimachi, Shirakawa-mura, Japan. *Tourism Management*, 32(2), 288–296. <https://doi.org/10.1016/j.tourman.2010.02.005>
28. Kastenholz, E., Eusébio, C., & Carneiro, M. J. (2018). Segmenting the rural tourist market by sustainable travel behaviour: Insights from village visitors in Portugal. *Journal of Destination Marketing and Management*, 10, 132–142. <https://doi.org/10.1016/j.jdmm.2018.09.001>
29. Katelieva, M., & Muhar, A. (2022). Heritage tourism products based on traditional nature-related knowledge: Assessment of cultural, social, and environmental factors in cases from rural Austria. *Journal of Heritage Tourism*, 17(6), 631–647. <https://doi.org/10.1080/1743873x.2022.2098040>
30. Kausar, D. R. K., & Nishikawa, Y. (2010). Heritage tourism in rural areas: Challenges for improving socio-economic impacts. *Asia Pacific Journal of Tourism Research*, 15(2), 195–213. <https://doi.org/10.1080/10941661003629995>
31. Khan, M. A., Pattnaik, D., Ashraf, R., Ali, I., Kumar, S., & Donthu, N. (2021). Value of special issues in the journal of business research: A bibliometric analysis. *Journal of Business Research*, 125, 295–313. <https://doi.org/10.1016/j.jbusres.2020.12.015>
32. Kim, E. G., Chhabra, D., & Timothy, D. J. (2021). Economics of experiential consumption in a rural heritage destination. *Tourism Review International*, 25(4), 339–351. <https://doi.org/10.3727/154427221x16098837280028>
33. Koseoglu, M. A., Rahimi, R., Okumus, F., & Liu, J. (2016). Bibliometric studies in tourism. *Annals of Tourism Research*, 61, 180–198. <https://doi.org/10.1016/j.annals.2016.10.006>
34. Leask, A. (2022). The nature and role of visitor attractions. In A Fyall, et al. (Eds) *Managing visitor attractions* (pp. 3–21). Routledge. <https://doi.org/10.4324/9781003041948-2>
35. Li, X., Wang, Z., Xia, B., Chen, S., & Chen, S. (2019). Testing the associations between quality-based factors and their impacts on historic village tourism. *Tourism Management Perspectives*, 32, 100573. <https://doi.org/10.1016/j.tmp.2019.100573>
36. MacDonald, R. M., & Jolliffe, L. (2003). Cultural rural tourism. *Annals of Tourism Research*, 30(2), 307–322. [https://doi.org/10.1016/s0160-7383\(02\)00061-0](https://doi.org/10.1016/s0160-7383(02)00061-0)
37. McMorran, C. (2008). Understanding the ‘heritage’ in heritage tourism: Ideological tool or economic tool for a Japanese hot Springs resort? *Tourism Geographies*, 10(3), 334–354. <https://doi.org/10.1080/14616680802236329>
38. Meneghello, S. (2021). The tourism–landscape nexus: Assessment and insights from a bibliographic analysis. *Land*, 10(4), 417. <https://doi.org/10.3390/land10040417>

39. Ming, S., Wall, G., & Xu, K. (2015). Heritage tourism and livelihood sustainability of a resettled rural community: Mount Sanqingshan World Heritage Site, China. *Journal of Sustainable Tourism*, 24(5), 735–757. <https://doi.org/10.1080/09669582.2015.1085868>
40. Ming, S., Wall, G., Ma, J., Notarianni, M., & Wang, S. (2020). Empowerment of women through cultural tourism: Perspectives of Hui minority embroiderers in Ningxia, China. *Journal of Sustainable Tourism*, 31(2), 307–328. <https://doi.org/10.1080/09669582.2020.1841217>
41. Muangasame, K., & Tan, E. (2022). Phygital rural cultural heritage: A digitalisation approach for destination recovery and resilience. *Worldwide Hospitality and Tourism Themes*, 15(1), 8–17. <https://doi.org/10.1108/whatt-08-2022-0096>
42. Mulet-Forteza, C., Martorell-Cunill, O., Merigó, J. M., Genovart-Balaguer, J., & Mauleon-Mendez, E. (2018). Twenty five years of the Journal of Travel & Tourism Marketing: A bibliometric ranking. *Journal of Travel & Tourism Marketing*, 35(9), 1201–1221. <https://doi.org/10.1080/10548408.2018.1487368>
43. Naruetharadhol, P., & Gebombut, N. (2020). A bibliometric analysis of food tourism studies in Southeast Asia. *Cogent Business & Management*, 7(1), 1733829. <https://doi.org/10.1080/23311975.2020.1733829>
44. Niñerola, A., Sánchez-Rebull, M. V., & Hernández-Lara, A. B. (2019). Tourism research on sustainability: A bibliometric analysis. *Sustainability*, 11(5), 1377. <https://doi.org/10.3390/su11051377>
45. Price, D. J. S. (1956). The exponential curve of science. *Discovery*, 17, 240–243.
46. Qiu, Q., Zuo, Y., & Zhang, M. (2022). Intangible cultural heritage in tourism: Research review and investigation of future agenda. *Land*, 11(1), 139. <https://doi.org/10.3390/land11010139>
47. Qu, M., & Cheer, J. M. (2020). Community art festivals and sustainable rural revitalisation. *Journal of Sustainable Tourism*, 29(11–12), 1756–1775. <https://doi.org/10.1080/09669582.2020.1856858>
48. Royo-Vela, M. R. (2009). Rural-cultural excursion conceptualization: A local tourism marketing management model based on tourist destination image measurement. *Tourism Management*, 30(3), 419–428. <https://doi.org/10.1016/j.tourman.2008.07.013>
49. Sasidharan, V., & Hall, M. E. (2007). Community-defined cultural and ecological tourism framework: Potential applications in Romania's Orastie zone. *Tourism Review International*, 11(4), 365–382. <https://doi.org/10.3727/154427207785908083>
50. Seočanac, M., & Dimitrovski, D. (2022). Factors influencing tourists' nightlife experience in Belgrade. *Consumer Behavior in Tourism and Hospitality*, 17(4), 436–452. <https://doi.org/10.1108/cbth-11-2021-0279>



51. Uduji, J. I., Okolo-Obasi, E. N., Onodugo, V. A., Nnabuko, J. O., & Adedibu, B. (2020). Corporate social responsibility and the role of rural women in strengthening agriculture-tourism linkages in Nigeria's oil producing communities. *Journal of Tourism and Cultural Change*, 19(6), 754–780. <https://doi.org/10.1080/14766825.2020.1826500>
52. van Eck, N. J., & Waltman, L. (2014). Visualizing bibliometric networks. In Y. Ding, R. Rousseau, & D. Wolfram (Eds.), *Measuring scholarly impact: Methods and practice* (pp. 285–320). Springer. [https://doi.org/10.1007/978-3-319-10377-8\\_13](https://doi.org/10.1007/978-3-319-10377-8_13)
53. World Tourism Organization. (2023). *Outcomes from the UNWTO Affiliate members world expert meeting on cultural tourism*. Madrid, Spain, 1–2 December 2022, UNWTO. <https://doi.org/10.18111/9789284424740>
54. Xu, Z., & Sun, B. (2019). Influential mechanism of farmers' sense of relative deprivation in the sustainable development of rural tourism. *Journal of Sustainable Tourism*, 28(1), 110–128. <https://doi.org/10.1080/09669582.2019.1675675>
55. Xue, L., & Kerstetter, D. L. (2017). Discourse and power relations in community tourism. *Journal of Travel Research*, 57(6), 757–768. <https://doi.org/10.1177/0047287517714908>
56. Ying, T., & Zhou, Y. (2007). Community, governments and external capitals in China's rural cultural tourism: A comparative study of two adjacent villages. *Tourism Management*, 28(1), 96–107. <https://doi.org/10.1016/j.tourman.2005.12.025>
57. Zhang, J., Xiong, K., Liu, Z., & He, L. (2022). Research progress and knowledge system of world heritage tourism: A bibliometric analysis. *Heritage Science*, 10(1), 42. <https://doi.org/10.1186/s40494-022-00654-0>
58. Zhang, J., Yu, Q., Zheng, F., Long, C., Lu, Z., & Duan, Z. (2015). Comparing keywords plus of WOS and author keywords: A case study of patient adherence research. *Journal of the Association for Information Science and Technology*, 67(4), 967–972. <https://doi.org/10.1002/asi.23437>
59. Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, 18(3), 429–472. <https://doi.org/10.1177/1094428114562629>

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# GASTRONOMY TOURISM AND THE PERCEIVED IMAGE OF SERBIAN NATIONAL CUISINE: STRUCTURAL EQUATION MODELING OF THE MAIN DETERMINANTS

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## ABSTRACT

Positioning and differentiation of Serbian cuisine among other ethnic cuisines can be the means to include Serbian gastronomy in heritage and cultural tourism. This paper's significance lies in its comparative analysis, specifically examining the impacts of taste and quality of food, food service quality, and the authenticity of national food. The goal is to identify the primary factors influencing the perceived image of Serbian national cuisine, ultimately leading to the successful development of gastronomic offerings. The research was conducted on a sample of 217 respondents. Data were collected using the survey method. Respondents expressed their level of agreement with questionnaire items on a seven-point Likert scale. Reliability, validity, and model fit were assessed in the data analysis. A structural equation modeling was used to test causal relations between the latent variables. The research results emphasize the taste and quality of food as the main driver of the perceived image of national cuisine.

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## Introduction

Tourist preferences are evolving globally, with a growing emphasis on unique experiences. Modern tourists no longer limit their interests to visiting cultural, historical,

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and natural landmarks; instead, they are increasingly seeking to explore destinations through additional elements, such as gastronomy (Dimitrovski, 2016). In recent times, numerous destinations have been marketing themselves as gastronomic hubs, whether situated in rural or urban settings. However, there has been a lack of focused attention on comprehending the specific products, attractions, and experiences desired by tourists (Kivela & Crofts, 2009; Tikkanen, 2007).

Over the centuries, the role of food has transcended mere sustenance, evolving into a cultural and ethnic identifier. It serves as a constant reminder of an individual's background, reflecting who they are in a cultural context. Research supports the idea that ethnic cuisine serves as a reflection of national customs and culture (Edles, 2004; Okumus, Okumus, Mckercher, 2007; Henderson, 2014).

Ethnic restaurants can be defined as establishments primarily focused on offering the cuisine and dishes of a specific country or region, accompanied by an authentic dining setting that includes physical artifacts representative of that location (Jang, Ha and Park, 2012). Visiting an ethnic restaurant that authentically serves the cuisine of a particular country or region transforms these establishments into platforms for experiencing different cultures, often fostering the development of gastronomy tourism. Literature indicates that the ethnic ambience and authenticity of a restaurant play vital roles in generating customer satisfaction (Gaytán, 2008). Increased satisfaction of customers or tourists with ethnic food and restaurants enhances the potential for successful development of a country's gastronomy tourism.

Therefore, the objective of this paper is to investigate the primary factors influencing the perceived image of national cuisine. By doing so, it offers valuable insights for decision-makers to gain a deeper understanding of customer needs, particularly in comprehending the specific products, attractions, and experiences desired by tourists. The aim is to provide guidance for the successful development of gastronomy tourism.

The study adds to the current body of literature by employing a quantitative field approach to investigate the drivers of the perceived image of national cuisine – a topic that has been explored in only a limited number of studies so far. The significance of this paper lies in its comparative analysis, specifically examining the impacts of food taste, the authenticity of national specialties, and service quality on the perceived image.

## **Literature overview**

### ***Gastronomy tourism as a part of national heritage***

As a fundamental human necessity and a captivating aspect of tourist appeal, gastronomy significantly enhances the allure of a destination. Serbian cuisine, in particular, stands out as one of the most favorable elements contributing to the region's tourism image. This study aims to investigate the locals' perception of gastronomic specificity of Serbian national (local) food and to investigate how Serbian food is perceived in terms of its tourist potential, authenticity, quality, taste, nutrition, food service quality, and its general role in the creation of a Serbian tourist brand (Jovičić, Vuković and Terzić, 2020).

Serbia's advantageous geo-strategic position in the broader region, coupled with available natural resources, a unique and diverse agro-biodiversity, and a longstanding tradition in well-known high-quality food, present excellent potential for developing a variety of added value opportunities such as: geographical indication (GI) products, organic agriculture etc. (Regional Rural Development Standing Working Group – SWG, 2020). These products could serve as catalysts for the advancement of the agricultural sector and rural areas in Serbia through ethno-tourism (Kovačević, Brenjo, Cvetković and Rainović, 2022).

The importance of quality of Serbian gastronomic offer stems from the structure of agricultural production in Serbia, namely, small, fragmented, economically weak and mostly unorganized agricultural farms which cannot claim their competitive advantage in the economy of scale – the average agricultural plot per farm is 6.2 hectares, approximately one-third of the EU27 average which is 14.5 hectares (Ministry of Agriculture, Forestry and Water Management Republic of Serbia and IPARD EU4 Rural Areas, 2022). By producing large quantities of standard quality products, they cannot gain competitive advantage, therefore, the way to improving competitiveness of Serbian agriculture, especially in hilly and mountainous areas, lies in the production of high-quality agricultural products (Zrnić, Gajić & Vukolić, 2022).

Gastronomy drives the tourism with the aim to strategically integrating culinary heritage into the tourism offering of the country (Kukanja and Peštek, 2020). Countries need to develop a comprehensive gastronomic tourism development plan, citing its potential to contribute to sustainable development goals, stimulate economic growth, create employment opportunities, and boost the income of those involved in the food industry (Tovmasyan, 2019). To cater for the preferences of tourists, the text underscores the importance of research to understand consumer motivations and behaviors, which can then inform the creation of targeted gastronomic tourism products. Furthermore, the significance of educational institutions in producing highly qualified professionals for the gastronomy sector is crucial by recognizing their role in influencing service quality and, consequently, customer satisfaction.

The significance of food in advancing tourism services cannot be overstated, given that it frequently constitutes 30% or more of tourist spending. Spain has emerged as a premier gastronomic destination by fostering regional culinary diversity and offering top-notch food experiences. Italy has a highly developed gastronomic landscape (Schmitt, Galli, Menozzi, Maye, Touzard, Marescotti, Six and Brunori, 2017). French Sopexa has established itself as a leading agency in global marketing, with a specialization in food, wine, and lifestyle. With over 50 years of experience, Sopexa has been instrumental in enhancing the reputation of the French agrifood sector and promoting France as a premier gastronomic destination. In Latin America, culinary heritage is now being recognized as a potential area for the development of sustainable tourism, which can be particularly important in generating income for local communities (OECD, 2012).

For the Republic of Serbia to become one of the leading gastronomic destinations in the Balkan region, improvement and promotion of added value production with the positive impact on improving the export structure is of utmost importance. Although agriculture is one of the few economic branches that constantly records a surplus in foreign trade, the structure of this exchange is unfavorable because cheap processed products are imported, while fresh unprocessed products dominate foreign exports (Grujic-Vuckovski, and Kovacevic, 2020). Furthermore, the development of gastronomy and related ethno-tourism enables the necessary diversification of income in urban and rural areas with the accent on the preservation of villages and the prevention of depopulation of those areas (Vuković, et al, 2021, Kovačević et. Al, 2021). Tracing the path to added value products has a positive effect on the preservation of the environment, considering that the production of traditional products is connected with traditional eco-friendly production methods.

To accomplish the objectives of cultivating a culture of nutritious eating and endorsing the high-quality food originating from Serbia, it is imperative to involve targeted ministries, food producers and distributors, tourism entities, as well as health and educational institutions. The objectives include establishing a culture of consuming nutritious and high-quality Serbian food, distinguishing and positioning Serbian cuisine from other ethnic cuisines in the region, boosting the production and consumption of Serbian food, and attracting a higher number of tourists (Vukolić, Gajić and Bugarčić, 2021).

Socio-cultural shifts, including changes in lifestyles and values, play a pivotal role in shaping food consumption patterns, delineating three significant trends in food preferences. The initial trend involves the gradual substitution of traditional homemade dishes crafted from fresh ingredients with processed, industrially manufactured food alternatives. The second trend is related to the disappearance of the seasonal cycle in food consumption, and the third is a trend towards “exotic” ethnic food (Verbeke and Lopez, 2005).

Consumers encounter novel ethnic cuisines as a result of globalization, the ever-expanding international trade, integrated marketing communications (particularly advertising), travel (including tourism and migration), as well as the presence of diverse stores and restaurants. Factors that provoke the growing demand for ethnic foods are: demographic changes, television shows about food, the Internet, a new ethnic restaurant chain (Duff, 2005). The increasing desire for ethnic cuisine stems from the growing demand for healthier options and a curiosity to explore different, flavors.

The convenience-oriented lifestyle and purchasing power of consumers, particularly in developed nations, result in a rising trend of dining out or utilizing catering services, thereby increasing exposure to a wider range of food options. The desire for both healthier and more flavorful cuisine stands as a significant factor driving the growth of ethnic food consumption.

To effectively position Serbian cuisine necessitates a clear definition of the concept of Serbian food, specifically identifying what constitutes Serbian cuisine. Considering global trends favoring healthier food options, the emphasis should shift towards

traditional “antique” Serbian food, beverages, and dishes rooted in nutritious, high-quality ingredients and preparation methods. To distinguish Serbian food, it should stand out from familiar and widely accepted culinary offerings. The comprehensive involvement of diverse stakeholders, guided by the defined concept of Serbian food, is vital in cultivating a positive image for Serbian national cuisine.

### ***Traditional Serbian cuisine – positioning and differentiation***

Understanding the perceived image of Serbian national cuisine is the key for positioning and differentiating traditional Serbian cuisine and highlighting specific regions within the Republic of Serbia and their unique products. By leveraging these products, tourism promotion can be enhanced and each region can be effectively presented, both in domestic and foreign markets.

Aforementioned can be done on the basis of: the attributes (taste and authenticity) and quality of healthy food, the benefits, food service quality, the group users and by comparing to foreign competitors e.g., highlighting local natural ingredients (Kovačić, Pivac, Akkar Ercan, Kimić, Ivanova-Radovanova, Gorica, and Tolica, 2023). Involvement of celebrities and/or experts in various fields who eat healthy food through social networks and other media channels can add additional value to the visibility and the perceived image of Serbian national cuisine (Vukolić, Gajić and Penić, 2022).

The strategy for positioning Serbian food involves a comprehensive approach to promote healthy eating on multiple fronts. The primary focus is on instilling a culture of consuming locally-produced, nutritious food in Serbia. Educational initiatives are essential, targeting institutes, schools, and universities to underscore the health and economic advantages of choosing healthy Serbian food. Concurrently, efforts are geared towards establishing a positive image of Serbian food, both domestically and internationally, with key responsibilities assigned to ministries, institutes, media, and other relevant organizations (Dogan and Petkovic, 2016).

Enhancing the favorable perception of Serbian national cuisine involves manufacturing and advertising top-tier traditional foods from diverse regions across Serbia, accentuating not just the culinary delights but also their regional origins. Recognizing the visual influence on food choices, there is an emphasis on attractive packaging. However, it is crucial that the product’s quality matches the appeal of the packaging for sustained success. In essence, this holistic approach acknowledges the interconnection of education, perception, product quality, and presentation in fostering a thriving culture of healthy Serbian food consumption (Kovačić, et al., 2023).

### ***Factors influencing the perceived image of Serbian national cuisine***

The perceived authenticity of regional foods is shaped by various factors (Gajić, Jovičić, Tešanović and Kalenjuk, 2014). Firstly, personal elements such as knowledge and experience play a crucial role. Then come the product-related factors, including product features, branding and positioning, or design and packaging. Additionally,

factors referring to the conditions, circumstances, or context, like where the product is purchased or consumed, also contribute to shaping the perception of authenticity. It is a blend of personal insights, product characteristics, and the context in which the food is encountered (Verbeke, Pieniak, Guerrero and Hersleth, 2012).

Organizations can impact these factors through strategies such as informing and influencing potential consumers, and advocating the significance of consuming healthy local foods, by organizing tasting promotions and fostering positive experiences. This involves using distinctive names, appealing design of packaging, and comprehensive ingredient descriptions, while also ensuring widespread products distribution and their availability in retail outlets, hotels, restaurants, and cafés. In essence, the organization becomes a key player in shaping perceptions by actively engaging with consumers, optimizing product characteristics, and strategically placing products in the market (Vuksanović and Demirović Bajrami, 2020).

Strategically incorporating Serbian cuisine into spa tourism, countryside or pilgrimage tourism should be a direction of action. With the growing appreciation of physical activity, tourists are particularly redirected towards wellness spa tourism. Spas are further positioned and differentiated based on their spa menu, which could be crafted around healthy Serbian food. Promotion of healthy diet option in spas encourage local tourists to continue consuming healthy food at home. This practice may also spur foreign tourists to opt for healthy Serbian foods.

With an increasing number of tourists visiting villages, collaboration between food producers, local tourist organizations, and households becomes crucial in shaping a culture of gastro-tourism and healthy eating with Serbian food at its core.

### **Materials and methods**

The study focuses on main determinants of the perceived Serbian national cuisine image. In this context, the new research model, which includes three potential drivers of image: taste and quality, authenticity, and the quality of service, was proposed. The paper determines which of the said variables creates the image of Serbian national cuisine to the greatest extent.

The sample for this research included 217 fans of Serbian national food, who were asked to evaluate national specialties presented at a Serbian gastronomic festival. The ratio of female and male respondents was 43.8% women against 56.2% of men. The respondents up to 30 years of age constituted 59.4% of the sample. As for their education level, 65.4% of respondents had primary or secondary school diploma. On the other hand, respondents with a higher education made up 34.6% of the sample.

Data were collected using the survey method. Using this method, a large sample of respondents can be included, and the collected data are suitable for carrying out quantitative analysis. Each variable within the model was assessed using multiple items crafted after reviewing pertinent literature. Participants indicated their level of agreement

with these items using a seven-point Likert scale. Food taste and quality statements were adapted from Dimitrovski (2016) and Updhyay and Sharma (2014). The national food authenticity statements were adapted from Mason and Paggiaro (2012). The study utilized criteria for assessing food service quality based on frameworks established by Wan and Chan (2013) and Updhyay and Sharma (2014). Based on the research conducted by Boo et al. (2009), we defined the items for measuring the perceived image of Serbian national cuisine.

Data were analyzed by the Statistical Product and Service Solutions (SPSS 20) and AMOS 18 software suite. First the constructs reliability was evaluated by examining the Cronbach's alpha coefficient. To test the model fit, several relevant fit indices were calculated ( $\chi^2/df$ ; GFI – Goodness of Fit Index; RFI – Relative Fit Index; NFI – Normed Fit Index; CFI – Comparative Goodness Of Fit; TLI – Tucker–Lewis Index; IFI – Incremental Fit Index; RMSEA – Root Mean Square Error of Approximation). Additionally, convergent and discriminant validity of the model and the composite reliability, were assessed. In the main part of the analysis, using structural equation modeling, the effects of food quality and taste, authenticity, and the quality of service on the perceived image of national cuisine were tested.

## Results

Before testing the causal relations between the model constructs, the reliability, validity and fit of the model were assessed. When it comes to the reliability analysis, Cronbach's alpha coefficient was calculated for individual constructs (*Table 1*). All obtained values were higher than the desired threshold of 0.7, indicating an adequate level of internal consistency of the statements that were used for measuring the latent variables (Nunnally, 1978).

The model reasonably fitted the data. *Table 2* shows fit indices values. The data from the table indicate that the value of the ratio  $\chi^2/df$  is lower than 3 (Dastane et al., 2023), the values of the GFI, NFI, RFI, CFI, TLI, and IFI indices are higher than 0.9 (Kaatz, 2020), while the RMSEA is below 0.08 (Hair et al., 2010).

The model fulfills the convergent validity according to the Fornell and Larcker (1981) criterion, since for each latent variable the average variance extracted (AVE) is higher than the threshold of 0.5 (Taste and quality of food: 0.685; Authenticity of national food: 0.636; Food service quality: 0.746; Perceived image of national cuisine: 0.845). The AVE for all constructs surpassed the squared correlations between them, confirming discriminant validity. *Table 3* shows the results of the correlation analysis. In addition, for every single construct, composite reliability is higher than 0.6 (Taste and quality of food: 0.866; Authenticity of national food: 0.89; Food service quality: 0.898; Perceived image of national cuisine: 0.942).



**Table 1.** The analysis of reliability

Variables	Cronbach's alpha
Taste and quality of food	0.86
Authenticity of national food	0.83
Food service quality	0.89
Perceived image of national cuisine	0.94

Source: Authors' calculations

**Table 2.** The model – fit indices

Fit indices	Recommended value	Measurement model
$\chi^2 / df$	< 3	2.30
GFI	> 0.9	0.923
NFI	> 0.9	0.946
RFI	> 0.9	0.926
CFI	> 0.9	0.969
TLI	> 0.9	0.957
IFI	> 0.9	0.969
RMSEA	< 0.08	0.078

Source: Authors' calculations

**Table 3:** Intercorrelation matrix

	1. Taste and quality of food	2. Authenticity of national food	3. Food service quality	4. Perceived image of national cuisine
1.	1	0.636	0.660	0.536
2.	0.636	1	0.739	0.521
3.	0.660	0.739	1	0.541
4.	0.536	0.521	0.541	1

Source: Authors' calculations

Following the evaluation of the model's reliability and validity, the statistical analysis then focused on testing the impacts of independent variables on the perceived image of national cuisine. Structural equation modeling (SEM) was applied using the maximum likelihood method (Fedajev et al., 2023; Yu and Huang, 2022; Chopdar and Balakrishnan, 2020). Two out of three tested effects were found to be statistically significant. *Table 4* lists the results.

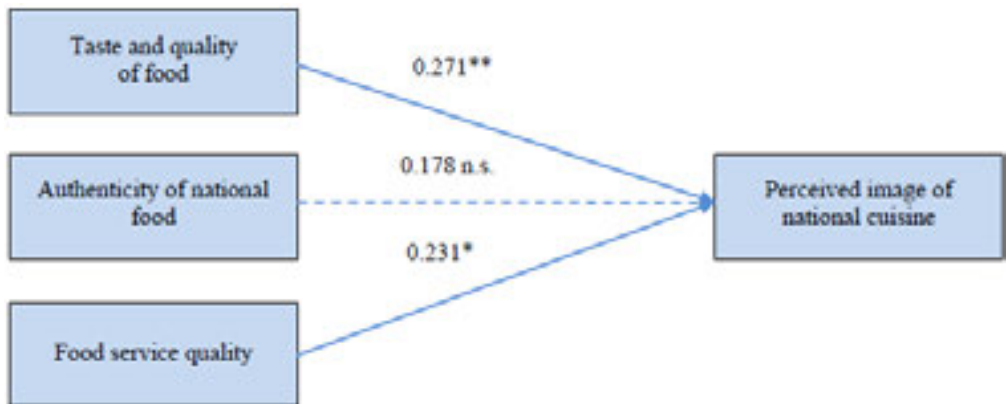
**Table 4.** SEM analysis results

Relationship	$\beta$ coefficient	Significance
Taste and quality of food → Perceived image of national cuisine	0.271	p < 0.01
Authenticity of national food → Perceived image of national cuisine	0.178	p > 0.05
Food service quality → Perceived image of national cuisine	0.231	p < 0.05

Source: Authors' calculations

Food quality and taste stood out as the major antecedent of the Perceived image of national cuisine ( $\beta= 0.271$ ,  $p < 0.01$ ). Food service quality influenced the Perceived image of national cuisine slightly less but still significantly ( $\beta= 0.231$ ,  $p < 0.05$ ). The unexpected finding was that the Authenticity of Serbian food did not yield a statistically significant impact on the Perceived image of the national cuisine ( $\beta= 0.178$ ,  $p > 0.05$ ). Obviously, the respondents believed that the Serbian food quality and taste and the friendliness and professionalism of the service staff created a positive image of the national cuisine, but that the local food, despite its good taste and quality, was not sufficiently authentic compared to the national specialties of some other countries. What strikes as a significant point here is that independent variables account for a moderate proportion of the variability in the dependent variable, with the coefficient of determination standing at 0.363).

**Figure 1.** Structural equation modeling results diagram



Notes: \*\*Significant at a 0.01 level

\*Significant at a 0.05 level

n.s. - Non-significant result

Source: Authors' calculations

## Conclusion

The literature review findings suggest that customers prioritize the food quality and pricing as major factors when selecting a specific ethnic restaurant. Certain findings suggest a correlation between respondents' individual preferences and their socioeconomic status, including interior of the ethnic restaurant as one of the factors shaping their positive impression. Subsequent to the interior, service quality emerged as the significant contributor to the perceived image (Marinković, Senić and Mimović, 2015). Given the fact that most of the research results are from Western Balkan region, the overall experience, including the interior and the quality of service, is significant in shaping customers' positive perceptions of an ethnic restaurant after their visit.

Up until now, not many local studies have dealt with the drivers of the perceived image of national cuisine, utilizing a quantitative field research approach. This paper contributes valuable theoretical insights, particularly through a comparative study of the effects of food taste, the authenticity, and service quality on the perceived image. Notably, the structural equation modeling of the data analysis enhances the robustness of the findings. The research results reveal that, according to local respondents, Serbian food is highly regarded for its taste. However, they also highlight that the cuisine lacks distinct authenticity in comparison to the specialties of other nations when shaping the image of national cuisine.

The conducted study has its limitations. Surveys, by nature, capture subjective perceptions of consumers, which may have some degree of divergence from the actual situation. This study recorded a one-time situation, lacking the capability to track changes in consumer perceptions over time. Furthermore, the research model only incorporated three independent variables, and future studies could benefit from using more intricate models. There is also a suggestion to conduct an analysis at the group level. An intriguing avenue for exploration would be to determine to what extent the image of the Serbian national cuisine held by local tourist differ from those of foreigners. This comparative analysis could significantly contribute to gastro-tourism growth in Serbia.

### **Conflict of interests**

The authors declare no conflict of interest.

### **References**

1. Boo, S., Busser, J., & Baloglu, S. (2009). A model of customer-based brand equity and its application to multiple destinations. *Tourism Management*, 30(2), 219–231. doi: 10.1016/j.tourman.2008.06.003
2. Chopdar, P., & Balakrishnan, J. (2020). Consumers response towards mobile commerce applications: S-O-R approach. *International Journal of Information Management*, 53, 102106. doi: 10.1016/j.ijinfomgt.2020.102106
3. Dastane, O., Goi, C.L., & Rabbanee, F.K. (2023). The development and validation of a scale to measure perceived value of mobile commerce (MVAL-SCALE). *Journal of Retailing and Consumer Services*, 71, 103222. doi: 10.1016/j.jretconser.2022.103222
4. Dimitrovski, D. (2016). Urban gastronomic festivals – Non-food related attributes and food quality in satisfaction construct: A pilot study. *Journal of Convention & Event Tourism*, 17(4), 247–265. doi: 10.1080/15470148.2015.1136978
5. Dogan, E. and Petkovic, G. (2016). Nation Branding in A Transnational Marketing Context: Serbia's Brand Positioning Through Food and Wine. *Transnational Marketing Journal*, 4(2), 84–99. doi: 10.33182/tmj.v4i2.392

6. Edles, L. D. (2004). Rethinking race ethnicity, and culture: s Hawaii the 'model minority' state? *Ethnic and Racial Studies*, 27(1), 37–68. doi: 10.1080/0141987032000147931
7. Fedajev, A., Pantović, D., Milošević, I., Vesić, T., Jovanović, A., Radulescu, M, Stefan, M.C, (2023), Evaluating the Outcomes of Monetary and Fiscal Policies in the EU in Times of Crisis: A PLS-SEM Approach. *Sustainability*, 15 (11), 8466. <https://doi.org/10.3390/su15118466>
8. Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–80. doi: 10.2307/3151312
9. Gagić, S., Jovičić, A., Tešanović, D., and Kalenjuk, B. (2014). Motives for food choice among Serbian consumers. *Economics of Agriculture*, 61(1), 41–51. doi: 10.5937/ekoPolj1401041G
10. Gaytán, M.S. (2008). From sombreros to sincronizadas: authenticity, ethnicity, and the Mexican restaurant industry. *Journal of Contemporary Ethnography*, 37(3), 314–341. doi: 10.1177/0891241607309621
11. Grujic-Vuckovski, B. & Kovacevic, V. (2020). *Organic agricultural production as a quality standard, Organic, farming, ecomarket and their capitalization through the entrepreneurial initiative*, Editors: Marco Platania, Marko Jeločnik, Irina Neta Gostin, Alexandru Ioan Cuza University – Iași (Romania) Institute of Agricultural Economics – Belgrade (Serbia), ISBN 978-86-6269-083-8 (online), 103–127.
12. Hair, J., Black, W., Babin, B., & Anderson, R. (2010). *Multivariate data analysis* (7th ed.). Prentice-Hall, NJ.
13. Henderson, J.C. (2014). Food and culture: in search of a Singapore cuisine. *British Food Journal*, 116(6), 904–917. doi: 10.1108/BFJ-12-2012-0291
14. Jang, S. (Shawn), Ha, J. and Park, K. (2012). Effects of ethnic authenticity: investigating Korean restaurant customers in the US. *International Journal of Hospitality Management*, 31(3), 990–1003. doi: 10.1016/j.ijhm.2011.12.003
15. Jovičić Vuković, A., & Terzić, A. (2020). Gastronomy and regional identity: Balkan versus national cuisine. *Gastronomy for Tourism Development - Potential of the Western Balkans*, 1–25. doi: 10.1108/978-1-78973-755-420201002
16. Kaatz, C. (2020). Retail in my pocket – replicating and extending the construct of service quality into the mobile commerce context. *Journal of Retailing and Consumer Services*, 53, 101983. doi:10.1016/j.jretconser.2019.101983
17. Kivela, J., & Crotts, J. C. (2009). Understanding travelers' experiences of gastronomy through etymology and narration. *Journal of Hospitality and Tourism Research*, 33(2), 161–192. doi: 10.1177/1096348008329868
18. Kovačević V., Brenjo, D., Cvetković S, & Rainović Lj. (2022). Comparative analyse of foodstuff geographical indications in the Western Balkans. *Economics of Agriculture* 69(1), 163–178. doi: 10.5937/ekoPolj2201163K

19. Kovačević V., Sibinovska S. & Veli Hoti (2021). Review of geographical indications schemes in South East Europe. *X International Symposium on Agricultural Sciences, Proceedings "AgroReS 2021"*, University of Banja Luka, Faculty of Agriculture, Trebinje, Bosnia and Herzegovina, 169–182. Website: <https://agrores.net/wp-content/uploads/2021/05/Proceedings-AgroReS-2021-1.pdf>
20. Kovačić, S., Pivac, T., Akkar Ercan, M., Kimić, K., Ivanova-Radovanova, P., Gorica, K., Tolica, E.K. (2023). Exploring the Image, Perceived Authenticity, and Perceived Value of Underground Built Heritage (UBH) and Its Role in Motivation to Visit: A Case Study of Five Different Countries. *Sustainability*, 15, 11696. doi: 10.3390/su151511696
21. Kukanja, M. & Peštek, A. (2020). Development of Slovenia's Gastronomy – From Peasant Food to the European Region of Gastronomy 2021. *Gastronomy for Tourism Development*, 109–131. doi: 10.1108/978-1-78973-755-420201007
22. Marinković, V., Senić, V. & Mimović, P. (2015). Factors affecting choice and image of ethnic restaurants in Serbia. *British Food Journal*, 117(7), 1903–1920. doi: 10.1108/BFJ-09-2014-0313
23. Mason, M. C., & Paggiaro, A. (2012). Investigating the role of festivalscape in culinary tourism: The case of food and wine events. *Tourism Management*, 33(6), 1329–1336. doi:10.1016/j.tourman.2011.12.016
24. Ministry of Agriculture, Forestry and Water Management Republic of Serbia & IPARD EU4 Rural Areas (2022). *Annual Implementation Report on IPARD II Programme for 2021*. Department for Management of IPARD Programme IPARD Managing Authority
25. Nunnally, J. C. (1978). Introduction to psychological measurement. McGraw-Hill, NY.
26. OECD (2012). Food and the tourism experience: The OECD-Korea workshop, OECD studies on tourism. *OECD Publishing*, 10–11.
27. Okumus, B., Okumus, F. and McKercher, B. (2007). Incorporating local and international cuisines in the marketing of tourism destinations: the cases of Hong Kong and Turkey. *Tourism Management*, 28(1), 253–261. doi: 10.1016/j.tourman.2005.12.020
28. Regional Rural Development Standing Working Group – SWG (2020). Food Quality Policy: Schemes of Geographical Indications and Traditional Specialities in South East Europe, ISBN 978-608-4760-31-3, Retrieved from: [seerural.org/wpcontent/uploads/2020/09/Food-Quality-Policy-Assessment.pdf](http://seerural.org/wpcontent/uploads/2020/09/Food-Quality-Policy-Assessment.pdf) (January 11, 2021)
29. Schmitt, E., Galli, F., Menozzi, D., Maye, D., Touzard, J., Marescotti, A., Six, J., & Brunori, G. (2017). Comparing the sustainability of local and global food products in Europe, *Journal of Cleaner Production*, Volume 165, 346–359, doi <https://doi.org/10.1016/j.jclepro.2017.07.039>. Tovmasyan, G. (2019). Exploring the role of gastronomy in tourism. *SocioEconomic Challenges*, 3(2), 30-39. doi: 10.21272/sec.3(3).30-39.2019

30. Tikkanen, I. (2007). Maslow's hierarchy and food tourism in Finland: Five cases. *British Food Journal*, 109(3), 721–734. doi: 10.1108/00070700710780698
31. Tovmasyan, G. (2019). Exploring the role of gastronomy in tourism. *SocioEconomic Challenges*, 3(2), 30-39. doi: 10.21272/sec.3(3).30-39.2019
32. Updhyay, Y., & Sharma, D. (2014). Culinary preferences of foreign tourists in India. *Journal of Vacation Marketing*, 20(1), 29–39. doi: 10.1177/1356766713486143
33. Verbeke, W. & Lopez, G. (2005). Ethnic food attitudes and behaviour among Belgians and Hispanics living in Belgium. *British Food Journal*, 107(11), 823–840. doi: 10.1108/00070700510629779
34. Verbeke, W., Pieniak, Z., Guerrero, L., & Hersleth, M. (2012). Consumers' awareness and attitudinal determinants of European Union quality label use on traditional foods. *Bio-based and Applied Economics*, 1(2), 213–229. doi: 10.13128/BAE-10558
35. Vukolić, D., Gajić, T., & Penić, M. (2022). The effect of social networks on the development of gastronomy – the way forward to the development of gastronomy tourism in Serbia. *Journal of Tourism Futures*, 1–16. doi: 10.1108/JTF-01-2022-0034
36. Vukolić, D., Gajić, T., & Bugarčić, J. (2021). Zadovoljstvo gostiju ponudom evropskih internacionalnih jela i proizvoda u restoranima Srbije. *Turističko Poslovanje*, 28, 27–38, doi: 10.5937/turpos0-33646 [in English: Vukolić, D., Gajić, T., & Bugarčić, J. (2021). Guest satisfaction with the international meals and food products on offer in restaurants in Serbia. *Turističko Poslovanje*, 28, 27–38, doi: 10.5937/turpos0-33646]. doi: 10.5937/turpos0-33646
37. Vuković, P., Arsić, S. & Kovačević, V. (2021). Condition for sustainable development of rural tourism in the area of lower Danube region in the Republic of Serbia. *Thematic proceedings, International scientific conference, Institute of Agricultural Economics, Belgrade*, 297–305, ISBN-978-86-6269-096-8
38. Vuksanović, N. and Demirović Bajrami, D. (2020). Image of Local Cuisine as Part of a Rural Tourism Offer. *Gastronomy for Tourism Development*, 91–108. doi: 10.1108/978-1-78973-755-420201006
39. Wan, Y. K. P., & Chan, S. H. J. (2013). Factors that affect the levels of tourists' satisfaction and loyalty towards food festivals: A case study of Macau. *International Journal of Tourism Research*, 15(3), 226–240. doi: 10.1002/jtr.1863
40. Yu, N., & Huang, Y-T. (2022). Why do people play games on mobile commerce platforms? An empirical study on the influence of gamification on purchase intention. *Computers in Human Behavior* 126, 106991. doi: 10.1016/j.chb.2021.106991
41. Zrnić M., Gajić, T. & Vukolić D. (2022). The influence of gastronomic offer and services on the branding of hotel Divčibare. *Turističko poslovanje*, 30, 13–22. doi: 10.5937/turpos0-40569



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## THE EU STATE AID REGIME IN AGRICULTURE –LEGAL ASPECT

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### ABSTRACT

*State aid to certain economic sectors in the European Union was an acceptable model until the establishment of the single market in 1992. The EC acknowledge that the allowance is imputable to the MS and that it constitutes State aid. In the light of the foregoing, the Commission concludes that the measures at issue in the present case constitute State aid (Article 107(1) TFEU). "Special rules on provision of state aids were created as secondary law rules by the EU Council and EU Commission". State aid to promote the economic development of the agricultural sector is part of the wider framework of the "Common Agricultural Policy" ("CAP"). This paper analyzes EU state aid regulation in the agriculture sector, with special focus on the provisions of the "Agriculture Block Exemption Regulation" – ABER. The paper also analyzes agricultural aid, which must be notified to the EC as being authorized under the "Agriculture Guidelines".*

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## Introduction

In the EU, state aid to companies, to certain industry branches was an acceptable model until the establishment of the single market in 1992, which largely organizes state aid. State aid represents a new legal institute. The legislation of the EU is the basis for the standardization of state aid in the legislation of the EU MS, but also of the potential MS. State aid in the EU is regulated by Articles 107-109. TFEU (OJEU 9.5.2008 C 115/91–93”), throw documents of EU authorities, but also by soft law. The EU Court of

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Justice has made considerable endowment to the interpretation and application of state aid rules. State aid control is carried out by the Commission, applying the principles of selectivity, temporality and transparency. (Maksimovic Sekulic, 2017)

The TFEU does not provide a completely precise definition of the concept of state aid, which leaves a lot of room for different interpretations. Namely, state aid is expressly prohibited on the territory of the EU MS. According to Article 107 of the TFEU “any aid granted by a MS or through State resources which distorts or threatens to distort competition by favoring certain industry sector or the production of certain goods, in particular if it affects trade between MS, shall be deemed incompatible with the common market”. Furthermore, a wide scope is left for discretionary interpretation of which all falls into the category of authorities that grant state aid. These can be the state, local or regional authorities or bodies over which the state, directly or indirectly, has a decisive influence, that is, entities over whose decisions and operations the state exercises control. In the European Union, it is completely forbidden to forgive the debts or taxes of companies that are in difficulties, that is, to give them loans under favorable conditions, to subsidize the operations of state enterprises and to give them land for use. (Maksimovic Sekulic, 2017)

However, there are also forms of state aid that are allowed and are in line with the single market. One of them is the agricultural sector, which has always been under special treatment. (Janku, 2013). Primarily, Regulation (EU) 2022/2472, the Agricultural Block Exemption Regulation (ABER), part of a package of measures the Commission adopted revising State aid rules on agriculture, forestry and rural areas with the Fishery Block Exemption Regulation (FIBER) and the Agricultural Guidelines and Fisheries Guidelines. (Janku, 2013)

### **Materials and methods**

The paper analyses the state aid regulations, with special focus on agriculture sectors and comparison of the ABER with the general TFEU rules on the state aids. Finally, agricultural aid that falls to be notified to the EC as it may be authorized under the Agriculture Guidelines will be discussed.

The basic methods of research are the content of secondary data sources analysis. Secondary data, the state aid regulations were taken mostly from the official EC documents and relevant literature.

### **Research results**

#### **Regulation (EU) 2022/2472**

Regulation (EU) 2022/2472 is known as the “agricultural block exemption regulation” (January 2023 to 31 December 2029). This regulation declares specific aid categories “compatible with EU State aid rules and exempts them from prior notification to, and approval by, the EC. Regulation (EU) 2022/2472 applies to the following categories of national aid for: (Regulation (EU) 2022/2472):

“micro and SMEs agricultural activities: investment in farms to improve agricultural performance and sustainability, environmental performance and infrastructure; land consolidation; relocation of farm buildings; investments in marketing of agricultural products; “start-ups for young farmers”, farming and producer groups and organizations; participation in “quality schemes”; know-how exchange, information and counseling services; services of farm replacement; promotion of agricultural products; repairing damage from unfavorable weather, such as storms or severe drought; “prevention, control and eradication of animal diseases and plant pests and repairs to any damage”; “livestock and fallen stock; payment of insurance premiums and contributions to mutual funds”; “repairs to damage caused by protected animals”; animal welfare; agricultural cooperation and non-agricultural activities in rural areas; environmental protection in agriculture; conservation of cultural and natural heritage on agricultural holdings and in forests; repair of damage from natural disasters in the agricultural sector; research, development and innovation in agriculture and forestry; other forestry measures.”

State Aid must be transparent, precise calculation of the gross grant equivalent (grants, loans, guarantees, interest rate subsidies); provide an incentive to change the behavior of a potential beneficiary (a written request for aid has to be submitted before starting the project or activity); be published on national and Commission websites.

The procedure for granting state aid must be implemented in compliance with the rules of transparency, with a special emphasis on the clarity of the procedure itself. State aid must be reported to the Commission, in accordance with the regulations that regulate in detail the application process - notification of state aid and according to the rules for awarding certain categories of state aid. The regulation requires: (Regulation (EU) 2022/2472) the Commission to instruct Member States to notify future aid, if it finds that the aid already given does not meet the conditions in the legislation; MS to: send to the EC a summary of each type of aid they give and provide an annual report; maintain detailed records, with supporting documentation, for at least 10 years; have aid schemes evaluated by independent experts after their implementation if spending is “over €150 million in 1 year or €750 million over the lifetime of the scheme”. Regulation 2022/2472 is part of a package of measures the EC adopted revising State aid rules on agriculture, forestry and rural areas. These revised rules align State aid with the EU’s strategic priorities, notably the common agricultural policy and the European Green Deal. (Regulation (EU) 2022/2472)

### **“Common agricultural policy”- CAP**

The CAP consists of two pillars – the “European Agricultural Guarantee Fund” (EAGF) and the “European Agricultural Fund for Rural Development” (EAFRD) – which together provide a basic layer of support for farmers in the Union and thereby create the conditions for preserving sustainable agriculture throughout the Union. In accordance with Article 39, Paragraph 1 of the Treaty, the objectives of the CAP are to increase agricultural productivity, ensure an adequate standard of living for the agricultural population, stabilize markets, ensure supply availability and ensure that goods reach

consumers at reasonable prices. (Maksimović, Sekulić & others, 2018) CAP and its special application methods must include: (Art. 39. Par. 2, TFEU):

- Agricultural activity nature and agricultural regions differences;
- Appropriate adjustments execution;
- Sector of agriculture in the EU MS, represents a sector that is closely related to the economy as a whole.

The goal of the reformed CAP is to: provide more targeted support to smaller agricultural assets, improve the contribution of agriculture to the environmental and climate goals of the EU, and enable member states greater flexibility in adapting measures to local conditions. (Regulation (EU) 2021/2115)

The main aspects of the policy are: a new green structure based on environmental conditions to be met by farmers and additional voluntary measures, the application of strategic planning for the purpose of more targeted direct payments and interventions in the field of rural development, a performance-based approach in which member states must report annually on his accomplishments. (Regulation (EU) 2021/2115)

The new policy includes the following components at the EU level: a common set of objectives set at the EU level for the entire CAP, which indicate what they said policy aims to achieve for farmers, citizens and the climate, an extensive set of broad intervention measures agreed at the level of the EU, which determine what member states can do to achieve the objectives of the CAP, a common set of result indicators agreed at the EU level in order to ensure equal conditions for evaluating the effectiveness of the applied measures. (Regulation (EU) 2021/2116)

Based on a clear assessment of its own needs, each country is free to choose specific intervention measures that it considers the most effective for achieving its specific goals. The new provisions state the following: “each EU member state is obliged to conduct a comprehensive analysis to determine its specific needs and create a strategic plan within the framework of the CAP, each plan states the way in which the member state will use CAP funds - and in order to meet these needs, including the tools to be applied and the specific objectives, each strategic plan under the CAP needs the approval of the Commission to ensure its alignment with the EU-wide objectives, countries must submit performance reports to the Commission in which they show the progress in achieving the goals established as indicators of results”. (Regulation (EU) 2021/2116)

By checking the strategic plans, it is ensured that they do not distort the single market, that is, that they do not represent too much of a burden for users or administrations. The committee can review the reports and, if necessary, propose recommendations to improve performance.

The new CAP also includes new obligations and incentives for farmers, such as:

- “Conservation of carbon-rich soils by protecting wetlands and peat lands,

- programs for ecology that EU countries should include in their plans to support farmers and/or to encourage farmers to use agricultural practices beneficial for the climate and the environment to an extent that goes beyond the mandatory requirements. Member States will have to allocate 25% of their direct payments to these programmes”. (Regulation (EU) 2021/2117)

In order to ensure stability and predictability, income support remains an essential part of the CAP, with certain changes, for example:

- EU countries must ensure that all payment entitlements reach a value of at least 85% of the average national amount in the EU by 2027,
- for all countries whose level of direct support per hectare is below 90% of the EU average, this gap will be closed by 2027,
- member states will be allowed to reduce direct payments per farmer (in the amount of EUR 60,000 per year or more) by a maximum of 85% and to limit them to EUR 100,000 per year,
- member states will have to redistribute at least 10% of the funds for their direct payments from larger agricultural holdings to smaller and/or medium-sized agricultural holdings, unless they would rather solve the need for redistribution with other means and can prove that this need is sufficiently met.

In November 2023, the European Commission published a report on joint efforts within all strategic plans within the CAP in EU member states. The report confirms the role of the new CAP in supporting the transition to a more sustainable agriculture model. In addition, the new CAP aims to ensure a fairer distribution of funds, with plans to support 377,000 young farmers. Income support to ensure an adequate standard of living for farmers and supporting food security remain key policy objectives.

The report found that certain improvements are needed, namely:

- “improving instruments for risk management and increasing the resilience of agricultural holdings
- Further support for innovation and digital technologies
- Complementary with EU and national policies and funds aimed at achieving environmental goals”. (Regulation (EU) 2021/2117)

### **Agriculture Guidelines**

The Commission has adopted in 2022 Guidelines for state aid to the agricultural and forestry sectors and in rural areas (“Agriculture Guidelines”). “The revised Agriculture Guidelines introduce a new simplified state aid authorization procedure for measures co-financed under the CAP, as well as new incentives for farmers to commit to schemes under which they respect stricter environmental standards than what is required by law”. (Commission Communication 2022/C485/01 C/2022/9120)

The Guidelines apply to support for SMEs, and big companies. However, large businesses are mostly less sensitive to market deficiencies than SMEs. In addition, large enterprises in the agriculture and forestry sectors are more likely to play a significant role in the market, and therefore, in specific cases, support granted to big companies can make distortion of competition and trade in the internal market. Entrepreneurs in difficulty are excluded from these Guidelines. The EC considers that undertakings in financial difficulties, since they are endangered, cannot be considered an appropriate means to promote other public policy objectives until they are ensured sustainability. Therefore, if the beneficiary is an undertaking, the aid will be granted in accordance with the State aid guidelines for the resolution and restructuring of enterprises in difficulty. MS notifying State aid not covered by Guidelines shall have to prove that the State aid concerned is compatible with Article 107(3)(c) of the TFEU. The Commission will only approve such measures if their positive contribution to the development of the sector clearly exceeds the risks of distorting competition in the internal market and the impact on trade between MS. (Commission Communication 2022/C 485/01C/2022/9120)

### **“Aid in favor of undertakings active in the primary production, processing and marketing of agricultural products”**

These aids relate to “investments in agricultural holdings” associated with “primary agricultural production” and to investments related to the processing of agricultural products and the placing on the market of agricultural products. Support for investments in tangible assets on farms related to primary agricultural production is covered. “Investment is carried out by one or more users or it applies to tangible assets or intangible assets used by one or more users”. Support may also apply to “investments in tangible assets and intangible assets associated with the production of bio fuels or with the production of energy from renewable sources on holdings, which meet one of the following conditions”: (Regulation (EU) 2020/852)

- In the case of investment for bio fuels production (Art. 2. (EU) 2018/2001) on farms, “renewable energy” production plants can be supported only if their annual production capacity is smaller or equal to the average annual fuel consumption on the farm concerned;
- the bio-fuel produced cannot be the market;
- in the case of investment for the production of heat and/or electricity from renewable sources on farms, renewable energy installations are eligible for support only if the customer’s goal is to meet their own energy needs and if their annual production capacity is less or equal to the common average of the annual heat and electricity consumption on the farm, including the farm;
- the sale of electricity to the electricity grid is permitted if the limit of its average annual consumption is respected.

Where investment for renewable energy production is carried out by more farms to meet their own energy needs or “to produce bio fuels on holdings, the average annual consumption is equal to the sum of the average annual consumption of all users”. MS must “require compliance with minimum energy efficiency standards for investments in energy generation infrastructure from renewable sources that consume or produce energy where such standards exist at national level”. (Regulation (EU) 2020/852)

Support for electricity production from biomass is strong prohibited, unless a “minimum percentage of the heat produced by MS is used”. MS will set thresholds for maximum starch, sugar crops and other starch-rich cultures, sugar crops and oilseeds used for bio-energy production, including bio-fuels, for different types of installations in accordance with Article 26. (Directive (EU) 2018/2001). Support for bio-energy projects must be limited to bio-energy that meets “the applicable sustainability and greenhouse gas” emission savings criteria (Art. 29 of Directive 2009/2009/EC).

“Investment must have at least one of the following objectives”:

- improve of farm sustainability -reducing production costs or improving and redirecting production;
- improving the environment, “hygiene or animal welfare standards”;
- creating and improving of development infrastructure, adaptation and modernization of agriculture, including access to agricultural land, land degradation and land improvement;
- restore the potential of agricultural production damaged by natural disasters, emergency events or adverse climate conditions that can be equated with natural disasters, animal diseases and plant-harmful organisms and which have damaged protected animals, as well as prevent and reduce the risk of damage caused by the above events and factors;
- contribute to climate change mitigation and adaptation - reducing greenhouse gas emissions and improving carbon sequestration;
- contribute to sustainable circular bio-economy and to foster sustainable development and efficient management of natural resources, (“water, soil and air, including by reducing chemical dependence”);
- contribute to stopping and reversing the process of biodiversity loss, improving ecosystem services and conservation of habitats and landscapes. (Directive (EU) 2018/2001)

#### **“Start-up aid for young farmers and start-up aid of agricultural activities”**

Aid shall be “granted to undertakings engaged in primary agricultural production and may relate to the setting-up of young farmers or to the setting-up of agricultural activities”. The aid must be conditional on the submission of the

business plan to the competent authority of the MS concerned. The amount of support shall not exceed EUR 100 000. In these cases, the EC will consider that the aid is “compatible with the internal market”. The activities must include one of the following elements:

- benefit for the climate and the environment”;
- Prevention of the development of antimicrobial resistance as identified in the Commission Communication entitled “A European action plan for Common Health” to combat antimicrobial resistance”;
- Risk prevention and management;
- Measures to modernize farms, build competitiveness, sectoral integration, innovation, market orientation;
- Digital technologies in agriculture (Art. 114 (b) of Regulation (EU) 2021/2115);
- “sustainable nutrient management”;
- Employment conditions (health and safety at work) and social support in agricultural communities;
- “the sustainable production of feed, the evaluation of feed in terms of nutrient content and value, and the documentation, planning and control of feed for farmed animals based on needs”.

“The aid must be granted in the form of subsidized services”. The institutions selected to provide advisory services shall have adequate resources in terms of professional staff undergoing regular training and advisory experience and reliability in the areas for which they provide advice. MS shall ensure that advisers are impartial and that advisory service providers are free from conflicts of interest. (Commission Communication 2022/C 485/01 C/2022/9120)

#### **“Aid for cooperation in the agricultural sector”**

The EC has a positive attitude towards “start-up aid for producer groups and producer organisations” as they encourage farmers to link up. The aid shall be granted to the following “undertakings or associations of undertakings”:

- cooperation between the agricultural operators and food supply chain operators (producer groups, cooperatives and inter-branch organisations)
- clusters and networks creations;
- succession of holdings, in particular for generational renewal at farm level.

Support may be granted for the following activities:

- “pilot projects”;

- “the development of new products, practices, processes and technologies in the agricultural and food sectors”;
- cooperation between small operators in the agricultural sector in the organisation of joint working procedures and the sharing of facilities and resources; horizontal and vertical cooperation between operators in the supply chain to establish and develop short supply chains and local markets;
- joint action to mitigate or adapt to climate change; the convergence of approaches to environmental projects and existing environmental management practices, including the efficient use of renewable energy sources and the sharing of facilities and resources;
- horizontal and vertical cooperation between operators in the supply chain to establish and develop short supply chains and local markets;
- the promotion of environmental education in the context of the development of short supply chains and local markets;
- joint action to mitigate or adapt to climate change; the promotion of common approaches to environmental projects and existing environmental management practices, including the efficient use of water and the sustainable use of resources in the agricultural sector;

The aid may be granted only for new forms of cooperation and for existing forms if a new activity is started. (Commission Communication2022/C 485/01C/2022/9120)

### **“Aid to make good the damage caused by natural disasters or exceptional occurrences”**

The Guidelines provide for State aid to make good the damage caused by natural disasters or exceptional occurrences. In this respect, the EC took the view that earthquakes, avalanches, landslides and floods can be considered as elementary disasters. The Commission has previously accepted exceptional events to include war, civil unrest or strikes and, subject to certain reservations and depending on the scale, major nuclear or industrial accidents and fires leading to major losses. The Commission considers that, in the absence of any evidence to the contrary, it is not possible to conclude that the aid granted to the beneficiary of the aid is compatible with the internal market. MS shall be free to determine in advance the criteria which will form the basis for official recognition. (Commission Communication2022/C 485/01C/2022/9120)

Aid cannot be granted for the following: for the purchase and planting of annual plants for the conservation of plant varieties threatened by genetic erosion in accordance with the Art. 107 (1) of the Treaty. However, they shall apply to the processing of agricultural products and the placing on the market of agricultural products to the extent laid down in these Guidelines. (Commission Communication2022/C 485/01C/2022/9120)



### “Unlawful State aid”

State aid should not encourage undertakings to take unnecessary risks. In order to ensure the efficient and effective use of resources, MS should be able to impose on undertakings the obligation to provide information to the public on the use of their resources. The EC considers that the aid does not have an incentive effect on the beneficiary if work on the relevant project or activity has already started before the beneficiary submitted the application for support to the national authorities. (Commission Communication 2022/C 485/01C/2022/9120)

“An aid application must contain at least the name of the applicant and the size of the undertaking, a description of the project or activity, including its location, the dates of start and end of the project, the amount of aid needed and the eligible costs. In addition, large undertakings must describe in the application a situation without support, referred to as a counterfactual scenario, or an alternative project or activity, and provide written evidence supporting the counterfactual scenario described in the application”. “This requirement does not apply to municipalities which are autonomous local authorities with an annual budget of less than EUR 10 million and with less than 5 000 inhabitants”. The EC considers that the aid is compatible with the internal market (Art. 107 (3) (c) TFEU). In the case of a project or an activity, the beneficiary shall be able to demonstrate that the project or activity in question has been carried out in accordance with the principles of sound financial management. the following categories of aid shall not have, or be deemed to have, an incentive effect: aid schemes for set-aside and aid schemes with environmental, protective and recreational objectives, if the following conditions are met: the aid scheme determines eligibility for the aid in accordance with objective criteria and without further application of the MS’s discretionary law; the aid scheme was adopted and came into force before the eligible costs of the beneficiaries; the aid scheme covered only SME; support for sector-specific deficiencies arising from certain mandatory requirements; “aid for areas with natural or other specific constraints support for information activities in the agricultural sector”; “aid to make good the damage caused by adverse climatic events which can be assimilated to a natural disaster”; “aid to compensate for the costs of the prevention, control and eradication of animal diseases and plant pests and for the losses caused by those animal diseases and plant”; aid to cover the costs of removing and destroying fallen stock; aid to compensate for damage caused by protected animals; aid for the removal of damage to forests caused by regulated animals; support for information activities in the forestry sector, consisting of making information available to an indefinite number of beneficiaries; aid for promotional measures; aid for the costs of treating and preventing the spread of pests and diseases of trees and for the removal of damage caused by pests and diseases of trees. In order to ensure that the aid is limited to the minimum necessary to achieve the objective of common interest, the Member State may decide that the aid is limited to the minimum necessary to achieve the objective of common interest. In order to allow for a comprehensive assessment, the Member State shall, together with information on the pro- demand forecasts, cost forecasts and financial

forecasts, documents submitted to the investment committee describing different investment scenarios or documents submitted to financial institutions. (Commission Communication2022/C 485/01C/2022/9120)

### **“Transparency”**

MS must ensure that the following information is published on the European Commission’s module on transparent granting of aid or on comprehensive national or regional state aid websites: (Commission Communication2022/C 485/01C/2022/9120)

- “the full text of the aid scheme and its implementing provisions or the legal basis for individual aid, or a link to that text”;
- “the aid provider identity”;
- “the identity of the individual beneficiaries, the form and amount of aid granted to each beneficiary, the date of grant, the type of undertaking” (SME/large enterprise),
- the beneficiary region (NUTS II level);
- the main economic sector of activity of the beneficiary (NACE group level).

“The Commission may adopt implementing acts. The amount of assigned revenue in accordance with Article 21 (3) of the Financial Regulation is estimated at EUR 100000. EUR 100 000 for beneficiaries active in the sectors of processing of agricultural products, placing of agricultural products on the market or forestry or engaged in activities not covered by the scope of Art. 42. TFEU. Such information must be published after the decision to grant the aid has been taken, must be kept for at least 10 years and must be available to the public without restriction”. (Commission Communication2022/C 485/01C/2022/9120)

### **Conclusions**

“EU competition policy seeks to ensure free competition an efficient allocation of resources and the unity of the EU market, whilst respecting the international commitments often EU. State aid rules in the agricultural sector are based on three different principles”:

1. “General principles of competition policy,
2. coherence with the EU’s common agricultural and rural development policies,
3. EU international obligations compatibility (WTO Agreement on Agriculture)”.

EC published a working document to the Commission services setting out the results of the evaluation of State aid rules for the agriculture and forestry sectors and for rural areas (2021). The evaluation found that those rules are fit for purpose, but that certain targeted adaptations are needed to align them with current EU priorities, in particular the future Common Agricultural Policy and the European Green Deal. The Commission

has therefore launched an impact assessment to gather additional information on the necessary improvements, inter alia, through an open public consultation launched in January 2022 and targeted consultations with Member States' authorities.

The main amendments to the Agriculture and Fisheries Block Exemption Regulations include a significant extension of the measures covered by the Block Exemption, namely: new categories of block exempted measures, such as aid to prevent or compensate for damage caused by protected animals, aid for environmental management obligations, aid for cooperation in the agriculture and forestry sectors or aid to prevent or compensate for damage caused by adverse climatic events in the fisheries and aquaculture sector; tailor-made measures covered by the block exemption for community-led local development projects aimed at promoting the development of rural areas at local level, a new ceiling for EIP Task Force projects targeting innovation in the agricultural sector and in rural areas. Projects with a value of less than EUR 500 000 or up to EUR 2 million per undertaking are now covered by the block exemption.

The new rules apply to almost half of the cases for which notification was previously mandatory. The revised agricultural guidelines introduce the following main changes: “a new and simplified procedure for the approval of State aid for measures co-financed under the CAP, the extension of measures targeting animal diseases and plant pests, allowing for the granting of support for emerging animal diseases and certain invasive alien species”; new incentives for farmers to commit themselves to programmes that meet environmental standards that go beyond legal standards”. The Commission notes that the aid granted to the beneficiary of the aid is limited to the minimum necessary to achieve the objective of common interest. In the case of aid for the development of certain economic activities, the aid must distort or threaten to distort competition and affect trade between MS, in particular by favouring certain undertakings or the production of certain goods. In the case of aid granted to an undertaking in difficulty, the aid must be limited to the minimum necessary to cover its operating costs. Unless exceptions are explicitly provided for in Union legislation or in Guidelines, State aid measures which simply seek to improve the financial situation of undertakings but which do not contribute in any way to the development of the sector, and in particular aid granted solely on the basis of price, quantity, production unit or unit of means of production, are considered to be operating aid which is incompatible with the internal market. In addition, such aid is likely, by its nature, to interfere with the mechanisms of the internal market organization.

The revised agricultural guidelines introduce the following main changes: “ a new and simplified procedure for the approval of State aid for measures co-financed under the CAP”, “the extension of measures targeting animal diseases and plant pests, allowing for the granting of support for emerging animal diseases and certain invasive alien species”; “new incentives for farmers to commit themselves to projects that meet environmental standards that go beyond legal standards.

In addition, it should be noted that measures to increase capacity are unlikely to be granted.

## Conflict of interests

The authors declare no conflict of interest.

## References

1. Domazet, S., Jotić, J., & Ješić, J. (2018). State aid for rural development in the European Union. *Poslovna ekonomija*, 12 (2), 90–110. <https://doi.org/10.5937/poseko14-19015>
2. Janku, M., (2013). EU law and state aids in agriculture. *EU agrarian Law*. 2. 10.2478/eual-2013-0011.
3. Maksimovic-Sekulic, N., (2017). State aid regime in the Republic of Serbia. *Pravni zapisi*. 8. 336-351. 10.5937/pravzap0-15556.
4. Maksimović Sekulić, N., Živadinović, J., & Dimitrijević, L. (2018). Concerns about harmonization process of Serbian agricultural policy with EU standards. *Economic of Agriculture*, 65(4), 1627-1639. <https://doi.org/10.5937/ekoPolj1804627M/>
5. Maksimović Sekulić, N., Vujić, T. ., & Stankovic, M. (2023). European legal framework of rural development policy. *Economic of Agriculture*, 70(1), 293–308.
6. Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast)
7. Communication from the Commission – Guidelines for State aid in the agricultural and forestry sectors and in rural areas (OJ C 485, 21.12.2022, pp. 1–90).
8. Consolidated version of the Treaty on the Functioning of the European Union – Part Three – Union policies and internal actions – Title VII – Common rules on competition, taxation and approximation of laws – Chapter 1 – Rules on competition – Section 2 – Aids granted by States – Article 107 (ex Article 87 TEC) (OJ C 202, 7.6.2016, pp. 91–92).
9. Consolidated version of the Treaty on the Functioning of the European Union – Part Three – Union policies and internal actions – Title VII – Common rules on competition, taxation and approximation of laws – Chapter 1 – Rules on competition – Section 2 – Aids granted by States – Article 108 (ex Article 88 TEC) (OJ C 202, 7.6.2016, pp. 92–93).
10. Regulation (EU) No 228/2013 of the European Parliament and of the Council of 13 March 2013 laying down specific measures for agriculture in the outermost regions of the Union and repealing Council Regulation (EC) No 247/2006
11. Regulation (EU) 2021/2115 of the European Parliament and of the Council of 2 December 2021 establishing rules on support for strategic plans to be drawn up by Member States under the common agricultural policy (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulations (EU) No 1305/2013 and (EU) No 1307/2013

12. Regulation (EU) 2021/2116 of the European Parliament and of the Council of 2 December 2021 on the financing, management and monitoring of the common agricultural policy and repealing Regulation (EU) No 1306/2013
13. Regulation (EU) 2021/2117 of the European Parliament and of the Council of 2 December 2021 amending Regulations (EU) No 1308/2013 establishing a common organisation of the markets in agricultural products, (EU) No 1151/2012 on quality schemes for agricultural products and foodstuffs, (EU) No 251/2014 on the definition, description, presentation, labelling and the protection of geographical indications of aromatized wine products and (EU) No 228/2013 laying down specific measures for agriculture in the outermost regions of the Union
14. Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 establishing a framework for facilitating sustainable investment and amending Regulation (EU) 2019/2088

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# VALORIZATION OF AGROPASTORAL PRODUCTS AND BY-PRODUCTS. CASE OF THE WILAYA OF NAÂMA (WESTERN ALGERIA)

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*Lamb, organic product, skin, wool, SWOT analysis, Naâma.*

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## ABSTRACT

The present work aims to design an approach of valorization of agropastoral products and by-products in the wilaya of Naâma (West Algeria). The analysis of the surveys carried out on 364 breeders reveals that lamb production is characterized by a high economic value with a share 85 % of sold products in total production, followed by «Milk» with a rate of 24%. The rate of wool shows that this resource is classified as a low-value by-product since 77% of producers are unable to sold their fleeces. The skin is classified as a by-product without significant value, since only about 03% of breeders sold their product. Our approach of valorization of this production is initiated in a broad conception that integrates several actors. The SWOT matrix for the valorization of agro-pastoral products highlights the internal strengths and strengths and external opportunities offered, identifying internal weaknesses to resolve them while limiting external threats.

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## Introduction

Located west of the Algerian steppes, the wilaya of Naâma (Figure 1) covers an area of 29,819.30 km<sup>2</sup>, characterized by a remarkable geographical diversity where the steppe area represents 74% of the total area according to the budget planning and monitoring directorate of the wilaya of Naâma (DPMD 2021). It is renowned for its agropastoral vocation resulting from the climatic and edaphic conditions characterizing the region

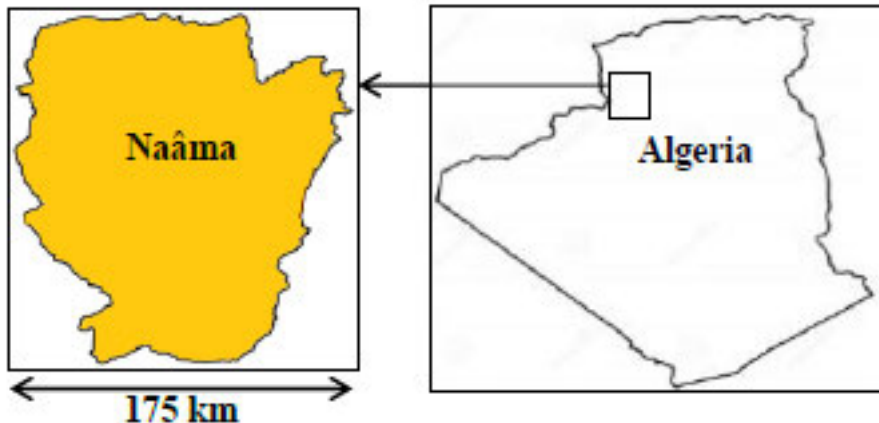
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since time immemorial, where sheep farming is the pillar business of the local economy (Youcefi and Marouf, 2023).

The main agricultural production can be summarized in the following order: winter cereals, market gardening, artificial fodder, arboriculture and phoeniculture. The total number of livestock is estimated at more than 1.7 million heads where sheep represent about 92%, followed by goats with a rate of more than 5% and cattle 2%.

The wilaya of Naâma is renowned for its animal production, qualified as important, both quantitatively and qualitatively. Lambs, milk, wool and hides are the main products resulting from breeding activities. In this context, several essential questions can be asked regarding the real economic value of these products and by-products, their sold and the possibility of their valorization.

**Figure 1.** General representation of the study area



The purpose of this work is to: evaluation of the real economic value represented by the share (%) of sold products in total production from sheep farming, design an approach to the valuation of products by integrating as many actors as possible into a recovery strategy of lost or underestimated richness, and initiation of a SWOT analysis that aims to create richness and promote agropastoral products by finding ways to best exploit internal strengths and assets by seizing the external opportunities offered, thus identifying internal weaknesses and resolving them in a general context that overcomes and limits external threats.

In order to gather the information necessary for this study, we opted for a field survey by interviewing a number of people, in order to interpret the various observations and remarks (Lhoste 2001; Bienvenu 2023).

## Materials and methods

The methodology chosen in this work is based on a survey in the form of semi-structured interviews (Dockès and Kling-Eveillard 2007) carried out during a unique passage in each breeding, because it allows to approach the reality of breeding in short time (Lhoste 2001). The estimated sample size of 364 breeders was calculated by setting the confidence level and margin of error at the most used thresholds 95% and 5% respectively (Giezendanner 2012), relative to the total population of 6700 breeders (DPMD 2021).

Our sample is composed of breeders encountered randomly during our movements and circulations through the territory of Naâma. The movements were made to cover the entire study area.

The SWOT analysis carried out in this work is presented in the form of a matrix by dividing the information into internal and external factors, then into positive and negative factors (UNIL 2018). Strengths and weaknesses form the internal environment of the company, while opportunities and threats represent its external environment (Mehadi et Kezzar 2021).

## Results and discussions

### **Evaluation of the economic value of livestock products (lamb, milk, wool, skin)**

To better express the real economic value of livestock products and by-products, we have chosen to calculate the share (%) of sold products in total production by die.

The estimated annual lamb sold rate is based on the number of lambs sold in the year versus the number kept for herd renewal. Our survey, reveals that lamb production is characterized by a very high economic value with an average the share of sell of 85 %.

Faced with insufficient local production, the milk sector in Algeria is in a critical period, aggravated by a very low collection rate and an increase in the prices of the raw material internationally (Belhadia et al 2009).

The analysis of the information from our survey, relating to the «milk» die, shows that only 24% of farmers succeed in sell their milk production (Fig. 2), the remaining rate, 76%, represents those who are unable to sell their products, or who favor the self-consumption of their production, either in its raw state or after traditional processing into dairy derivatives.

The data in relation to wool production shows that this resource is classified as a by-product of little value, 77% of producers of this material do not market their products (Fig. 2), while the remaining 23% have difficulty selling their fleeces at low prices that do not even cover mowing costs.

Like wool, the skin is also classified as a worthless by-product, of which only about 03% of farmers sell their product (Fig. 2), knowing that, apart from the number of



heads marketed annually, the farmer produces on average between 15 and 20 skins per year, which means that annually about 0.1 million units of skin is not sold to tanneries or traditionally exploited by households.

**Figure 2.** The share (%) of sold products in total production



**Approach of valorization of agropastoral products and by-products**

The quantity of milk not sold, skin units not sold and not exploited see thrown away! , the volume of unprocessed wool and «organic» agricultural products sold at prices equivalent to the prices of conventional products represent an important part of a wealth lost, and which is likely to allow the creation of small industries producing local raw materials or processing and conditioning. This industry can be initiated in a broad conception that integrates as many actors as possible namely: producers, households, local authority and processing units. The main components of this axis can be summarized as follows:

### *Valorization and sold of milk*

Give great importance to the sold of milk produced locally, this operation will begin with the establishment of a strict and meticulous system to collect the maximum amount of milk produced, and the installation of a sufficient number of milk production and processing units.

### *Valorization of sheep's milk*

Given the emergence of industries based on goat and camel milk, we imagine that sheep milk deserves its place in the market, because it is renowned for its nutritional richness and recognized by its excellent quality, which gives right to the promotion of its commercialization while creating systems that guarantee its labeling with its derivatives.

### *Establish campaigns of shearing and valorization of wool*

Faced with the difficulty faced by farmers to mow their animals, as well as to sell their products, and faced with the insignificance of the selling prices of wool, we consider it useful to organize annual campaigns devoted to shearing at the charge of state services, or wool units. Breeders will be exempt from payment of mowing fees.

### *Creation of collection points of skins*

Estimated at 97%, the production of unsold hides suffered heavy losses since it is a very important by-product, given the economic value of hides from livestock, especially sheep. To remedy this situation, the first thing to do is to create collection points for the skins throughout the municipalities of our wilaya, to then sell them to the nearest tanneries.

### *Integration of households in the hide's conservation chain*

We will insist on the need to integrate households in the chain of conservation of skin quality at home by its immediate salting to avoid its rot while waiting for its evacuation.

### *Valorization of «Organic» agricultural products*

Ensuring food security for a population is a challenge for agriculture. Intensive farming systems rely on the massive use of inputs such as chemical fertilizers and pesticides, in order to stimulate production by achieving high yields but threatening human health is threatened (Stoian et al 2022). Through our survey, we noticed that more than 67% of the farmland by agro-pastoralists does not benefit from livestock manure or industrial fertilizers, and only 30% of agro-pastoralists use phytosanitary substances, the remaining 70% have a potential for the «organic» product from natural agricultural practices that do not use any chemical or industrial substances. It is a production method that excludes the use of synthetic chemicals and limits the use of inputs. This valorization can be ensured through a commercial device that guarantees the labeling and reasonable prices of these products classified with high nutritional value and sought by a large part of consumers.

*Integration of local authorities in the commercial chain*

Initiate a device that allows local authorities represented by municipalities to integrate into the commercial chain of products and by-products from livestock activities (skin and wool), for enhance this production by finding a link between producer breeders and processors on the one hand, and on the other hand to strengthen the communal recipe.

*Establishment of a sheep meat industry chain*

Set up a sheep meat industry chain that will start with slaughter and cutting up to the processing and maturation of meat products intended for human consumption. This device will allow the valorization of all products and by-products from livestock farming activities, and will offer variations for farmers to sell their livestock, other than in livestock markets.

*Promote the integration of small livestock units*

Popularize and generalize the diversification of secondary economic activities through the integration of small livestock units (beekeeping, cuniculture, etc.), to improve family recipes and diversify the diet of their members.

*Integration of fish farming in agricultural activities*

Integrate fish farming into agricultural activities using the irrigation basins available to agro-pastoralists, in order to initiate a culture of production and consumption of freshwater fish among the rural population.

**SWOT analysis**

In order to create wealth and enhance the value of agro-pastoral products, the sale of «lost wealth» represented by the unsold quantities of «milk, wool and skin» by-products, the diversification of economic activities and the improvement of incomes of the rural population, should be a main objective of future visions, where any steps taken must take into account the points of strength and weakness crossed with the opportunities and threats as presented in Table 1.

**Table 1.** SWOT analysis

	<b>Positive</b>	<b>Negative</b>
	<b>Strengths</b>	<b>Weaknesses</b>
<b>Internal</b>	Availability of significant animal production, both quantitatively and qualitatively (lambs, milk, wool and hides) Availability of a potential of the «Organic» product from natural agricultural practices Recruitment of the workforce alien to the family Existence of a large rural female ratio	Underestimation and neglect of the real economic value of by-products Low integration of households in the chain of conservation of livestock products, especially skins Dominance of stereotyped production and lack of innovation, creation and diversification Insufficient marketing and sales channels
	<b>Opportunities</b>	<b>Threats</b>
<b>External</b>	The importance given to food security by public authorities Growing demand for livestock and agricultural products Increased international needs of consumers of organic agricultural products Increased desire to consume traditional dairy products Existence of significant natural tourism potential, which can create points of sale for traditional products	Insufficient production and processing units (dairy, tannery, wool). Insufficient collection device for livestock products The absence of a sheep meat industry chain Lack of a real culture of consumerism, where consumers prefer quantity to quality Weak infrastructure and tourist flow in the region that can participate and encourage the flow of local products

### Conclusions

Through this work, we have noticed that lamb production is characterized by a very important economic value followed by the «Milk» sector, while the skin and wool are classified as by-products without great value. This production, not sold, is likely to allow the creation of small industries of production of local raw materials or processing, in a broad design that integrates as many actors as possible namely: producers, households, local government and processing units.

The SWOT analysis carried out at the end of this work, shows that the region has its own strengths summarized as follows: availability of an important animal production and a potential of the «Bio» product resulting from natural agricultural practices. The opportunities to be seized are numerous, the main one being the importance given to food security by the state authorities, the growing demand for livestock and agriculture products, the increased needs of «Organic» products and traditional dairy products.

The main weaknesses can be summarized in the underestimation of the value of by-products, poor integration of households in the chain of conservation of livestock products and insufficient commercial circuits.

Threats may be posed by insufficient production and processing units and collection facilities for livestock products, the absence of a chain of sheep meat industry and the absence of a real culture of consumerism where consumers prefer quantity to quality.

### Conflict of interests

The authors declare no conflict of interest.

### References

1. Belhadia, M., Yakhlef, H., Bourbouze, A., Saadoud, M. (2009). La production laitière bovine en Algérie : Capacité de production et typologie des exploitations des plaines du Moyen Cheliff. *Revue Nature et Technologie*, 1(2), 54-62. <https://www.asjp.cerist.dz/en/downArticle/47/1/2/41188>. [*in English*: Belhadia, M., Yakhlef, H., Bourbouze, A., Saadoud, M. (2009). Beef milk production in Algeria: Production capacity and farm typology of the Middle Cheliff plains. *Nature and Technology*, 1(2), 54-62. <https://www.asjp.cerist.dz/en/downArticle/47/1/2/41188>.].
2. Bienvenu, M. S. (2023). Cours de techniques d'enquête. Paper presented at the Cours en sciences économiques, Université de Kalemie. [https://www.researchgate.net/publication/370595297\\_Cours\\_de\\_techniques\\_d%27enquete#fullTextFileContent](https://www.researchgate.net/publication/370595297_Cours_de_techniques_d%27enquete#fullTextFileContent). [*in English*: Bienvenue, M. S. (2023). Cours de techniques d'enquête. Paper presented at the Cours en sciences économiques, Université de Kalemie. [https://www.researchgate.net/publication/370595297\\_Cours\\_de\\_techniques\\_d%27enquete#fullTextFileContent](https://www.researchgate.net/publication/370595297_Cours_de_techniques_d%27enquete#fullTextFileContent).].
3. Direction de la programmation et du suivi budgétaire. (2021). *Annuaire statistique de la wilaya de Naâma 2020* (Vol. Edition Avril 2021, pp. 132). Wilaya de Naâma. [*in English*: Directorate of Programming and Budget Monitoring. (2021). *Statistical Yearbook of the wilaya of Naâma 2020* (Vol. Edition April 2021, pp. 132). Wilaya of Naâma].
4. Dockès, A.C., Kling-Eveillard, F. (2007) : « Les représentations de l'animal et du bien-être animal par les éleveurs français». *INRA Productions Animales* 20,1, 23–28. [*in English*: Dockès, A.C., Kling-Eveillard, F. (2007): “The representations of the animal and animal welfare by French breeders”. *INRA Productions Animales* 20,1, 23–28.].
5. Giezendanner, F. D. (2012). Taille d'un échantillon aléatoire et Marge d'erreur (pp. 22). Genève, Suisse: Service Ecoles-Médias. [https://icietla-ge.ch/voir/IMG/pdf/taille-d\\_un-echantillon-aleatoire-et-marge-d\\_erreur-cms-spip.pdf](https://icietla-ge.ch/voir/IMG/pdf/taille-d_un-echantillon-aleatoire-et-marge-d_erreur-cms-spip.pdf) [*in English*: Giezendanner, F. D. (2012). Random sample size and margin of error (pp. 22). Geneva, Switzerland: Service Ecoles-Médias. [https://icietla-ge.ch/voir/IMG/pdf/taille-d\\_un-echantillon-aleatoire-et-marge-d\\_erreur-cms-spip.pdf](https://icietla-ge.ch/voir/IMG/pdf/taille-d_un-echantillon-aleatoire-et-marge-d_erreur-cms-spip.pdf).].

6. LHOSTE, P. (2001). Atelier de Formation des agronomes SCV Paper presented at the L'étude et le diagnostic des systemes d'élevage, Madagascar. <http://agroecologie.cirad.fr>. [*in English*: LHOSTE, P. (2001). SCV Paper presented at the L'étude et le diagnostic des systemes d'élevage, Madagascar. <http://agroecologie.cirad.fr>].
7. Mehadi. S., Kezzar, R. (2021). Contribution à l'élaboration des stratégies de développement des entreprises: application de l'analyse SWOT au cas de Hodna-lait,. Journal des Etudes Economiques Contemporaines,, 6(2), 625-642. <https://www.asjp.cerist.dz/en/downArticle/469/6/2/174096> [*in English*: MEHADI, S., Kezzar, R. (2021). Contribution to the development of business development strategies: application of the SWOT analysis to the case of Hodna-lait,. Journal of Contemporary Economic Studies, 6(2), 625-642. <https://www.asjp.cerist.dz/en/downArticle/469/6/2/174096>.].
8. Stoian, M., Dobre, I., Popescu, C. G., Vasile, M. C., Dimitriu, A. T., & Ion, A. (2022). Increasing sustainability of food production and ensure human health through agriculture digitalization, Ekonomika poljoprivrede, 69(4), 1209-1223. <https://doi.org/10.5937/ekoPolj2204209S>
9. Université de Lausanne. (2018,). Guide de réalisation d'un développement stratégique...ou comment réaliser une analyse SWOT puis passer à un plan de développement. (pp. 12). [https://www.unil.ch/culture-qualite/files/live/sites/culture-qualite/files/shared/Guide\\_SWOT\\_PdD\\_20150610-complet.pdf](https://www.unil.ch/culture-qualite/files/live/sites/culture-qualite/files/shared/Guide_SWOT_PdD_20150610-complet.pdf). [*in English*: University of Lausanne. (2018,). Guide to achieving strategic development... or how to perform a SWOT analysis and then move to a development plan. (pp. 12). [https://www.unil.ch/culture-qualite/files/live/sites/culture-qualite/files/shared/Guide\\_SWOT\\_PdD\\_20150610-complet.pdf](https://www.unil.ch/culture-qualite/files/live/sites/culture-qualite/files/shared/Guide_SWOT_PdD_20150610-complet.pdf).].
10. Youcefi Ahmed Toufik, Marouf Abderrazak. (2023). Structure and age dynamics of breeders in the western Algerian steppes (region of Nâama). Ikonomika i upravljenje na selskoto stopanstvo, 68(1), 32-37 (Bg). [https://journal.jaem.info/page/en/details.php?article\\_id=576](https://journal.jaem.info/page/en/details.php?article_id=576)



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## OPTIMISING INVESTMENT IN THE ENERGY SECTOR IN DEVELOPING COUNTRIES IN SOUTH EAST EUROPE

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### ABSTRACT

In this paper we are researching the optimality of developing countries for investing in their energy sector as a way of diversifying portfolio by applying the multicriteria decision making model. There are multiple quantitative and qualitative criteria that can be considered when finding the adequate market for investment, other than its natural potential, such as the level that its energy sector is developed, legal framework that surrounds this sector, market openness of the observed economy, ease of investment and market liquidity. The four sources of the energy sector that are considered are oil, gas, coal and renewable energy sources. Even though the renewable energy sources aren't sufficiently exploited, the countries that have high potential could provide significant financial profits by exploiting them.

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Through this study we are using the most significant and impacting criteria in order to explore and deduce the developing country that has the highest potential of the energy sector and represents the most optimal market to invest.

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## Introduction

There are numerous factors that can influence choosing the optimal country, to invest in its energy sector, that can be economical, political and legal. Even though certain countries may have the highest energy potential and based on only these factors could perhaps represent the best market to invest in, due to legal limitations or unstable political environment could present high risks to its investors and due to this could be less favorable for investment.

The subject of the paper that is going to be investigated in this research study is finding the adequate model for comparing the parameters of the energy sector, to reach the most objective results and choose the most appropriate economy to invest in. Choosing the best criteria to adequately compare best countries to invest is the aim of this problem. The concept of decision making is defined as choosing between possible multiple possibilities and that there must be at least two possible choices, it is appropriate to choose the decision making theory in this research subject to choose between the ten developing economies of South East Europe as the representative and comparable economies.

Each criterion is considered an attribute of the element that is compared between multiple alternative choices. First of all, it's necessary to define the criteria that will best provide the image of the factors that we want to consider as relevant to the subject in question. There are quantitative and qualitative criteria that need to be considered and they are separated based on the possibility to measure them. If a criterion can be shown through a unit of measurement then it is considered as a quantitative and if it can't then it's considered as qualitative. Qualitative criteria can either be described to a certain degree and compared or they don't possess any quantitative attribute that can be compared.

## Research Methodology

In the paper we are going to use the AHP (Analytic Hierarchy Process) and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) methods to calculate the optimal energy sector for investment. The AHP method is defined by Thomas Saaty (Saaty, 1980) as a multicriteria analysis when making group or single decisions. It is based on defining the problem hierarchy and determining the weights of all alternatives in relation to the given goal. AHP method is based on decomposing a complex problem into several levels of factors that have a defined hierarchy, making it the adequate method for the research subject.

TOPSIS method is based on choosing the option or alternative that is closest to the positive ideal result and furthest from a negative ideal result (Prašević, Prašević, 2014). This method is appropriate when deciding for investment opportunity as it focuses on criteria that are maximizing benefits and minimizing losses.

### Defining the mathematical framework for Multicriteria decision-making

Mathematical expression of the multicriteria decision-making model is as follows (Čupić, Suknović, 2010):

$$\max [f_1(x), f_2(x), \dots, f_p(x)], p \geq 2$$

it contains these constraints

$$\begin{aligned} g_i(x) &\leq 0, i = \overline{1, m} \\ x_j &\geq 0, j = \overline{1, n} \end{aligned}$$

The elements are:

$n$  – variable quantity,

$p$  – criteria functions quantity,

$m$  – quantity of constraints,

$X$  – Vector in an  $n$ -dimensional space representing variables  $x_j, j = \overline{1, n}$ ,

$f_k$  - Objective associated to the criteria  $k = \overline{1, p}$ ,

$g_i(x)$  – set of constraints,  $i = \overline{1, m}$ .

We should highlight that maximizing target function vector occurs within the specified restrictions, as the minimization criteria can be equivalently expressed as maximization criteria as follows:

$$\max f_r(x) = -\min [-f_r(x)], r \in \{1, p\}$$

The solution of this model provides a set of acceptable results denoted by vector  $X$  that is a part of a set of natural numbers  $X \in \mathbb{R}^n$  and it refers to:

$$X = \{x \mid g_i(x) \leq 0, i = \overline{1, m}, x_j \geq 0, j = \overline{1, n}\}$$

The attained set of results for  $X$ , derived by using this formula is aligned with the values provided by vector  $f(x)$  which represents the values of the function for criteria, thus the set acceptable values for  $X$  can be associated to  $S$ :

$$f(x) = [f_1(x), f_2(x), \dots, f_p(x)]$$

$$S = \{f(x) \mid x \in X\}$$

## Combination of the AHP and TOPSIS methods for evaluating advantages of economies

Choosing the adequate structure of decision making to select the optimal economy for the portfolio investment is the research subject that is going to be addressed by combining AHP methods (Nikolic, Borovic, 1996) and TOPSIS (Lin MC, et all, 2008) Eligibility criteria, based on alternatives that will be evaluated in this case are (Đukić, 2011):  $K_1$  - Energy Sector Liquidity;  $K_2$  -Energy Sector Efficiency;  $K_3$  - Legal framework and  $K_4$  - Ease of investment.

These criteria are going to be analyzed based on information that indicates economy results for the observed counties, gathered in 2022, considering the values taken from developing counties in South-East Europe.

The data shown in the following table (Table 1) represents information that has been obtained for the first part of the decision matrix, which is the database:

**Table 1.** Decision matrix (database)

Alternatives	Eligibility criteria			
	$K_1$	$K_2$	$K_3$	$K_4$
Serbia	1.68	0.37	0.34	16.86
Bosnia and Herzegovina	1.55	0.27	0.34	24.93
Romania	2.91	0.43	0.45	17.25
North Macedonia	1.77	0.42	0.13	18.85
Montenegro	1.25	0.39	0.06	17.76
Bulgaria	2.39	0.41	0.06	17.47
Albania	1.47	0.42	0.15	26.61
Croatia	2.12	0.37	0.23	15.6
Moldova	1.81	0.33	0.13	24.36
Slovakia	2.3	0.32	0.12	26.47

*Source:* Data collected by the authors

First of all, we need to identify the relative weights of the criteria and their importance in our decision-making process. For the purpose of defining the relate weights we will use the AHP method and to estimate their relative weights we will use the Saaty scale (Saaty, 1980).

**Table 2.** Assessment of relative weights of the criteria

	Energy Sector Liquidity	Energy Sector Efficiency	Legal framework	Ease of investment
Energy Sector Liquidity	1	5	3	7
Energy Sector Efficiency	(5)	1	(3)	3
Legal framework	(3)	3	1	5
Ease of investment	(7)	(3)	(5)	1
$\Sigma$	1.675	9.333	4.533	16

*Source:* Data collected by the authors

**Table 3.** Eigenvector computation of the corresponding eigenvalues

	Energy Sector Liquidity	Energy Sector Efficiency	Legal framework	Ease of investment	$\Sigma$	$W(\Sigma/4)$
Energy Sector Liquidity	0.597	0.535	0.661	0.437	2.23	0.557
Energy Sector Efficiency	0.119	0.107	0.073	0.187	0.486	0.121
Legal framework	0.198	0.321	0.220	0.312	1.051	0.262
Ease of investment	0.085	0.035	0.044	0.062	0.226	0.056

Source: Data collected by the authors

In the second phase we will include the TOPSIS methods, as a way of identifying the most favorable answer of the analyzed subject matter.

**Table 4.** Decision matrix which should be normalized

<i>Eligibility criteria</i>	Energy Sector Liquidity	Energy Sector Efficiency	Legal framework	Ease of investment
<i>Observed economies</i>	$w_1=0.6$	$w_2=0.1$	$w_3=0.2$	$w_4=0.1$
Serbia	1.68	0.37	0.34	16.86
Bosnia and Herzegovina	1.55	0.27	0.34	24.93
Romania	2.91	0.43	0.45	17.25
North Macedonia	1.77	0.42	0.13	18.85
Montenegro	1.25	0.39	0.06	17.76
Bulgaria	2.39	0.41	0.06	17.47
Albania	1.47	0.42	0.15	26.61
Croatia	2.12	0.37	0.23	15.6
Moldova	1.81	0.33	0.13	24.36
Slovakia	2.3	0.32	0.12	26.47

Source: Data collected by the authors

**Table 5.** Normalized decision matrix

<i>Eligibility criteria</i>	Energy Sector Liquidity	Energy Sector Efficiency	Legal framework	Ease of investment
<i>Observed economies</i>	$w_1=0.6$	$w_2=0.1$	$w_3=0.2$	$w_4=0.1$
Serbia	0.268	0.311	0.453	0.253
Bosnia and Herzegovina	0.247	0.227	0.453	0.375
Romania	0.464	0.361	0.599	0.259
North Macedonia	0.282	0.353	0.173	0.283
Montenegro	0.199	0.328	0.079	0.267
Bulgaria	0.381	0.345	0.078	0.263
Albania	0.234	0.353	0.199	0.4
Croatia	0.338	0.311	0.306	0.234
Moldova	0.288	0.277	0.173	0.366
Slovakia	0.366	0.269	0.159	0.398

Source: Data collected by the authors

**Table 6.** Multiplication of normalized matrix values by criterion weights

<i>Eligibility criteria</i>	Energy Sector Liquidity	Energy Sector Efficiency	Legal framework	Ease of investment
<i>Observed economies</i>	$w_1=0.6$	$w_2=0.1$	$w_3=0.2$	$w_4=0.1$
Serbia	0.161	0.031	0.090	0.025
Bosnia and Herzegovina	0.148	0.023	0.090	0.037
Romania	0.278	0.036	0.119	0.025
North Macedonia	0.169	0.035	0.034	0.028
Montenegro	0.119	0.032	0.016	0.027
Bulgaria	0.228	0.034	0.015	0.026
Albania	0.140	0.035	0.039	0.04
Croatia	0.202	0.031	0.061	0.023
Moldova	0.173	0.027	0.034	0.036
Slovakia	0.219	0.027	0.031	0.039

Source: Created by the authors

Given that all criteria falls under the category of the maximization criteria, it can be defined that the ideal result is:

$$A^* = \{0.278, 0.036, 0.119, 0.04\}$$

Opposite to the ideal result:

$$A^- = \{0.119, 0.023, 0.015, 0.023\}$$

By marking the opposite ends of the ideal result with  $S_i^*$  for the ideal result and  $S_i^-$  for the negative result we can calculate the maximum and minimum distance from the ideal result and the values for the observed economies can be shown in the following table.

**Table 7.** Rankings of the observed economies

<i>Observed economies</i>	Opposite ends of the ideal result	
	$S_i^*$	$S_i^-$
Serbia	0.376	0.086
Bosnia and Herzegovina	0.134	0.081
Romania	0.015	0.187
North Macedonia	0.139	0.055
Montenegro	0.190	0.009
Bulgaria	0.118	0.105
Albania	0.159	0.038
Croatia	0.097	0.095
Moldova	0.135	0.058
Slovakia	0.106	0.195

Source: Created by the authors

After calculating opposite ends of the ideal result for the economies in question, we are going to calculate the vicinity to the ideal solution through the next formula:

$$Q_i^* = S_i^+ / S_i^+ + S_i^-, i=1, \dots, n$$

After calculating the results, the proximity shows the ranks of the observed economies and the order can be seen in Table 8.

**Table 8.** Ranking of alternatives

<i>Observed economies</i>	Relative proximity	Rank
Serbia	0,383	5.
Bosnia and Herzegovina	0,353	6.
Romania	0,933	1.
North Macedonia	0,249	8.
Montenegro	0,048	10.
Bulgaria	0,456	2.
Albania	0,171	9.
Croatia	0,444	4.
Moldova	0,266	7.
Slovakia	0,454	3.

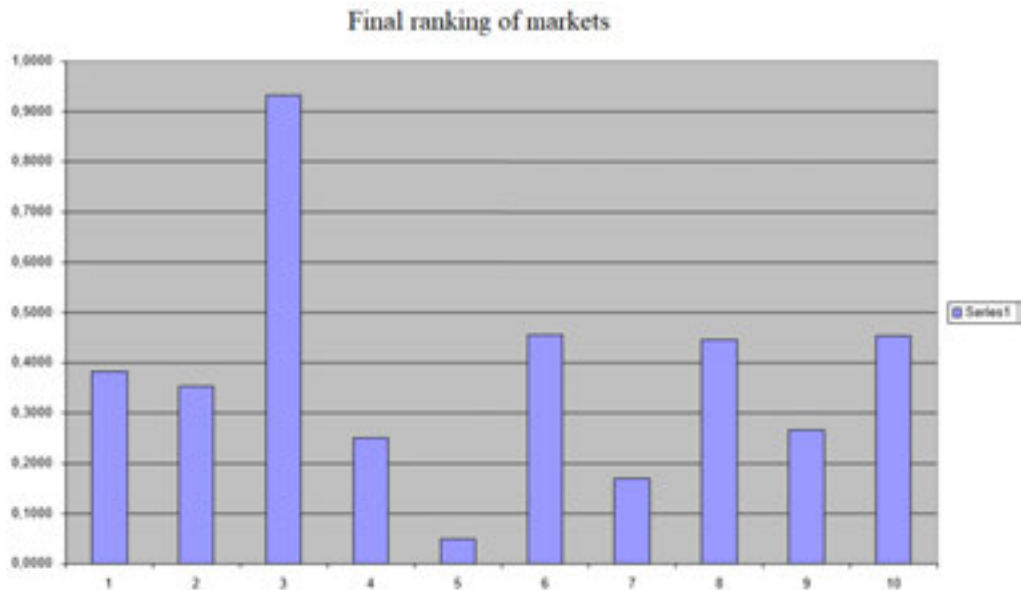
*Source:* Created by the authors

Based on the TOPSIS method implemented, a obtained solution is that the most suitable investment market is Romania, which has the highest ranking among all alternatives.

## DISCUSSION OF RESULTS

The results indicate the market's ranking for the investor.

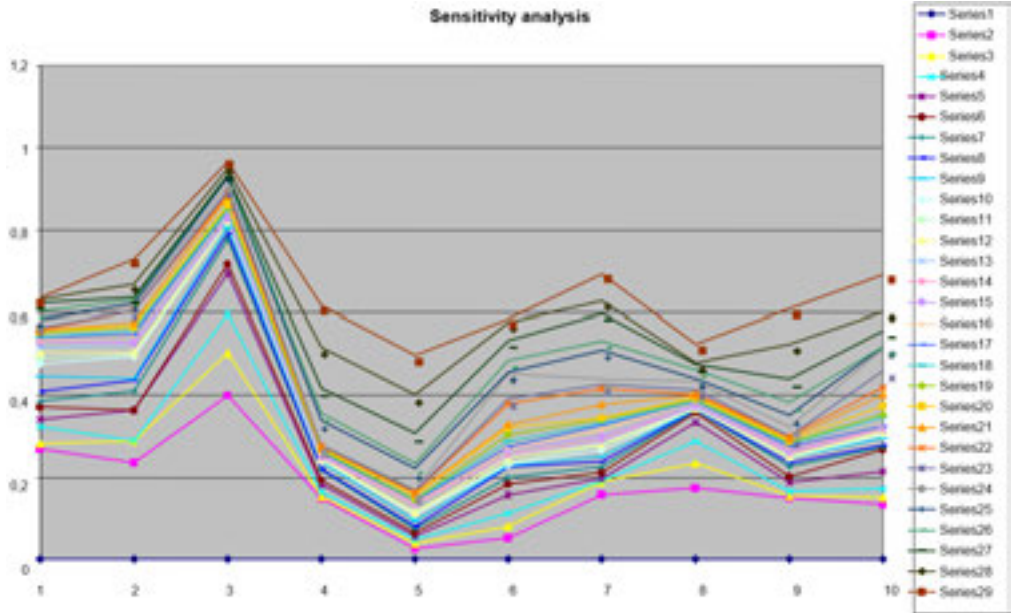
**Figure 1.** The final ranking of alternatives



*Source:* Created by the authors

The stability of the obtained solution in case of change of criteria can be performed by the sensitivity analysis procedure. Figure 1 shows the impact of the criteria on each market or alternative.

**Figure 2.** The impact of changing the weight of all criteria on alternatives



Source: Created by the authors

From the chart above, we can deduce that the optimal results are obtained by choosing Romania that is alternative 3, as the reduction in weight of  $K_1$  - Energy Sector Liquidity, shows a rise for  $K_2$  -Energy Sector Efficiency,  $K_3$  - Legal framework and  $K_4$  - Ease of investment criteria thus additionally concluding that Romania’s energy sector shows most positive effects and least uncertainty of investment as a way of portfolio diversification. For the other observed economies that were taken into account, even though there is an increase in the weight of criteria  $K_2$ ,  $K_3$  and  $K_4$  they showed an increase in relative proximity, but not sufficient to alter the results, still making option 3 the best alternative.

### Conclusion

All participants of an economy make choices that have an effect on a small and a large scale that transcend the national borders. When there is a need to find a solution for a problem or make a decision, there are multiple viable options that can be chosen. The question that arises is which decision-making process to apply and how to decide on the best option. Depending on the problem type, the possible criteria, as well as comparable results from other market participants, we can decide on the most appropriate method to apply in the decision making process.

Thus, problem solving practices in the energy sector show that there are numerous methods to find a solution, adhering to the relevant criteria. In the past years, considering the energy sectors of the considered developing counties, there have been significant positive changes in Romania's exploitation method, causing efficient exploitation of its energy potential, which is confirmed by the parameters that indicates an increase in profits over stable production of its biggest producing energy sources, such as coal, natural gas, oil and nuclear power. Romania needs additional funding through foreign direct investment to additionally exploit the energy sector, which would bode well for both its economy and foreign investors. Additional fund would provide it with the possibility to modernize its equipment and reduce costs, thus increasing profits and provide higher return on investments for its investors.

By applying the multicriteria decision making methods we are combining the economic principles with its statistics to make the optimal decision. Main attributes of optimal energy sectors are visible in achieving long term positive results, maximization of profits, cost control and other. Various methods can be used to assess the performance of these attributes, all of which ultimately involve the application of specific ratios to a greater or lesser extent. By assessing these attributes through historical data and employing the adequate method, it's possible for a potential investor the calculate the efficiency of the energy sector, the impact it can have on further development of the energy sectors, as well as the possible return on investment. This historical data can be compared with other developing counties that are potential investment markets for the energy sector. For the purpose of statistical data, they could compare the data with other energy markets that had the same conditions, concluding the viability of the investment. It has the possibility to utilize numerous methods in the decision-making process which provide support in eliminating risk to investment, support the business and provide better understanding of the available alternatives. By using AHP and TOPSIS methods together, we are provided the methodology on how a decision-making process should work by combining relevant criteria and providing further evidence for application of the scientific method in the decision-making process.

### Conflicts of interests

The authors declare no conflict of interest.

### References

1. Algarin, C.R., Llanos, A. P., & Castro, A. O. (2017). An Analytic Hierarchy Proces Based Approach for Evaluating Renewable Energy Sources, *International Journal of Energy Economics and Policy*, 7(4), 38-47.
2. Ćirović, M., (2006). *Bankarstvo*, European Center For Peace and Development, Beograd. [in English: Ćirović, M., (2006). Banking, European Center For Peace and Development, Belgrade]



3. Čavlin, M., Vapa-Tankosić, J., Davidovac, Z., & Ivaniš, M. (2023). Analysis of risk factors of the financial and profit position with the objective of improving the vitality of the energy sector, *Oditor*, 9(2), 22-53.
4. Čupić, M., & Suknović M. (2010) *Odlučivanje*, Fakultet organizacionih nauka, Beograd. [in English: Čupić, M., & Suknović M. (2010) Decision-making, Fakultet organizacionih nauka, Belgrade]
5. Đukić, Đ. (2011). *Upravljanje rizicima i kapitalom u bankama*, drugo izdanje, Ekonomski fakultet, Beograd. [in English: Đukić, Đ. (2011). Managing risks and capital in banks, Second Edition, Faculty of Economics, Belgrade]
6. Đurković, V., Radosavljević, M., & Stanković, R. (2019). Application of the “AHP” method in determining the importance of the application of modern banking products to the performance of banks, *Oditor*, 5(1), 70-80.
7. Gojkov, D. (2023). Teorijski aspekti negocijabilnosti kao pravno-ekonomske kategorije, *Revija prava*, 3(1), 39-48. [in English: Gojkov, D. (2023). Theoretical aspects of negotiability as a legal-economic category, *Law review*, 3(1), 39-48]
8. Golubović, M., & Janković, G. (2023). FDI inflow in the function of improving economy competitiveness of the Republic of Serbia, *Održivi razvoj*, 5(1), 19-31.
9. Hemed, R. I. (2022). Normative arrangement of financial innovations in banking, *Finansijski savetnik*, 27(1), 25-64.
10. Jestrović, V., & Jovanović, V. (2022). The role of corporate governance in sustainable development, *Održivi razvoj*, 4(1), 43-53.
11. Ligus, M., & Peternek, P. (2018). Determination of most suitable low-emission energy technologies development in Poland using integrated fuzzy AHP-TOPSIS method, *5th International Conference on Energy and Environment Research, ICEER 2018*, 153, 101-106
12. Lin M. C., Wang, C. C., Chen, M. S., & Chang C. A. (2008). Using AHP and TOPSIS approaches in customer-driven product design process, *Computers in Industry*, 59(1) 18-31.
13. Madžarević, A., Ivezić, D., Tanasijević, M., & Živković, M. (2020). The Fuzzy–AHP Synthesis Model for Energy Security Assessment of the Serbian Natural Gas Sector, *Symmetry*, 12(6), 908
14. Mihajlović M., Burić T., & Krstić S. (2014). Menadžment operativnim rizikom u bankarskom poslovanju, *17th DQM International Conference, Dependability and Quality management ICDQM-2014*, 397-403. [in English: Mihajlović M., Burić T., & Krstić S. (2014). Operational risk management in the banking sector, *17th DQM International Conference, Dependability and Quality management ICDQM-2014*, 397-403.]

15. Milojević, I., Mihajlović, M., & Vukša S. (2018). Novčani tokovi privrednog subjekta kao predmet revizije, *Vojno delo*, 70(3), 361-371 [in English: Milojević, I., Mihajlović, M., & Vukša S. (2018). Cash flow of a business entity as a subject of audit, *Vojno delo*, 70(3), 361-371]
16. Milutinović, S., Mikić, M., & Stojanović, M. (2021). The use of multicriteria decision-making methods in determining the optimal solution in the form of selection the priority in exploitation the ore deposit in Eastern Serbia. *Mining and Metallurgy Engineering Bor*, 1-2, 63-74
17. Mitić, N., Janjušić, D., & Beslać, M. (2022). Multikriterijumski metod odlučivanja-AHP u zelenim nabavkama. *Ekonomika*, 68(3), 61-70. <https://doi.org/10.5937/ekonomika2203061M> [in English: Mitić, N., Janjušić, D., & Beslać, M. (2022). Multicriteria decision-making method-AHP in green procurement. *Ekonomika*, 68(3), 61-70.]
18. Nikolić, B., Tasić, V., & Petrović, M. (2022). Savremeni državni sistemi, *Revija prava*, 2(2), 6-22. [in English: Nikolić, B., Tasić, V., & Petrović, M. (2022). Contemporary state systems, *Law review*, 2(2), 6-22]
19. Nikolić, I., & Borović S. (1996). *Višekriterijumska optimizacija: metode, primena u logistici, softver*, Centar vojnih škola Vojske Jugoslavije, Beograd. [in English: Nikolić, I., & Borović S. (1996). Multi-criteria optimization: methods, application in logistics, software, Center of Military Schools of the Army of Yugoslavia, Belgrade]
20. Prašćević, Ž., & Prašćević, N. (2014). Application of modified fuzzy TOPSIS method for multicriteria decisions in civil engineering, *Building Materials and Structures* 57(3), 43-61.
21. Ristić, K., Živković, A., & Jemović, M. (2023). Political economy of money, *Oditor*, 9(1), 103-125.
22. Rstić, M. (2020). Kanali distribucije životnih i neživotnih osiguranja u sportu, *Management In Sport*, 11(1), 18-22. [in English: Rstić, M. (2020). Distribution channels of life and non-life insurances in sport, *Management In Sport*, 11(1), 18-22]
23. Pantić, N., Damnjanović, R., & Kostić, R. (2021). Method of economic analysis as a part of methods of social sciences, *Akcionarstvo*, 27(1), 7-26.
24. Saaty, T. (1980). *The Analytic Hierarchy Process*, McGraw-Hill, New York.
25. Savić, B. (2022). Importance of integrated reporting for functioning of capital markets, *Akcionarstvo*, 28(1), 7-20.
26. Savić, B., & Milojević, I. (2022). Challenges of targeted formation of financial reports in modern business conditions, *Oditor*, 8(2), 30-53.

27. Stanojević, A. (2020). Ponašanje i odluke potrošača, *Management In Sport*, 11(1), 7-11. [in English: Stanojević, A. (2020). Behavior and decisions of consumers, *Management In Sport*, 11(1), 7-11]
28. Suknović M., & Delibašić B. (2010). *Poslovna inteligencija i sistemi za podršku odlučivanju*, Fakultet organizacionih nauka u Beogradu, Beograd. [in English: Suknović M., & Delibašić B. (2010). Business Business intelligence and decision support systems, Faculty of Organizational Sciences, Belgrade]
29. Zekić, M., & Brajković, B. (2022). Uloga finansijskog menadžmenta u preduzeću, *Finansijski savetnik*, 27(1), 7-24. [in English: Zekić, M., & Brajković, B. (2022). The role of financial management in a company, *Financial advisor*, 27(1), 7-24]

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# DOES ECONOMIC INDICATORS OF SUSTAINABLE TOURISM PRESENT A PROMISING TREND OF RURAL DESTINATION DEVELOPMENT? ATTITUDES OF VOJVODINA RURAL RESIDENTS

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## ABSTRACT

To be considered sustainable, tourism in rural destinations should provide long-term economic benefits and have a push-up effect on the population's determination to engage in sustainable tourism. Also, sustainable tourism must reduce the negative effects of business activities on the natural environment and improve the quality of life as well as the standard of living of the local population. In order to check the impact of sustainable tourism on the development of rural destinations, economic indicators of sustainability are most often used, as measurable indicators of sustainable development. In the paper, we examined the attitudes of 421 local residents using the TIAS scale, in 17 Vojvodina villages. Only those who declared that they are involved in the tourism economy were taken for further analysis. It was concluded that positive economic indicators of sustainable development are "wind in the sails" of the development of rural destinations, and that sustainable tourism is a desirable economic activity in the villages of Vojvodina to whom more and more residents are turning, especially women as of very sensitive category.

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## Introduction

Tourism can long ago be said to that is a catalyst for rural development. It is a two-way principle that at the same time contributes to raising awareness of the importance of the development of rural destinations, while that development is taking place

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(Kachniewska, 2015). The authors believe that only what is sustainable is desirable (An & Alarcon, 2020), which means that such forms of tourism, which can carry the epithet “sustainable”, are important for the development of rural destinations. Whether something is sustainable or not is viewed through a kind of sustainability indicator prism. These are economic (Quaranta et al., 2016; Boley et al., 2018; Petelca & Garbuz, 2020; Akhtar, 2023), sociological (Quaranta et al., 2016; Petelca & Garbuz, 2020) and ecological sustainability indicators (Ahmadi et al., 2018). The extent to which certain indicators will provide sustainable results applicable to rural destinations depends on a number of factors (Nunkoo & Ramkissoon, 2012; Wardana et al., 2020), and above all on the local population and its perception (Lin et al., 2017; Kurniawan & Cahyono, 2020; Lindberg et al., 2021). Many scientists have dealt with this topic (Dyer et al., 2007; Ma et al., 2022; Hu et al., 2023), the attitudes of the local population and in what way to influence those attitudes. It turns out that the economic aspects of development are the most visible and have the most far-reaching impacts (Vujko et al., 2021). According to Blake (2009), the economic indicator “creation of new jobs” directly affects the gross domestic product (GDP), and it expresses the economic well-being of rural areas, and thus the overall well-being of the country. Bearing in mind that the development of tourism affects the creation of new jobs (Strzelecka et al., 2017), it is assumed that the local population will be directly involved in the benefits of development and thus be a part of sustainability. The assumption that there are attractions at the destination that are able to satisfy some of the heterogeneous tourist needs without jeopardizing the possibility that future generations will also satisfy that kind of needs (Fallon & Schofield, 2006) must be included. According to Balaguer & Cantavella-Jorda (2002), the economic aspect of sustainable development implies ensuring the economic well-being of the population in order to improve the standard of living and the quality of life of both the individual and the entire community. Here, special emphasis is placed on the economic empowerment of women in rural areas, on which sustainable tourism in the economic sense has the greatest effect (Maksimović et al., 2019). Economic indicators are therefore excellent indicators of the long-term possible determination of the community in which direction it should develop, and if the balance turns out to be positive, these indicators are an important basis for examples of good practice and they show how, based on the positive experiences of the local population of some rural destinations, others rural destinations can develop. Therefore, the economic indicators are in direct relation with the environment of business practice, business excellence and sustainable business, which sustainable tourism in rural destinations certainly is.

The paper started from the initial hypothesis H1 that the economic indicators of sustainable development are the basis of the determination of the local population to engage in tourism in rural destinations, and that tourism is a factor of village survival in modern conditions. Using the opinion of the local population directly involved in the tourism industry in 17 Vojvodina villages, the paper tried to show that sustainable tourism directly affects rural development in the destinations, and represents the backbone of the quality of life and the increase in living standards.

By development of economic indicators of sustainable development would create a system of continuous monitoring of the quality of life of the local population in rural destinations, thus giving state structures a powerful tool for comparison with the indicators of other local communities, i.e. rural destinations, which would create a basis for defining possible directions of development and action priorities.

### **The research methodology**

A total of 421 local residents from 17 Vojvodina villages were surveyed, which were proposed by the Provincial Secretariat for the Economy of the Government of AP Vojvodina and are part of the “Wealth of Diversity” project, the Danube tourist cluster “Istar 21”. We wanted to examine the attitudes of the local population, which is directly involved in the tourist economy, in the broadest sense. We considered that such a population would be competent to give answers which concern the issue of economic indicators of sustainable development of tourism in rural destinations. From the initial number of respondents, 303 of them, who declared that they are directly employed in the tourism industry, were taken for further analysis.

The “Wealth of diversity” project of the Danube tourist cluster “Istar 21” was started in 2011 when 14 villages were initially included, and in 2012, 3 more villages were added. The goal of this project was the development of a multicultural tour through Vojvodina and Danube Region, through the presentation of this region of Europe as a unique tourist product. Project activities are aimed at raising the level of service quality of cluster members through innovation and education, then strengthening cooperation between cluster members, increasing the capacity of the cluster for the realization of larger projects and marketing activities. The villages that were chosen and analyzed in this paper, listed in alphabetical order, are: Banoštor, Bački Monoštor, Bezdan, Belo Blato, Velebit, Golubinci, Gudurica, Donji Tavankut, Kovilj, Krčedin, Ruski Krstur, Selenča, Skorenovac, Stapar, Stari Slankamen, Totovo Selo and Turia.

The paper presents a unique model for measuring the impact of tourism development on the attitudes of the local population (most often in rural areas), called TIAS (Tourism Impact Attitude Scale - TIAS). This scale was created on the basis of several significant methodologies proposed by eminent theorists, such as Likert (Likert, 1967, 66-67), Churchill (Churchill, 1979, 66-67), Parasuraman and associates (Parasuraman et al., 1988, 15 -22). In 1994, American professors Samuel W. Lankford and Dennis R. Howard (Lankford & Howard, 1994a) write a scientific paper entitled “Developing a Tourism Impact Attitude Scale” (Eng. “Developing a Tourism Impact Attitude Scale”) and publish it in the reference journal “Annals of Tourism Research” (eng. “Annals of Tourism Research”<sup>24</sup>) in number 21(1). Although the original scale has 28 items grouped into two factors, in our work we will use a modified version of 12 questions grouped into 3 factors adapted according to the original variables of Lankford and Howard (Lankford & Howard, 1994a, 130; Kunasekaran et al., 2011; Long & Kayat, 2011; Woosnam, 2012).

In this way, a model with 12 modified questions was obtained, which are grouped into three factors that directly rely on the economic indicators of influence on sustainable development of tourism on the development of rural destinations, and which are named as follows:

**Factor 1 (F1)** - Benefits from tourism development for individuals and the local community (Personal and community benefits) groups the variables:

F1a - My neighborhood has better roads and sidewalks thanks to the development of tourism.

F1b - Quality of public services (health, cleanliness, water supply, fire protection etc.) in my neighborhood has improved thanks to the development of tourism.

F1v - I have more money thanks to tourism.

F1g - Tourism has an impact on increasing my standard of living.

F1d - Jobs provided by tourism are very attractive.

F1e - In my settlement, the number of shops has increased as a result of the development of tourism.

F1ž - Tourism will play a leading economic role in my settlement in the future.

**Factor 2 (F2)** - Concern/support for local tourism development groups the variables:

F2a - The development of tourism should be actively encouraged in my place.

F2b - My settlement has the resources to become an attractive tourist destination.

F2v - Tourism needs to become the main economic branch in my settlement.

F2g - The development of tourism in my settlement will provide more employment opportunities for the local population.

**Factor 3 (F3)** - General opinion on tourism development (eng. General opinion) includes variables:

F3a - The community should encourage more intensive construction of tourist facilities.

F3b - Tourism plays an important role in the community's economy.

To understand the relationship between gender and these economic indicators, we used Pearson Chi-Square Tests for each variable separately. If the value of  $p$  is less than 0.05, it is considered that the Chi-Square Test shows statistical significance in relation to the gender of the respondent, while a value of  $p$  that is greater than 0.05 indicates the absence of statistical significance.

## Result and Discussion

A total of 421 respondents participated in the research. Respondents were asked to answer the question, are they involved in the tourismic ecinimy? Out of the total number of respondents, 303 answered positively, while 118 respondents answered negatively.

Therefore, a sample of 303 respondents, declared to be in the tourism industry (197 male and 106 female respondents), was taken for further analysis.

The respondents were then asked to state in which sector of the tourism industry they are employed. The answer to that question can be seen in table 1. In this table it can be seen that most of the employees are in the catering sector (hotel and restaurant industry).

**Table 1.** Sector of tourism industry

		Frequency	Percent
Valid	Accommodation	62	14,7
	Hotel industry	68	16,2
	Gastronomy	55	13,1
	Restaurant business	32	7,6
	Food production	16	3,8
	Production of souvenirs	37	8,8
	Service activities in tourism (guiding service, recreation, animation, etc.)	9	2,1
	Transport	4	1,0
	Trading	3	,7
	Hairdressing services	4	1,0
	Renting of means of transport	4	1,0
	Local self-government	4	1,0
	Project activity	1	,2
	Education	2	,5
	Destination management	2	,5
	Something else	<b>118</b>	<b>28,0</b>
Total	421	100,0	

*Source:* Autors, 2023

The first part of the results shows Factor 1 (F1) - Benefits from tourism development for individuals and the local community (Personal and community benefits). These results indicate the economic aspects of development, i.e. the improvement of the standard of living, the quality of life of the local population and the determination of the population to engage in tourism in the future. Table 2 indicates data regarding the tourist infrastructure network, one of the main prerequisites for tourism development (Gao & Wu, 2017). It can be seen and concluded that the local population believes that the infrastructure is in a much better condition since tourism began to develop in their places. According to Kumar et al., (2020) tourism and infrastructure are in a symbiotic relationship, so these answers are not surprising (Song, et al., 2020).



**Table 2.** State of infrastructure in settlements

		Gender		Total
		Male	Female	
My settlement has better roads and sidewalks, thanks to the development of tourism	I completely agree	123	82	205
	I agree	70	23	93
	No changes	4	1	5
Total		197	106	303

Source: Autors, 2023

Table 3 shows the interdependence of responses in relation to the gender of the respondents, and as  $p=0.29$  it can be concluded that there is no statistical significance, that is, both male and female respondents agree that the change is positive.

**Table 3.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	7,059 <sup>a</sup>	2	,029

Source: Autors, 2023

The quality of any business is expressed in different categories, and one of the most significant is revenue (Germanovich et al., 2020). The bottom line is to make as much profit as possible, and the respondents agreed that they have more money thanks to tourism (Table 4).

**Table 4.** Income and tourism

		Gender		Total
		Male	Female	
I have more money thanks to tourism	I completely agree	170	92	262
	I agree	23	13	36
	No changes	4	1	5
Total		197	106	303

Source: Autors, 2023

Table 5 shows that in this case as well, there is no statistically significant difference in the respondents' answers in relation to gender, that is, both men and women agree that they have more money thanks to tourism. This is a particularly important statement considering stereotypes and prejudices. According to Maksimović et al., (2019) women are generally in less favorable positions compared to men. They are paid less than men, are in worse positions, and at the same time are usually more educated and usually take care of the entire family (Schrock & Schwalbe, 2009). This data points to the awakening of awareness about gender equality, which can be a prerequisite for the revival of villages and the return of young people to rural destinations.

**Table 5.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	,516a	2	,773

*Source:* Autors, 2023

If we would say that the standard of living represents a set of living and working conditions of the population (Ruiz-Real et al., 2022), then of extremely importance is the opinion of the population that precisely tourism affects the increase of the standard of living (Table 6). The standard of living is directly related to employment (Nunkoo et al., 2020), and the development of tourism in rural destinations is directly related to the creation of new jobs (Vytautas & Vytautas, 2014). Therefore, the connection between these two statements is clear. Observing the standard of living from the aspect of tourism development, it can be said that it is all related to economic development and determination of rural destinations to develop in that direction.

**Table 6.** Standard of living and tourism

		Gender		Total
		Male	Female	
Tourism has an impact on increasing my standard of living	I strongly agree	170	91	261
	I agree	23	14	37
	No changes	4	1	5
Total		197	106	303

*Source:* Autors, 2023

Table 7 again shows the uniformity of respondents' answers in relation to gender, where both men and women have a uniform attitude: the development of tourism in rural destinations has positive economic effects on the lives of them, both.

**Table 7.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	,628 <sup>a</sup>	2	,731

*Source:* Autors, 2023

There are studies (Kortoci & Kortoci, 2017; Ling et al., 2023) that support the fact that tourism creates numerous jobs in various sectors such as catering, transport, souvenir trade and other services (Table 1). The increase in employment directly affects the increase in household income (Table 4) and reduces unemployment. The population of rural destinations "feels" an increase in the standard of living (table 6), which is reflected through numerous positive aspects of sustainability. One of those aspects is both attractive and very dynamic workplaces. Working with people is exactly that: dynamic and attractive (Vunjak et al., 2020). Table 8 shows the respondents' agreement with that statement.

**Table 8.** Jobs and tourism

		Gender		Total
		Male	Female	
Jobs provided by tourism are very attractive	I completely agree	179	88	267
	I agree	14	18	32
	No changes	4	0	4
Total		197	106	303

*Source:* Autors, 2023

Table 9 shows that both male and female respondents agree that jobs in tourism are very attractive, considering that there is no statistically significant difference in the responses of the respondents in relation to gender.

**Table 9.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	8,996a	2	,011

*Source:* Autors, 2023

As it is an activity in which the multiplication effect is highly developed (Verma et al., 2023), the respondents' answers regarding the development of other economic activities as a result of the development of tourism are quite normal and expected (Table 10). Trade is one of those activities that is directly proportional to the increase in the number of tourists at destinations.

**Table 10.** Trade and tourism

		Gender		Total
		Male	Female	
The number of shops has increased in my settlement as a result of the development of tourism.	I completely agree	172	83	255
	I agree	21	23	44
	No changes	4	0	4
Total		197	106	303

*Source:* Autors, 2023

Table 11 shows that there is no statistical significance regarding this issue, when the gender of the respondents is concerned. Both men and women agree that shops should be opened in their villages and that they are directly related to the development of tourism.

**Table 11.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	8,599 <sup>a</sup>	2	,014

*Source:* Autors, 2023

The second part of the results shows Factor 2 (F2) - Concern/support for local tourism development. Table 12 shows the views of the local population regarding their long-term determination to engage in tourism as an economic activity. Long-termism is synonymous with quality (Singh et al., 2022), which means that in this way the foundations are laid for future generations, such that professions in tourism are left as a legacy, and the rural destination takes on the epithet “sustainable tourist destination”. Many scientists believe that the name and surname in this context, the brand and the quality that everyone recognizes and is always happy to return to.

**Table 12.** Economic aspects of tourism development

		Gender		Total
		Male	Female	
In the future, tourism will play a leading economic role in my settlement	I completely agree	180	98	278
	I agree	17	8	25
Total		197	106	303

*Source:* Autors, 2023

Table 13 shows that there is no statistically significant difference in relation to the gender of the respondents, which also has a very significant foundation in the statement that precisely tourism is an excellent base for the sustainable development of rural destinations. In tourism, more than in any other activity, there is room for work and development for both men and women.

**Table 13.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	,107a	1	,744

*Source:* Autors, 2023

Given that the majority of respondents declare that tourism should be actively invested in and that it must be developed in the future as well (Table 14), it is clear that it is an activity that has economic effects on their personal lives and on the community. Everyone is satisfied.

**Table 14.** Respondents' attitude towards the development of tourism in the future

		Gender		Total
		Male	Female	
The development of tourism should be actively encouraged in my place	I completely agree	163	87	250
	I agree	20	18	38
	No changes	14	1	15
Total		197	106	303

*Source:* Autors, 2023

Table 15 indicates that both male and female respondents gave uniform answers to this question, that is, there is no statistically significant difference in the answers in relation to gender.

**Table 15.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	7,854 <sup>a</sup>	2	,020

Source: Autors, 2023

When talking about rural destinations from the aspect of tourism, we are talking about attractiveness factors that are becoming more and more popular among modern tourists. Ethnographic values of Vojvodina (houses, old workshops, farms, windmills, shadoofs, folk carts, music, dance, etc.), together with the rich gastronomy of these regions, represent attractions with a world contractive zone. Food and drink in combination with the ethno environment, as well as natural resources, represent the main potential for the development of rural tourism, with which the respondents agree (Table 16).

**Table 16.** Tourist attractions and tourism development

		Gender		Total
		Male	Female	
My settlement has the resources to become an attractive tourist destination	I completely agree	147	61	208
	I agree	37	41	78
	No changes	13	4	17
Total		197	106	303

Source: Autors, 2023

Taking into account that a statistically significant difference in answers in relation to gender, can be observed for this question (Table 17), the conclusion is that male and female respondents perceive tourist attractions differently (Temelkov & Gulev, 2019). Women prefer handicrafts and jobs related to gardens and economic yards, while men consider gastronomy as a key attraction.

**Table 17.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	14,506 <sup>a</sup>	2	,001

Source: Autors, 2023

Regardless of how one evaluates what is to whom attractive more and what is less, both men and women of the observed rural destinations agree that tourism should become the main economic branch in their villages (table 18).

**Table 18.** Comparative advantage of tourism development

		Gender		Total
		Male	Female	
Tourism should become the main economic branch in my settlement	I completely agree	164	81	245
	I agree	20	22	42
	No changes	13	3	16
Total		197	106	303

Source: Autors, 2023

Both male and female respondents agree with this statement, given that there is no statistically significant difference in the respondents' answers in relation to gender (Table 19).

**Table 19.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	7,841 <sup>a</sup>	2	,020

Source: Autors, 2023

Completely compatible with the previous attitudes in relation to the economic aspects of tourism development in rural destinations, respondents to the greatest extent believe that the development of tourism will also provide more opportunities for employment of the local population in the future (table 20). There are studies that show the connection between tourism and other economic activities, primarily transport, trade, agriculture and the like. Investments in the tourism economy directly affect all aspects of business. What stands out here is the empowerment of women and female entrepreneurship, through handicrafts, marketing of finished products in the form of winter meat and other meat products, production of brandy and wine and the like (Vujko et al., 2018). It is a system from which everyone can benefit, so investing in tourism in rural destinations should be one of the main priorities for every country.

**Table 20.** Predispositions for the development of tourism in rural destinations

		Gender		Total
		Male	Female	
The development of tourism in my settlement will give more employment opportunities for the local population	I completely agree	131	64	195
	I agree	51	38	89
	No changes	15	4	19
Total		197	106	303

Source: Autors, 2023

Both men and women have equal views on whether they see a future in tourism. There is no statistical significance in the respondents' answers in relation to gender (Table 21).

**Table 21.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	4,350 <sup>a</sup>	2	,114

Source: Autors, 2023

The final part of the research shows Factor 3 (F3) - General opinion on tourism development. This is primarily about the influence that decision-makers at the Municipal level, and then at the Provincial level, have on the development of rural destinations. Tourism must be a development priority. This is indicated by all previous researches (Vujko & Gajić, 2014), including ours, where all answers were in the highest percentage a reflection of the complete agreement of the local population, with the statement that tourism is the backbone of the sustainable development of rural destinations. In Table 23, we can see the attitude of the respondents regarding the construction of a different tourism suprastructure, as a basis for the development of tourism. Respondents agree that the construction of a tourist suprastructure is desirable and necessary for the further development of tourism in rural destinations.

**Table 22.** Tourism superstructure and development of tourism

		Gender		Total
		Male	Female	
The community should encourage more intensive construction of tourist facilities	I completely agree	148	82	230
	I agree	43	16	59
	No changes	6	8	14
Total		197	106	303

Source: Autors, 2023

Both male and female respondents agree with the previous statement (Table 23), considering that there is no statistically significant difference in the responses of respondents in relation to gender.

**Table 23.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	4,672 <sup>a</sup>	2	,097

Source: Autors, 2023

The last answer in the TIAS scale questions related to the question of whether respondents think that tourism plays an important role in the community's economy. It did not differ from other answers because the respondents in this case overwhelmingly answered with a completely positive attitude. Namely, respondents believe (Table) that tourism in rural destinations plays an important role in the overall economy of the entire community. Regardless of what activity they are engaged in, if tourism is developed in rural destinations, they are all directly or indirectly relied on tourism. Each activity plays its role in creating a complex tourist product.

**Table 24.** Tourism and economic development

		Gender		Total
		Male	Female	
Tourism plays an important role in the economy of the community	I completely agree	157	83	240
	I agree	30	17	47
	No change	10	6	16
Total		197	106	303

*Source:* Autors, 2023

Table 25 shows that men and women have the same opinion regarding this position, that is, that there is no statistically significant difference in the respondents' answers in relation to gender.

**Table 25.** Pearson Chi-Square Test

	Value	df	Statistical significance (p)
Pearson Chi-Square Test	,091a	2	,956

*Source:* Autors, 2023

## Conclusion

The conclusion regarding the research is visible at first glance, because all points of the TIAS scale confirm the initial hypothesis H1, that economic indicators of sustainable development are the basis of the determination of the local population to engage in tourism in rural destinations, and also that tourism is a factor of village survival in modern conditions. By this, it is first of all meant that rural destinations have problems with intensive depopulation, and that tourism can represent a peculiar factor of rural preservation and the effect of attracting young people to return from cities to villages. Especially the highly educated workforce, it is visible that both male and female respondents have a positive attitude towards tourism as a sustainable form of development of rural destinations, primarily because of the economic indicators of that development. If something changes so that everyone gets better and everyone can feel that improvement, it is clear that they will be in favor of such a direction of development.

Tourism, more than any other activity, unites different economic activities into one whole, so that even the smallest links in the chain feel equally important and have an equally important role for the whole. It is a question of the multiplicative influence of tourism, which is primarily based on the circulation of tourist consumption funds in the economy, which affects the entire economic activity of rural destinations, but also the economic activity of the State. Therefore, the most visible indicator of sustainable development of tourism in rural destinations is economic.

In the paper, economic indicators are presented as starting points for sustainable rural development, that is, in what way tourism directly and indirectly affects the standard of living and quality of life of the local population. In addition to activating and using existing resources (natural-geographical and social-geographical characteristics),



tourism requires certain investments in infrastructure and superstructure, as well as investments in personnel, which implies the creation of numerous jobs. In this way, the revitalization of rural destinations is encouraged, because depopulation is one of the biggest problems of the modern countryside.

Bearing all this in mind, one of the conclusions of the work is that tourism in rural destinations requires greater involvement of tourism policy holders. Here, first of all, we are referring to the relevant ministries, as well as tourist organizations and associations. It is necessary to make more efforts to present examples of good practice, such as the “Wealth of Diversity” project, of the Danube tourist cluster “Istar 21” to the wider rural public, and other villages to involve also in active sustainable development of rural destinations through various educations and new projects, highlighting tourism as the leading activity of the national economy.

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### References

1. Ahmadi, M., Khodadadi, M., & Shahabi, H. (2018). Planning for ecotourism in the protected area of Manesht and Ghelarang, Ilam Province, Iran. *Journal of Quality Assurance in Hospitality & Tourism*, 19(2), 243-268.
2. Akhtar, M. N. (2023). Rural Tourism in Kashmir valley:-Tool for rural infrastructure and rural economy. *Vidhyayana-An International Multidisciplinary Peer-Reviewed E-Journal-ISSN 2454-8596*, 8(si6), 502-517.
3. An, W., & Alarcon, S. (2020). How can rural tourism be sustainable? A systematic review. *Sustainability*, 12(18), 7758.
4. Balaguer, J., & Cantavella-Jorda, M. (2002). Tourism as a long-run economic growth factor: The Spanish case. *Applied Economics*, 34, 877–884.
5. Blake, A. (2009). The dynamics of tourism’s economic impact. *Tourism Economics*, 15(3), 615–628.
6. Boley, B. B., Strzelecka, M., & Woosnam, K. M. (2018). Resident perceptions of the economic benefits of tourism: Toward a common measure. *Journal of Hospitality & Tourism Research*, 42(8), 1295-1314.
7. Churchill, G. A. (1979). A Paradigm for Developing Better Measures of Marketing Constructs. *Journal of Marketing Research*, 16, 64-73.
8. Dyer, P., Gursoy, D., Sharma, B., & Carter, J. (2007). Structural modeling of resident perceptions of tourism and associated development on the Sunshine Coast, Australia. *Tourism Management*, 28(2), 409-422.

9. Fallon, P., & Schofield, P. (2006). The dynamics of destination attribute importance. *Journal of Business Research*, 59(6), 709-713.
10. Gao, J., & Wu, B. (2017). Revitalizing traditional villages through rural tourism: A case study of yuanjia village, shaanxi province, China. *Tourism management*, 63, 223–233.
11. Germanovich, A. G., Vasilieva, O. N., Ordynskaya, M. E., Allanina, L. M., & Gorokhova, A. E. (2020). Impact of tourism on sustainable development of rural areas: International experience. *Journal of Environmental Management & Tourism*, 11(4 (44)), 965-972.
12. Huo, M., Shao, Y., Li, M., & Li, Z. (2023). Residents' participation in rural tourism and interpersonal trust in tourists: The mediating role of residents' perceptions of tourism impacts Tingting Huo, Feng Yuan, *Tourism Management*, 54, 457-471
13. Kachniewska, M. A. (2015). Tourism development as a determinant of quality of life in rural areas. *Worldwide Hospitality and Tourism Themes*, 7(5), 500-515.
14. Kortoci, Y., & Kortoci, M. (2017). The assessment of the rural tourism development in the Valbona Valley National Park. *Tourism Economics*, 23(8), 1662-1672.
15. Kumar, G. S., Rajesh, D. R., & Kumar, P. (2020). Rural Tourism Development and Promotion in Potential Villages of Tamilnadu. *International Journal of Management*, 11(10).
16. Kunasekaran, P., Ramachandran, S., Yacob, M. R. & Shuib, A. (2011). „Development of Farmers' Perception Scale on Agro Tourism in Cameron Highlands, Malaysia”. *World Applied Sciences Journal (Special Issue of Tourism & Hospitality)*, 12, 10-18.
17. Kurniawan, M. U., & Cahyono, A. E. (2020, May). The community empowerment program based on local potential through tourism village. In *IOP Conference Series: Earth and Environmental Science* (Vol. 485, No. 1, p. 012089). IOP Publishing.
18. Likert, R. (1967). “The Method of Constructing an Attitude Scale”. In *Readings in Attitude Theory and Measurement*, M. Fishbein, (ed.). pp. 90-95. New York: Wiley
19. Lin, Z., Chen, Y., & Filieri, R. (2017). Resident-tourist value co-creation: The role of residents' perceived tourism impacts and life satisfaction. *Tourism Management*, 61, 436–442.
20. Lindberg, K., Munanura, I. E., Kooistra, C., Needham, M. D., & Ghahramani, L. (2021). Understanding effects of tourism on residents: A contingent subjective well-being approach. *Journal of Travel Research*, 61(2), 346–361.
21. Ling, M., Daisy, D., fan, X.F., Wang, R., O, YH., & M, XL. (2023). Doas rural tourism revitalize the countryside? An exploration of the spatial reconstruction through the lens of cultural connotations of rurality. *Journal of Destination Marketing & Management*, 29, 100801, <https://doi.org/10.1016/j.jdmm.2023.100801>
22. Lankford, S.V. and Howard, D.R. (1994a). “Developing a Tourism Impact Attitude Scale.” *Annals of Tourism Research*, 21(1), 121-139.

23. Long, P. H. & Kayat, K. (2011). "Residents' perceptions of tourism impact and their support for tourism development: the case study of Cuc Phuong National Park, Ninh Binh province, Vietnam". *European Journal of Tourism Research*, 4 (2), 123-146.
24. Maksimović, G., Ivanović, T., Vujko, A. (2019). Self-employment of women through associations in the rural areas of Sirinicka zupa. *Economic of Agriculture*, 66(1), 251-263.
25. Ma, L.X., Wang, R., Dai, M.L., Ou, H.Y. (2022). The action logic and interpretation framework of residents' resistance in rural tourism development. *Journal of Hospitality and Tourism Management*, 51, 79-87.
26. Nunkoo, R., & Ramkissoon, H. (2012). Power, trust, social exchange and community support. *Annals of Tourism Research*, 39(2), 997–1023. <https://doi.org/10.1016/j.annals.2011.11.017>
27. Nunkoo, R., Seetanah, B., Jaffur, Z. R. K., Moraghen, P. G. W., & Sannasee, R. V. (2020). Tourism and economic growth: A meta-regression analysis. *Journal of Travel Research*, 59(3), 404–423.
28. Petelca, O., & Garbuz, V. (2020). Social and economic effects of rural tourism on the development of rural areas. *CES Working Papers*, 12(2), 123-143.
29. Parasuraman. A., Zeithaml, A.V. & Bern, L. L. (1988). „Servqual: Multiple-item Scale for Measuring Consumer Perceptions of Service Quality”. *Journal of Retailing* 64, 12-40.
30. Quaranta, G., Citro, E., & Salvia, R. (2016). Economic and social sustainable synergies to promote innovations in rural tourism and local development. *Sustainability*, 8(7), 668.
31. Ruiz-Real, J. L., Uribe-Toril, J., de Pablo Valenciano, J., & Gázquez-Abad, J. C. (2022). Rural tourism and development: Evolution in scientific literature and trends. *Journal of Hospitality & Tourism Research*, 46(7), 1322-1346.
32. Schrock, D., & Schwalbe, M. (2009). Men, masculinity, and manhood acts. *Annual review of sociology*, 35, 277-295.
33. Singh, K., Puri, G., & Vohra, S. K. (2022). Rural Tourism: Emerging Trends & Possibilities In Indian Context Amid COVID 19. *Journal of Positive School Psychology*, 2217-2224.
34. Song, S., Feng, C. C., & Diao, M. (2020). Vehicle quota control, transport infrastructure investment and vehicle travel: A pseudo panel analysis. *Urban Studies*, 57(12), 2527-2546.
35. Strzelecka, M., Boley, B. B., & Strzelecka, C. (2017). Empowerment and resident support for tourism in rural Central and Eastern Europe (CEE): The case of Pomerania, Poland. *Journal of Sustainable Tourism*, 25(4), 554-572.

36. Temelkov, Z., & Gulev, G. (2019). Role of crowdfunding platforms in rural tourism development. *SocioBrains, International scientific refereed online journal with impact factor*, (56), 73-79.
37. Verma, V., Ahlawat, R., Ghai, M., & Bansal, S. (2023). Rural tourism in Himachal Pradesh in transition: Challenges for regional sustainability. *Multidisciplinary Reviews*, 7(1), 2024010-2024010.
38. Vujko, A., Zečević, S.O., Zečević, L., Nedeljković, D., Zečević, M. (2021). Rural residents' perceptions on economic impacts of cultural and promotional aspects of tourism. *Economic of Agriculture*, 68(1), 155-173.
39. Vujko, A., Tretiakova, N.T., Petrović, M., Radovanović, M., Gajić, T., Vuković, D. (2018). Women's empowerment through self-employment in tourism. *Annals of tourism research*, 76, 328-330, <https://doi.org/10.1016/j.annals.2018.09.004>
40. Vunjak, M.N., Vujko, A., Dragosavac, M., Antonijević, N.T. (2020). Descriptive statistics in corporate management and employee engagement in rural destinations. *Economic of Agriculture*, 67(4), 1087-1101.
41. Vujko, A., Gajić, T. (2014). The government policy impact on economic development of tourism. *Economic of Agriculture*, 61(3), pp. 789-804
42. Vytautas, S., & Vytautas, B. (2014). 19th International Scientific Conference; Economics and Management 2014, ICEM 2014, 23-25 April 2014, Riga, Latvia. The impact of economic factors on the development of rural tourism: Lithuanian case. *Procedia - Social and Behavioral Sciences*, 156, 280 – 285.
43. Wardana, I. M., Sukaatmadja, I. P. G., Yasa, N. N. K., & Setini, M. (2020). Comparative and competitiveness advantages: perspective of rural tourism (study on tourism in the province of Bali Indonesia). *Geo Journal of Tourism and Geosites*, 33, 1493-1500.
44. Woosnam, K. M. (2012). "Using Emotional Solidarity to explain residents' attitudes about tourism and tourism development." *Journal of Travel Research*, 51(3), 315–327.



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# IMPACT OF OIL SHOCKS ON THE OIL, AGRICULTURAL AND FOOD INDUSTRY - QUANTILE AND OLS REGRESSION

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## ABSTRACT

This paper determines the impact of Brent oil shocks on the price of shares of companies from the oil, agricultural and food industries that includes the period of the COVID-19 pandemic. For this purpose, they use a quantile regression approach and compare its findings with a standard Ordinary Least Squares (OLS) regression model. Moreover, in this research they use quantile regression, which enables them to analyze different quantiles of share prices of companies from the oil industry, the agricultural industry, and the food industry. They observe three different periods - a period of recession, a normal period and a period of expansion. Finally, empirical evaluations using quantile regression and OLS models show us that shocks from the oil market are more pronounced in companies from the oil industry compared to companies from the agricultural and food industries. The findings of this research provide important information for investors, economic policy makers, and other parties.

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## Introduction

The price of Brent crude oil is a key economic factor that has a significant impact on the world economy. Brent crude oil price movements have become increasingly complex in recent years, mainly as a result of geopolitical reasons, including the war between Russia and Ukraine (Jahanshahi et al, 2022, Wang et al, 2022). The conflict has caused significant disruptions in oil supplies and has led to increased levels of uncertainty in the oil market, hindering the ability to make accurate predictions. Forecasting Brent crude oil prices is a difficult task. Thus, incorporating the consequences of conflict with the Brent price simulation may prove useful for policy makers, especially in oil-producing countries, as it may help them formulate appropriate fiscal policies (Mati et al, 2023).

Besides the war, the COVID-19 pandemic has had a detrimental effect on the global energy economy. The implementation of response measures, such as a widespread lockdown, has led to disruptions in production and supply chains. This led to a decrease

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in demand for products and services, which in turn caused a drop in commodity prices and a significant global economic downturn. In addition to the health crisis, the pandemic has led to the unemployment of numerous individuals, threatening their livelihoods (Eroğlu et al, 2020). Also, the COVID-19 pandemic caused significant disruptions in the agricultural sector (Zahraee et al, 2022). Various theories have been proposed in recent years to explain the correlation between oil prices and food prices. Regarding agricultural products, it can be explained that the oil and agriculture sectors are closely related due to the high energy needs of agricultural production. Consequently, as the price of oil rises, it leads to increased costs for fertilizers, chemicals and transportation, which in turn leads to an increase in the prices of agricultural products (Pal & Mitra, 2018). Ready (2018) presents a new approach for analyzing factors affecting oil prices by separating them into three different shocks in the context of factors affecting oil: demand shocks, supply shocks, and risk shocks.

Currently, the financial and economic literature widely acknowledges that crude oil and agricultural commodity prices significantly affect global economic activity (Charfeddine et al., 2018, 2020; Vu et al., 2020; Vo, 2019). Crude oil is a key resource for oil exporting and importing countries. Thus, significant fluctuations in crude oil prices will increase global economic unpredictability and deeply affect the economic performance of both economies (Naeem et al., 2022). Moreover, agricultural products have significant importance as strategic resources for all nations at the global level. Consequently, any significant volatility in their prices can lead to serious consequences for both agricultural commodity exporting countries and countries struggling with food insecurity. Therefore, due to the changing characteristics and increasing interdependence of both commodities, it is crucial to prioritize a comprehensive understanding of the nexus between energy and agriculture in order to maintain commodity price stability. This research seeks to address this gap by investigating the co-explosiveness and causality between Brent crude oil price shocks and stock prices of agricultural, food and oil companies.

Han et al. (2015) argued that the price ratio between the crude oil market and the agricultural product market is vulnerable to financial shocks. The correlation between the crude oil market and the agricultural market has been shown to intensify after the financial crisis (Ji & Fan, 2012). Chen et al. (2010) showed that price fluctuations of individual grains between the third week of 2005 and the twentieth week of 2008 were significantly affected by fluctuations in crude oil prices and other food costs. Cabrera & Schulz (2016) noted that the increased linkage between crude oil and agricultural products signifies growing market integration. Furthermore, advances in biofuels have resulted in an increased impact of crude oil price shocks on agricultural prices. World economic activity could potentially affect the situation, as it is possible to assume that global economic growth could lead to higher demand for oil and food, resulting in higher prices for both commodities. Dong et al. (2019) exclusively examined the impact of global economic activity on oil prices and found a significant correlation between them. Another explanation is related to the financialization of the commodity

market. Financialization is a term used to describe the phenomenon when commodity prices exhibit similar behavior to financial assets (Adams et al., 2020).

Umar et al. (2021) conducted a study that examined how COVID-19 affected commodity price fluctuations using wavelet analysis. The researchers used a global index of the coronavirus pandemic and commodity prices from the first seven months of 2020. Their findings have hedging significance, as different levels of coherence indicate different levels of association in both the time and frequency domains between Covid-19 outbreaks and commodity market volatility. In their study, Shahzad et al. (2018) examined unilateral risk transmission from oil prices to agricultural commodities, specifically wheat, corn, soybeans, and rice. The researchers noted evidence of tail-dependent symmetry between the variables, but observed asymmetry in spillovers from oil to agricultural products. The spillover effect was particularly evident during periods of financial instability.

Yip et al. (2020) investigated volatility transmission from crude oil to agricultural products using fractionally integrated VAR and autoregressive Markov Switching models. Their research shows that volatility transmission from crude oil to agricultural products decreased during periods of low volatility but increased during periods of high volatility. Gokmenoglu et al. (2020) conducted a study in Nigeria where they analyzed the dynamic correlation between oil prices and prices of agricultural products. They used monthly data from 2006 to 2015, focusing on cocoa, coffee, wheat, palm oil, soy, livestock and crude oil. Panel techniques show that over time there is a significant and favorable effect of oil prices on prices of agricultural products. However, there was no direct cause and effect relationship between oil prices and agricultural products in Nigeria. A study by Sun et al. (2021) found a reciprocal relationship between the price of oil and agricultural products, as evidenced by the results of comprehensive sample causality tests and sliding windows. Moreover, both agricultural and oil prices have shown resilience to the shocks that have occurred in both markets throughout the duration of the COVID-19 epidemic. Kumar et al. (2021) examined the ratio between oil and five agricultural commodity markets using a dependence shift copula to explore their dependence structure. The findings point to the simultaneous occurrence of oil market crashes and declines in agricultural products, especially during periods of crisis, in contrast to normal economic situations. Moreover, they presented compelling evidence of risk transfer from oil markets to agricultural markets, especially in the context of the financial crisis. Oseni and Kinbode (2018) conducted a study to examine the impact of oil price shocks on agricultural commodity prices in Nigeria. They used a nonlinear autoregressive distributed lag (NARDL) approach and studied monthly oil, corn, wheat, soybean, and exchange rate data from 1997 to 2016. It has been found that the rise in oil prices consistently leads to an increase in agricultural products. Similarly, the exchange rate, viewed as a control variable, showed a statistically significant positive correlation with agricultural products. They provided evidence of the unequal impact of oil prices on agricultural prices in Nigeria. Zafeiriou et al. (2018) examined the correlation between crude oil and futures prices of agricultural products (corn and



soybeans) using the ARDL model. Crude oil has been found to exhibit a strong and persistent relationship with agricultural commodity prices, which is relevant in both the long and short term. Eissa and Refai (2019) used linear and nonlinear ARDL models to estimate the dynamic relationship between oil and agricultural commodity prices. Although the linear model indicates no long-term correlation between these series, the non-linear model shows that barley, corn and canola oil show a long-term correlation with oil prices. Furthermore, the impact of dynamic multipliers shows that barley, corn and canola oil prices show quick and strong responses to cyclical declines in oil prices over a short period of time.

The main goal of this work is to determine the impact of shocks from the Brent oil market on the movement of share prices of companies from three industries, oil, agriculture and food industry. Crude oil and its trading is very widespread, and any kind of oscillation in the price of oil greatly affects the movements in the financial market.

Namely, oil plays a very large role in agriculture and the food industry. According to economic theory, there is a direct impact of rising crude oil prices on agricultural prices. Agriculture, as a sector that requires a large amount of energy, significantly affects the demand for energy. The agricultural sector is directly affected by elevated and fluctuating global oil prices, which consequently affects the costs associated with agricultural production (Aye & Odhiambo, 2021).

**Figure 1.** Oil price trends 2017-2022. year (in USD)



Most of the authors researched the impact of oil shocks on stock prices (Dai & Kang, 2021; Jingjian et al., 2023). Figure 1 shows the movement of the price of Brent oil in the period from 2017-2022. year. As we can see based on the results obtained during the Covid-19 pandemic, there was a significant drop in the price of oil. Our obtained results are in agreement with results and conclusions reached in his research by McMillan et al (2021), proving the consistency of the findings.

Their focus in this research is primarily on the American market and American companies. Initially, the US market served as the primary catalyst for spillover effects to

other markets. Subsequently, COVID-19 spread rapidly throughout the United States, mirroring the crisis that had previously unfolded in China, Italy, and Korea. It is clear that US economic policymakers were well informed about the challenges posed by COVID-19, drawing from the experiences of these aforementioned nations. Not only have the financial markets of the United States of America been affected by COVID-19, but other major financial markets have also been significantly disrupted by the drop in oil prices. After the outbreak of the pandemic, there was a significant drop in the price of oil by 30% within two months (Sharif et al, 2020).

Based on their knowledge, so far no work has dealt with the implementation of research in this sense. Quantile regression approach and Least Square Method - OLS approach will be used in this research.

This paper is organized into several segments. After the previously given introduction, there follows a chapter in which there is an explanation of the methodology used in this research. After that segment of the research, the empirical results are shown, while the last segment gives the conclusion of the research, followed by a list of the literature used.

### **Material and methods**

Linear regression is a statistical technique used to model the linear relationship between a dependent variable and one or more independent variables, including an error component. The fit and regression results improve as the value of the error term decreases. The ordinary least squares (OLS) method provides estimates for the conditional mean of the dependent variable based on the specified independent variables. The efficiency of ordinary least squares (OLS) decreases noticeably when applied to extreme values in distributions or in the context of detailed analysis. The concept of quantile regression was first developed by Koenker & Bassett (1978). This approach is based on the use of conditional quantile functions. Quantile regression is a statistical method used to estimate the conditional median or conditional quartile of a dependent variable, given a set of independent factors. In an ordinary least squares (OLS) context, the regression coefficients of the independent variables represent the magnitude of the effects resulting from a one-unit increase in the respective predictor variables. Similarly, the coefficients obtained from quantile regression represent the changes in a given quantile when the predictor variables experience a one-unit change. Quantiles and percentiles are used to divide data samples into different categories (Maiti, 2021). The OLS model focuses mostly on the conditional mean of the dependent variable, the application of the quantile regression model allows us a more complete way of the variability of the dependent variable in specific quantiles. In situations where the disturbance moment is not normally distributed, the application of quantile estimators allows us a higher degree of efficiency than the OLS estimator.

At time  $t$ , for a given  $X$  variable, while the quantile regression of the  $y$  variable can be expressed as follows:

$$Q_{yt}(\tau|x) = a(\tau) + x'_t \beta(\tau)$$

According to Koenkar and Bassett (1978),  $Q_{yt}(\tau|x)$  represents the  $\tau$  conditional quantile of  $y_t$ ,  $a(\tau)$  indicates effects not observed in the quantile model,  $Ks'_t = (k1t, k2t, \dots, kmt)$  includes all independent variables  $kkt(k = 1, 2, \dots, m)$  that represent the cause of change (Cao, Xie, 2023).

The data set included in this research includes daily data from two different sectors of the economy. Daily data were converted to logarithmic values using the following equation:

$$r_{it} = 100 \times \ln(p_{it} / p_{it-1})$$

In this way, they corrected the disparities that manifest themselves within the time series. Specifically, all observed variables are matched to correct for dimensional differences across the time series. In other words, all variables are treated as growth rates. The data was obtained from stooq.com statistical records, with the research period from 2017 to 2022. This research period also includes the period of the COVID-19 pandemic, and they will observe its impact on shocks in the oil market, and consequently on the impact of oil on the price of company shares. The survey included 9 companies from three different industries, the oil, food and agricultural industries. The main focus of our research is on the US market and US companies for several reasons. Initially, the US market played a central role in causing spillover effects in other markets. After that, COVID-19 spread rapidly across the United States, similar to what happened earlier in China, Italy, and Korea. US economic policymakers have demonstrated a clear understanding of the challenges posed by COVID-19, drawing on insights from the experiences of other nations (Shariff et al, 2020).

### Results of empirical research

Table 1 shows the descriptive statistics of the time series.

**Table 1.** Descriptive statistics

	Mean	Sd	Min	Max	Skewness	Kurtosis	Jarque - Bera	Dickey-Fuller GLS
Panel A. Oil companies								
BPL Plc	0.001	0.916	-9.413	8.488	-0.268	18.831	15829.17	-36.888
Petroleo Brasileiro SA	0.016	1.468	-16.108	8.547	-1.698	20.849	20757.96	-11.932
Total Energies SE	0.013	0.845	-8.526	6.174	-0.980	20.697	23606.26	-25.893
Panel B. Food companies								
General Mills INC	0.015	0.633	-5.262	4.837	-0.685	12.047	5195.149	-8.432

	Mean	Sd	Min	Max	Skewness	Kurtosis	Jarque - Bera	Dickey-Fuller GLS
Kraft Heinz Co	-0.014	0.843	-13.943	7.733	-2.770	62.656	225694.6	-8.652
Tyson Food INC	0.003	0.799	-6.653	8.884	0.212	20.550	19377.57	-2.989
Panel C. Agricultural companies								
Agco Corporation	0.028	1.003	-9.034	7.922	-0.375	12.663	5907.351	-1.449
Bunge Limited	0.014	0.893	-6.694	6.670	-0.516	11.621	4740.782	-6.353
Deere & Company	0.033	0.862	-6.586	5.441	-0.557	9.877	3519.120	-2.993

*JB stands for the Jarque-Bera coefficients of normality, DF-GLS is Dickey-Fuller generalized least squares test with 10 lags assuming only constant, and 1% and 5% critical values are 2.566 and 1.941, respectively.*

*Source: Own calculation*

As they can conclude that time series are primarily stationary, that is, the mean value of the data tends to zero. The companies Petroleo Brasileiro SA and Agco Corporation show the highest degree of riskiness, i.e. dispersion around the mean value. Also, the value of skewness indicates that the tail of the distribution is extended to the left, i.e. there is a negative asymmetry in most of the observed companies. A high value of kurtosis indicates the fact that the values are concentrated within the middle of the distribution, that is, they indicate the existence of extreme shocks. The Jarque-Bera test indicates the non-normality of the observed time series. The Dickey-Fuller GLS test suggests the stationarity of the observed time series.

**Results obtained using the Least Square regression - OLS model.** The following table shows the results obtained using the Least Square regression - OLS model. By looking at the obtained parameters, they can conclude that most of them are statistically significant. First, they will present the results obtained using the least squares method. In this case, they tried to determine whether there is a strong or weak relationship between the observed independent variable Brent oil and the stock price of the observed companies, in this case the dependent variables. In their work, they dealt with the price of shares of companies from two industrial sectors, the first one is the oil industry, and the second one is the agricultural industry. In the majority of observed companies, they observe the statistical significance of the obtained data.

**Table 2.** Least Square regression - Brent oil and companies from the oil, agricultural and food industries

Companies	Least Squere regression OLS
BPL Plc	0.416 (0.019)***
Petroleo Brasileiro SA	0.597 (0.031)***
Total Energies SE	0.402 (0.018)***
General Mills INC	0.023 (0.015)***
Kraft Heinz Co	0.138 (0.019)***
Tyson Food INC	0.141 (0.018)***
Agco Corporation	0.094 (0.021)***
Bungle Limited	0.115 (0.016)***
Deere & Company	0.161(0.017)***

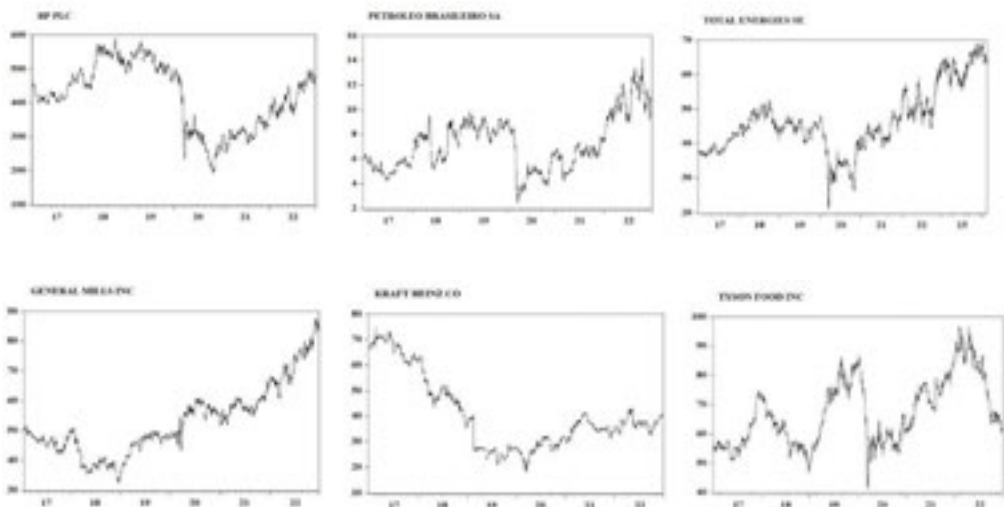
Note: \*\*\*, \*\*, \* represent statistical significance at the 1%, 5% and 10% level, respectively; numbers in parentheses represent standard error

Source: Own calculation

The results obtained and shown in table 2 indicate that the results of companies from the agricultural and food industry are several times lower than companies from the oil industry, which is economically logical. This happens depending on whether the companies are more or less energy dependent on oil. Given that companies from the oil industry are more energy dependent on oil, based on the parameters we can see a stronger effect on their share prices.

The use of the OLS regression method, which is used frequently, can be sensitive if the data does not conform to the assumptions, which can result in unreliability. Among other things, there is the disadvantage of handling non-linear relationships and missing values.

**Figure 2.** Graphic representation of changes in share prices of observed companies from the oil, agricultural and food industries



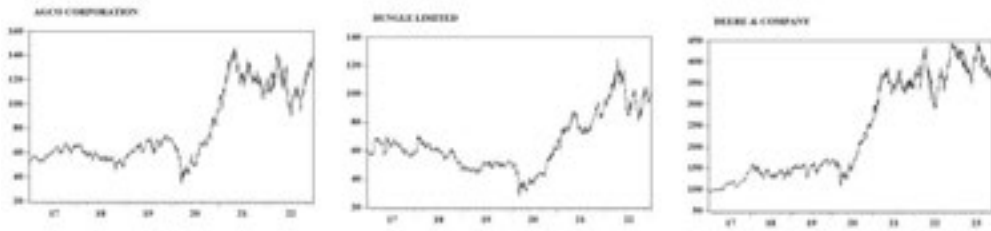


Chart 2 gives them a view of the change in share prices of the observed 9 companies from the oil, agricultural and food sectors in relation to changes in the price of Brent oil. As they can see, the Covid-19 pandemic has significantly affected the observed companies, and the majority of companies have recorded a drop in the price of the observed companies' shares. Lee (2022) in his research determines that COVID-19 has a significant impact on stock price volatility in the banking sector, as well as that there is a strong spillover effect on America's economic and financial systems. Insaïdoo et al (2023) dealt in their research with the cause of changes in the financial market in developing countries (Brazil, India, Kenya and South Africa) and although they consider that a deeper research of the financial market is limited, they confirm that the COVID-19 pandemic is the biggest cause of changes in the financial market. As Tian et al (2023) confirms in their research, predicting the price of crude oil is of great importance considering that it is one of the world's most important commodities and sources of energy. Its influence is very uncertain, especially during the pandemic, but also under the conditions of the Russian-Ukrainian conflict.

**Results obtained using the quantile regression model.** In the next part of the research, they will analyze the results obtained through the estimated quantile parameters, which are shown in the interval from  $\tau^{0.05}$  to  $\tau^{0.95}$ . As they can see

the following table presents the obtained research data, while the Figure shows the obtained quantiles. For most observed quantiles, the obtained parameters are statistically significant, ie the probability is greater than 99%. The application of quantiles gives them the opportunity to see what shocks are in the oil market, that is, shocks in a recession, in stable economic growth, as well as in a state of high economic growth. They will present seven quantiles, i.e. quantiles  $\tau^{0.05}$  and  $\tau^{0.15}$  indicate the state of the economy in recession,  $\tau^{0.35}$ ,  $\tau^{0.50}$  and  $\tau^{0.65}$  indicate the state of stable economic growth, while quantiles  $\tau^{0.8}$  and  $\tau^{0.95}$  indicate the state of high economic growth. In the table, they have presented the impact of shocks from the Brent oil market on the price of shares of companies from the oil, agricultural and food industries, that is, they will look at 9 companies. The period covered by the research is 2017-2022. where, among other things, changes are expressed as a result of the COVID-19 pandemic. The results include data before the pandemic, during the pandemic, and after it.

**Table 3.** Representation of quantile regression - Brent oil and the price of shares of companies from the oil and agricultural industry

Companies	0.05	0.20	0.35	0.50	0.65	0.80	0.95
BPL Plc	0.496 (0.027)***	0.424 (0.030)***	0.390 (0.026)***	0.382 (0.033)***	0.366 (0.028)***	0.376 (0.030)***	0.361 (0.036)***
Petroleo Brasileiro SA	0.665 (0.027)***	0.519 (0.039)***	0.451 (0.040)***	0.480 (0.036)***	0.505 (0.040)***	0.534 (0.051)***	0.501 (0.141)***
Total Energies SE	0.470 (0.023)***	0.404 (0.030)***	0.405 (0.026)***	0.396 (0.022)***	0.381 (0.022)***	0.379 (0.029)**	0.345 0.058
General Mills INC	0.109 (0.052)***	0.021 (0.013)***	0.031 (0.013)***	0.017 (0.017)***	-0.005 (0.018)***	0.006 (0.017)**	0.069 (0.015)***
Kraft Heinz Co	0.220 (0.014)***	0.127 (0.027)***	0.093 (0.016)***	0.094 (0.016)***	0.077 (0.022)***	0.071 (0.024)***	0.096 (0.021)*
Tyson Food INC	0.226 (0.066)***	0.153 (0.036)***	0.124 (0.017)***	0.103 (0.027)***	0.078 (0.022)***	0.054 (0.020)***	0.056 (0.035)
Agco Corporation	0.278 (0.070)***	0.262 (0.026)***	0.267 (0.032)***	0.181 (0.038)***	0.189 (0.028)***	0.206 (0.024)***	0.193 (0.042)***
Bunge Limited	0.197 (0.044)***	0.109 (0.016)***	0.062 (0.026)***	0.067 (0.031)***	0.071 (0.031)***	0.070 (0.033)***	0.144 (0.070)***
Deere & Company	0.296 (0.072)***	0.272 (0.028)***	0.191 (0.025)***	0.180 (0.030)***	0.185 (0.024)***	0.209 (0.044)***	0.187 (0.040)***

Note: \*\*\*, \*\*, \* represent statistical significance at the 1%, 5% and 10% level, respectively; numbers in parentheses represent standard error.

Source: Own calculation

Observing the obtained results, they will first analyze the company from the oil industry - BPL Plc. It is interesting to note that the estimated quantile parameters on the left and right sides of the distribution  $\tau^{0.05}$  and  $\tau^{0.95}$  are the highest in companies from the oil industry, which leads them to conclude that Brent oil has the greatest impact on those companies that have a higher level of energy dependence, that is, with those companies that are looking for a much higher level of energy compared to other industries. Thus, they can see that at the observed quantile  $\tau^{0.05}$   $\tau^{0.20}$  at the moment of a drop in the price of oil by 1%, there was also a drop in the price of shares of BPL Plc by 0.49% and 0.42%. The conditions of stable economic growth are characterized by quantiles that depict a lower level of influence of oil on company share prices. In a period of high economic growth, that is, the quantile parameters  $\tau^{0.80}$  and  $\tau^{0.95}$  indicate that if there is a 1% increase in the price of Brent oil, it will contribute to the increase in the price of the company's shares by 0.37% and 0.36%, respectively.

The next observed company is Petroleo Brasileiro SA, and they can see that at the observed quantile  $\tau^{0.05}$  and  $\tau^{0.20}$ , at the moment of a drop in the price of oil by 1%, there was also a drop in the share price of Petroleo Brasileiro SA by 0.66% and 0.52%. The conditions of stable economic growth are illustrated by the quantiles  $\tau^{0.35}$ ,  $\tau^{0.50}$  and  $\tau^{0.65}$ , and an increase in the price of Brent oil by 1% is likely to be followed by an increase in the price of Petroleo Brasileiro SA shares by about 0.45%, 0.48% and 0.50%, which implies that there is positive association between these two markets. In the conditions of high economic growth illustrated by the quantiles  $\tau^{0.80}$  and  $\tau^{0.95}$ , a 1% increase in Brent oil contributes to an increase in the company's share price by 0.53% and 0.50%, respectively.

The next observed company is Total Energies SE, and they can see that at the observed quantiles  $\tau^{0.05}$  and  $\tau^{0.20}$  at the moment of a drop in the price of oil by 1%, there was also a drop in the price of shares of Total Energies SE by 0.47% and 0.40%. . In the conditions of stable economic growth and the corresponding quantiles, the impact of the price of Brent oil on the price of the company's shares is observed at 0.40%, 0.39% and 0.38%. In conditions of high economic growth illustrated by the quantiles  $\tau^{0.80}$  and  $\tau^{0.95}$ , a 1% increase in Brent oil contributes to an increase in the company's share price by 0.37% and 0.34%, respectively.

The company from the food industry that they looked at next is General Mills INC, and they can see that at the observed quantile  $\tau^{0.05}$  and  $\tau^{0.20}$  at the moment of a drop in the price of oil by 1%, there was also a drop in the price of shares of General Mills INC by 0.10% and 0.02%. In conditions of stable economic growth, a weaker influence of the price of Brent oil on the price of the company's shares is observed in 0.03% and 0.01% compared to the other quantiles they observed. In the conditions of high economic growth depicted by the quantiles  $\tau^{0.80}$ , the impact of shocks from the oil market is not pronounced, while on the quantile  $\tau^{0.95}$  and 0.06%, respectively.

The company from the food industry that they observed next is Kraft Heinz Co, and they can see that at the observed quantile  $\tau^{0.05}$  and  $\tau^{0.20}$  at the moment of the drop in the price of oil by 1%, there was also a drop in the price of shares of Kraft Heinz Co by 0.22% and 0.12%. The conditions of stable economic growth are illustrated by the quantiles  $\tau^{0.35}$ ,  $\tau^{0.50}$  and  $\tau^{0.65}$ , and an increase in the price of Brent oil by 1% is likely to be accompanied by an increase in the price of the company's shares by about 0.09%, 0.09% and 0.07%, which implies that there is a weaker positive association between the two markets. In conditions of high economic growth illustrated by quantiles  $\tau^{0.80}$  and  $\tau^{0.95}$ , a 1% increase in Brent oil contributes to an increase in Kraft Heinz Co's stock price by 0.07% and 0.09%, respectively.

The company from the food industry that we looked at next is Tyson Food INC, and they can see that at the observed quantile  $\tau^{0.05}$  and  $\tau^{0.20}$  at the moment of the drop in the price of oil by 1%, there was also a drop in the price of shares of Tyson Food INC by 0.22% and 0.15%. The conditions of stable economic growth are illustrated by the quantiles  $\tau^{0.35}$ ,  $\tau^{0.50}$  and  $\tau^{0.65}$ , and an increase in the price of Brent oil by 1% is likely to be followed by an increase in the price of the company's shares by about 0.12%, 0.10%



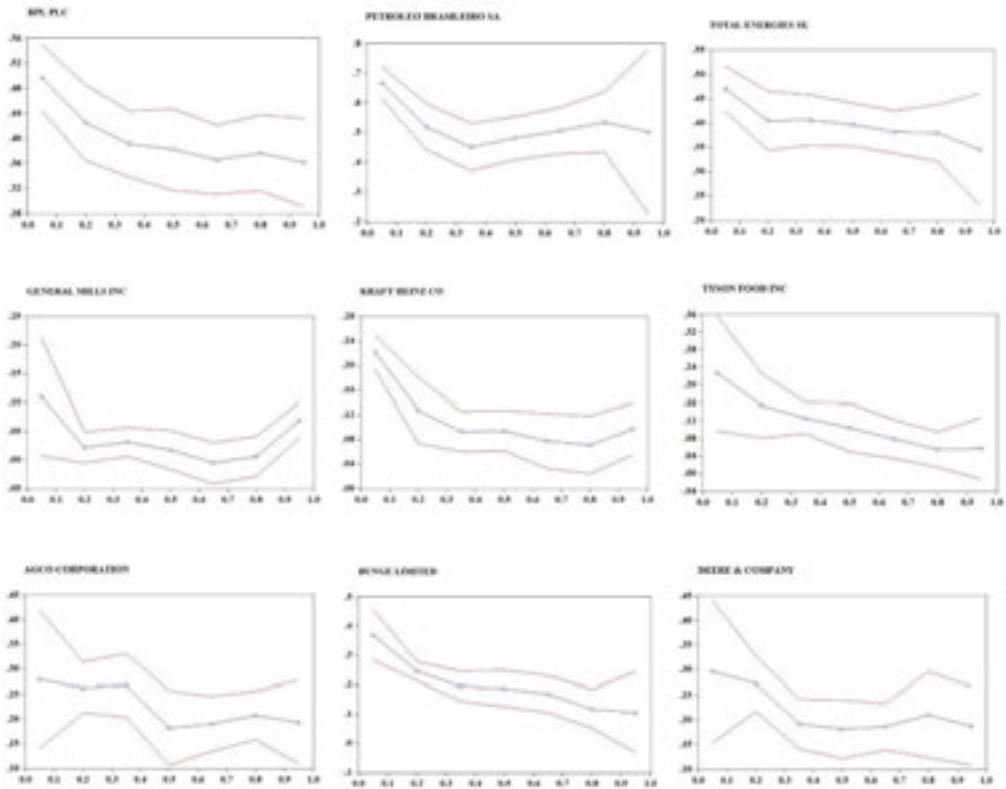
and 0.07%, which implies that there is a weaker positive association between the two markets. In conditions of high economic growth depicted by the  $\tau^{0.80}$  and  $\tau^{0.95}$  quantiles, a 1% increase in Brent oil contributes to a 0.05% and 0.05% increase in Tyson Food INC's share price, respectively.

The company from the agricultural industry that they observed is Agco Corporation, and they can see that at the observed quantiles  $\tau^{0.05}$  and  $\tau^{0.20}$  at the moment of a drop in the price of oil by 1%, there was also a drop in the price of shares of Agco Corporation by 0.27% and 0.26%. The conditions of stable economic growth are illustrated by the quantiles  $\tau^{0.35}$ , and an increase in the price of Brent oil by 1% is likely to be followed by an increase in the price of the company's shares by about 0.26%, while the quantiles  $\tau^{0.50}$  and  $\tau^{0.65}$  show the impact of shocks from the oil market by 0.18% and 0.18%. In conditions of high economic growth illustrated by quantiles  $\tau^{0.80}$  and  $\tau^{0.95}$ , a 1% increase in Brent oil contributes to an increase in Agco Corporation's stock price by 0.20% and 0.19%, respectively.

The company from the agricultural industry that they looked at next is Bunge Limited, and they can see that at the observed quantile  $\tau^{0.05}$  and  $\tau^{0.20}$  at the moment of the drop in the price of oil by 1%, there was also a drop in the price of Bunge Limited's shares by 0.19% and 0.10%. The conditions of stable economic growth are illustrated by the quantiles  $\tau^{0.35}$ ,  $\tau^{0.50}$  and  $\tau^{0.65}$ , and an increase in the price of Brent oil by 1% is likely to be followed by an increase in the price of the company's shares by about 0.06%, 0.06% and 0.07%, which implies that there is a positive association between these two markets. In conditions of high economic growth, which are illustrated by the quantiles  $\tau^{0.80}$  and  $\tau^{0.95}$ , oil growth Brent by 1% contributes to the growth of Bunge Limited's share price by 0.07% and 0.14%, respectively.

The next agricultural company that they looked at next is Deere & Company, and they can see that at the observed quantile  $\tau^{0.05}$  and  $\tau^{0.20}$  at the moment when the price of oil fell by 1%, the share price of Deere & Company fell by 0.29% and 0.27%. The conditions of stable economic growth are illustrated by the quantiles  $\tau^{0.35}$ ,  $\tau^{0.50}$ ,  $\tau^{0.65}$ , and an increase in the price of Brent oil by 1% is likely to be followed by an increase in the price of the company's shares by about 0.19%, 0.18%, 0.18%, which implies that there is a positive correlation between these two markets. In conditions of high economic growth, which are depicted by the quantiles  $\tau^{0.80}$  and  $\tau^{0.95}$ , they also observe that there is an evident influence of the price of oil on the price of shares by 0.20% and 0.18%.

As they can see in the conducted research, more intense effects are found in the industry that is more energy dependent on oil, that is, in the oil industry. Also, the obtained results suggest that the spillover effects of shocks from the oil market on the price movement of shares of the agricultural industry are much smaller. Yang et al (2023) confirms the findings obtained by this research. Namely, the price of oil has a very significant effect on companies from the oil industry compared to other industries.

**Figure 3.** Graphic representation of quantiles  $\tau^{0.05}$  and  $\tau^{0.95}$ 

On the Figure shown, they can see the movement of quantiles in different periods. They can notice that the quantiles located on the left edge of the distribution have a greater degree of change in the period of economic recession, while those quantiles located on the right side indicate that there is a lesser degree of change in the period of high economic growth. The middle quantiles show them the normal state of the economy, in which the price of oil and the price of shares usually move together. As they can see from the graphic representation, companies from the oil industry suggest a much higher degree of sensitivity to shocks in the oil market than companies from the agricultural and food industry. The companies Agco Corporation indicate that there is no influence of the oil price on the price of shares of these companies on the left quantile  $\tau^{0.05}$ , the company Deere & Company indicates that there is no spillover of shocks from the oil market to the observed company on the quantiles  $\tau^{0.65}$ ,  $\tau^{0.80}$  and  $\tau^{0.95}$ . Tyson Food INC shows that there is no impact of shocks from the oil market on the company's share price, which is confirmed in the parameters they have listed in the table.

## Conclusion

This research presents a comprehensive analysis of the impact of Brent oil, the most important commodity at the global level, on the share prices of companies operating in three different sectors, i.e. the oil industry, the agricultural industry and the food industry in the period (before) the COVID-19 era and the war between Russia and of Ukraine. To obtain the research results, they used quantile regression and OLS approach. By applying these two techniques, it is guaranteed that the results achieved will be objective and credible. The obtained results further show the limited applicability of the OLS methodology, while the use of quantile regression provides more comprehensive data. With the aim of the research, they wanted to determine the existence of shocks from the Brent oil market on the share price of companies from three different sectors, and with the obtained results they determined that there is a connection between shocks from the Brent oil market and companies, while the degree of influence is different.

First of all, the results of the research indicate that oil, as the most valuable resource at the global level, affects the price fluctuations of various organizations, as well as their supply, which facilitates the execution of a wide range of economic undertakings. Consequently, it can be concluded that the decrease in the value of Brent oil is particularly noticeable in periods of economic decline, characterized by a significant contraction of economic activity. Moreover, the findings indicate that the fall in the price of Brent oil has a particularly significant impact on companies in the oil industry, making them the most disadvantaged.

The proposal for future research could cover a longer time period of analysis, and therefore a longer-term analysis of the effects of these shocks, cover different sectors, cover some other factors such as geopolitical risks, economic activities or technological innovations. The scientific impact of this research can be seen as a contribution to the understanding of the complex ratio between oil prices and share prices of companies from the oil, food and agriculture industries, providing useful insights for the academic community, analysts and economic policy makers.

## Conflict of interests

The authors declare no conflict of interest.

## References

1. Adams, Z., Collot, S., & Kartsakli, M. (2020). Have commodities become a financial asset? Evidence from ten years of Financialization. *Energy Economics*, 89, 104769.
2. Aye, G. C., & Odhiambo, N. M. (2021). Oil prices and agricultural growth in South Africa: A threshold analysis. *Resources Policy*, 73, 102196.
3. Cabrera, B. L., & Schulz, F. (2016). Volatility linkages between energy and agricultural commodity prices. *Energy Economics*, 54, 190-203.

4. Cao, G., & Xie, F. (2023). The asymmetric impact of crude oil futures on the clean energy stock market: Based on the asymmetric variable coefficient quantile regression model. *Renewable Energy*, 218, 119303. <https://doi.org/10.1016/j.renene.2023.119303>
5. Charfeddine, L., Klein, T., & Walther, T. (2018). Oil price changes and US real GDP growth: is this time different?. *University of St. Gallen, School of Finance Research Paper*, (2018/18).
6. Chen, S. T., Kuo, H. I., & Chen, C. C. (2010). Modeling the relationship between the oil price and global food prices. *Applied Energy*, 87(8), 2517-2525.
7. Dai, Z., & Kang, J. (2021). Bond yield and crude oil prices predictability. *Energy Economics*, 97, 105205.
8. Dong, M., Chang, C. P., Gong, Q., & Chu, Y. (2019). Revisiting global economic activity and crude oil prices: A wavelet analysis. *Economic Modelling*, 78, 134-149.
9. Eissa, M. A., & Al Refai, H. (2019). Modelling the symmetric and asymmetric relationships between oil prices and those of corn, barley, and rapeseed oil. *Resources Policy*, 64, 101511.
10. Eroğlu, A. Y., Çakır, Ö., Sağdıç, M., & Dertli, E. (2020). Bioactive characteristics of wild *Berberis vulgaris* and *Berberis crataegina* Fruits. *Journal of Chemistry*, 2020, 1-9.
11. Gokmenoglu, K. K., Güngör, H., & Bekun, F. V. (2021). Revisiting the linkage between oil and agricultural commodity prices: Panel evidence from an Agrarian state. *International Journal of Finance & Economics*, 26(4), 5610-5620. <https://doi.org/10.1002/ijfe.2083>.
12. Han, L., Zhou, Y., & Yin, L. (2015). Exogenous impacts on the links between energy and agricultural commodity markets. *Energy Economics*, 49, 350-358.
13. Insaïdo, M., Ullah, A., Dziwornu, R. K., Amoako, S., & Abdul-Mumuni, A. (2023). COVID-19 pandemic and stock market performance: A comparative study of emerging economies. *Heliyon*, 9(5). <https://doi.org/10.1016/j.heliyon.2023.e16054>
14. Jahanshahi, H., Uzun, S., Kaçar, S., Yao, Q., & Alassafi, M. O. (2022). Artificial intelligence-based prediction of crude oil prices using multiple features under the effect of Russia–Ukraine war and COVID-19 pandemic. *Mathematics*, 10(22), 4361. <https://doi.org/10.3390/math10224361>.
15. Ji, Q., & Fan, Y. (2012). How does oil price volatility affect non-energy commodity markets?. *Applied Energy*, 89(1), 273-280.
16. Jingjian, S., Xiangyun, G., Jinsheng, Z., Anjian, W., Xiaotian, S., Yiran, Z., & Hongyu, W. (2023). The impact of oil price shocks on energy stocks from the perspective of investor attention. *Energy*, 127987.
17. Koenker, R., & Bassett Jr, G. (1978). Regression quantiles. *Econometrica: journal of the Econometric Society*, 33-50. <https://doi.org/10.2307/1913643>

18. Kumar, S., Tiwari, A. K., Raheem, I. D., & Hille, E. (2021). Time-varying dependence structure between oil and agricultural commodity markets: A dependence-switching CoVaR copula approach. *Resources Policy*, 72, 102049. <https://doi.org/10.1016/j.resourpol.2021.102049>
19. Li, S. (2022). COVID-19 and A-share banks' stock price volatility: From the perspective of the epidemic evolution in China and the US. *Global Finance Journal*, 54, 100751. <https://doi.org/10.1016/j.gfj.2022.100751>
20. Maiti, M. (2021). Quantile regression, asset pricing and investment decision. *IIMB Management Review*, 33(1), 28-37. <https://doi.org/10.1016/j.iimb.2021.03.005>
21. Mati, S., Radulescu, M., Saqib, N., Samour, A., Ismael, G. Y., & Aliyu, N. (2023). Incorporating Russo-Ukrainian war in Brent crude oil price forecasting: A comparative analysis of ARIMA, TARMA and ENNReg models. *Heliyon*, 9(11).
22. McMillan, D. G., Ziadat, S. A., & Herbst, P. (2021). The role of oil as a determinant of stock market interdependence: The case of the USA and GCC. *Energy Economics*, 95, 105102.
23. Naeem, M. A., Karim, S., Hasan, M., Lucey, B. M., & Kang, S. H. (2022). Nexus between oil shocks and agriculture commodities: Evidence from time and frequency domain. *Energy Economics*, 112, 106148.
24. Oseni, I., & Oladele, K. S. (2018). Oil price shock and agricultural commodity prices in Nigeria: A Non-Linear Autoregressive Distributed Lag (NARDL) Approach. *African Journal of Economic Review*, 6(2).
25. Pal, D., & Mitra, S. K. (2018). Interdependence between crude oil and world food prices: A detrended cross correlation analysis. *Physica A: Statistical Mechanics and its Applications*, 492, 1032-1044.
26. Ready, R. C. (2018). Oil prices and the stock market. *Review of Finance*, 22(1), 155-176.
27. Shahzad, S. J. H., Hernandez, J. A., Al-Yahyaee, K. H., & Jammazi, R. (2018). Asymmetric risk spillovers between oil and agricultural commodities. *Energy Policy*, 118, 182-198.
28. Sharif, A., Aloui, C., & Yarovaya, L. (2020). COVID-19 pandemic, oil prices, stock market, geopolitical risk and policy uncertainty nexus in the US economy: Fresh evidence from the wavelet-based approach. *International review of financial analysis*, 70, 101496. <https://doi.org/10.1016/j.irfa.2020.101496>
29. Sun, Y., Mirza, N., Qadeer, A., & Hsueh, H. P. (2021). Connectedness between oil and agricultural commodity prices during tranquil and volatile period. Is crude oil a victim indeed?. *Resources Policy*, 72, 102131. <https://doi.org/10.1016/j.resourpol.2021.102131>, 1-8.
30. Tian, G., Peng, Y., & Meng, Y. (2023). Forecasting crude oil prices in the COVID-19 era: Can machine learn better?. *Energy Economics*, 106788. <https://doi.org/10.1016/j.eneco.2023.106788>

31. Umar, Z., Gubareva, M., & Teplova, T. (2021). The impact of Covid-19 on commodity markets volatility: Analyzing time-frequency relations between commodity prices and coronavirus panic levels. *Resources Policy*, 73, 102164.
32. Vo, D. H., Vu, T. N., Vo, A. T., & McAleer, M. (2019). Modeling the relationship between crude oil and agricultural commodity prices. *Energies*, 12(7), 1344.
33. Vu, T. N., Ho, C. M., Nguyen, T. C., & Vo, D. H. (2020). The determinants of risk transmission between oil and agricultural prices: an IPVAR approach. *Agriculture*, 10(4), 120.
34. Wang, X., Li, X., & Li, S. (2022). Point and interval forecasting system for crude oil price based on complete ensemble extreme-point symmetric mode decomposition with adaptive noise and intelligent optimization algorithm. *Applied Energy*, 328, 120194. <https://doi.org/10.1016/j.apenergy.2022.120194>.
35. Yip, P. S., Brooks, R., Do, H. X., & Nguyen, D. K. (2020). Dynamic volatility spillover effects between oil and agricultural products. *International Review of Financial Analysis*, 69, 101465.
36. Zafeiriou, E., Arabatzis, G., Karanikola, P., Tampakis, S., & Tsiantikoudis, S. (2018). Agricultural commodities and crude oil prices: An empirical investigation of their relationship. *Sustainability*, 10(4), 1199.
37. Zahraee, S. M., Shiwakoti, N., & Stasinopoulos, P. (2022). Agricultural biomass supply chain resilience: COVID-19 outbreak vs. sustainability compliance, technological change, uncertainties, and policies. *Cleaner Logistics and Supply Chain*, 4, 100049.
38. Yang, J., Li, Y., & Sui, A. (2023). From black gold to green: Analyzing the consequences of oil price volatility on oil industry finances and carbon footprint. *Resources Policy*, 83, 103615. <https://doi.org/10.1016/j.resourpol.2023.103615>



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# THE INFLUENCE OF FACTORS ON THE COSTS OF DIFFERENT TYPES OF LOANS IN BUSINESS OF AGRICULTURAL FARMS AND MEDIUM-SIZED AGRICULTURAL ENTERPRISES

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## ABSTRACT

The application of the use of different types of loans in the real organization of agricultural production in Republic of Serbia was the focus of the authors of the study. The goal of the research was to determine the existence of legality based on the analysis of 7 factors affecting the loans of agricultural farms and medium-sized agricultural enterprises, namely: limit, repayment delay, efficiency, average exchange rate, possibility of repayment, increase in production, currency, as well as the overall score of all analyzed factors as well as the total score. Using the t test (Table 1), the authors found that there are significant differences in the evaluation of all 7 analyzed factors ( $p < 0.0005^*$ ). In addition, the authors determined that there are significant differences in the evaluation of the use of three types of loans ( $p < 0.0005^*$ ) by agricultural farms and medium-sized agricultural enterprises in the Republic of Serbia.

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## Introduction

The organization of agricultural production is increasingly based on a combination of different forms of organization. One of the key factors, i.e. the form of organizing agricultural production, is the organization of it in agricultural farms, which was pointed out by numerous authors in their works, such as (Kovacs, 2021; Kvartiuk & Herzfeld, 2022; Mazumder & Kabir, 2022; Adenauer et al., 2022; Hopewell, 2022).

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The functioning of a real agricultural farm essentially depends on numerous factors. One of the important factors is keeping proper documentation of all business events when organizing agricultural production (Novaković et al., 2018; Kumar & Narayanamoorthy, 2021; Arnautović et al., 2022; Popović et al., 2022; Luković et al., 2023).

The activities that take place at the end of the agricultural production process have their own value, which represents the very meaning of the same organization, which was pointed out by numerous authors in their works, such as (Popović et al., 2018; Finžgar & Brezovnik, 2019; Živković et al., 2019; Assima et al., 2022; Radović et al., 2023).

The real maintenance of the functionality of the economic production sustainability of farming in agricultural farms is in the broader focus of numerous studies, in which the economic justification of production in them is observed from a certain aspect (Popović et al., 2015; Seleka & Mmopelwa, 2020; Vitomir et al., 2020; Uyar et al., 2022). However, it should be emphasized that the result of productive economic activity in agricultural farms is primarily measurable in monetary units, as pointed out by authors such as (Burešova et al., 2020; Lososová & Zdeněk, 2023).

In agricultural holdings, business decision-makers should adapt to the newly created market conditions as soon as possible. Many authors point to such activities and from two aspects. We meet the first in works that focus on the application of internal controls in the organization of agricultural activities, which are engaged in by the agricultural holdings themselves (Popović et al., 2014; Miletić & Radić, 2022; Vitomir et al., 2021).

The owners of agricultural holdings, more precisely the holders of business decision-making in them, should apply a high degree of standardization in their work, which was pointed out by authors such as (Popović et al., 2017), and which essentially should enable the improvement of the economic results achieved in the agricultural holdings themselves.

The observation of business operations in agricultural farms requires the management decision-makers to apply realistic management models in them in order to ensure the achievement of better economic production effects, as pointed out by authors such as (Hoyo et al., 2022; Jakubowska & Sadílek, 2023; Jordan et al., 2023).

The overall success of the organization of agricultural farms can depend to a great extent on the adopted measures of the overall economic policy, which were emphasized in their works by authors such as (Zhang & Colak, 2022), but also on the degree of deeper integration in all sectors of the economy (Wang et al., 2022; Adžić et al., 2022; Xu et al., 2022).

### **Theoretical background**

The activities of agricultural farms, especially when they are observed after the end of the production intended for the market, passes into the next phase of the action of the realization of goods, where the real establishment of a credit relationship between the goods intended for the market and other participants increasingly comes to the fore,

which was pointed out by authors such as (Chen et al., 2019). Such an observation can be said to have its own social-credit basis of observation and that in all phases of the movement of goods of agricultural holdings when they enter the market (Chong, 2019), however, the creation of a credit relationship can essentially mean the formation of a cultural dimension between all participants in the market (Colebrooke et al., 2023).

However, the process of bringing out the more valuable products produced by the agricultural economy has another dimension, which is the origin and development of the credit relationship and responsibility, which first of all has its manifestation on the market, as pointed out by an author like (Curzer, 2021), noting that such an observation, first of all, of the credit cycle should be fundamentally evolutionary (Dermineur, 2022).

In addition, it should be pointed out that the widest appreciation of the credit-agricultural commodity relations that have been put on the market comes from observing the Government's decision-making decisions (Downey, 2023), which have their own implications for agricultural production and therefore also for agricultural farms.

The observation of the creation of credit relations in agriculture should largely be focused on the analysis and study of partial lending (Gurmessa et al., 2022), but with full respect for the establishment of controls on funds and loans that follow agricultural holdings (Popović, 2014; Savić & Milojević, 2022; Hang, 2023), which can greatly affect the formation of the overall picture of the existence of a real credit score (Hearn, 2023).

Overall crediting, which follows the entire system of agricultural production in a country, is based on a full appreciation of the credit risk (Kanazir, 2023), which must be respected especially if the decisions of the state leadership are aimed at achieving real agricultural development (Kumari & Garg, 2023), because based on such an observation, the development of agricultural farms and the realization of their real benefits can be established (Kovacs, 2021).

Organized agricultural production, and thus the organized system of agricultural farms in the chain of monitoring financial results, requires the decision-makers to keep as accurate records of all financial transactions as possible (Lee & Carlisle, 2020), because agricultural farms themselves are also clients of banks (Mésonnier, 2022), and in this way all forms of agricultural production can come to the fore (Oparinde & Olutumise, 2022).

The allocation of loans on all grounds related to agriculture is becoming a reality in market economies, as seen in the study (Paor, 2021), that is, such appreciation of the problem of lending in agriculture should be viewed from the broadest social point of view, because in this way the broadest impact on the mentioned branch of the economy is realized (Nwosu et al., 2023).

Therefore, agricultural production, and therefore its organization in agricultural farms, should respect the reality and perspective of activities in agriculture (Shi et al., 2020), but also of other heterogeneous companies (Wasserman, 2022; Su et al., 2023).

## Materials and methods

This study was created by surveying 205 participants, i.e. 152 registered agricultural holdings and 53 medium-sized agricultural enterprises in the Republic of Serbia. The research period included the period July-August 2023. In order to conduct the research, the data obtained by the survey were used in the process of classical statistical data processing through the application of the stages shown in the study.

The aim of the research carried out by the author was to determine the possible differences in the valuation of the owners of agricultural farms and medium-sized agricultural enterprises in relation to three types of loan use (more specific limit, investment loan and use of loans for permanent working capital) i.e. in relation to their operations .

In addition, the authors, based on the evaluation of the owners of agricultural farms and the evaluation of the management of agricultural companies, made a comparison with the obtained amount of costs related to the use of loans from the previous period of operation (the final account from 2022).

The assessment of possible impacts in relation to the type of bank loans on the business of farms was done in a way that has two logical units.

The first unit was made on the basis of seven analyzed factors, namely: on the basis of determining the amount of the loan limit, the possibility of delaying the repayment of the loan, increasing the efficiency of business, the average loan repayment rate, the possibility of repaying the loan debt in installments, increasing production after taking the loan, choosing the currency for repayment credit ratio, as well as the values obtained by the total evaluation of the factors.

The evaluation based on the conducted survey ranged from 1 to 10. The lowest evaluation included weak impact and was given the opportunity to express it with a score of 1, and the most pronounced impact was evaluated with 10.

In the second part, there is a presentation of the business forecast in relation to the costs related to the creation of credit relations from the previous period based on the valuation of the owners of agricultural holdings. After that, the authors gave a presentation of the obtained results, i.e. after the classic statistical analysis.

The research was essentially done in such a way that it was examined whether there is a significant difference in the analysis of the factors of the use of different forms of credit in the business of agricultural farms in relation to owners of agricultural farms and managers of medium-sized agricultural enterprises. The t test of independent samples was used to examine the differences.

## Hypotheses

For the purposes of this study, i.e. examining the relationship between the use of credit in relation to agricultural holdings and medium-sized agricultural enterprises, the authors set the following hypotheses.

**H:1** That there is no difference in the amount of individually obtained ratings from owners of agricultural holdings and managers of medium-sized agricultural enterprises in relation to the analyzed factors influencing the use of credit, namely: limit, delay in repayment, efficiency, average exchange rate, possibility of repayment, increase in production, currency, as well as total score of all analyzed factors.

**H:2** That there is no difference in the relationship between the use of the mentioned forms of credit and the three types of analyzed loans measured by costs, namely: multi-purpose limit, investment loan and loan for permanent working capital in agriculture.

### **Data processing**

Statistical data processing and analyzes were performed using IBM SPSS (Statistical Package of Social Science) software version 25. The t test of independent samples was used in the paper to examine the difference between groups. A level of 0.05 was used for the threshold value of significance.

Statistical package SPSS IBM 22.0 was used for data processing. This was done in order to test the hypotheses. The authors used descriptive statistics with cross-tabulation, and from the statistical tests the t-test for independent samples and the t-test for independent samples with Bonferroni correction were used.

### **Results**

The obtained results of the research were done using the t-test of independent samples, i.e. the results of the use of three forms of credit were obtained: multipurpose limit, investment loan and loan for permanent working capital in agriculture in relation to the analyzed factors: limit, repayment delay, efficiency, medium exchange rate, repayment possibilities, increase in production, currency, as well as the total score of all analyzed factors.

The grouping of the study results was done in two units.

#### **Determining the differences in relation to the factors of using different forms of loans in the business of agricultural farms and medium-sized agricultural enterprises**

The existence of differences in relation to the analyzed factors of the use of different forms of loans in the business of agricultural farms and medium-sized agricultural enterprises was determined based on the results of the t test.

The obtained results are shown in Table 1 for all 7 analyzed factors as well as for the total evaluation score of the analyzed factors.

**Table 1.** Differences in relation to the factors of the use of different forms of loans between the operations of agricultural farms and medium-sized agricultural enterprises in the Republic of Serbia

Influence factors analyzed	Owners of agricultural holdings (N=152)	Managers of medium-sized agricultural enterprises (N=53)	t	p
	Middle value			
Determining the amount of the loan limit	7.54 ± 0.55	6.00 ± 0.73	16.087	<0.0005*
Loan repayment delay	9.36 ± 0.48	6.26 ± 2.58	8.704	<0.0005*
Business efficiency	9.53 ± 0.50	9.20 ± 0.84	2.713	0.009*
Middle course	6.11 ± 0.74	8.00 ± 0.73	-16.000	<0.0005*
Possibility of installment payments	4.78 ± 0.71	7.73 ± 0.44	-34.973	<0.0005*
Increase in production	9.17 ± 0.76	9.73 ± 0.44	-6.411	<0.0005*
Choice of payment currency	2.87 ± 0.73	4.00 ± 0.73	-9.553	<0.0005*
Total score	49.40 ± 1.79	50.94 ± 2.83	-3.714	<0.0005*

\* Statistical significance at the level of 0.05

Source: Authors.

### Determining the existence of differences based on the type of loan and loan costs incurred at the end of the previous year

The results obtained in the study, which were obtained based on the determination of differences based on the type of loan and loan costs, which were obtained on the basis of operations and which were obtained at the end of the previous year and which were obtained from the data on the amount of the final bill from 2022, are presented in Table 2.

**Table 2.** Presentation of the resulting differences in the type of loan and loan costs

Analyzed factors	Owners of agricultural holdings (N=152)	Medium-sized agricultural enterprises (N=53)	t	p
	Middle value			
Multipurpose limit	9.53 ± 0.66	7.94 ± 0.69	14.910	<0.0005*
Investment loan	8.37 ± 0.69	9.73 ± 0.44	-16.329	<0.0005*
Loan for permanent working capital	2.92 ± 0.59	5.52 ± 0.50	-28.608	<0.0005*
Loan costs from 2022	14.87 ± 1.25	17.79 ± 0.84	-18.943	<0.0005*

\* Statistical significance at the level of 0.05

Source: Authors.

### Discussion

The results obtained in the study indicate that it can be concluded that there is a statistically significant difference based on all seven analyzed factors of influence, as well as for

the total factor evaluation score in relation to both included groups in the study, i.e. in relation to agricultural holdings and medium-sized agricultural enterprises because the obtained values for all are presented ( $p < 0.0005^*$ ), which is given in the presentation of Table 1. The obtained data essentially coincide with the already published works of authors such as (Bjelica et al., 2017; Athari, 2021; Popović et al., 2021).

In addition, the obtained results indicate that the owners of agricultural farms have greater confidence in factors such as: determining the amount of the loan limit, delaying loan repayment and increasing business efficiency, which is in line with the views of the authors (Radović et al., 2021) which are essentially indicated the need for continuous implementation of numerous controls in the processes of business organization.

Managers of medium-sized agricultural enterprises paid more attention to the importance of factors such as: the average exchange rate for borrowed funds through loans, the possibility of repayment in installments, the increase in production itself and the choice of currency. In addition, for both analyzed groups of respondents, the observation of the total score as an important factor of the sum of all analyzed factors applies because the results were obtained ( $p < 0.0005^*$ ).

Based on the obtained results, hypothesis 1 can be safely rejected, i.e. there are statistically significant differences for all analyzed factors in terms of the use of different forms of credit and for the total score in the business and organization of agricultural production, especially in the observation of the same in Repulbica, Serbia (Zelenović et al., 2018).

The results obtained in the second part of the study after the t-test, which are shown in Table 2, are such that they indicate the existence of statistically significant differences for all three types of analyzed loans as well as for loan costs, where owners of agricultural holdings give more confidence to loans that have a multi-purpose limit in agriculture. For all other types of loans and loan costs, managers of medium-sized agricultural enterprises have more confidence in their use.

This indicates the importance of objectively making valid business decisions by decision-makers, which is in line with the already published views of authors such as (Zhang, 2022; Tomas-Miskin et al., 2022; Radović et al., 2023). On the basis of such presentations of the obtained results, hypothesis 2 can be rejected with certainty, that is, there are statistically significant differences based on the use of the type of credit and the costs of credit that arise in the real business of agricultural production.

## Conclusions

The study showed that there is a real practical and theoretical importance regarding the study of the use of different types of loans in the organization of agricultural production. In the study, the focus was on the study of two groups of agricultural producers, namely agricultural farms and medium-sized agricultural enterprises in the Republic of Serbia. The obtained results can be grouped into four large groups.

Thus, the first conclusion after the presentation of the results of the study would be that there is a significant difference based on all seven analyzed factors of influence, as well as for the total factor score in relation to the application of lending in agricultural farms and medium-sized agricultural enterprises in the Republic of Serbia.

Another conclusion is that the owners of agricultural farms have more confidence in factors such as: determining the amount of the loan limit, delay in loan repayment and increasing business efficiency.

The third is that the managers of medium-sized agricultural enterprises show greater confidence in factors such as: the average exchange rate for borrowed funds through loans, the possibility of repayment in installments, the increase in production itself and the choice of currency.

The fourth conclusion would be that there are significant differences based on the application of the use of the three types of loans analyzed, as well as the costs incurred on that basis. More precisely, the owners of agricultural holdings give more confidence in the use of loans with a multi-purpose limit, while the managers of medium-sized agricultural enterprises have more confidence in the use of investment loans and loans for permanent working capital in agriculture.

Based on the conclusions presented in the study, it can be pointed out that in the author's opinion there is full justification in the preparation of this study, and the research itself can be continued by expanding the research focus to a larger number of factors influencing lending in agriculture, that is, the research can be continued in the future other economies on this very important issue for the existence of a large number of participants in agriculture.

### **Conflict of Interests:**

The authors declare no conflicts of interest.

### **References**

1. Adenaeuer, L., Breen, J., Witzke, P., Kesting, M., Hayden, A. & Donnellan, T. (2022). The potential impacts of an EU-wide agricultural mitigation target on the Irish agriculture sector, *Climate Policy*, 23:4, 495-508, <https://doi.org/10.1080/14693062.2022.2105791>
2. Adžić, S., Kostić, R., Milunović, M., Savić Tot, T., Jeremić, D., & Stanojević, S. (2022). Role of team management in modern business conditions. *Oditor*, 8(1), 63-83. <https://doi.org/10.5937/Oditor2201062A>
3. Arnautović, I., Davidov, T., Nastić, S., Popović, S. (2022). Značaj donošenja racionalne poslovne odluke top menadžmenta u poljoprivrednim preduzećima u Republici Srbiji, *Poljoprivredna tehnika*, 1-8, [http://www.jageng.agrif.bg.ac.rs/files/casopis/PT\\_02-2022.pdf](http://www.jageng.agrif.bg.ac.rs/files/casopis/PT_02-2022.pdf)

4. Assima, A., Smale, M. & Kone, B. (2022). Diverse crops and input subsidies: a village-scale analysis in Mali, *International Journal of Agricultural Sustainability*, 20:5, 926-941, <https://doi.org/10.1080/14735903.2021.2016261>
5. Athari, S. (2021). Domestic political risk, global economic policy uncertainty, and banks' profitability: evidence from Ukrainian banks, *Post-Communist Economies*, 33:4, 458-483, <https://doi.org/10.1080/14631377.2020.1745563>
6. Bjelica, B., Bakmaz, O., Mijić, R., Popović, S. & Popović, V. (2017). The implementation of heterogeneous risk to the company's operations and transition countries respecting the behavior of agricultural enterprises in the Republic of Serbia. *Annals of the „Constantin Brâncuși” University of Târgu Jiu, Economy Series, Special Issue, volume 3/17*, <https://ideas.repec.org/a/cbu/jrnlec/y2017v3p207-213.html>
7. Burešova, P., Mrkvová, K., & Dudić, B. (2020). Changes in gastronomy. *Hotel and Tourism Management*, 8(1), 79–88. <https://doi.org/10.5937/menhottur2001079B>
8. Chen, Z., Yuan, K. & Zhou, S. (2019). Supply chain coordination with trade credit under the CVaR criterion, *International Journal of Production Research*, 57:11, 3538-3553, DOI: [10.1080/00207543.2018.1543966](https://doi.org/10.1080/00207543.2018.1543966)
9. Chong, G. (2019). Cashless China: Securitization of everyday life through Alipay's social credit system—Sesame Credit, *Chinese Journal of Communication*, 12:3, 290-307, DOI: [10.1080/17544750.2019.1583261](https://doi.org/10.1080/17544750.2019.1583261)
10. Colebrooke, L., Leyshon, C., Leyshon, M. & Walker, T. (2023). 'We're on the edge': Cultures of care and Universal Credit, *Social & Cultural Geography*, 24:1, 86-103, DOI: [10.1080/14649365.2021.1921244](https://doi.org/10.1080/14649365.2021.1921244)
11. Curzer, H. (2021). Authorship and justice: Credit and responsibility, *Accountability in Research*, 28:1, 1-22, DOI: [10.1080/08989621.2020.1794855](https://doi.org/10.1080/08989621.2020.1794855)
12. Dermineur, E. (2022). The evolution of credit networks in pre-industrial Finland, *Scandinavian Economic History Review*, 70:1, 57-86, DOI: [10.1080/03585522.2021.1884594](https://doi.org/10.1080/03585522.2021.1884594)
13. Downey, L. (2023). Governing public credit creation, *New Political Economy*, 28:1, 42-56, DOI: [10.1080/13563467.2022.2061437](https://doi.org/10.1080/13563467.2022.2061437)
14. Finžgar, M. & Brezovnik B. (2019). Direct international comparison of EU member states fiscal decentralization systems with the conceptual index of fiscal decentralization (CIFD) in the context of European charter of local self-government (ECLSG), *Transylvanian Review of Administrative Sciences*, 56E/2019, 41-59, <https://rtsa.ro/tras/index.php/tras/article/view/587>
15. Gurmessa, N., Ndinda, C., Agwanda, C. & Akiri, M. (2022). Partial credit guarantee and financial additionality for smallholders coffee cooperatives: experience from Ethiopia, *Development in Practice*, 32:8, 1049-1062, DOI: [10.1080/09614524.2021.1958161](https://doi.org/10.1080/09614524.2021.1958161)



16. Hang, N. (2023). Policy recommendations for controlling credit risks in commercial banks after the Covid-19 pandemic in Vietnam, *Cogent Economics & Finance*, 11:1, DOI: [10.1080/23322039.2022.2160044](https://doi.org/10.1080/23322039.2022.2160044)
17. Hearn, A. (2023). The collateralized personality: creditability and resistance in the age of automated credit-scoring and lending, *Cultural Studies*, 37:1, 123-148, DOI: [10.1080/09502386.2022.2042576](https://doi.org/10.1080/09502386.2022.2042576)
18. Hopewell, K. (2022). Heroes of the developing world? Emerging powers in WTO agriculture negotiations and dispute settlement, *The Journal of Peasant Studies*, 49:3, 561-584, <https://doi.org/10.1080/03066150.2021.1873292>
19. Hoyo, D., Giraldo, O., Rosset, P., Corona, O., Cassarino, J. & Nautiyal, S. (2022). Building an agroecological model to understand the effects of agrochemical subsidies on farmer decisions, *Agroecology and Sustainable Food Systems*, 46:5, 712-735 <https://doi.org/10.1080/21683565.2022.2039837>
20. Jakubowska, D. & Sadílek, T. (2023). Sustainably produced butter: The effect of product knowledge, interest in sustainability, and consumer characteristics on purchase frequency, *Agricultural Economics – Czech*, 69, 1: 25–34, DOI: [10.17221/294/2022-AGRICECON](https://doi.org/10.17221/294/2022-AGRICECON)
21. Jordan, C., Donoso, G. & Speelman, S. (2023). Irrigation subsidy policy in Chile: lessons from the allocation, uneven distribution and water resources implications, *International Journal of Water Resources Development*, 39:1, 133-154, <https://doi.org/10.1080/07900627.2021.1965964>
22. Kanazir, S. (2023). Credit risk cyclicity in Serbian banking sector, *Applied Economics*, 55:22, 2505-2520, DOI: [10.1080/00036846.2022.2103083](https://doi.org/10.1080/00036846.2022.2103083)
23. Kovacs, E. (2021). Seeing subsidies like a farmer: emerging subsidy cultures in Hungary, *The Journal of Peasant Studies*, 48:2, 387-410, <https://doi.org/10.1080/03066150.2019.1657842>
24. Kumar, M. & Narayanamoorthy, A. (2021). Fixing agricultural power tariff without hurting farmers, *International Journal of Water Resources Development*, 37:6, 1035-1039, <https://doi.org/10.1080/07900627.2020.1823335>
25. Kumari, A. & Garg, V. (2023). Impact of credit on sustainable agricultural development in India, *Journal of Sustainable Finance & Investment*, 13:1, 560-571, DOI: [10.1080/20430795.2021.1964811](https://doi.org/10.1080/20430795.2021.1964811)
26. Kvartiuk, V. & Herzfeld, T. (2022). Why Do Farmers Seek Office? Regulatory Capture in Russian Agricultural Subsidization, *Eastern European Economics*, <https://doi.org/10.1080/00128775.2022.2149556>
27. Lee, B. & Carlisle, L. (2020). A case study of the financial benefits of a credit union's homeless prevention scheme, *Public Money & Management*, 40:1, 63-71, DOI: [10.1080/09540962.2019.1621050](https://doi.org/10.1080/09540962.2019.1621050)

28. Lososová, J. & Zdeněk, R. (2023). Simulation of the impacts of the proposed direct payment scheme – The case of the Czech Republic, *Agricultural Economics – Czech*, 69, 1: 13–24, <https://www.agriculturejournals.cz/pdfs/age/2023/01/03.pdf>
29. 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,
30. Mazumder, M. & Kabir, M. (2022). Farmers' adaptations strategies towards soil salinity effects in agriculture: the interior coast of Bangladesh, *Climate Policy*, 22:4, 464-479, <https://doi.org/10.1080/14693062.2021.2024126>
31. Mésonnier, J. (2022). Banks' climate commitments and credit to carbon-intensive industries: new evidence for France, *Climate Policy*, 22:3, 389-400, DOI: [10.1080/14693062.2021.2012121](https://doi.org/10.1080/14693062.2021.2012121)
32. Miletić, S., & Radić, S. (2022). Evolution of earnings management practice: A new threat to the quality of financial reports. *Oditor*, 8(3), 117-142. <https://doi.org/10.5937/Oditor2203117M>
33. Novaković, S., Vukasović, D., Laban, B., Ivić, M., Popović, V. & Popović, S. (2018). Managing agricultural company by using internal control and significance of risk presentation, *Economics of Agriculture*, 2: 801-812. <https://www.ea.bg.ac.rs/index.php/EA/article/view/497>
34. Nwosu, E., Orji, A., Urama, N., Emecheta, C., Chukwuma, Q. & Chukwuma, J. (2023). Social Capital, Credit Access and Household Nonfarm Enterprises in Nigeria: A new Empirical Evidence, *Forum for Social Economics*, 52:1, 1-21, DOI: [10.1080/07360932.2020.1825983](https://doi.org/10.1080/07360932.2020.1825983)
35. Oparinde, L. & Olutumise, A. (2022). Impact of credit constraints on aquaculture production and risk exposure in Ondo State, Nigeria, *Journal of Applied Aquaculture*, 34:1, 79-96, DOI: [10.1080/10454438.2020.1815629](https://doi.org/10.1080/10454438.2020.1815629)
36. Paor, C. (2021). Credit allocation and programmes design: insights from metaphor, *Journal of Further and Higher Education*, 45:6, 836-844, DOI: [10.1080/0309877X.2020.1826033](https://doi.org/10.1080/0309877X.2020.1826033)
37. Popović, D., Vitomir, J., Tomaš-Miskin, S., Davidov, T., Popović, S., Jovanović, M., Aćimić-Remiković, M. & Jovanović, S. (2021). Implementation of internal control with reference to the application of “it” in companies operating on the principles of the green economy. *Agriculture & Forestry*, 67(2): 261-269, DOI: [10.17707/AgricultForest.67.2.19.2021](https://doi.org/10.17707/AgricultForest.67.2.19.2021)
38. Popović, D., Rajčić, V., Popović, V., Buric, M., Filipović, V., Gantner, V., Lakić Z., Božović, D. (2022). Economically significant production of *Secale cereale* L. as functional food. *Agriculture and Forestry*, 68 (3): 133-145, [http://www.agricultforest.ac.me/paper.php?journal\\_id=224&id=3142](http://www.agricultforest.ac.me/paper.php?journal_id=224&id=3142)

39. Popović, S. (2014). Socio-economic factors limiting the development of agrarian, Feljton, Novi Sad. [in Serbian: Popović, S. (2014). Socio-ekonomski faktori ograničenja razvoja agrara, Feljton, Novi Sad].
40. Popović, S., Mijić, R. & Grublješić, Ž. (2014). Internal control and internal audit in the function of management, *Škola Biznisa*, 1, 95-107. [in Serbian: Popović, S., Mijić, R. i Grublješić, Ž. (2014): Interna kontrola i interna revizija u funkciji menadžmenta, *Škola Biznisa*, 1, 95-107].
41. Popović, S., Majstorović, A. & Grublješić Ž. (2015). Valuation of facilities in use and application of international accounting standards, *Actual problems of economics*, 3(165): 379-387, <https://eco-science.net/en/downloads>
42. Popović, S., Novaković, S., Đuranović, D., Mijić, R., Grublješić, Ž., Aničić, J. & Majstorović, A. (2017). Application of international accounting standard-16 in a public company with predominantly agricultural activities, *Economic Research-Ekonomska Istraživanja*, 30, (1): 1850–1864, <https://doi.org/10.1080/1331677X.2017.1383171>
43. Popović, S., Đuranović, D., Laban, B., Ivić, M., Jovin, S., Nastić, S., Grublješić, Ž. & Popović, V. (2018). Impact of different light intensity on the production of the plant narcissus l. and its financial effects, *Economics of Agriculture*, 4: 1359-1370, doi:10.5937/ekoPolj1804359P
44. Radović, M., Vitomir, J. & Popović, S. (2021). Impact of internal control in enterprises founded by local self-government units: the case of Republic of Serbia, *Inzinerine Ekonomika-Engineering Economics*, 32(1), 82–90, <https://doi.org/10.5755/j01.ee.32.1.23243>.
45. Radović, M., Vitomir, J., Popović, S. & Stojanović, A. (2023). The Importance of Establishing Financial Valuation of Fixed Assets in Public Companies whose Founders Are Local Self-Government Units in the Republic of Serbia, *Engineering Economics*, Vol. 34 No. 3 (2023) 246-255, <https://inzeko.ktu.lt/index.php/EE/issue/view/940>
46. Radović, M., Vitormir, J., Popović, S. & Stojanović, A. (2023). The Importance of Establishing Financial Valuation of Fixed Assets in Public Companies whose Founders Are Local Self-Government Units in the Republic of Serbia, *Engineering Economics*, 34(3): 246-257, DOI: [10.5755/j01.ee.34.3.29288](https://doi.org/10.5755/j01.ee.34.3.29288)
47. Seleka, T. & Mmopelwa, D. (2020). Effects of input subsidies on cropland allocation and diversification in Botswana's subsistence economy, *Agrekon*, 59:3, 337-353, <https://doi.org/10.1080/03031853.2020.1758175>
48. 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>

49. Shi, X., Wang, A. & Tan, S. (2020). Trade-Credit Financing under Financial Constraints: A Relational Perspective and Evidence from Listed Companies in China, *Emerging Markets Finance and Trade*, 56:4, 860-893, DOI: [10.1080/1540496X.2018.1555462](https://doi.org/10.1080/1540496X.2018.1555462)
50. Su, D., Xu, S. & Tong, Z. (2023). Credit availability and corporate risk-taking: evidence from China's green credit policy, *Post-Communist Economies*, 35:3, 236-270, DOI: [10.1080/14631377.2023.2169516](https://doi.org/10.1080/14631377.2023.2169516)
51. Tomas-Miskin S., Vitomir, J., Popović, S. & Vitomir, G. (2022). Decision-making of Top Management and Internal Audit on the Issue of Archiving Documentation in Companies Founded by Local Government Units in the Republic of Serbia, *Lex Localis – Journal of Local Self-Government*, 20(4), 889 – 995, <http://pub.lex-localis.info/index.php/LexLocalis/article/view/1848>
52. Uyar, A., Karmani, M., Kuzey, C., Kilic, M. & Yaacoub, C. (2022). Does Governance Quality Explain the Sustainability Reporting Tendency of the Public Sector? Worldwide Evidence, *International Journal of Public Administration*, 45:13, 931-947, DOI: [10.1080/01900692.2021.1900243](https://doi.org/10.1080/01900692.2021.1900243)
53. Vitomir, J., Tomaš-Miskin, S., Ivić, M., Popović, S. (2020). Implementation of the Tender by the Municipal Service Administration from the Aspect of Management in the Municipalities of the Republic of Serbia, *Lex Localis – Journal of Local Self-Government*, 8(3), 469 – 486, <http://pub.lex-localis.info/index.php/LexLocalis/article/view/1302>
54. Vitomir, J., Radović, M. & Popović, S. (2021). The Effect of Public Finance Control on the Improvement of Work of Internal Auditors in Enterprises Founded by the Local Self-government Units on the Example of the Republic of Serbia, *Lex localis - Journal of Local Self-Government*, 19(2), [https://doi.org/10.4335/19.2.245-261\(2021\)](https://doi.org/10.4335/19.2.245-261(2021)).
55. Wang., Z., Wang., Q., Nie., Z. & Li., B. (2022). Corporate financial distress prediction based on controlling shareholder's equity pledge, *Applied Economics Letters*, 29:15, 1365-1368, DOI: [10.1080/13504851.2021.1931656](https://doi.org/10.1080/13504851.2021.1931656)
56. Wasserman, M. (2022). Debts facing death. Discovering everyday credit practices through testaments in seventeenth-century Buenos Aires, *The History of the Family*, 27:2, 350-369, DOI: [10.1080/1081602X.2022.2075425](https://doi.org/10.1080/1081602X.2022.2075425)
57. Xu., C., Xu., Y. & Li., F. (2022). Can the exit threat of non-controlling major shareholders promote corporate innovation?, *Technology Analysis & Strategic Management*, 34:8, 876-890, <http://encyclopub.com/ems/article/view/7257>
58. Zhang, Z. (2022). Do agricultural subsidies raise the income of rural households effectively? Evidence from rural China, *Applied Economics Letters*, <https://doi.org/10.1080/13504851.2022.2159003>

59. Živković, A., Pantić, N., & Rosić, M. (2019). Fiscal sustainability of the macroeconomic system of European Union members. *Oditor*, 5(2), 32-41. <https://doi.org/10.5937/Oditor1902033Z>
60. Zelenović, V., Vojinović, Ž & Cvijanović, D. (2018). Serbian agriculture loans with the aim of improving the current situation, *Economics of Agriculture*, 323-336. [https://www.academia.edu/56723416/Serbian\\_agriculture\\_loans\\_with\\_the\\_aim\\_of\\_improving\\_the\\_current\\_situation?email\\_work\\_card=titledoi:10.5937/ekoPolj1801323](https://www.academia.edu/56723416/Serbian_agriculture_loans_with_the_aim_of_improving_the_current_situation?email_work_card=titledoi:10.5937/ekoPolj1801323)
61. Zhang, L. & Colak, G. (2022). Foreign direct investment and economic policy uncertainty in China, *Economic and Political Studies*, 10:3, 279-289, <https://harisportal.hanken.fi/en/publications/foreign-direct-investment-and-economic-policy-uncertainty-in-chin>

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# PUBLIC – PRIVATE PARTNERSHIP IN THE FUNCTION OF SUSTAINABLE BUSINESS OF ECONOMIC ENTITIES IN AGRICULTURE

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## ABSTRACT

In the global competition in agriculture, countries must allocate considerable financial resources in order to create preconditions for the continuous development of agriculture. Bearing in mind the unfavorable competitive position, the low investment rating, insufficient foreign direct investments, the Republic of Serbia can see its development opportunity in the application of public-private partnership in agriculture. Cooperation models are conditioned by investor plans and regulations created by the state. The mutually significant and complex relationship between the private and public partner beside economic and legal aspects, also acquires significant social and political dimensions. That is why through public-private partnership operations, there is an opportunity to improve the operations of economic entities. The authors conducted a survey of business entities in the territory of Srem, analyzed a successful case and concluded that the mentioned partnership can lead to an improvement in the competitiveness of business entities in the field of agriculture.

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## Introduction

Globally, governments cannot meet the ever-increasing need for public services by acting alone, especially in times of economic crisis. That is why the need to look for a solution in other sectors and sources of financing was imposed. During periods of slow growth, government revenues are often insufficient to meet all market needs, requiring

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budget cuts to reduce spending or unpopular increases in taxes and other levies on business entities (Altuzarra, et al., 2023). The partnership can ensure the continuation of the provision or improvement of the level of services, with reduced costs for both contracting parties (Garelli, 2009).

The modern economy is faced with ever-increasing competition. Strong and permanent competition threatens markets that are unable to adapt, that is, to be innovative, creative, productive and able to respond to competitive pressures (Kačer, H., et al, 2008; Altuzarra, et al., 2023).

Due to the increasing need for building new public infrastructure, investing in goods of general interest as well as providing services of public importance in the Republic of Serbia (RS), it was necessary to create a legal and institutional framework for attracting private investments (Bela knjiga, 2022).

Therefore, in November 2011, the Republic of Serbia adopted the Law on Public-Private Partnerships and Concessions (Law on Public-Private Partnerships - ZJP, 2011), which is of great importance, because at the same time there were reduced opportunities for obtaining favorable loans from international financial organizations. These are the reasons why there is a need to engage private capital for numerous significant investments necessary for all economic entities, regardless of what activity they are engaged in, such as: the construction of road networks, schools, water supply, landfills and all those projects for which they do not have funds from the traditional budget financing (Bogdanov, et al, 2011). The essence of the introduction of the private sector is the reduction of fiscal pressure on the local budget, the acceleration of infrastructure investments, the improvement of services and the reduction of their prices.

With the Law on Public-Private Partnership, the concept of public-private partnership (PPP) was introduced into the legal system of the Republic of Serbia for the first time, and for the first time state and local authorities were in a position to realize their needs for infrastructure and public services according to this model with a clear established rules of conduct (Rajnović, 2023).

The nature of PPP is reflected in the fact that public and private business entities achieve cooperation for mutual benefit and share the risk of joint cooperation, i.e. responsibility for the achievement of set goals, which is why they have a common interest in the project being successful in the long term (Ivanović, et al., 2009 ). Partners are assigned, on a contractual basis, clearly defined tasks, as well as risks, and the public sector has the role of supervisor, and the private sector the role of executive body. Risk sharing and the long-term nature of the arrangement are two elements that distinguish PPP from other, similar arrangements (Milovanović, 2006). Cooperation between the private and public sectors on this basis usually lasts between 10 and 30 years. PPP participants retain their own legal personality.

The goal of this cooperation is to make the knowledge and resources of the private sector available to the public sector in order to create additional value in this way,

while increasing the efficiency in the provision of public services, but also encouraging innovation (Brdarević, 2012). Each of the partners has different goals that they want to achieve through cooperation - the public partner wants to achieve social satisfaction, shorten the time needed for investments in large projects, gain social trust, while the private partner achieves its interest, primarily economically, by charging for services from the users of facilities through a concession or some other form of payment (Persoli, 2010; Vuković, 2014; Žeglen, 2011).

Realization of public-private partnership can be implemented in practice through two bases:

- on the basis of a contract, in which case the private business entity is most often in charge of designing, building, financing and managing the service or good (Rajnović, 2021). In this case, the partnership between the public and private sectors is based on contractual ties. It can be regulated through the commonly known Guidelines (European Directives on Public Procurement). Some of the pure contractual PPP models are characterized by a direct connection between the private partner and the end user: the private partner provides a direct service to the end users, under the control of the public partner, such as concession (Todorović, 2003). The characteristic of this form implies the method of compensation for the private party, which consists of the charged service to the end users.
- institutional partnership, in which case a new legal entity is established that is owned by both partners. The direct connection of the public and private partner through legal subjectivity enables the public partner to maintain a relatively high degree of control over the development of projects through its presence in the bodies that make decisions on behalf of the joint venture (Marenjak, et al., 2007). In this way, the public partner can develop its own service delivery experience, using the resources and experience of the private partner.

The Law on Public-Private Partnership of the RS regulates: the conditions and manner of drafting, proposing and approving public-private partnership projects; determine the competent entities, i.e. authorized to propose and implement public-private partnership projects; rights and obligations of public and private partners; form and content of public-private partnership contracts with or without concession elements and legal protection in public contract awarding procedures; conditions and method of granting concession, subject of concession, entities competent, i.e. authorized for the procedure of granting concession, termination of concession; protection of rights of participants in procedures for awarding public contracts; establishment, position and competence of the Commission for Public Private Partnership, as well as other matters of importance for public-private partnership (PPP).

The law is aligned with the legal acquis of the European Union, with the aim of improving the control of financial implications and risks of public-private partnership projects and alignment with international standards and best international practice.



The law allows the Government, the province and local self-governments, each within their jurisdiction, to independently make a decision on initiating the procedure for the realization of the PPP project and on cooperation with a private partner (Ivanović, et al., 2009). This must be preceded by an analysis of the economic efficiency of the proposed project, i.e., the public sector must prove that a specific project is better implemented through a partnership with the private sector and that it is profitable (greater value for the money invested) (Brdarević, 2012).

Public-private partnership in agriculture is in accordance with Treasury Regulation 16 (National treasury, Public Finance Management Act 1999, Treasury Regulation 16, 2002) and represents a public-private partnership that can be realized through commercial transactions between public institutions and a business entity in private ownership. who is engaged in agriculture. PPP in the field of agriculture in the RS is often based on a contractual basis, according to which the private company: performs an executive function, i.e. acquires the right to use state property for its own commercial purposes and very often assumes considerable financial, technical and operational risks in relation to the use state property, but also obtains benefits by performing functions and/or using state property through fees that the private partner collects from service users or provides services to users (Samardžić, 2011).

Public-private partnership in agriculture and rural tourism, which have a great influence on each other, has a significant role in countries where the development of tourism is at an early stage. In this sense, infrastructure projects are accompanied by high risk and a long time frame. In order to ensure against risks, the governments of these countries formulate basic principles that must be met before establishing a public-private partnership, which implies that the economic and social framework must be stable.

Multi-stakeholder business partnership is an important element in the promotion of agricultural products. It offers material and life opportunities for the local population, such as employment opportunities, development of tourism, diversification of activities of small economic entities into agriculture, especially family farms, and development of other service activities. The local population is also engaged in small businesses such as shops of local products, various craft shops and others (Milošev, 2023).

Agricultural development or sustainable agricultural development significantly depends on the growing cooperative attitude of the private and public sectors. The authorities responsible for the planning and promotion of agriculture and rural tourism at the local, regional and national levels have begun to include the private sector in the decision-making process (Leković, et al., 2013). The overarching goal of the public and private sectors is to create a positive image of the country as a producer of agricultural products.

### **Material and methods**

The subject of research in this paper is public-private partnership in the function of raising the competitiveness of economic entities engaged in agriculture in the Republic of Serbia, that is, the successful placement of agricultural offers.

The goal of the research is to answer the question of how to choose and implement an optimal public-private partnership model that would serve to increase the competitiveness of economic entities engaged in agriculture in the Republic of Serbia, that is, to ensure the successful positioning of Serbia as a provider of quality agricultural products and the development of rural tourism.

Through the research, it will be possible to find out which model of public-private partnership can be applied in agriculture in Serbia and increase competitiveness, which should result in a recognizable agricultural product of high quality, prosperity and a better quality of life for citizens in rural areas.

The research was conceived as a theoretical-empirical one, which decided to apply the basic analytical and synthetic methods in the theoretical part, and in the empirical part the research method through a survey.

During the preparation of the theoretical part, numerous contemporary scientific and professional literature, as well as practical experiences, were consulted through the research of foreign and domestic literature that deals with issues of public-private partnership in agriculture: books, collections of works, textbooks, expert articles, as well as research that contains models public-private partnership.

In order to research this topic, the following was done:

- Case analysis of a public-private partnership based on a contractual basis in the territory of the municipality of Ruma, which gave good results for both contracting parties. In this case, the public partner handed over agricultural land, which was actually a lake, to the private partner for use, in order to build the facilities needed for the maintenance of the public structure, sport fishing and the provision of other supporting services to the users.
- A survey in which 30 representatives of companies and larger agricultural holdings in the territory of Srem participated, who have 5 or more employees and have been in business for more than 10 years, which implies that they have sufficient knowledge about the activity they are engaged in and the ability to follow events and news on market, which also includes concepts of public-private partnership. The aim of the survey was to determine the interest of the private sector in participating in PPP projects, what results they expect from the introduction of PPP and whether they think that public-private partnership can be used to increase the competitiveness of their business in Serbia.

All properties that have been reached through research have been classified, in order to point out important connections and relationships, and the method of comparison has been used to find out about the desired goals, ways and directions of cooperation of partners from different sectors. By applying the deductive method, the results of the research were formed in the form of a development model.

Bearing in mind the strategic importance of agriculture in RS and the fact that public-private partnership synergistically connects several components - economic, political, social, legal and environmental issues, the main hypothesis of this work is based on the assumption that public-private partnership can be in the function of raising competitiveness of agriculture in the Republic of Serbia.

### **Results and discussion**

This work includes a scientific and social aspect.

The scientific aspect means the creation of knowledge that contributes to the theoretical development of the idea of improving agriculture through the development of a public-private partnership model.

The social aspect implies the application of research results that contribute to the creation of systemic solutions to improve the legal and financial framework, competitive positions in rural tourism and better quality of life in rural areas.

The authors present a case of a successful public-private partnership in which the public partner handed over to the private partner the land on which the lake is located in a village, in the territory of the municipality of Ruma, in order to maintain public infrastructure and build facilities designed for lake maintenance and sport fishing as well as provision of other supporting services to users. The lake was located in the immediate vicinity of the village and country roads that the population of that village and surrounding villages used daily. The lake was low-lying and often flooded large areas of farmland, roads, football pitches and farmhouses around the lake.

By definition, a lake is a natural depression on land filled with water, which is not directly connected to the sea, and which is relatively large in size. The regulations do not provide a minimum area that should be covered by the lake, but in practice it is considered that the lake should not have an area of less than 1 hectare. The public partner handed over the lake with the owning business facility to the private partner for use with the obligation of the private partner to maintain the lake and the surrounding infrastructure, build the necessary facilities for sport fishing and other facilities that can benefit the said activity.

The public partner allowed the private partner to carry out commercial activities and build other facilities within the framework of the PPP project implementation, because it was not possible to ensure the necessary level of profitability of the public-private partnership project implementation and the return of the private partner's invested funds in any other way.

The private partner fulfilled his obligation, he built all the facilities needed for sport fishing, bought fish, maintained the lake and the surrounding area of over 2 ha in good condition for visitors, equipped a restaurant, built a parking place and built additional facilities for the all-day stay of the residents on the lake. . The lake has become an interesting tourist attraction for numerous visitors from the wider area as well as

competitors in fishing. The private partner procured agricultural products and other foodstuffs needed for their business from the people of the village where the lake is located. Over time, he hired 5 new workers from the village and its surroundings.

The PPP established in this way fulfilled the mutual goal of both contracting parties:

- a public partner and an economic goal - the private partner's investment contributed to the increase of the state's public income, which contributes to the political and social function for which the state is responsible, through the employment of a certain number of people, the development of rural tourism and the improvement of the well-being of the population in the village and its surroundings (Brdarević, 2012) and, goals
- a private partner - who achieved/achieves his business goal, which is the return of invested funds and the acquisition of profit on invested funds (Rajnovic, et al, 2023).

In order to check the views on public-private partnership related to a specific case, a survey was conducted of representatives of the private partner, public partner and users: tourists and rural residents (among whom there were 50% sellers of groceries to the private partner and 50% other residents of the village and the surrounding area), which referred to satisfaction with the completed project.

The answers offered were:

1. *Yes*
2. *Mostly yes*
3. *Mostly not*
4. *No*

**Table 1.** Satisfaction with the PPP project

	Question	Private partner	Public partner	Project beneficiaries
1	Is the economic interest of partners and users satisfied?	Yes	Yes	Yes
2	Does the private partner provide good service?	Yes	Yes	Yes
3	Was there a need for a PPP?	Yes	Yes	Yes
4	Have the objectives of the PPP been achieved?	Yes	Yes	Yes

*Source:* Research of Autors.

The authors investigated the following with a survey of business entities:

- Willingness of the private partner to participate in PPP projects, as well as to plan, implement and monitor PPP projects.
- Is there a need for PPP?

- Are there any obstacles to the implementation of PPP?
- Is the private sector interested in participating in PPP projects?
- Can PPP be in the function of increasing competitiveness

The answers offered were:

- 1. *Yes*
- 2. *Mostly yes*
- 3. *Mostly not*
- 4. *No*

**Table 2.** Attitudes of private business entities on PPP

	Question	Private partner	Answers	Comment
1	Willingness of the private partner to participate in the PPP	Yes	60%	The objections boil down to the following: administrative obstacles, long deadlines for PPP procedures; not enough practice.
		Mostly yes	20	
		Mostly no	20	
		No		
2	Is there a need for PPP?	Yes	Yes	
3	Are there any obstacles to the implementation of PPP?	Yes	Yes	
4	Can PPP be in the function of increasing competitiveness?	Yes	Yes	

*Source:* Research of Authors.

The Republic of Serbia adopted the Law on PPP adopted in 2011, which was amended twice in 2016. The Commission for Public-Private Partnership approved 2241 public-private partnerships by the end of 2022, which does not represent a significant number of projects.

However, due to the COVID 19 pandemic, PPP projects stagnated further during that period. After that, a large number of new PPP projects were approved, the further realization and development of which has yet to be analyzed, so the effects are not yet known (White Book, 2022).

According to the Global Competitiveness Index - GCI, it is assumed that countries go through three stages of development (World Economic Forum, The Global Competitiveness Report 2012-2013):

- In the first phase, the basic factors of competitiveness are important for growth and productivity: good functioning of public and private institutions, developed infrastructure, stable macroeconomic trends, good and qualified workforce;
- With further development, countries enter the second phase where they achieve more efficient production processes and increasing product quality. In this phase, the growth of competitiveness is influenced by higher education and

training, a well-functioning labor market, goods, a developed financial market, a large domestic and foreign market, and the possibility of using existing technologies;

- Countries are moving into the third phase in which the growth of productivity and competitiveness is conditioned by factors of high business sophistication and innovation (Ivanović, et al, 2009).

There is no doubt that the geographical position of the Republic of Serbia, natural and anthropogenic resources represent a significant potential for the development of agriculture and rural tourism, which should be recognized and turned into a competitive advantage, for which there is an interest of the public and private sector in establishing a public-private partnership, as well as service users, especially in the country's villages (Samardžić, 2011).

Each country, which opts for a public-private partnership, determines its own interest in choosing a public-private partnership model, which depends on the form of management and method of financing, and the choice is influenced by the following factors:

- PPP project,
- country regulations and administrative potential, cooperation between institutions dealing with PPP
- the level of decentralization of the country,
- the duration of the project should be in accordance with the proportion of the invested funds and the period required for the return of the investment and the realization of profit on the invested funds,
- the method and form of compensation to the private partner for participating in the project,
- percentage of participation and contribution to profit i
- willingness and extent of risk taking by both contracting parties.

The specifics of the social and political environment also influence the contracting and establishment of public-private partnerships. Various forms of establishment of institutional partnership are encouraged by international institutions, especially those related to the financing of public investment projects, through direct financing or involvement through their advisory body for public-private infrastructure (Public-Private Infrastructure Advisory Facility - PPIAF).

Whether and to what extent public-private partnership will be accepted is also influenced by changes in the public's attitude towards the participation of the private sector, that is, the level of awareness of the importance of partnership and the attitude towards privatization when it comes to countries that have gone through the transition process (Kunst, 2011).

Combining the resources and knowledge of the public and private sectors ensures efficiency in meeting the interests of both parties. This cooperation enables the state to obtain new sources of capital, accelerate the development of infrastructure, improve the quality of services used by citizens, that is, business entities of the country, and to put into use until then insufficiently used resources (Ivanović, et al., 2009). The introduction of PPP in public institutions in the Republic of Serbia resulted in the realization of significant savings of 17-20% compared to the management of those affairs only by the public sector (Vuković, 2014). On the other hand, the private sector/partner gets access to new markets, and increases its own credibility, and what is more important, PPP enables faster development of the local community.

There are numerous PPP models, but not all of them are applicable to all projects. When it comes to PPP projects that are feasible with a private partner in the field of agriculture, the following models are mainly possible:

- Build-Operate (“BO”): in which case the construction and management is carried out by the private sector. Ownership of the building is not transferred to the relevant public authorities.
- Transfer of Operating Rights TOR (“Guidelines”): This is a public-private partnership model where the relevant public partner transfers its operating rights to the private sector for a certain period of time and under certain conditions. Exclusive rights are not transferred. Only operational rights on a specific facility are granted/granted for use and use by a private partner.
- Build-Lease model (“BL”): in this model, the private partner finances and builds a facility on land owned by the public partner or the state and then, after the expiration of the PPP term, hands this facility over to the public sector.

It is obvious that public-private partnership is one of the most promising forms of cooperation between the public sector and private economic entities, that it is applicable in agriculture, while achieving the goals of both partners and satisfying the interests of users. It is based on the recognition that both public and private sectors can benefit from pooling their financial, administrative, human resources, knowledge and expertise to improve the provision of services to all users (Rajnović, 2023).

### **Conclusion**

Public-private partnership is an economic model of long-term pooling of the potential of two sectors in which each of them brings the best of what they have into the partnership. Public-private partnership is the model of the future because it enables long-term investments in large projects.

The Republic of Serbia adopted the Law on Public-Private Partnerships and Concessions, and the reasons for its adoption are reflected in the increasing need for the construction of new or renovation of existing public infrastructure, investment in goods in general use, as well as in the efficient provision of public services and the ability to adequately respond to observed needs.

Due to the lack of public funding and insufficient resources of state authorities to develop and modernize projects of public interest, which is a prerequisite for the economic development of every country, there was a need to improve legal and economic mechanisms without delay in order to attract private investors.

The good geographical position of the Republic of Serbia, transit character and various natural and cultural-historical resources provide the possibility of development of transit as well as nautical, mountain, spa, recreational and cultural tourism. However, its development requires a developed and high-quality traffic infrastructure and other projects, the construction of which requires capital investments to enable the development of agriculture and rural tourism, which entails the purchase of other products and services.

The analysis of the conducted research indicates the existence of interest from both the public and private sectors in establishing a public-private partnership.

In order to overcome obstacles to achieving faster development of agriculture and rural tourism, through more intensive cooperation between the public and private sectors, it is necessary to implement and improve existing and create new forms of institutional, financial, coordination, and legislative support.

Therefore, Serbia has a task to position itself in a demanding market, valorize its potential, build attractive projects related to agriculture, develop tourist products with the largest possible scope of cooperation with the public partner.

By analyzing the results of the research in this work, certain guidelines and possible models for the successful implementation of the public-private partnership model with business entities in agriculture with possible sources of financing were defined and at the same time provided security to the project participants: private and public sector. In this way, public-private partnership projects would influence the improvement of the quantity and quality of agricultural products and, consequently, tourist products, which would certainly contribute to increasing the competitiveness of Serbian agriculture.

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### **Conflict of interests**

The authors declare no conflict of interests.



## References

1. Altuzarra, A., Bustillo, R., Rodriguez, C., (2023), Is World Trade Slowing Down? New Evidence on Trade-Income Elasticity, *Panaeconomicus*, Union of Economists of Vojvodina, Novi Sad, UDC 339.5:303.406.3”1970/217” doi.org/10.2298/PAN190722013A, p. 191-217.
2. Bogdanov, N., Zečević, B., Versači, A., Rohač, J. (2011). Public-private partnership in rural tourism The United Nations Development Program (UNDP) within the United Nations joint program “Sustainable tourism in the function of rural development”, Belgrade.
3. Brdarević Lj., (2012), Development of local self-government through public-private partnership, Manual for local authorities, USAID and the Republic of Serbia.
4. Garelli S., (2009), The Fundamentals and history of competitiveness, IMD World, *Competitiveness Yearbook*.
5. Ivanović M. and Klasarić M, (2009). Strategic planning in the public sector - the key to development and reforms, Security - theoretical expert journal No. 3, *Ministry of Internal Affairs of the Republic of Serbia*.
6. Kačer H., Kružić, Perkušić A. (2008). Public-private partnership. Proceedings of the Faculty of Law in Split, 45(3), 611 – 640.
7. Kunst, I. (2011). The applicability of the public-private partnership model in tourism. *Acta turistica*, 23(2), 175 – 201.
8. Leković, J., Đurić, A. (2013), Application of public-private partnership as a basis for the development of the competitiveness of Serbian tourism. IX International Professional Symposium: The Impact of Global Tourist Flows on the Quality of Hotel Business, Zlatibor, Proceedings, p. 219 – 234.
9. Marenjak, S., Skenderović, V., Vukmir, B., Čengija, J. (2007). Public-private partnership and its application in Croatia, *Builder* 59(7), 597-605.
10. Milovanović, D. (2006), Public and Private Sector Partnership, Serbia 2006–2012: Development, Financial System and Competitiveness. Kopaonik Business Forum 2006, *Association of Economists of Serbia*, p. 99–116.
11. Milošev, I., (2023), Determinations of profitability in the agricultural sector in Serbia, *Economics of Agriculture*, *Scientific Society of Agrarian Economists of the Balkans*, Belgrade, *Institute for Agricultural Economics*, Belgrade, *Academy of Economic Sciences*, Bucharest, Romania, UDC 338.486.4:338.43 (497.11), doi:10.59267/ekoPolj2304953M, p. 953-966.
12. National treasury, Public Finance Management Act 1999, Treasury Regulation 16, (2002), Gazette No 23463, dated 25th, May 2002.
13. Persoli, A. M. (2010), Public-private partnership in the function of satisfying public needs, *Croatian Public Administration*, 4, 1019–1044.

14. Perugini, C., Tekin, I., (2022), Financial Development, Income Inequality and Governance Institutions, *Panoeconomicus*, Union of Economists of Vojvodina, Novi Sad, UDC 336.11 (4/9):303.446.3”1996/2014” doi.org/10.2298/PAN191022004P, pp. 353-379.
15. Rajnović, Lj., (2021), Contracts in the economy with reference to external influences on the contractual relationship, *Institute for Agricultural Economics Belgrade*, ISBN 978-86-6269-106—4: eISBN 978-86-6269-107-1.
16. Rajnović, Lj., Vujić, T., Vujić, M., (2023). Socially responsible business with reference to agricultural farms, *Economics of Agriculture, Scientific Society of Agrarian Economists of the Balkans, Belgrade, Institute for Agricultural Economics, Belgrade, Academy of Economic Sciences, Bucharest, Romania*, UDC 338.43:63; ISSN 0352-3462; doi: 10.59267/ekoPolj23041089R; UDC 338:172.2):631.1.017; Vol 70.
17. Rajnović, Lj., (2023) Challenges of organizing state enterprises that perform activities of general interest in the Republic of Serbia, *Institute for Agricultural Economics, Belgrade*.
18. Samardžić S., Gavrilović-Gagović S., (2011), Trends in the service economy of the Serbian sector, *Market, money, capital*, no. 2, Institute for Foreign Trade, Belgrade.
19. Vuković, V. (2014), Implementation of the public-private partnership model in the Republic of Srpska. *Annals of Business Economics*, 10, 142–151.
20. Todorović, J. (2003) Strategic and operational management, *CONZIT*, Belgrade.
21. Žeglen, P. (2011), The use of public-private partnership (PPP) in the development of the tourist economy - the example of the Subcarpathian region, Poland. *Acta Turistica Nova*, 5(1), 75 – 94.
22. White Book, (2022), Proposals for improving the business environment in Serbia, *Foreign Investor Council*.
23. World Economic Forum, The Global Competitiveness Report 2012-2013.
24. Law on Public-Private Partnership and Concessions (“Official Gazette of the Republic of Serbia”, No 88/11, 15/16, 104/16).



In memoriam

**Др МЛАДЕН Д. МИРИЋ**  
(1942–2024)



научни саветник, агроном, полихистор

Својим широким образовањем и ерудицијом, афирмисао се као један од ретких агронома - полихистора. Он је био и привредник, и високи државни службеник, и научни саветник. Истовремено је био културни и друштвени делатник, систематски се бавећи и агрокултуром и српском духовном баштином. Имао је заиста редак дар, да бројне проблеме које је истраживао, у својим делима вло прецизно систематијује и агументовано и сликовито опише.

Младен Мирић је рођен 1942. године, у Личком селу Крбавица, код Коренице, као 15-то дете српских тежака: мајке Марије и оца Данета. Породица је, као и многе, после Другог светског рата колонизирана и пресељена у бачко село Колут, код Сомбора, где је Младен завршио гимназију као један од најбољих ђака.

Студирао је и докторирао на Пољопривредном факултету у Новом Саду, чији је био стипендиста, где је више пута награђиван. Озбиљно се бавио истраживањем проблематике семенарства, још од своје докторске дисертације под насловом: *Настанак, развој и ефекти семенарства у Југославији*.

У својој агрономској струци почео је у ПК *Елан* из Србобрана, где је радио 10 година као одговорни стручњак за производњу и дораду семена. Ту је био градитељ једног од највећих центара за дораду семена на свету, почео своја научна истраживања и објавио своје прве научне радове. Потом је, у свом најбољем животном добу, око 15 година (1977-1992), радио у

некадашњем Савезном министарству пољопривреде, где је марљиво и одговорно приступао креирању привредних прописа, највише из области биљне производње и семенарства: приредио је Правилник о квалитету семена; био секретар државне Комисије за биљне генетичке ресурсе, учествовао у једном од најважнијих научних пројеката о генетичким ресурсима у СФРЈ и припреми градње Банке биљних гена у Земун Пољу; био је покретач ИСО стандардизације семенских лабораторија и агропредузећа у Србији, касније постао оцењивач стандарда, па и рецензент наставних програма на факултетима. Радни век је завршио у Институту за кукуруз “Земун Поље”, у својству шефа лабораторије за испитивање семена.

Био је иницијатор, оснивач и секретар Друштва селекционера и семенара (и доживотни почасни члана УО), покретач и уредник часописа Селекција и семенарство. Објавивео око сто стручних и научних чланака. Написао је читав низ стручних биографија познатих агронома – полихистора, истичући њихове велике доприносе, не само агрономији, него и другим наукама и друштвеним делатностима. Своје практично и теоријско искуство из области семенарства, преточио је у три научне монографије: *Семенарство као изазов*, *Дорада семена* и *Технологија производње семена*. Дубоку емотивну везаност за семенарску струку, потврђује и његов Полемички есеј о семену са поднасловом семељубље, у којем научно-филозофски промишља о значењу и значају семена за човечанство.

Поред свестраног доприноса својој агрономској и агроекономској струци, будући да је систематски *претраживао* по дубинама историје и културе српског народа, др Младен Мирић ће остати трајно упамћен као агроном полихистор, по својим не-агрономским књигама, којима је на јединствен и систематичан начин дао велики допринос српској националној култури памћења и сећања. Посебно се истичу три такве његове књиге:

*Српска баштина*, у којој је изнео много новог и прекретничког, трајно вредних надахнућа, укључујући добротинитеље дубоких мисли, или вредних изума, открића и теорија. То је свесрпско наслеђе завештано култури, као темељно упориште за идентитет, опстанак и будућност Срба;

*Агроеволуција*, обимна и јединствена књига, у којој је дат систематичан и свеобухватан преглед еволуције агро-иновација од постанка пољопривреде до данас. Мирић је у овој књизи открио, или пресистематизовао, чак преко 1.000 битних особености агрокомплекса: законитости, процеси, чиниоци раста, преображаји, парадокси, апсурди, предрасуде, идеје и прикази највећих агро-умова целокупне агроеволуције.

*Аутор се овим величанственим делом, као мало који аграрни посленик, суштински одужио својој струци и науци, своје роду и своје језику;*

Извори српског идентитета, последње велико Мирићево дело (2022), које припада националној култури памћења, у којем је на оригиналан и јединствен начин, систематизовао и детаљно описао главна исходишта српског идентитета, од народа као најширег гнезда, преко српског сељаштва, војске и спорта; ктитора династија и задужбинара, Српске православне цркве као духовног и културног миљеа, до знамења и канона одржавања врлина идентитета.

Младен је заслужио и добио многа друштвена признања, од ударничких значака са радних акција, награда током студирања, захвалница удружења и установа, до Златне значке СПИТС-а. Био је члан управе многих струковних и других удружења: од Савез пољопривредних инжењера и техничара и Друштва селекционера и семенара Србије, до Удружења за одбрану ћирилице.

Због свих поменутих резултата и трајних белега, које је он кроз своја дела завештао општој националној култури и породичном потомству (ћерке Јелене и сина Душана, посебно унука Стефана, Јована и Андреја), др Младен Мирић ће трајно живети својим стваралачким доприносима развоју своје агрономске и агроекономске, посебно семенарске струке, а још више, својим капиталним приносима култури памћења и сећања српског народа.

Преминуо је 26. јануара у Ургентном центру КЦ Србије, сахрањен је 2. фебруара 2024. године на Бежанијском гробљу у Београду. И Младенова породица (његова супруга, деца и унуци), када подигну споменик изнад његове хумке, знаће да је Младен својим делима, већ за живота, себи подигао трајан споменик. Његове колеге и пријатељи, као и нови нараштаји агро-стваралаца, имају по чему памтити др Младена Мирића, као неуморног ствараоца, писца и научника, врсног и ретко плодног агронома – полихистора.

Др Милан Р. Милановић



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Introduction is the first section of an IMRAD paper. Its purpose is to state clearly the problem investigated and to provide the reader with relevant background information. State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

The purpose of the Introduction should be to supply sufficient background information to allow the reader to understand and evaluate the results of the present study without needing to refer to previous publications on the topic. Much of the Introduction should be written in the present tense. /Times New Roman, 11/

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**Sub-headings** should be written by font **Times New Roman, font size 11, bold, centred**, only first letter capital, interspace between sub-heading and paragraph above 6 pt (**before 6 pt**), and interspace between sub-heading and paragraph below 6 pt (**after 6 pt**). Please use the writing style presented in this template.

### **Materials and methods**

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### Acknowledgements

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The authors declare no conflict of interest.

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5. Domanović, V., Vujičić, M., & Ristić, L. (2018), Profitability of food industry companies in the Republic of Serbia, *Economic of Agriculture*, 65(1), 11-32. doi:10.5937/ekoPolj1801011D
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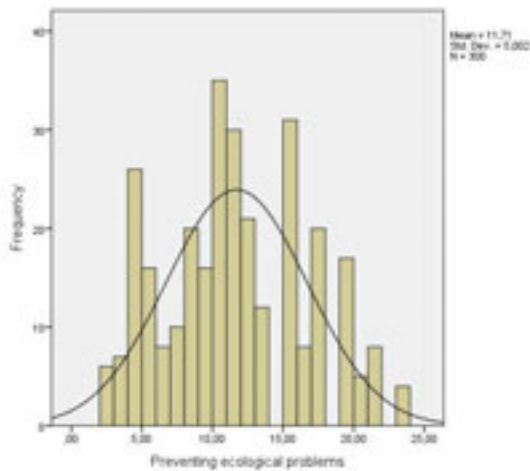
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**Example:****Table 1.** The distribution cost of packaged goods from Subotica to retail-store objects

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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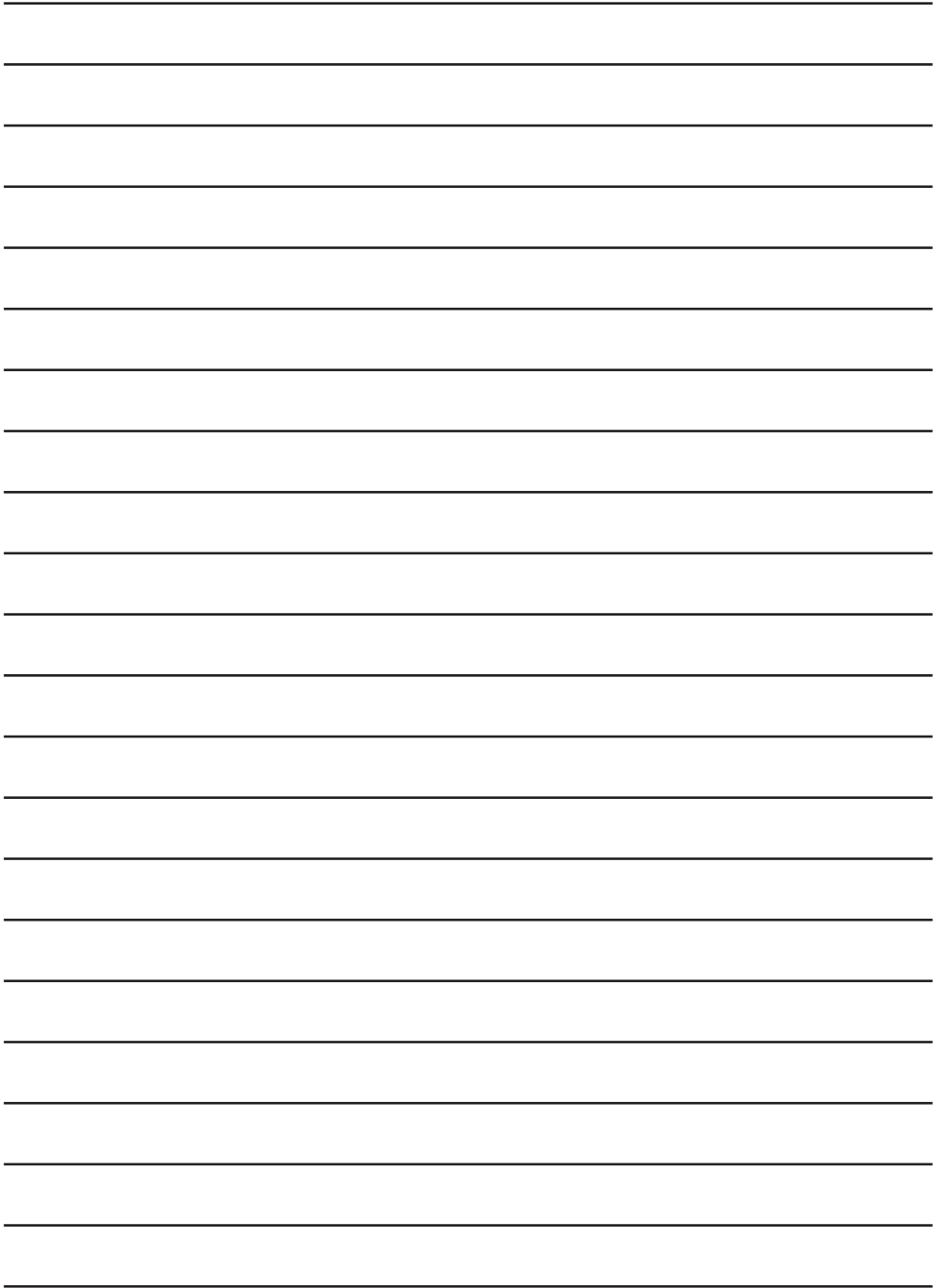
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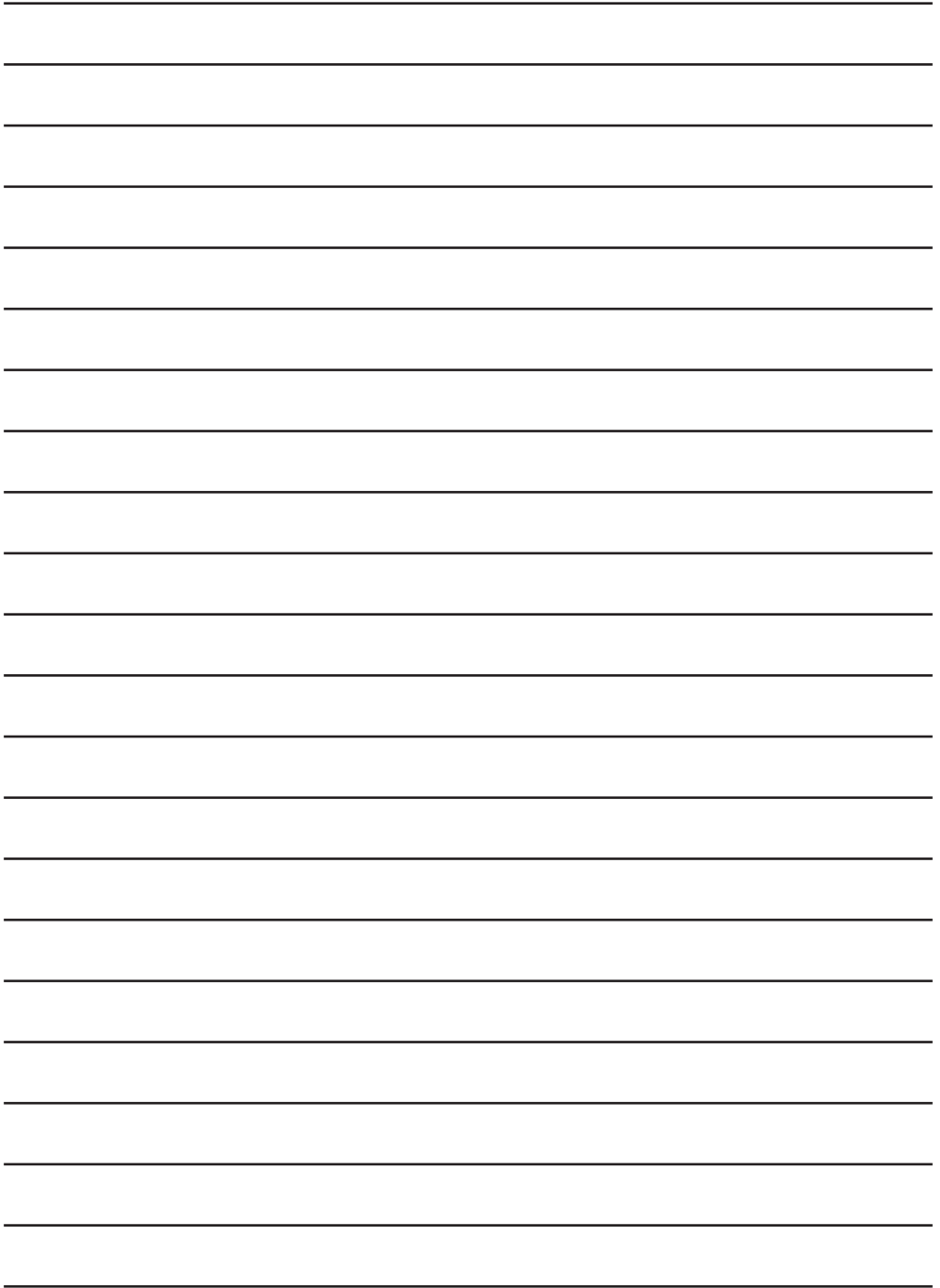
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