
AGRICULTURE 4.0 AND IMPROVING COMPETITIVENESS OF THE DOMESTIC AGRO-FOOD SECTOR

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ARTICLE INFO

Review Article

Received: 05 March 2020

Accepted: 19 April 2021

doi:10.5937/ekoPolj2102531B

UDC 631:[339.137:338.439]

Keywords:

competitiveness, agriculture 4.0, standardization, ICT, agro-food sector

JEL: D24, O13, Q16, Q18

ABSTRACT

The domestic agro-food sector has an important role in economic development and in overall GDP growth. The concept of Agriculture 4.0 that integrates the use of information-communication technologies presents a direction in which the domestic agriculture sector should focus. Additionally, besides conducting business within the frameworks of Agriculture 4.0, the standardization of processes in the agro-food sector can also contribute to achieving competitiveness on the globalized market. In this paper the importance and number of ISO standards are investigated. In addition, factors and indicators that characterize Agriculture 4.0 are analysed. Based on the collected and analysed data, a unified competitiveness factor (UCF) is calculated for the period from 2017 to 2020. The UCF provides an overview on the potential competitiveness of the domestic agro-food sector. The paper contributes to the existing body of literature as it managed to provide a strong basis for future research in this domain.

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Introduction

In this research the digitalization of agriculture - Agriculture 4.0, the necessity of standardization, the importance of highly finalized and processed agricultural products are analysed. Data from FAO, ISO and other organizations was collected and analysed in order to derive significant insight into the competitiveness of the domestic agro-food sector. Additionally, potential future trends are discussed, which are accompanied by suggestions and guidelines for improving the Serbian agricultural sector in accordance with the concepts that are part of Agriculture 4.0. This explorative research is significant as it addresses crucial competitiveness factors in the domestic agro-food sector in the context of Agriculture 4.0, which can be viewed as a concept within framework of Industry 4.0. In addition, it takes into consideration recent studies and the newest available data, thus it contributes to the existing body of literature.

This paper consists of four sections (excluding the Introduction and Conclusion sections). The first section provides details on the materials and methods. More precisely, the data sources and the approach to data analysis are described. In the second section the importance of ISO standards and ICTs are noted and additional data on ISO standards is provided. In the third section the concept of agriculture 4.0 is highlighted and the crucial role of highly processed, finalized products in competitiveness is highlighted. Additionally, a unified competitiveness factor (UCF) is calculated with the goal to identify the future potential competitiveness of the domestic agro-food sector. From here, graphs for predicting future trends are presented. In the fourth section the results are briefly discussed, suggestions and guidelines for improving competitiveness of the domestic agro-food sector are proposed.

Competitiveness, ICT and the importance of standardization

Traditional approaches to agriculture and the overall food industry are no longer viable due to increasing food demands. More precisely, by 2050 the demand for food will rise by up to 70% (De Clercq et al., 2018). This increase in demand further increases production. However, this production has to be improved and revolutionized in order to reduce water and energy consumption, and to achieve higher quality foods, higher yields with less pesticides and fertilizers. Further, the concept of the fourth evolution in farming technology - Agriculture 4.0 arises and it aims at increasing productivity, adapting to climate change laws and requirements, avoiding waste and effectively allocating resources (Zhai, et al., 2020). It can be argued that Agriculture 4.0 includes modern information-communication technologies (ICTs), which are the cornerstone of the fourth industrial revolution - Industry 4.0. Next, in order to achieve the aims and strategic goals that are outlined in the Agriculture 4.0 approach, it is necessary to digitalize farming procedures and supply chains in order to reduce the consumption of water, fertilizers, and pesticides.

The digitalization of the agro-food sector includes the implementation and application of robots, moisture sensors, temperature sensors, GPS technology, and aerial images

(De Clercq et al., 2018). Furthermore, the domestic agro-food sector is characterized with the process of standardization of agro-products with the goal to increase regional competitiveness (Ikram et al., 2020). However, the majority of standards that are applied in the Balkans, more precisely in Serbia, are mainly mandatory standards, which don't contribute significantly to the competitiveness of the domestic agro-foods sector (Ćočkalo et al., 2019). The lack of national competitiveness additionally affects the competitiveness of the domestic agro-food sector. Low productivity, minimal standardization, and old farming equipment significantly contribute to the inadequate competitive ability of the Serbian agricultural sector (Bešić et al., 2014).

Furthermore, the modern business environment is characterized by constant changes on the globalized market. These changes are increasing and intensifying over time and present a challenges for enterprises in all industrial sectors (Đorđević, et al., 2016). In order to stay relevant on the market, enterprises have to meet customers' demands and expectations, and to provide high, consistent levels of product and service quality in order to increase customer satisfaction (Popović, & Miletić, 2016; Milojević et al., 2020). When it comes to overall competitiveness of the domestic economy, according to the latest rankings noted in the Global Competitiveness Report 2019 (WEF, 2019), Serbia is ranked 72nd (out of 141). In the same report, neighbouring countries and countries in the region are ranked as follows: Albania 81st; Austria 21st; Bosnia and Herzegovina 92nd; Bulgaria 49th; Croatia 63rd; Greece 59th; Hungary 47th; Montenegro 73rd; North Macedonia 82nd; and Slovenia 35th (WEF, 2019). It is evident that Serbia has room for improvement regarding its competitiveness ranking. ICT adoption, the financial system, and the institutions have to be improved in order to increase national competitiveness. Significant investments into to the ICT sector and the application of ICT in other sectors is crucial for economic growth (Domazet et al., 2018).

ICT adoption in the agriculture sector is a prerequisite for Agriculture 4.0, which brings improvements when it comes to agricultural development (Simonović, Čurčić, 2018). Further, standardization of business operations can improve productivity, increase product and service quality, and increase the competitive advantage on the market (Miletić et al., 2020). The importance of standards is present in the agriculture sector, as the increase of ISO standards can improve product quality and increase competitiveness when it comes to export of agricultural goods (Aničić, Paraušić, 2020). Next, in Table 1., the number of ISO standards in all sectors for 2018 and 2019, for Serbia and neighbouring countries is presented.

Table 1. Number of ISO standards in Serbia and region (all sectors)

Country	ISO 9001		ISO 14001		ISO/IEC 27001		ISO 50001		ISO/IEC 20000	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Albania	214	363	144	151	19	33	4	8	3	1
Austria	3282	3325	1079	1052	157	81	237	236	9	/
Bosnia and Herzegovina	1346	935	291	742	24	31	12	11	/	/

Country	ISO 9001		ISO 14001		ISO/IEC 27001		ISO 50001		ISO/IEC 20000	
Bulgaria	5943	6278	1946	1993	339	367	181	252	92	95
Croatia	2343	2715	1027	1182	138	190	136	194	10	15
Greece	6165	6570	1415	1542	240	336	81	109	13	17
Hungary	6658	7107	2391	2547	484	554	613	472	30	26
Montenegro	137	163	63	91	11	11	/	/	/	/
North Macedonia	436	502	306	292	33	30	6	3	25	/
Romania	9299	9506	4553	4658	585	654	58	57	51	42
Serbia	2427	2707	1169	1275	223	258	73	87	22	10
Slovenia	1710	1761	432	468	80	31	30	27	/	/

Source: ISO, 2019

According to Table 1., there is an increase of ISO standards in Serbia from 2018 to 2019. The largest number of standards is noted in Romania, followed by Greece, and Bulgaria on the third place by the number of ISO standards.

Overall, the number of standards in Serbia is not adequate, improvement is necessary, however, there is a solid base when it comes to the current number of ISO certificates. Next, in Table 2. the number of ISO standards in the agriculture sector for 2018 and 2019, for Serbia and neighbouring countries is presented.

Table 2. Number of ISO standards in Serbia and region (agriculture sector)

Country	ISO 9001		ISO 14001		ISO/IEC 27001		ISO 50001		ISO/IEC 20000		SUM
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	
Albania	2	2	1	2	/	/	/	/	/	/	7
Austria	2	2	/	1	/	/	/	/	/	/	4
Bosnia and Herzegovina	5	4	3	3	/	/	/	/	/	/	15
Bulgaria	236	315	42	38	11	9	/	/	/	/	631
Croatia	22	28	12	13	/	/	/	/	/	/	75
Greece	33	41	4	4	/	/	/	/	/	/	82
Hungary	35	56	5	10	/	/	1	/	/	/	106
Montenegro	1	1	1	1	/	/	/	/	/	/	4
North Macedonia	/	2	/	3	/	/	/	/	/	/	5
Romania	20	41	11	23	/	/	/	/	/	/	95
Serbia	19	18	6	4	/	/	1	1	/	/	49
Slovenia	3	3	/	/	/	/	/	/	/	/	6

Source: ISO, 2019

Based on the data in Table 2., Serbia has 49 ISO standards in the agriculture sector, and this number should be higher, considering the importance of the agriculture sector from the aspect of national economic growth (Tomić, Radanov, 2020). Therefore, it can be argued that this number is inadequate, and there should be an increase in number

of standards in the agriculture sector. Further, the ISO 22000:2018 standard for food and safety management systems that defines the requirements for any organization in the food chain, plays a significant role in the agriculture sector as well as sectors that are directly or indirectly connected to the agriculture sector. The ISO 22000 standard can be implemented and used by every participant in food supply chains. Therefore, in the context of competitiveness of the domestic agro-food sector, ISO 22000 provides a cornerstone of food safety improvement, food quality improvement, reducing costs in supply chains, and increasing customer trust (Chen et al., 2019). In Table 3. the number of ISO standards for 2018 and 2019 (latest data) in Serbia and neighboring countries is presented.

Table 3. Number of ISO 22000 standards in Serbia and other countries

Country/year	AL	AU	BH	BU	CRO	GR	HU	MN	NM	RO	SRB	SLO
2018	29	72	30	324	59	1912	127	13	61	653	216	12
2019	12	82	20	310	58	2024	126	12	54	639	195	13

Legend:
 AL - Albania; AU - Austria; BH - Bosnia and Herzegovina; BU - Bulgaria; CRO - Croatia;
 GR - Greece; HU - Hungary; MN - Montenegro; NM - North Macedonia; RO - Romania; SRB - Serbia; SLO – Slovenia

Source: ISO, 2019

The data in Table 3. indicates that, compared to neighbouring countries, Serbia has a moderate number of ISO 22000 standards, thus it can be argued that there is a basis for further development in the agro-food sector. In the next section, Agriculture 4.0, the necessity for highly processed agricultural products, and the potential competitiveness of the domestic agro-foods sector are addressed.

Data and methods

The globalization of markets and the changes that are brought on by the fourth industrial revolution - Industry 4.0 significantly affect the process of achieving and maintaining competitiveness on the market, regardless of industry (Bakator et al., 2019). This lack of competitiveness of domestic enterprises is evident in the agro-food sector as well.

The research was carried out for over a month where spreadsheets were collected, and data extracted, categorized for comparison and analysis. Data on the number of ISO standards was obtained via the ISO database with the latest data (ISO, 2019). Further, data regarding the agro-food sector was obtained from the Food and Agriculture Organization of the United Nations (FAO, 2021). Next, data on the implementation and application of information-communication technologies (ICT) in domestic enterprises was obtained from the Statistical Office of the Republic of Serbia (RSZ, 2021). Additionally, information and data was obtained and analysed from other studies in this domain.

Data analysis included data categorization, deduction, and qualitative correlation analysis. In addition, graphs presenting future potential trends are modelled. In addition,

several metrics in the agricultural sector (water consumption, production, industry valued GDP, agriculture valued GDP etc.). In addition, data regarding the digitalization of domestic enterprises was obtained and analysed. Through categorization and tabular comparison of data it was managed to develop comprehensive tables that present the competitiveness of the domestic agro-food sector. Further, graphs indicating trends are modelled in order to provide an overview on the strategic potential of the domestic agro-food sector in the future.

The obtained results, presented in these tables and graphs, are further examined in the discussion section. Here, suggestions and guidelines for improving the domestic agro-food sector within the frameworks of Agriculture 4.0 are proposed. The suggestions and guidelines are based on the obtained results. More precisely, the current situation regarding the competitiveness of the domestic agro-food sector, and future potential trends are the cornerstones of the noted suggestions and guidelines.

Agriculture 4.0 and the potential of the domestic agriculture sector

Digitalized agricultural production, and the effects of ICT application in farming are mainly positive as they contribute to productivity, water use efficiency, and less pesticide use (Klerkx et al., 2019). However, the use of advanced technologies such as artificial intelligence systems, robotics, Big Data Analytics, and Internet of Things should be strategically implemented, as these changes have societal effects besides economic effects (Rose, Chilvers, 2018). As agricultural production is faces challenges when it comes to yield, pesticide use, and sustainable development, the use of technologies that are within the framework of Agriculture 4.0 slowly becomes an imperative (Ozdogan et al., 2017). Besides the noted necessity for modern ICT use in the agro-food sector, it is necessary to process and finalize agricultural products to the highest degree, as such products bring the most value when exported (Đurić et al., 2017). This further indicates the necessity for higher number of standards (Wilcock, Boys, 2017).

Standards in the agro-food sector can be implemented from various aspects, including products, ICT, and environment sustainability. More precisely, the implementation of the ISO 14001 standard provides a solid basis for sustainable development in the agro-food sector, where the environment is not uncontrollably exploited, but rather strategic actions are introduced in in order to comply with the ISO 14001 standard, which further increases environmental protection and preservation (Carrillo-Labela et al., 2020; Zhao et al., 2020). Standardization of finalized products positively affects exports of agricultural products (Kim, 2021).

It can be argued that Agriculture 4.0 goes along and relies on modern ICT adoption, standardization, and highly finalized products that have higher value compared to raw or semi-processed products. In Table 4., the agriculture gross value added to GDP for the period of 2003 to 2017, for Serbia and neighbouring countries is presented.

Table 4. Agriculture value added to GDP in % (and in millions of US)

Country	2003-2007	2008-2012	2013-2017
Albania	17.15% (1.831)	18.77% (2.312)	19.01% (2.476)
Austria	1.42% (5.505)	1.35% (5.521)	1.20% (5.033)
Bosnia and Herzegovina	7.71% (1.215)	6.14% (1.057)	5.60% (1.012)
Bulgaria	4.65% (2.066)	4.41% (2.345)	4.04% (2.995)
Croatia	3.73% (2.242)	3.34% (1.886)	2.94% (1.624)
Greece	3.04% (9.673)	3.24% (7.954)	3.70% (7.540)
Hungary	3.49% (4.887)	3.91% (5.012)	3.80% (5.374)
Montenegro	7.23% (266)	7.45% (304)	6.85% (332)
North Macedonia	8.93% (744)	9.11% (887)	7.87% (890)
Romania	5.50% (9.605)	4.67% (8.002)	4.31% (9.131)
Serbia	8.28% (3.336)	7.53% (3.069)	6.02% (2.656)
Slovenia	2.05% (983)	1.96% (914)	1.85% (899)

Source: FAO, 2021

The Food and Agriculture Organization of the United Nations (FAO, 2021), only has data up to 2017. The Statistical Office of the Republic of Serbia has data from 2018 to 2020, where the agriculture gross added value to GDP in 2018 was 7%, in 2019 was 6.9%, and in 2020 was 7.5%. (RZS, 2018; RZS, 2019). It is also noted that the agriculture gross added value to GDP is an important factor that made the COVID-19 pandemic and economic crisis less impactful on the overall GDP loss in 2020 (Danas, 2020). The real growth of the agricultural sector in 2007, 2012, and 2017 was -11.4%, 15.1% and 1.6% respectively (FAO, 2021). The latest growth rate has to be improved as the agricultural sector is a strong cornerstone of the domestic economy (Gligorijević et al., 2020). Next, in Table 5 the percentage of agricultural water withdrawal from the total renewable water sources and irrigated agriculture water use efficiency in 2007, 2012, and 2017 for Serbia and neighbouring countries is presented.

Table 5. Agriculture water withdrawal as % of total renewable water sources (and Irrigated Agriculture Water Use Efficiency (US\$/m³))

Country	2003-2007	2008-2012	2013-2017
Albania	1.76 (0.708)	1.98 (1.444)	3.00 (1.220)
Austria	0.11 (3.148)	0.010 (3.484)	0.10 (3.365)
Bosnia and Herzegovina	/	/	/
Bulgaria	3.28 (0.116)	4.46 (0.081)	3.92 (0.092)
Croatia	0.003 (10.23)	0.034 (1.124)	0.072 (1.496)
Greece	12.37 (0.464)	12.11 (0.387)	13.22 (0.440)
Hungary	0.296 (0.431)	0.31 (0.651)	0.499 (0.332)
Montenegro	/	/	/
North Macedonia	1.96 (1.564)	21.14 (0.169)	5.14 (0.682)
Romania	0.518 (0.258)	0.515 (0.263)	0.703 (0.270)
Serbia	0.079 (/)	0.385 (0.149)	0.407 (0.122)
Slovenia	0.014 (/)	0.007 (6.651)	0.012 (4.117)

Source: FAO, 2021

Based on the data in Table 5. it can be seen that in Serbia agriculture water withdrawal as of total renewable water sources is 0.407%. This number is low compared to Greece (13.22%), North Macedonia (5.14%), Bulgaria (3.92%), and Albania (3%). In order to become competitive within the frameworks of Agriculture 4.0. it is necessary address this factor.

Next, in Table 6. the percentages of ICT application in domestic enterprises from all sectors are presented.

Table 6. Information-communication technology application in enterprises (all sectors)

	2017	2018	2019	2020
Internet connection in Serbian enterprises	99.7%	99.8%	99.8%	100%
Broadband, fast Internet connections in Serbian enterprises	98.6%	98.8%	97.1%	98.4%
Mobile Internet use in domestic enterprises	81.9%	75.4%	79.1%	77%
Domestic enterprises that have a website	82.6%	82.6%	83.6%	84.4%
Website has the function of online purchasing	18.7%	25.1%	28.9%	28.1%
E-commerce	23.8%	26.3%	27.5%	27.9%
Use of Cloud applications	15.5%	15.5%	21.9%	18.6%
Average %	60.11	60.5	62.56	62.06

Source: RZS, 2021

Based on the data presented in Table 6., there is an increase in ICT solution implementation and application across various sectors. The lowest percentages are noted in the E-commerce sector and in the application of cloud-based solutions.

Quantification and integration of values from Tables 2., 4., 5., and 6. is conducted in order to create a unified competitiveness indicator of the domestic agro-food sector. The unified competitiveness indicator takes into consideration:

- the number of ISO standards in the domestic agriculture sector (label: **ISODA**);
- the agriculture value added to GDP in % (label: **GDPA**);
- real growth in % of gross value added (GVA) of the agriculture, forestry and sighthing sector (label: **GVAG**)
- agriculture water withdrawal as % of total renewable water sources (label: **AWW**);
- irrigated agriculture water use efficiency (US\$/m³) (label: **AWUE**);
- and the average potential of information-communication technology (ICT) application in domestic enterprises (label: **ICTDE**).

The noted indicators are chosen as these encompass several key concepts that characterize Agriculture 4.0. These concepts are standardization as a mechanism to improve international presence (export potential) (Caetano, 2017); agriculture % of total GDP as an indicator of how agriculture affects the performance of the overall domestic economy (Aničić, et al., 2016); agriculture GVA real growth in % as this can show what trends are present in the agriculture sector when it comes to growth; agriculture water withdrawal % of total renewable water sources present a key indicator within Agriculture 4.0, as one of the goals are to increase the use of water from renewable resources (Velasco-Muñoz et al., 2018); water use efficiency from agriculture irrigation has the same impact and importance as using water from renewable sources and together are also important factors for sustainable development (Aznar-Sánchez et al., 2018); the potential of ICT implementation and application present a driving mechanism of agriculture development as it can increase productivity, yield, and contribute to the increase of production of highly processed agricultural products that have higher market value compared to raw or half-processed goods (Mikhailushkin, 2018; Saidu, 2017).

An equation for determining the unified competitiveness factor (**UCF**) is introduced:

$$\text{UCF} = \frac{\text{xisum}_{2019}}{\text{xmaxsum}_{2019}} * 100 + 100 * \text{GDPA}(\%) + 100 * \text{GVAG}(\%) + 100 * \text{AWW}(\%) - (\text{xmintabx} * 100 / \text{AWUE}) + 100 * \text{ICTDE}(\text{avg}\%)$$

Overall, based on the equation the percentages are multiplied with 100, while for water efficiency use, the lowest value from the table is multiplied with 100 and divided with the domestic values). For the ISO standards the sum values for 2019 are used (this is the latest data). Further, for ICT, as there are several factors with percentages, the average percentage is used and it is multiplied with 100.

The UCF is calculated for 2017, 2018, 2019 and 2020. The newest available data is used. However, as for some factors there is no available data for example 2020. In those cases, the value from previous year used.

The noted equation for calculating the UCF presents an approach that can provide some insight into future trends when it comes to Agriculture 4.0 development and competitiveness of the domestic agro-food sector. The results of the calculation for the years 2017, 2018, 2019, and 2020 are presented in Table 7.

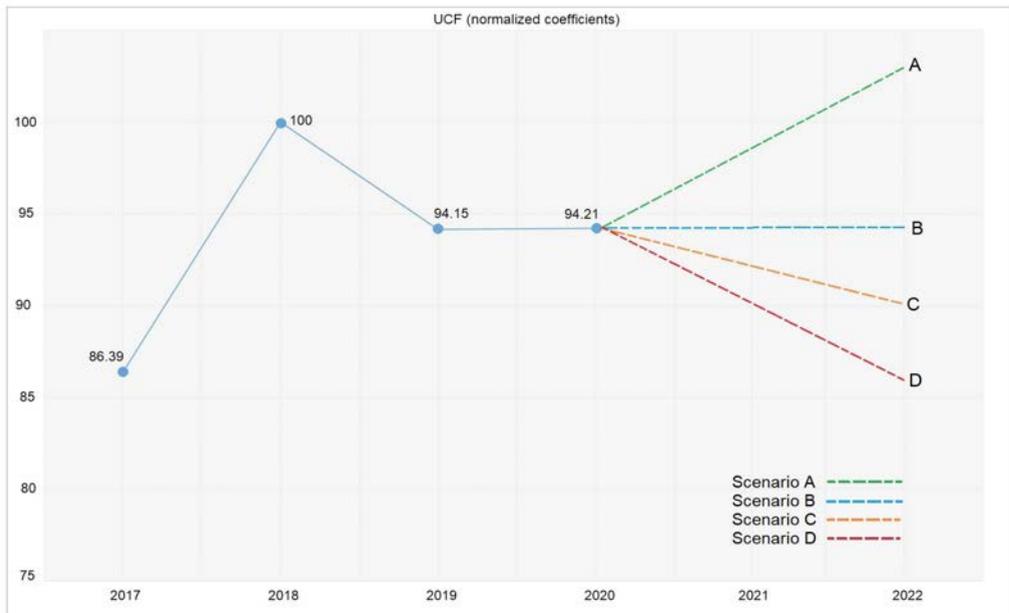
Table 7. Unified competitiveness factor (UCF) of the domestic agro-food sector

	2017	2018	2019	2020
UCF for the agro-food sector	170.57	197.45	185.91	186.01
UCF for the agro-food sector (normalized into scale of 1-100)	86.39	100	94.15	94.21

Source: Authors

The results in Table 7. indicate a gradual rise in competitiveness of the domestic agro-food sector. From here, the results are presented on a graph Figure 1. and future potential scenarios for the upcoming years are noted and discussed. The potential scenarios are based on the obtained and analysed data.

Figure 1. Potential competitiveness outcomes (scenarios) of the domestic agro-food sector



Source: Authors

Figure 1. depicts the UCF from 2017 to 2020. Additionally, four scenarios (A, B, C, and D) are noted. These scenarios represent the potential of the domestic agriculture sector in the next two years. The scenarios are derived from logical assumptions are by analysing previous trends.

Scenario A presents an outcome where there is an increased number of ISO standards in the agriculture sector; higher water use efficiency for irrigation; higher percentages of water use from renewable water resources; higher percentage of ICT implementation and application; and a significantly higher growth of gross added value to GDP and percentage of total GDP.

In **scenario B**, only mild increase of the noted factors would be sufficient to maintain the current competitiveness ability of the domestic agriculture sector. Mild increase is necessary, as the market is constantly changing and competition on the market is evolving and intensifying. Next, **scenario C** is the potential outcome if there is no change and a slight decrease in the noted factors and indicators.

Finally, the least favourable competitive strength of the domestic agriculture sector is presented as **scenario D**. This scenario would occur if there is a significant decrease in the number of ISO standards, decrease of water efficiency use, decrease of water use from renewable water sources, as well as decrease in ICT application percentages. Due to the COVID-19 pandemic, the current business environment is dynamic and enterprises face challenges in all sectors. Therefore, if scenario A has a low probability of occurring. Scenario B is a more likely outcome of the current economic climate.

Discussion

Increasing the competitiveness of the domestic agro-food sector requires significant and systematic engagement on various levels of government. The obtained and analysed data regarding ISO standards, agro-food indicators, and ICT application provided significant insight into the current state of competitive ability of the domestic agro-food sector. With the goal to provide a concise overview of current and future potential competitiveness of the domestic agro-food sector, a unified competitiveness factor (UCF) was calculated. From here, the graph (Figure 1.) was constructed with potential future competitiveness scenarios. Based on the analysed data, and on the obtained results of the analysis the following suggestions and guidelines for improving competitiveness of the domestic agro-food sector are proposed:

- Systematically increase the number of ISO standards in the agro-food sector, but also in other industrial sectors as well. Focus should be on standards that would result in improvement of quality, ICT adoption and sustainable development.
- Increase awareness among local communities on the importance and significance of the ISO 22000 when it comes to the competitiveness of the domestic agro-food sector.
- Increase the awareness of ICT application benefits in agriculture to farmers and local communities.
- Provide adequate infrastructure for ICT solutions across various agro-food sub-sectors. This should include farmlands, semi-processing, and finalized processing of products.

- Develop strategic plans for implementing ICTs in the agro-food sector, and provide support in the form of seminars and education of workers that would apply the ICT.
- Systematically increase the number and intensity of highly processed, finalized agricultural products. This involves creating value in products rather than exporting raw or semi-processed products.
- Develop short-term and long-term plans regarding national and local agricultural product processing with the goal to reduce the export of unprocessed (raw) products and increase the number finalized products.
- Focus on environment preservation through Agriculture 4.0 concepts, including the increase of irrigation water use efficiency, increase of water use from renewable water sources, and reduction of pesticide use.

Overall, when it comes to Agriculture 4.0 the domestic agro-food sectors requires a multi-solution approach where several mechanisms are introduced with the goal to strategically and organically increase the number of ISO standards in agriculture, increase water use efficiency, reduce pesticide use; increase the percentage of finalized products in export, and to overall increase productivity, and yield in agriculture production.

This current paper contributes to the existing body of literature as it integrates important data on the domestic agro-food sector, standardization, and ICT application. This data is categorized, analysed, and used to create a significant overview on the potential competitiveness of the domestic agro-food sector.

Conclusion

Competitiveness of the domestic agro-food sector is affected by numerous factors. In this paper data regarding ISO standards, agriculture, and ICT application in enterprises is analyzed. It can be concluded that the potential competitiveness of the domestic agro-food sector relies on several indicators in these three aspects (standards, agriculture, ICT). In addition, it was noted that in order to increase competitiveness in agriculture, it is necessary to address all the “weak points” regarding product-type exports (highly processed and finalized products, instead of raw and semi processed products); agriculture (water use efficiency, growth of gross added value, organic farming and/or reduced use of pesticides); and number of standards (primarily in the agro-food sector, but in other sectors as well).

The limitation of this paper is that the research is conceptualized around obtaining and analyzing data from external databases, as there were no surveys within this research. However, the goal of the paper was to provide an overview and solid basis for future research, thus the noted limitation is not severe. For future research empirical data from farms and other agriculture-based enterprises could be collected via survey or interview.

Conflict of interests

The authors declare no conflict of interest.

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