UDC 338.43:63

ISSN 0352-3462

ЕКОНОМИКА ПОЉОПРИВРЕДЕ

ECONOMICS OF AGRICULTURE

Vol. LXVI, № 2 (333-660), 2019

BELGRADE

UDC 338.43:63

ISSN 0352-3462

ЕКОНОМИКА ПОЉОПРИВРЕДЕ
ECONOMICS OF AGRICULTURE

Journal is indexed and abstracted in Emerging Sources Citation Index.

66.

"Сагласно одлуци из члана 27. став 1. тачка 4), Закона о научноистраживачкој делатности („Службени гласник РС", бр. 110/05, 50/06-испр. и 18/10), утврђена је категоризација домаћих научних часописа

Листа часописа за друштвене науке

5. Економика пољопривреде М24"
(Часопис међународног значаја)
http://www.nauka.gov.rs (28. Jun 2010)

Београд, април-јун 2019. године
Belgrade, April-June, 2019

Часопис
◊ ЕКОНОМИКА ПОЉОПРИВРЕДЕ ◊

Journal
◊ ECONOMICS OF AGRICULTURE ◊

Основан 1954. године / Established 1954

ИЗДАВАЧИ / PUBLISHERS

Научно друштво аграрних економиста Балкана, Београд
The Balkan Scientific Association of Agrarian Economists, Belgrade
Институт за економику пољопривреде, Београд (Србија)
Institute of Agricultural Economics, Belgrade, (Serbia)
Академија економских наука, Букурешт (Румунија)
Academy of Economic Studies, Bucharest (Romania)

Адреса уредништва / Editorial office
Београд, Волгина 15; тел/факс (+381)11/6972-848; E-mail: economicsofagriculture@ea.bg.ac.rs
Belgrade, Volgina 15; phone/fax (+381)11/6972-858; E-mail: epoljoprivrede@gmail.com

http://ea.bg.ac.rs

INTERNATIONAL EDITORIAL REVIEW BOARD

UDC 338.43:63 ISSN 0352-3462

ECONOMICS OF AGRICULTURE

CONTENT

ENCOURAGING CONSUMER ETHNOCENTRISM IN THE FUNCTION OF DOMESTIC FOODSTUFFS CONSUMPTION

Mira Rakic [1], Beba Rakic[2], Ljiljana Stanojevic[3]

**Corresponding author E-mail: rakic.mira@gmail.com*

ARTICLE INFO

Original Article

Received: *10 July 2018*

Accepted: *27 November 2018*

doi:10.5937/ekoPolj1902341R

UDC 338.439.63:659.117.3

Keywords:

consumer ethnocentrism, consumers, foodstuffs, Serbia

***JEL**: Q13, M31*

ABSTRACT

The objective of this study was to examine the actors and the activities of the actors influencing consumer ethnocentrism in the consumption of domestic foodstuffs in Serbia. To do this, the items of the modified Consumer Ethnocentric Tendencies Scale were used as the framework for the focus-group interview. The two basic questions were 1) who (which actors) and 2) what (which activities) should actors take in order to encourage consumer ethnocentrism. The findings have interesting implications for actors with respect to marketing activities. The results show that governments, schools, producers, retailers, the media and consumers need to promote ethnocentrism in Serbia. There are two basic conclusions with the recommendations for actors' activities in order to encourage ethnocentrism: first, consumer behavior influencing the profit of companies and the gross domestic product of Serbia and second, all other actors can influence the consumer awareness of the importance of ethnocentric behavior in consumption.

Introduction

Agricultural and food sector has a very important role in the economic development of Republic of Serbia (Đurić et al., 2017). Serbia has the potential for production and processing of high quality and healthy products and development of conventional, integral and organic agricultural production for the needs of the domestic market and export (Cvijanović et al., 2016). Households buy food products that vary from cheap to expensive, from healthy to unhealthy, from basic to value-added. Beside the nutritional,

1 Mira Rakic, Ph.D., Full Professor, Faculty of Business Studies, Bulevar marsala Tolbuhina 8, Belgrade, Serbia, Phone: +381 11 2203011, E-mail: rakic.mira@gmail.com, ORCID ID (http://orcid.org/0000-0003-4937-7645)

2 Beba Rakic, Ph.D., Full Professor, Faculty of Business Studies, Bulevar marsala Tolbuhina 8, Belgrade, Serbia, Phone: +381 11 2203011, E-mail: brakic@gmail.com, ORCID ID (http://orcid.org/0000-0001-7779-4548)

3 Ljiljana Stanojević, Ph.D., Associate Professor, MEF, Jevrejska 24, Belgrade, Serbia, Phone: +381 11 264 3390, E-mail: ljstanojevic@gmail.com ORCID ID (https://orcid.org/0000-0002-4157-4989)

economic factors have a major and often decisive significance on a households' ability to afford certain food products. Income, price and housing costs have a significant influence on the purchase of food products (Kovljenić, Savić, 2017). The importance of the agro-food sector for the development of Serbia and the interdependence between CE and the consumption of domestic foodstuffs influenced the subject matter of this paper. In the introductory part, the related literature is reviewed. Ethnocentrism and CE (the factors influencing CE, the types of ethnocentric consumers) are first presented. In addition, in the introductory part, the concepts of local, regional and traditional foods are presented. In this paper, the term "domestic food product" is used for local, regional and traditional food products. After presenting the literature in the field of consumer ethnocentrism (CE) and domestic food products, the focus-group method applied in the research studies described. Then, the results of the research are described and the discussion is presented. At the end of the paper, the conclusions and recommendations for the actors and their activities are given.

Literature review

The term "ethnocentrism" is introduced by Sumner (1906). Sumner defines ethnocentrism as: "... the view of things in which one's own group is the center of everything, and all others are scaled and rated with reference to it... Each group nourishes its own pride and vanity, boasts itself superior, exalts its own divinities and looks with contempt on outsiders" (Sumner, 1906, p. 13). The concept of ethnocentrism implies the people who view their own group as the center of the universe, interpret other social units from the perspective of their own group, and reject the persons who are culturally dissimilar, while blindly accepting those who are culturally like themselves (Booth, 1979; Shimp, Sharma, 1987).

The concept of consumer ethnocentrism is introduced by Shimp and Sharma (1987). "From the perspective of ethnocentric consumers, purchasing imported products is wrong because, in their minds, it hurts the domestic economy, causes loss of jobs, and is plainly unpatriotic; products from other countries (i.e., out groups) are objects of contempt to highly ethnocentric consumers" (Shimp, Sharma, 1987, p. 280). Consumer ethnocentrism remains fervent despite globalization and represents one of the strongest import blockades of our time (Shankarmahesh, 2006). CE is also called "patriotic consumption behavior" (Schnettler et al, 2011).

Research on CE has largely focused on consumer choices between domestic and imported products. There are a small, but growing, number of the studies of regional ethnocentrism, or CE at a subnational level, or in an inter-regional context (Fernández-Ferrín, Bande-Vil, 2013; Fernández-Ferrín, Bande, Galán-Ladero, 2017; Ouellet, 2007; Poon, Evangelista, Albaum, 2010).

Shimp and Sharma (1987) formulated and validated an instrument called Consumer Ethnocentric Tendencies Scale (CETSCALE) so as to measure consumers' ethnocentric tendencies related to purchasing foreign- versus American-made products. CETSCALE

is translated into other languages and tested in different countries and different product categories (Bianchi and Mortimer, 2015; Orth, Firbasová, 2003; Schnettler et al, 2011; Šmaižien, Vaitkien, 2014). Modificated CETSCALE is tested in Serbia (Gašević, Tomašević, Vranješ, 2017; Kragulj, Parežanin, Miladinović, 2017; Marinković, Stanišić, Kostić, 2011).

The majority of prior studies consider the factors influencing CE and the types of consumers with the degrees of ethnocentrism (based on CETSCALE). In the literature, the following factors that have an influence on ethnocentric consumer behavior were investigated most in relation to the consumption of local foodstuffs: the health issues (Schnettler et al, 2011), the country-of-origin (COO) (Chung, Boyer, Han, 2009; Schnettler et al, 2011; Verlegh, Steenkamp, Meulenberg, 2005), the demographic factors like age, etc. (Alfnes, 2004; Balabanis et al., 2002; Huddleston, Good, Stoel, 2001; Javalgi et al., 2005; Shimp, Sharma, 1987; Verbeke, Ward, 2006), gender (Alfnes, 2004; Balabanis et al., 2002; Chung et al., 2009; Javalgi et al., 2005; Schnettler et al, 2011; Shimp and Sharma, 1987), income (Balabanis et al., 2002; Javalgi et al., 2005; Schnettler et al, 2011; Verbeke, Ward, 2006), education (Balabanis et al., 2002; Javalgi et al., 2005; Schnettler et al, 2011; Verbeke, Ward, 2006) etc. COO implies that consumers use the product origin as an attribute related to its quality, either alone or in combination with other attributes (Schnettler et al, 2011). Elderly people show stronger ethnocentric tendencies than the younger (Alfnes, 2004; Balabanis et al., 2002; Huddleston, Good, & Stoel, 2001; Javalgi et al., 2005; Shimp, Sharma, 1987; Verbeke, Ward, 2006). Various studies have determined stronger ethnocentric tendencies in women (Alfnes, 2004; Balabanis et al., 2002; Chung et al., 2009; Javalgi et al., 2005; Schnettler et al, 2011; Shimp and Sharma, 1987). Education and income tend to present a negative relation to ethnocentrism (Balabanis et al., 2002; Javalgi et al., 2005; Schnettler et al, 2011; Verbeke, Ward, 2006). Consumers residing in rural zones have been found to demonstrate a stronger rejection of imported products (Alfnes, 2004; Schnettler et al, 2011).

The previous studies have indicated consumers (Autio et al., 2013; Arsil et al., 2013; Bianchi, Mortimer, 2015; Schnettler et al, 2011), governments (Bianchi, Mortimer, 2015; Coderre et al., 2010; Ilbery et al., 2006), producers (Bianchi, Mortimer, 2015; Paustian, Reinecke, Theuvsen, 2016), retailers (Bianchi, Mortimer, 2015; Carpio, Isengildina-Massa, 2009; Darby et al., 2008), schools (Bianchi, Mortimer, 2015; Nabham, 2002) and media (Bianchi, Mortimer, 2015; Nabham, 2002) as the actors responsible for CE fostering.

The growing awareness of environmental and health-related issues, the healthy life-style led by consumers influence consumer interest in the origins of the food they purchase and the transparency of the food chain (Autio et al., 2013; Arsil et al., 2013; Bianchi and Mortimer, 2015; Costanigro et al., 2014; Rakic, Rakic, 2015a, Rakic, Rakic, 2015b). Consumers are willing to pay a premium for unconventional products (Costanigro et al., 2014).

Governments are also showing an increasing interest in supporting and promoting local foods (Bianchi, Mortimer, 2015; Coderre et al., 2010; Ilbery et al., 2006). Sustainability-oriented actors in the macro-environment (regulators and governments, the general public, environmental and social pressure groups, NGOs, neighbourhood communities, the media and schools) have the roles of setting "the patterns of sustainable behavior", promotions, pressures and controls of actors' sustainable behaviour (Rakic, Rakic, 2018).

Producers and retailers need to develop campaigns explaining how consuming local food supports local businesses and farmers (Bianchi, Mortimer, 2015). Some retailers and culinary experts have better understood this opportunity and have invested heavily into the production, distribution and serving of domestic food as a way to connect with consumers and increase profits (Bianchi, Mortimer, 2015; Carpio, Isengildina-Massa, 2009; Darby et al., 2008). Farmers, processors and retailers can differentiate their products by using labels and by providing information about the origin or the geographical indications (GI) of their local, regional and traditional products (Paustian, Reinecke, Theuvsen, 2016). In the European Union, the region-of-origin can be distinguished between two different GI labels, i.e. the Protected Designation of Origin (PDO) and the Protected Geographical Indication (PGI), which are regulated by the Regulation (EC) 510/2006 (Paustian, Reinecke, Theuvsen, 2016). Farmers and processors can commercialize domestic food through short chains without intermediaries, or in other cases, by engaging the minimum possible number of intermediaries (Fernández-Ferrín et al., 2018; Holcomb et al., 2016; Renting, Marsden, Banks, 2003). As the channels of the sale and promotion of and communication between actors, digital media provide direct contacts between producers and consumers (Rakic Rakic, 2017a, Rakic, Rakic, 2017b). An increasing number of manufacturers open pages on Facebook and orders in other social media, which allows them a quick sale and simple communications with consumers in real time. The local-food interest is also apparent in food-related books and programs (Bianchi, Mortimer, 2015; Nabham, 2002).

Consumer demand for local food has risen (Bianchi, Mortimer, 2015; Fernández-Ferrín et al., 2018; Penney, Prior, 2014). The previous literature has addressed the concepts of local, regional and traditional products as if they were independent concepts. In practice, however, many food products combine all of the three concepts (Fernández-Ferrín et al., 2018). Local food is usually defined as the food produced, retailed and consumed in a specific geographical area (Bianchi, Mortimer, 2015). The local product is that produced and consumed locally and the geographical proximity gives it a superior quality with regard to the taste, freshness, and sustainability. Local products are defined according to the geographical proximity of their production to consumption. There are two criteria usually used for the purpose of geographical delimitation. The first measures the distance between the location of production and the location of consumption. The second criterion is related to political-administrative boundaries, such as counties, states or provinces (Fernández-Ferrín et al., 2018). The regional product is that produced locally, which may or may not be consumed outside that environment, and which offers a superior quality derived from the specific

conditions of its identifiable geographical origin (Fernández-Ferrín et al., 2018). The traditional product is that produced locally, which may or may not be consumed outside that environment, and which offers the quality level stemming from tradition and the geographical origin (Fernández-Ferrín et al., 2018). Traditional food products are defined by European consumers as those "frequently consumed or associated with specific celebrations and / or seasons, transmitted from one generation to another, made in a specific way according to gastronomic heritage, naturally processed, and distinguished and known because of its sensory properties and associated with a certain local area, region or country" (Vanhonacker et al., 2010, p. 454). For the purpose of this study, the term "domestic food products" is used to refer to local, regional and traditional food products in Serbia.

The literature has identified a number of the reasons for purchasing local foods, which can be broadly divided into food-focused motivations, societal and ecological motivations. Food-focused motivations are: the quality of food (the taste, nutritional values, its shelf-life, appearance, and maturity), food safety, the origin (as the key information) (Paustian, Reinecke, Theuvsen, 2016). Personal motivations for buying local include: it is more pleasurable (a better taste, connectedness with rural life); it is perceived as healthier (fresher, eaten during a season, containing fewer chemicals, taking less time to transport and store) and safer than non-local food because the traceability of such food is made possible (Bianchi, Mortimer, 2015). Local products are considered as fresher, more nutritious and tastier than other products. A higher quality is derived from the geographical proximity between the production of such food and its consumption, which shortens the transportation time, thus allowing the optimum maturation and the use of fewer preservatives (Fernández-Ferrín et al., 2018; Galli, Brunori, 2013; Groves, 2005).

Societal motivations for buying local include: providing support to local business, small-scale producers or family-owned enterprises, the economy and employment; generating local jobs (Bianchi, Mortimer, 2015; Fernández-Ferrín et al., 2018; Lang, Stanton, Qu, 2014; Martinez et al., 2010; Morris, Buller, 2003), safeguarding jobs, supporting the regional industry (Paustian, Reinecke, Theuvsen, 2016), the preservation of a local heritage and tradition (Paustian, Reinecke, Theuvsen, 2016; Seyfang, 2006; Fernández-Ferrín et al., 2018) and local food culture, regional culinary traditions and the traditional methods of cultivating, producing and preparing food (Dansero, Puttilli, 2013; Fernández-Ferrín et al., 2018), as well as the preservation of the local identity and culture (Galli, Brunori, 2013; Groves, 2005).

Ecological motivations are inclusive of purchasing local food because it is perceived to be more environmentally sustainable (fewer food miles) (Bianchi, Mortimer, 2015), climate-friendly, and offering animal welfare (Paustian, Reinecke, Theuvsen, 2016). The benefits of the proximity between the producers, on the one hand, and the consumers of domestic food, on the other, are associated with the values related to sustainability. Local consumption reduces the use of fuels and chemicals, as well as greenhouse gas emissions (Fernández-Ferrín et al., 2018; Karner, 2010; La Trobe, 2002).

Method

The present study of CE has the focus on identifying:

- the factors influencing CE
- the demographic and other variables influencing ethnocentric consumer behavior
- the typologies of consumers with the degrees of ethnocentrism (based on CETSCALE).

The objective of this study is to identify the key actors and the activities of the actors influencing the ethnocentric behavior of the consumers of foodstuffs in Serbia.

Before the research design for collecting primary data is formulated, the relevant secondary data is analyzed. The Serbian Government produces large amounts of secondary data. The documentation published in the form of reports and guidelines on the web-site of the Ministry of Agriculture, Forestry and Water Management (http://www.minpolj.gov.rs/) is an important source.

Consumers choose and buy products, and (un)consciously decide on the survival and profit of companies. Therefore, consumers are selected as respondents. Focus group is an appropriate research method for consumer research. Qualitative research based on focus group provides insights and understanding of the objective setting. The key criterion for selecting the members of the focus group was the respondents' ethnocentric orientation. The focus group included 12 students in the master studies in the field of business, who are responsible for buying food for their homes and who are ethnocentrically oriented as consumers.

The items of modified CETSCALE (*Figure 1*) was presented to the respondents and used as the framework for the face-to-face interview. The two basic questions were: 1. who (which actors) and 2. what (which activities) should the actors take in order to encourage CE.

Figure 1. Modificated 17-Item CETSCALE as guide for interview

Item
1. Serbian people should always buy Serbian-made food products instead of imports.
2. Only those food products that are unavailable in Serbia should be imported.
3. Buy Serbian-made food products. Keep Serbia working.
4. Serbian food products first, last, and foremost.
5. Purchasing foreign-made food products is un-Serbian.
6. It is not right to purchase foreign food products, because it puts Serbians out of jobs.
7. A real Serbian should always buy Serbian-made food products.
8. We should purchase food products manufactured in Serbia instead of letting other countries get rich off us.
9. It is always best to purchase Serbian food products.
10. There should be very little trading or purchasing of food products from other countries unless out of necessity.

11. Serbians should not buy foreign food products, because this hurts Serbian business and causes unemployment.
12. Curbs should be put on all imports.
13. It may cost me more in the long-run, but I prefer to support Serbian food products.
14. Foreigners should not be allowed to put their products on our markets.
15. Foreign food products should be taxed by higher taxes heavily to reduce their entry in Serbia.
16. We should buy from foreign countries only those food products that we cannot obtain within our own country.
17. Serbian consumers who purchase food products made in other countries are responsible for putting their fellow Serbians out of work.

Source: Based on Shimp and Sharma, 1987.

Results of research and discussion

First, the analysis was conducted on the external secondary data displayed on the website of the Ministry of Agriculture, Forestry and Water Management (http://www.minpolj.gov.rs/). By searching and analyzing the content displayed on the website, the following documents were extracted:

- the mark of a higher quality: "Serbian Quality"
- the list of the agricultural and food products with the mark of the geographical origin that were certified in 2017 or are still undergoing the certification process
- the certification authorities authorized by the Ministry to conduct control of the quality and special features of the agricultural and food products with the marks of the geographical origin.

The "Serbian Quality" mark is a national mark of a higher quality by means of which agricultural and food products are labelled with the aim of informing domestic and foreign consumers about the special features of such products. The mark guarantees the quality of the products characterized by specific features, first of all those manufactured from the raw materials from the territory of the Republic of Serbia and possessing a proved higher quality in comparison with the products of the same category in the market. This voluntary standard of quality is regulated by the *Regulation on the Marking of Agricultural and Food Products with the "Serbian Quality" National Mark of a Higher Quality*. The Ministry of Agriculture is responsible for conducting the procedure of marking agricultural and food products with the "Serbian Quality" mark (Ministry of Agriculture, Forestry and Water Management, 2018).

A conclusion may be drawn that the companies which can do so should position themselves on the basis of the "Serbian Quality" mark of a higher quality and the geographical origin.

The results of the research study and the extensive discussions between the moderator and the respondents are the answers to the two questions. The first question was: Who can influence CE? The respondents answered: consumers, governments, schools, producers, retailers and the media. All actors in the supply chain can contribute to CE

encouraging. CE has an influence on domestic foodstuffs consumption, the profit of companies and Serbia's GDP.

The second question was: What (which activities) should the actors take in order to encourage CE? Based on the discussions of the focus-group participants, the conclusions about the key activities of the actors that are in the function of stimulating consumer ethnocentrism are highlighted (*Figure 2*).

In the decision-making process, consumers can choose domestic products over foreign products. The respondents agree that consumers' responsibility is important. Also, the respondents agree that: "many products are ours, but we don't know it because there is no product labelling". Consumers can actively engage and communicate information about the importance of purchasing domestic products. Creating, raising and sharing content on the Internet is important for informing the public about the importance of consumer ethnocentrism. Companies and governments can influence consumer engagement on the Internet.

Governments (state and local governments, Government's appropriate ministries), chambers of commerce and associations – they all have the greatest opportunity to act on the behavior of all actors. Governments can influence the macro-environment, provide incentives to domestic producers, and create campaigns that encourage the purchase of domestic products.

Teachers in schools and at faculties can present and encourage CE. The subjects in which this is possible to do (for example in the fields of economics, agriculture, etc.), one teaching unit can be dedicated to CE. Teachers can encourage discussions about CE in their lectures, exercises, creative workshops, at conferences and seminars.

The media can create and promote content in the function of CE encouraging. In the digital environment, digital media users become content producers – digital prosumers (users as producers and consumers of content). Online users can quickly share information with a large auditorium. Influentials have an opportunity to disseminate a CE promoting content.

Figure 2. The activities of the actors in the function of stimulating consumer ethnocentrism

Consumers
• The purchase of domestic products • Engaging on social networks and in social media, and promoting CE • WOM communications in traditional and digital contexts
Governments (State and Local)
• An impact on the macro-environment – the political, economic, socio-cultural, technological, legal and ecological environments for the production of quality domestic products • Incentives to domestic producers • Campaigns encouraging CE; creating an image of a good quality of domestic products can influence consumer awareness of the importance of purchasing domestic products • Encouraging retailers to better position domestic products

Schools
• Consuming domestic products in school kitchens • The presentation of CE in lectures, workshops, at seminars and conferences • Presenting CE in books and journals
The Media
• Content in the function of CE encouraging
Producers
• Marketing Mix –4Ps • Product: the production and supply of domestic products, a focus on the quality and the product quality control; the labeling of domestic products • Price – determining the prices at which buyers can buy products • Place – marketing channels: the constant availability of products in marketing channels • Promotion – integrated marketing communications: promoting domestic products, encouraging consumers to buy and promote the purchase of domestic products, engaging reference individuals and influential persons
Retailers
• Marketing mix – 7Ps • Product –the assortment of products: domestic products • Price – determining the prices at which buyers can buy products • Place – the availability of domestic products • Promotion – integrated marketing communications: promoting domestic products • People – friendly and helpful sellers presenting domestic products at the point of sale • Process – the process of providing services that encourage the purchase of domestic products

Source: Authors

Profit often depends on marketing activities. Producers can contribute to the promotion of ethnocentrism through the marketing mix (the four instruments – 4Ps). First, products can be produced from domestic inputs, with a focus on the quality and quality control and a clear label, confirming that they are domestic products. Domestic products can be differentiated with respect to their respective features, quality, durability and labeling. Second, the price is a critical element of the marketing mix. Producers must determine the prices at which buyers can buy products. Third, decisions on selecting proper marketing channels are among the most critical decisions producers are faced with. Marketing channels serve markets; however, they also make markets. Effective channel management allows the availability of a product in channels. Fourth, the role of promotion and integrated marketing communications is to inform, persuade and remind consumers to buy domestic products. Producers can engage reference individuals and influential persons to promote domestic products in both traditional and digital media.

Retailers can use 7 marketing tools (7Ps) to influence consumers. They are in a better position than the producers because they are in direct contact with consumers. First, they can have domestic products in their assortment of products. A growing trend for retailers concerns a private-label brand (also called the distributor, store or reseller brand). Second, the decision on prices must be in accordance with customers' purchasing

power. Third, the place as an instrument of the marketing mix can refer to decisions on the location of the store and the positioning of domestic products. There is a saying that the three keys to a retailer's success are: the location, the location, and the location. Fourth, retailers can use integrated marketing communications in promoting domestic products. Fifth, friendly and helpful sellers can present domestic products at the point of sale. Sixth, retailers must decide on the services mix to be offered to customers. Seventh, additionally, the three keys to a success of domestic products in stores are: positioning, positioning and positioning.

Conclusion

The findings demonstrate interesting implications for actors regarding marketing activities, as well as for researchers regarding further research in to both regional and local CE.

The actors – governments, schools, producers, retailers, the media and consumers – can encourage CE by the production, distribution, consumption and presentation of the benefits of domestic food products.

The Government can influence the other actors to behave ethnocentrically in the purchase and consumption of products, create conditions in the macro-environment for all the other actors, and wage campaigns in order to encourage CE.

School curricula, the agendas of scientific conferences and seminars, food-related books, programs in the media – they all have an opportunity to present CE.

Manufacturers and retailers are in contact with consumers and can exert influence on their choices and behaviours in the context of product purchase and consumption. To create effective marketing programs and labels, it is necessary that the key factors affecting consumers' preferences for domestic products should be known. A potential basis for the positioning and differentiation of domestic food products, producers and retailers is: the quality (raspberries, etc.), the geographical proximity between production and consumption, the specific geographical origin of products (raspberries of Arilje, the homemade ayvar of Leskovac, the lamb of Sjenica, the cow cheese of Sjenica, the honey of Djerdap, etc.); the uniqueness of the culture, traditions and methods of production (the peppers and pepper products of Leskovac, such as the homemade ayvar of Leskovac, the barbeque meat and meat specialities of Leskovac, the paprika-flavored sausage of Srem, the pork rinds of Valjevo).

In marketing, that "the consumer is the king" is generally known. Consumer behavior depends on a number of factors. It is necessary that consumers be informed about, persuaded and reminded of the importance of ethnocentric behavior. All the other actors can influence the consumer awareness of the importance of purchasing domestic products.

Conflict of interests

The authors declare no conflict of interest.

References

1. Alfnes, F. (2004). Stated preferences for imported and hormone-treated beef. Application of a mixed logit model. *European Review of Agricultural Economics*, 31(1), 19-37. doi: https://doi.org/10.1093/erae/31.1.19
2. Arsil, P., Li, E., Bruwer, J., & Lyons, G. (2013). Exploring consumer motivations towards buying local fresh food products: a means-end chain approach. *British Food Journal*, 116(10), 1533-1549. doi: https://doi.org/10.1108/BFJ-04-2013-0083
3. Autio, M., Collins, R., Wahlen, S., & Anttila, M. (2013). Consuming nostalgia? The appreciation of authenticity in local food production. *International Journal of Consumer Studies*, 37(5), 564-568. doi: https://doi.org/10.1111/ijcs.12029
4. Balabanis, G., Mueller, R., & Melewar, T. C. (2002). The relationship between consumer ethnocentrism and human values. *Journal of Global Marketing*, 15(3/4), 7-37. doi: https://doi.org/10.1300/J042v15n03_02
5. Bianchi, C., & Mortimer, G. (2015). Drivers of local food consumption: a comparative study. *British Food Journal*, 117(9), 2282-2299. doi: https://doi.org/10.1108/BFJ-03-2015-0111
6. Booth, K. (1979). *Strategy and Ethnocentrism*. Croom-Helm, London.
7. Carpio, C., & Isengildina-Massa, O. (2009). Consumer willingness to pay for locally grown products: the case of South Carolina. *Agribusiness,* 25(2), 412-426. doi: https://doi.org/10.1002/agr.20210
8. Chung, Ch., Boyer, T., & Han, S. (2009). Valuing quality attributes and country of origin in the Korean Market. *Journal of Agricultural Economics*, 60, 682-698. doi: https://doi.org/10.1111/j.1477-9552.2009.00218.x
9. Coderre, F., Boivin, C., & Etaabaa, I. (2010). Measuring retailers' commitment toward regional foods: the CIBLE-chaire bombardier index. *British Food Journal,* 112(11), 1190-1204. doi: https://doi.org/10.1108/00070701011088188
10. Costanigro, M., Kroll, S., Thilmany, D., & Bunning, M. (2014). Is it love for local/organic or hate for conventional? Asymmetric effects of information and taste on labels preferences in an experimental auction. *Food Quality and Preference*, 31, 94-105. doi: https://doi.org/10.1016/j.foodqual.2013.08.008
11. Cvijanović, D., Ignjatijević, S., Milivojević, I., & Mihailović, B. (2016). *Potentials of Serbia in international frameworks - importance of agriculture and health tourism*. Faculty of Hotel Management and Tourism, Vrnjacka Banja, Serbia. [*in Serbian*: Cvijanović, D., Ignjatijević, S., Milivojević, I., & Mihailović, B. (2016). Potencijali Srbije u međunarodnim okvirima - značaj poljoprivrede i zdravstvenog turizma. Fakultet za hotelijerstvo i turizam u Vrnjačkoj banji, Republika Srbija].
12. Dansero, E., & Puttilli, M. (2013). Multiple territorialities of alternative food networks: six cases from Piedmont, Italy. *Local Environment: The International Journal of Justice and Sustainability*, 19(6), 626-643. doi: https://doi.org/10.1080/13549839.2013.836163

13. Darby, K., Batte, M., Ernst, S., & Roe, B. (2008). Decomposing local: a conjoint analysis of locally produced foods. *American Journal of Agricultural Economics*, 90(2), 476-486. doi: https://doi.org/10.1111/j.1467-8276.2007.01111.x

14. Đurić, D., Ristić, J., Đurić, D., & Vujanić, I. (2017). Export of agricultural and food products in the function of economic growth of Republic of Serbia. *Economics of Agriculture*, 64(3), 887-900.

15. Fernández-Ferrín, P., & Bande-Vil, B. (2013). Regional ethnocentrism: Antecedents, consequences, and moderating effects. *Food Quality and Preference*, 30, 299-308. doi: https://doi.org/10.1016/j.foodqual.2013.06.011

16. Fernández-Ferrín, P., Bande, B., & Galán-Ladero, M. M. (2017). Parental influence on levels of regional ethnocentrism of youth: an exploratory analysis. *Spanish Journal of Marketing-ESIC*, 21, 52-62. doi: https://doi.org/10.1016/j.sjme.2016.11.001

17. Fernández-Ferrín, P., Calvo-Turrientes, A., Bande, B., Artaraz-Miñón, M., & Galán-Ladero, M. (2018). The valuation and purchase of food products that combine local, regional and traditional features: The influence of consumer ethnocentrism. *Food Quality and Preference*, 64, 138–147. doi: https://doi.org/10.1016/j.foodqual.2017.09.015

18. Galli, F., & Brunori, G. (Eds.). (2013). Short food supply chains as drivers of sustainable development (Evidence Document). Retrieved from http:// www.foodlinkscommunity.net/fileadmin/documents_organicresearch/foodlinks/ CoPs/evidence-document-sfsc-cop.pdf

19. Gašević, D., Tomašević, D., & Vranješ, M. (2017). Key Factors Determining the Ethnocentric Tendencies of Consumers in Serbia. *Management: Journal of Sustainable Business and Management Solutions In Emerging Economies*, 22(3), 63-73. doi:10.7595/management.fon.2017.0028

20. Groves, A. (2005). *The local and regional food opportunity (Research Report)*. Institute of Grocery Distribution (IGD), Watford.

21. Holcomb, R. B., Bendfeldt, E., Lelekacs, J., Velandia, M., Woods, T. A., Goodwin, H. L., & Rainey, R. L. (2016). *A local foods system glossary: A rose by any other name*. In: Paper presented at the Annual Meeting of the Southern Agricultural Economics Association, San Antonio, Texas

22. Huddleston, P., Good, L. K., & Stoel, L. (2001). Consumer ethnocentrism, product necessity and Polish consumers' perceptions of quality. *International Journal of Retail and Distribution Management*, 29(5), 236-246. doi: https://doi.org/10.1108/09590550110390896

23. Ilbery, B., Watts, D., Simpson, S., Gilg, A., & Little, J. (2006). Mapping local foods: evidence from two English regions. *British Food Journal*, 108(3), 213-215. doi: https://doi.org/10.1108/00070700610651034

24. Javalgi, R., Khare, V., Gross, A., & Schere, R. (2005). An application of the consumer ethnocentrism model to French consumer. *International Business Review*, 14, 325-344. doi: https://doi.org/10.1016/j.ibusrev.2004.12.006

25. Karner, S. (Ed.). (2010). Local food systems in Europe: Case studies from five countries and what they imply for policy and practice (FAAN Project Booklet). Retrieved from http://www.faanweb.eu/sites/ faanweb.eu/files/FAAN_Booklet_PRINT.pdf.

26. Kovljenić, M., & Savić, M. (2017). Factors influencing meat and fish consumption in Serbian households – evidence from silc database. *Economics of Agriculture*, 64(3), 945-956.

27. Kragulj, D., Parežanin, M., & Miladinović, S. (2017). Consumer ethnocentrism in transitional economies: Evidence from Serbia. *Sociološki pregled*, 51(1), 59-79.

28. Lang, M., Stanton, J., & Qu, Y. (2014). Consumers' evolving definition and expectations for local foods. *British Food Journal*, 116(11), 1808-1820. doi: https://doi.org/10.1108/BFJ-03-2014-0117

29. La Trobe, H. (2002). Local food, future directions (FOE Research Report). Retrieved from http://www.foe.co.uk/sites/default/files/downloads/local_food_directions.pdf

30. Marinković, V., Stanišić N., & Kostić M. (2011). Consumer Ethnocentrism of Serbian Citizens. *Sociologija*, LIII(1), 43-58.

31. Martinez, S., Hand, M., Da Pra, M., Pollack, S., Ralston, K., Smith, T., & Newman, C. (2010). Local food systems: Concepts, impacts and issues (Economic Research Report No. 67). Retrieved from https://www.ers.usda.gov/webdocs/publications/err97/7054_err97_1_.pdf.

32. Ministry of Agriculture, Forestry and Water Management. (2018). Serbian Quality. Retrieved from http://www.minpolj.gov.rs/srpski-kvalitet/

33. Morris, C., & Buller, H. (2003). The local food sector: a preliminary assessment of its form and impact in Gloucestershire. *British Food Journal*, 105(8), 559-566. doi: https://doi.org/10.1108/00070700310497318

34. Nabham, G. (2002). *Coming Home To Eat: The Pleasures And Politics Of Local Foods*. Norton, New York, NY.

35. Orth, U.R., & Firbasová, Z. (2003). The Role of Consumer Ethnocentrism in Food Product Evaluation. *Agribusiness*, 19(2), 137-153. doi: https://doi.org/10.1002/agr.10051

36. Ouellet, J. F. (2007). Consumer racism and its effects on domestic cross-ethnic product purchase: An empirical test in the United States, Canada, and France. *Journal of Marketing*, 71(1), 113-128.

37. Paustian, M., Reinecke, F-E., & Theuvsen, L. (2016). Consumer preferences for regional meat products. *British Food Journal*, 118(11), 2761-2780. doi: https://doi.org/10.1108/BFJ-01-2016-0002

38. Penney, U., & Prior, C. (2014). Exploring the urban consumer's perception of local food. *International Journal of Retail & Distribution Management*, 42(7), 580-594. https://doi.org/10.1108/IJRDM-09-2012-0077

39. Poon, P., Evangelista, F., & Albaum, G. (2010). Attitudes of migrants towards foreignmade products: An exploratory study of migrants in Australia. *Journal of Consumer Marketing*, 27(1)35-42. doi: https://doi.org/10.1108/07363761011012930

40. Rakic, B., & Rakic, M. (2015a). Holistic management of sustainability marketing in the process of sustainable development. *Environmental Engineering and Management Journal*, 14(4), 887-900.

41. Rakic, M., & Rakic, B. (2015b). Sustainable Lifestyle Marketing of Individuals: the Base of Sustainability. *Amfiteatru Economic*, 17(40), 891-908.

42. Rakic, B., & Rakic, M. (2017a). *From Marketing Myopia to Contemporary Marketing: Transformations in Marketing in the Context of Digitalization and Sustainability (Integration of Traditional, Digital, Co-Creative and Sustainability-Oriented Mindsets Inside Actors in Contemporary Marketing)*. Digital Book, available at eBook retailers: Amazon.com - Kindle Store, etc.

43. Rakic, B., & Rakic, M. (2017b). *Sustainability-Oriented Mindset: Revolutionary Role of Sustainability Marketing as the Driver of Transformations for Sustainability*, Digital Book, available at eBook retailers: Amazon.com - Kindle Store, etc.

44. Rakic, B., & Rakic, M. (2018). Collaborative partnership paradigm in the sustainability-oriented supply chain as the way to sustainability. *Applied ecology and environmental research*, 16(3), 2639-2650. doi: http://dx.doi.org/10.15666/aeer/1603_26392650

45. Renting, H., Marsden, T., & Banks, J. (2003). Understanding alternative food networks: exploring the role of short food supply chains in rural development. *Environment and Planning A: Economy and Space*, 35, 393-411. doi: https://doi.org/10.1068/a3510

46. Schnettler, B., Miranda, H., Lobos, G., lveda, J.S., & Denegri, M. (2011). A study of the relationship between degree of ethnocentrism and typologies of food purchase in supermarkets in central-southern Chile. *Appetite*, 56, 704-712. doi: https://doi.org/10.1016/j.appet.2011.02.007

47. Shankarmahesh, M. N. (2006). Consumer ethnocentrism: an integrative review of its antecedents and consequences. *International Marketing Review*, 23(2), 146-172. doi: https://doi.org/10.1108/02651330610660065

48. Shimp, T.A., & Sharma, S. (1987). Consumer ethnocentrism: construction and validation of the CETSCALE. *Journal of Marketing Research*, 24, 280-289. doi: 10.2307/3151638

49. Siemieniako, D., Kubacki, K., Glińska, E., & Krot, K. (2011). National and regional ethnocentrism: a case study of beer consumers in Poland. *British Food Journal*, 113(3)404-418. doi: https://doi.org/10.1108/00070701111116464

50. Seyfang, G. (2006). Ecological citizenship and sustainable consumption: examining local organic networks. *Journal of Rural Studies*, 22(4), 383-395. doi: https://doi.org/10.1016/j.jrurstud.2006.01.003

51. Sumner, W.G. (1906). Folkways: The Sociological Importance of Usages, Manners, Customs, Mores, and Morals, Ginn & Co., New York, NY.

52. Šmaižien,I., & Vaitkien, R. (2014). Consumer ethnocentrism and behavior in a market of dietary supplements. *Procedia - Social and Behavioral Sciences*, 156, pp.463-467. doi: https://doi.org/10.1016/j.sbspro.2014.11.222

53. Vanhonacker, F. et al. (2010). How European consumers define the concept of traditional food: Evidence from survey in six countries. *Agribusiness*, 26(4), 453-476. doi: https://doi.org/10.1002/agr.20241

54. Verbeke, W., & Ward, R. W. (2006). Consumer interest in information cues denoting quality, traceability and origin. An application of ordered probit models to beef labels. *Food Quality and Preference*, 17, 453-467. doi: https://doi.org/10.1016/j.foodqual.2005.05.010

55. Verlegh, P. W. J., Steenkamp, J.B.E.M., & Meulenberg, M. (2005). Country-of-origin effects in consumer processing of advertising claims. *International Journal of Research in Marketing*, 22,127-139. https://doi.org/10.1016/j.ijresmar.2004.05.003

SIGNIFICANCE OF FISCAL POLICY FOR ECONOMIC DEVELOPMENT AND AGRICULTURE

Petar Veselinović[1], Miloš Dimitrijević[2], Milan Kostić[3]

**Corresponding author E-mail: mdimitrijevic@kg.ac.rs*

A R T I C L E I N F O

Original Article

Received: *17 April 2019*

Accepted: *28 May 2019*

doi:10.5937/ekoPolj1902357V

UDC 336.02:[330.34+338.43.01

Keywords:

fiscal policy, economic development, fiscal policy as part of economic policy, agricultural policy, global economic crisis

***JEL**: C12, E62, H60, I31, O23, Q18*

A B S T R A C T

With the latest global economic crisis (2007-2009) the importance of fiscal policy as a part of economic policy is growing. Its significance extends from the experience of the Great Depression of the 1930s. In this paper, with the help of the ARIMA model, the influence of fiscal policy instruments on macroeconomic fiscal indicators and some selected indicators of economic development in the context of countries of Southeast Europe have been explored. Friedman's test has shown that the countries have not yet recovered from the global economic crisis. The results shows that fiscal policy can act on the individual's standard of living, but only responsible implementation will have the same effect on public finances and the overall sustainable development of a country. Also, fiscal policy is an important measure of agricultural policy and is increasingly being used as a directional development factor.

Introduction

In the modern economy, which is burdened with numerous problems which has an impact on economic development and increase of social inequality, great attention is paid to the interaction of monetary and fiscal policy. The public economy is a vital system of production and delivery that produces scores of products: goods, services, benefits and innovations (Sekera, 2018).

State interventionism imposed even in traditionally highly neoliberal economies, took

1 Petar Veselinović, Ph.D, Full Professor, Dept. of General Economics and Economic Development, University of Kragujevac – Faculty of Economics, Liceja Knezevine Srbije 3, 34000 Kragujevac, Serbia. Phone:+381 34 303 569. E-mail: pveselinovic@kg.ac.rs. ORCID ID (https://orcid.org/0000-0002-2765-1730)

2 Miloš Dimitrijević, Ms.C, Research trainee, Dept. of General Economics and Economic Development, University of Kragujevac – Faculty of Economics, Liceja Knezevine Srbije 3, 34000 Kragujevac, Serbia. Phone:+381 34 303 562. E-mail: mdimitrijevic@kg.ac.rs. ORCID ID (https://orcid.org/0000-0001-9253-8876)

3 Milan Kostić, MSc in Economics, University of Kragujevac – Faculty of Economics, Liceja Knezevine Srbije 3, 34000 Kragujevac, Serbia. Phone:+381 66387484, E-mail: kosticmilan@live.com

on various forms (Allen et al., 2015, Caprio et al., 2014, Classenes et al., 2014).). In contemporary economic conditions and with the emergence of economic integration, the issue of budget deficit is one of the main problems of public finances (Despotović, Durkalić, 2017). Fiscal policy is a part of economic policy that through the management of public revenues and public expenditures seeks to achieve certain macroeconomic and microeconomic goals (Fabris, Pejović, 2013). Fiscal policy is an important measure of agrarian policy, and considering that at the time of state formation agriculture was the only activity, tax had a fiscal character. The tax conditions are determined by the needs of the state budget and direction of development (Ristić, 2015). Agricultural policy, as an integral part of economic policy, is implemented through state programs in the field of agriculture (Ristić, 2015) that play a significant role in the economic development of each country.

In the case of Serbia, if the agricultural household is not in the VAT system, it's the taxpayer on the Personal Income tax on the income from agriculture and forestry on the basis of cadastral income (Tica et al., 2011), which has a function to raise money for the budget and influence development through stimulating activities in agriculture and the village (Ristić, 2015). If the farmers make the sale of agricultural and forest products or agricultural services to taxpayers, the taxpayer is obliged to charge a VAT fee in the amount of 8% on the value of goods and services received and pay off to farmers in cash. A farmer whose total turnover of goods and services in the previous 12 months doesn't exceed 8,000,000 RSD doesn't charge VAT for executed turnover of goods and services. If a farmer is recorded for VAT by submitting a registration application, a VAT rate of 20% is prescribed, except for certain products, such as milk, bread, sugar, sunflower oil etc., where the rate is 10% (Value Added Taxual Law according to "Official Gazette RS ", no. 30/2018). VAT is a modern method of collecting taxes that is necessary to create a stable economic system (Ristić, 2015). Farmer in the VAT system, unlike others, has the right to refuses the tax paid when purchasing agricultural machinery, fertilizers, reproduction seeds, planting stock, breeding cattle and etc. (Vujičić, Ristić, 2006). Agricultural household in the VAT system is allowed to reduce the tax base for tax incentives (Tica et al., 2011). In addition, corporate income tax rate of 15% is proportional, with many options available for reduction of corporate income tax burden – for example, investment tax incentive and tax loss carryforward. (Corporate Profit Taxual Law according to "Official Gazette RS ", no. 95/2018).

The efficiency of the market is very difficult to achieve because of unanticipated policies (Stiglic 2013) and influence of foreign companies on government (Lazonick, 2014, Hamilton, Hepburn, 2017). That is why a state is required to take care of citizens (Bryne, Ruane, 2017). The dilemmas about the degree of state intervention in the field of production are no more recent. Free market and mandatory control have long been the focus of theoretical discussions. Free market means the elimination of all directed programs that directly affect the supply of agricultural products. However, this doesn't eliminate other forms of government intervention that indirectly affect the market of certain commodities (Vujičić, Ristić, 2006). Agricultural products are specific in

relation to others, and therefore, it's impossible to leave this area in the domain of market laws, so the state should specifically apply to this economic branch of vital importance for economic development (Ristić, 2015), which is reflected in the resource management and the role of management in agriculture, which includes the entire complex of decisions of the state related to the economy of the country as whole. (Ristić, 2015). Also, food industry is very important for future economic activity of the whole country (Domanović, Vujičić, Ristić, 2018). The concept of sustainable development, which represents harmonious relationship between econmy and environment, is very important in agriculture because the constant aspiration for the economic growth puts a strong pressure on the environment (Aničić et al., 2019).

Some authors deal with linking economic growth to fiscal policy (Moreno-Dodson, 2013) and some questioned linked budgetary parameters (public revenue and expenditure) with the rate of economic growth expressed in GDP through Laffer's production and fiscal curve, Armey-Rahn curve (Balatsky, Ekimova, 2012) and concluded that growth is positively related to good fiscal performance. Authors who have dealt with modern theories of economic growth and welfare are exploring policies to eradicate poverty (Acemoglu, 2006, Aghion, Howitt, 2009, Yifu Lin, 2012), as well as the impact of public expenditure and tax on growth (Bleaney, Gemmel, Kneller, 2001).

Different factors in economic literature (Stanković, 2006) encountere that fiscal policy measures can be used to control aggregate demand in the economy. Coordination of fiscal and monetary policy is important, but the state intervene in the economy primarily by fiscal policy which responsible for not having unemployment and falling living standards (Vukadin and Labus, 2012; Singh et al., 2018; Tylor, 2018; Koppel and Kolencik, 2018; Hyers and Kovacova, 2018; Popescu et al, 2018). In accordance with that, it is important to have independent central bank (Thiele, 2018). It is clear that the issues related to unemployment might affect business environment, not only the consumers and human resources (Furtula, Durkalić, Simionescu, 2018). It's necessary to compare burden of tax financing and borrowing (Rozen, Gejer, 2009) in the context of the analysis of the possible impact of the budget deficit and public debt on economic growth. Servicing obligations on the basis of the budget deficit can lead to an increase in taxes and a reduction in available income, which would as a result have a fiscal policy effect on the decline in living standards and the rate of economic growth through the reduction of real GDP (Despotović, 2015). This was particularly reflected during the global economic crisis when many economies didn't have space for the implementation of a fiscal expansion (Praščević, 2012). Fluctuations in developing countries which follows procyclical policies are greater than in developed countries which follows a countercyclical monetary and fiscal policy, that increases the advantage of developed countries (Stiglic, 2013). The implications of fiscal policy on social welfare require a model of social policy that links fiscal policy instruments to outcomes that include the growth model and the way in which it shapes social welfare (Moreno-Dodson, 2013).

There is no measure that can cover all the complexity of what is happening in modern society. The United Nations Development Program has designed a broader measure that

includes education, health and income (Stiglic, 2013), it's Human Development Index. The unemployed faced the highest risk of poverty and the accent for its reduction is put on a healthier economic development (Todaro, Smith, 2006). The reason for research period (2000-2016) is that the transition countries we are looking at with more serious reforms started in the late 1990s due to war events in the Balkans and other factors that led to the delay. For market fundamentalism, the day when the Liman braders fell (September 15, 2008) is the same like fall of the Berlin Wall was for communism (Stiglic, 2013), due to which attention was paid to the period of global economic crisis and after it. Although the first signs of the recovery of the world economy were registered at the end of 2009, this still does not mean that the world has escaped the crisis (Kovačević, 2010).

The subject of this paper is to identify the impact of key fiscal policy instruments available to create macroeconomic stability which contribute to growth of agricultural sector and overall economic development. In this context, the aim of the work is to focus on how the application of different fiscal policy instruments reflects on economic development.

The starting point of the conceptual framework for empirical research in this paper consists of fiscal policy instruments, taxation and public expenditure whose role is to reflect the nature of fiscal policy to create macroeconomic stability and economic development in the Southeast Europe during the period 2000-2016.

The basic hypothesis on which this work is based relates to the fact that changes in fiscal policy instruments affect the economic growth and welfare of society. Individual hypotheses, whose validity should be checked by empirical research, are formed by stratifying the basic hypothesis:

X1: Tax revenues and public expenditure, like fiscal instruments, affects on the budget deficit/surplus and public debt.

X2: Tax revenues and public expenditure, such as fiscal instruments, affects on the GDP per capita, unemployment rate and human development index.

Materials and methods

Secondary data were used as data sources from: Trading Economics, Eurostat, The World Bank, UNCTADstat, The Global Economy, IMF and United Nations. As a macro analysis unit eight Southeast European countries were selected without Montenegro because of the inaccessibility of most data.

The task of the empirical research was to determine the relationship of fiscal policy instruments with two groups of dependent variables. In order to test individual hypotheses, an empirical research as a basis had a positivistic scientific paradigm which chosen because of its inherent insistence on isolating only some of the relevant indicators for analysis and insisting on a more precise measurement of the relationship between them (Lancaster, 2005, Wilson, 2010). Such a paradigm in view of the goals

set in this paper corresponded to the quantitative methodology because the essence was an attempt to describe and explain the behavior in the field of finance by collecting a large number of individual data of an objective nature and numerical character, and according to a prestructured conceptual framework (Lee, Lee, Lee, 2010). The selected analysis techniques were conditioned by the numerical nature of the independent and dependent variables, that is, the fact that all the analyzed variables are time series.

The first level of analysis was the construction of Autoregressive Integrated Moving Average Model, ARIMA. The goal of constructing this model through an expert option in the SPSS computer program was to describe and evaluate the relationship between the variables analyzed (Yaffee, McGee 2000, Brockwell, Davis 2002, Montgomery, Jennings, Kulahci, 2008). ARIMA models are among the most efficient linear models for analyzing time series in macroeconomics and finance due to their flexibility (Montgomery, Jennings, Kulahci, 2008). Since the precondition of Box- Jenkins methodology, which is the essence of the ARIMA model, is the completeness of the time series it is operating with the first step in building the ARIMA model was to replace the data missing from the corresponding algorithms (Yaffee, McGee, 2000). In accordance with the recommended methods for removing this defect in time series that were not too asymmetrical, the missing data in them were replaced by the arithmetic mean of the string, while in the cases of time series that had a high degree of asymmetry of missing data replicated using mediation (Armstrong, 2006). The ARIMA model procedure can be represented by the following formula (Weisang, Awazu, 2008):

$$\varphi_p(B)[\Delta(Y_t - \sum_{i*1}^{m} C_i X_{it}) - \mu] = \Theta_q(B) a_t \quad (1)$$

where is:

B = the backshift operator, $BX_t = X_t - 1$

Δ = the differencing operator, $\Delta = (1 - B)^d$

$\varphi_p(B)$ = the AR polynomial,

$\Theta_q(B)$ = the MA polynomial (MA)

X_{it} = independent variable

Y_t = dependent variable.

The second level of analysis was to determine the existence of statistically significant differences between the macro analysis units. Friedman's test is used to estimate the difference between three and more types of data derived from successive measurements, and is an alternative to the analysis of variance in cases where this test can not be applied due to a violation of its assumptions (Gravetter, Wallnau, 2017). The essence of this test is the chi-square, $\chi 2$, statistics that rank the sums of squares for each column of data and their entrances involved in testing (Dalgaard, 2008).

Results

The results of the ARIMA model were presented as a test results for the individual hypotheses by each country. Based on the observed Stationary R-squared concluded that in all countries models were suitable for analyzing given data.

In the case of Albania (Table A1) the obtained data didn't give arguments to confirm H1 hypothesis, but confirmed H2 in the case of GDP per capita and human development index as a economic development indicators. In FYR of Macedonia (Table A2) H1 was confirmed in the case of a budget deficit/surplus and H2 for GDP per capita and human development index. In B&H (Table A3) H1 was confirmed for budget deficit/surplus, and confirmed the H2 in the case of GDP per capita and human development index. In Bulgaria (Table A4) H1 was confirmed in the case of public debt and budget deficit/surplus, and H2 in the case of the unemployment rate and the human development index. In Greece (Table A5) the obtained data gave an argument for the confirmation hypothesis H1 and the H2. In Romania (Table A6) H1 was confirmed in the case of a budget deficit/surplus and H2 in the case of GDP per capita, unemployment rate and human development index. In Serbia (Table A7) H1 hypothesis was confirmed in the case of public debt, and the hypothesis H2 confirmed in the case of GDP per capita and human development index. In Croatia (Table A8) H1 hypothesis was confirmed in the case of a budget deficit/surplus, and confirmed H2 in the case of GDP per capita and human development index as a economic development indicators.

Table 1. Results of Friedman's test

Test Statistics[a]						
		p_debit	**suf_def**	**gdp_pc**	**Unemplo**	**hd_index**
N		8	8	8	8	8
Chi-square		64.025	55.355	89.581	27.337	123.142
Df		16	16	16	16	16
Asymp. Sig.		.000***	.000***	.000***	.038*	.000***
Mean Rank	2000	11.94	9.44	11.75	9.19	1.19
	2001	11.13	8.63	10.00	10.00	2.00
	2002	10.94	8.19	11.38	9.88	2.88
	2003	8.63	9.63	11.38	8.25	3,94
	2004	7.38	12.31	14.19	10.25	5.00
	2005	7.50	13.31	12.00	8.94	6.00
	2006	4.75	13.50	14.31	9.19	7.13
	2007	2.75	12.81	14.88	6.50	7.94
	2008	3.13	8.81	12.88	3.00	9.44
	2009	6.13	2.88	2.50	5.69	10.56
	2010	7.25	5.25	4.38	9.50	11.56
	2011	8.50	5.50	4.94	11.13	12.00
	2012	9.88	6.69	2.38	10.75	12.50
	2013	11.44	5.69	5.40	12.63	14.13
	2014	14.13	6.25	5.75	11.38	15.31
	2015	13.94	10.75	7.50	9.50	16.63
	2016	13.63	13.38	7.61	7.25	16.81

Source: Author's calculation, **Notes**: * p<0.05; ** p<0.01; *** p<0.001

The results of the Friedman test showed that the existence of a statistically significant difference in: the public debt of the analyzed countries for a period of 16 years at the level of $\chi 2$ (16.8) = 64.025, p =.000, with a declining ranking of the arithmetic mean in the period from 2000 to 2008, growth the ranking of the arithmetic mean between 2008 and 2014, and its mild fall in 2015 and 2016; in the budget surplus/deficit $\chi 2$ (16.8) = 55.355, p =.000, with decreasing arithmetic mean in the period from 2000 to 2003, growth the ranking of the arithmetic mean from 2003 to 2006, a fall it in the period from 2006 to 2009, and its fluctuations in the period from 2009 to 2016; in GDP per capita $\chi 2$ (16.8) = 89.581, p =.000, with frequent fluctuations in the arithmetic mean ranges from 2000 to 2012, but with an huge fall in 2009, and a rise it from 2012 to 2016; in the unemployment rate $\chi 2$ (16.8) = 27.337, p =.038, with the fluctuations of the arithmetic mean ranking from 2000 to 2008, growth it from 2008 to 2011, refluctuation in the period from 2011 to 2013, and its decline in the period from 2014 to 2016 and in the human development index $\chi 2$ (16.8) = 123.142, p =.000, with careless growth of the arithmetic mean in the observed period.

Discussions

Fiscal policy instruments records different results because we have abstracted reality from other influences. The most represented influence of fiscal policy instruments is on the human development index as a comprehensive measure of economic development which expressed in all observed countries, with the biggest significant in Greece, p <0.000, where is the best results of the study that both hypotheses were fully proven, Serbia, p <0.000 and Croatia p <0.001, as well as on the GDP per capita, where only Bulgaria has not recorded this connection with it. Regarding the impact on macroeconomic fiscal indicators, the most significant is the impact on the budget surplus/deficit, where only Serbia and Albania have not been recorded.

Friedman test showed that economic crisis turned into a crisis of public debts (Reinhart, Rogoff, 2011), as well as that it had an impact on the decline in economic activity and the rise in unemployment. The economic crisis turned into a crisis of public debts and most affected the public debt of the countries, as they fell to 2008, and since then, they have grown, with a slight tendency of decreasing the arithmetic mean in 2015 and 2016. There are frequent fluctuations in budget deficits/surpluses. GDP per capita in 2009 recorded a major drop and has not yet returned to the precrisis level, although there is a tendency for growth after 2012. The crisis has also had an impact on unemployment, which had a tendency to decline by 2008, since it is growing. It is good that this growth was stopped in 2014. The human development index was been recording steady fluctuations.

Observing public expenditures and revenue from taxes in absolute values, the management of an expansive or restrictive policy has been established. From the point of view of the public expenditures of the observed countries, they led an expansive fiscal policy by 2008 until they increase. It is noticeable that all countries in 2016 have less public expenditures compared to 2009 so it can be said that the crisis has imposed

a restrictive fiscal policy. What is worrying is that states continue to reduce public expanditures, which means they have not yet recovered from the crisis. Income from taxes is until 2008 grew up. The reason for this growth can be used for further research to see if the countries concerned with this item have led a restrictive policy and are incompatible with public expenditures or the reason for better tax collection was the expansion of the tax base, or some other indicators relating to efficiency. In 2009 they are falling in all countries, but in B&H since 2010 they are in the rise, in Croatia since 2012, Macedonia in 2010, Bulgaria in 2011, Romania and Serbia in 2010 (with slight fluctuations in all countries), which can give indications of a restrictive fiscal policy. Unlike these countries, they continue to decline in Greece, also with slight fluctuations. This can give an answer to the notion that more developed countries can implement a countercyclical fiscal policy, unlike developing countries that carry out a procyclical fiscal policy. Also, this gives a signal to agricultural households in those countries, and when it comes to Serbia from the implementation of fiscal policy also depend whether it would enter the VAT system, from which they can benefit, considering that agricultural production in our conditions has great importance and series of specifics in relation to other activities, and on the other hand, it's a tax that represents the most important source of tax revenues in the budget of the Republic of Serbia (Tica et al., 2011). Also, the entry into the VAT system is especially justified for agricultural households that have significant investments in agricultural production (Tica et al., 2011). Adequate fiscal and agricultural policies are needed for the poor who live mainly in rural areas and are employed mainly in agriculture which is the dominant economic activity (Zekić et al., 2016), both globally (World bank group, 2016) and in Serbia (Maksimović, 2011). Also, agricultural production is a very specific area of the entire economy of the Republic of Serbia, provides the basic source of income for all persons engaged in agricultural production activities and has great economic and social significance (Zelenović, Vojinović, Cvijanović, 2018).

Conclusions

Observed countries have not yet recovered from the effects of the crisis and were forced to led restrictive fiscal policies so that the consequences would not be even worse, which also reflected on economic development and agricultural policy.

Recommendations for further research should be establish link between the economic cycle (expansion, recession) and economic policy implementation (expansive, restrictive), look at the profile and causes of poverty rural areas and farmers and set up an appropriate fiscal policy, especially in the context of allocation for education, health care, social benefits and inclusion, and also compare these indicators with some reference values of developed countries.

Some limitations are that economists with a high degree of openness can be deenergized to use fiscal stimulus, because, as the economy is more open, fiscal stimulus less benefits the domestic economy (Praščević, 2012). Unlike the authors who dealing with fiscal policy constraints (time lag, tax multipliers, Laffer and Armey-Rahn curves, etc.)

is a tearful number of those who deal with social welfare, especially empirical research and the reflection on the lives of individuals. There is no measure that can cover all the complexity of what is happening in modern society. An expansive fiscal policy can increase budget deficits and public debt, while a restrictive one can lead to social exclusion, for which farmers are exposed in the most cases.

What is positive and what can be derived as a general conclusion is that fiscal policy instruments can influence development indicators and that restrictive fiscal policy in the observed countries has yielded results, ie improvements in the recent years have been recorded in all observed dependent variables. Also, instruments of fiscal policies in all countries have had an impact on the human development index as a comprehensive measure of economic development.

This has just proven the general hypothesis that fiscal policy instruments can affect indicators of economic development, but these indicators are generally far from precrisis level, which means that the basis for the implementation of expansive fiscal policy and the growth of social welfare has not yet been created. Therefore, states have to conduct responsible fiscal policy in accordance with their capabilities in order to reduce poverty and social inequalities, which is particularly pronounced in rural areas where agriculture is the dominant economic activity. Economic policy should not be limited only to responsible implementation of fiscal policy, than to all the elements that should lead to sustainable development. It should involve all social groups which will reduce inequality and create conditions for economic development.

Acknowledgements

This work was supported by the Ministry of Science, Education and Technological development of the Republic of Serbia under Grant number III47005.

Conflict of interests

The authors declare no conflict of interest.

References

1. Acemoglu, D. (2006). *Introduction to economic growth.* The MIT Press, London.
2. Aghion, P., & Howitt, P. (2009). *The economics of growth.* The MIT Press, London.
3. Allen, F., Carletti, E., Goldstein, I., & Leonello, A. (2015). Moral Hazard and Government Guarantees in the Banking Industry. *Journal of Financial Regulation,* 1(1), 30–50. doi: https://doi.org/10.1093/jfr/fju003.
4. Aničić, D., Nestorović, O., Simić, N., & Miletić, S. (2019). The Perspectives of Sustainable Development of Serbia's Agriculture in Globalized Environment. *Economics of Agriculture*. 66(1), 221-235. https://doi.org/10.5937/ekoPolj1901221A.

5. Armstrong, J.S. (2006). Findings from evidence-based forecasting: Methods for reducing forecast error. *International Journal of Forecasting*, 22(3), 583-598. doi: https://doi.org/10.1016/j.ijforecast.2006.04.006.

6. Balatsky, E., & Ekimova, H. (2012). Fiscal Policy and Economic Growth. *Problems of Economic Transition,* 54(12), 55-70. doi: 10.2753/PET1061-1991541204.

7. Bleaney, M., Gemmel, N., & Kneller, R. (2001). Testing the endogenous growth model: public expenditure, taxation, and growth over the long run. *Canadian Journal of Economics, 34(1),* 36-57. doi: 10.1111/0008-4085.00061.

8. Brockwell, P.J., & Davis, R.A. (2002). *Introduction to Time Series and Forecasting*, 2nd ed. Springer-Verlag New York Inc, New York.

9. Bryne, D., & Ruane, S. (2017). *Paying For The Welfare State In The 21st Century: Tax And Spending In Post-industrial Societies*. Bristol University Press, Bristol.

10. Caprio, G., D'Apice, V., Ferri, G., & Walter Puopolo G. (2014). Macro-financial determinants of the great financial crisis: Implications for financial regulation. *Journal of Banking & Finance,* 44(7), 114-129. https://doi.org/10.1016/j.jbankfin.2014.03.001.

11. Claessens, S., Ayhan Kose M., Laeven, L., & Valencia F. (2014). *Financial Crises: Causes, Consequences and Policy Responses.* International Monetary Fund, Washington, D. C.

12. Corporate Profit Taxual Law according to "Official Gazette RS ", no. 95/2018 [In Serbian: Zakon o porezu na dobit pravnih lica "Sl. Glasnik RS", br. 95/2018].

13. Dalgaard, P. (2008). *Introductory Statistics with R, 2nd ed*. Springer, New York, NY.

14. Despotović D. (2015). The importance of fiscal consolidation in the process of EU accession. In: M. Jakšić, V. Stojanović Aleksić, P. Mimović (Eds.), *Economic and social aspects of Serbia's accession to the European Union* (pp. 127-140). Faculty of Economics, University of Kragujevac, Kragujevac. [In Serbian: Despotović D. (2015). Značaj fiskalne konsolidacije u procesu pristupanja EU. U: M. Jakšić, V. Stojanović Aleksić, P. Mimović (Eds.), *Ekonomsko-socijalni aspekti priključivanja Srbije Evropskoj uniji*].

15. Despotović, D., & Durkalić, D. (2017), Analysis of budget deficit in the candidate countries for EU membership, *Serbian Journal of Management*, 12 (2), 237-253. DOI: 10.5937/sjm12-14122.

16. Domanović, V., Vujičić, M, & Ristić, L. (2018). Profitability of Food Industry Companies in The Republic of Serbia. *Economics of Agriculture.* 65(1), 11-32. doi:10.5937/ekoPolj1801011D.

17. Fabris, N., & Pejović, I. (2013). *Economic Policy - Theory and Practice*. High School of Economics and Administration, Belgrade. [In Serbian: Fabris, N., Pejović, I. (2013). *Ekonomska politika-teorija i praksa*].

18. Furtula, S., Durkalić, D., & Simionescu, M. (2018). Testing Phillips Curve For Serbian And Romanian Economy. *Romanian Statistical Review*, (3), 40-56. http://www.revistadestatistica.ro/wp-content/uploads/2018/09/RRS-3_2018_A4.pdf.

19. Gravetter, F.J., & Wallnau, L.B. (2017). *Statistics for the Behavioral Sciences. 10th ed*. Cengage Learning, Boston, MA.

20. Hyers, D., & Kovacova, M. (2018). The Economics of the Online Gig Economy: Algorithmic Hiring Practices, Digital Labor-Market Intermediation, and Rights for Platform Workers. *Psychosociological Issues in Human Resource Management*, *6*(1), 160-165.

21. Hamilton, K., & Hepburn, C. (2017). *National Wealth: What Is Missing, Why It Matters*. Oxford University Press, Oxford.

22. Kovačević, R. (2010). *International finances*. Center for publishing at the Faculty of Economics in Belgrade, Belgrade. [In Serbian: Kovačević, R. (2010). *Međunarodne finansije*].

23. Koppel, J., & Kolencik, J. (2018). The Future of Workers: Contingent Forms of Labor Contracting in the Platform Economy. *Psychosociological Issues in Human Resource Management*, 6(1), 172-177

24. Lancaster, G. (2005). *Research Methods in Management: A Concise Introduction to Research in Management and Business Consultancy*. Butterworth-Heinemann, Oxford.

25. Lazonick, W. (2014). Profit without Prosperity: Stock Buybacks Manipulate The Market And Leave Most Americans Worse Off. *Harward Business Review*, *September*, 46-55. Retrieved from https://hbr.org/2014/09/profits-without-prosperity.

26. Lee, C.,F., Lee, A.C., & Lee, J. (2010). *Handbook of Quantitative Finance and Risk Management*. Springer, New York, NY.

27. Maksimović, G. (2011). Demographic factors of local economic development in the Republic of Serbia, *Agroeconomics,* 49-50(2011). 47-57. [In Serbian: Maksimović, G. (2011). Demografski faktori lokalnog ekonomskog razvoja u Republici Srbiji. *Agroekonomika*].

28. Montgomery, D.C., Jennings, C.L., & Kulahci, M. (2008). *Introduction to Time Series - Analysis and Forecasting*. John Wiley & Sons Inc, Hoboken, NJ.

29. Moreno-Dodson, B. (2013). *Is fiscal policy the answer?*. The world bank, Washington.

30. Popescu, G. H., Petrescu, I. E., & Sabie, O. M. (2018). Algorithmic labor in the platform economy: digital infrastructures, job quality, and workplace surveillance. *Economics, Management and Financial Markets*, 13(3), 74-79.

31. Praščević, A. (2012). *Economic Crises and Macroeconomic Policy Models*. Center for publishing at the Faculty of Economics in Belgrade, Belgrade. [In Serbian: Praščević, A. (2012). *Ekonomske krize i modeli makroekonomske politike*].

32. Reinhart, C. M., & Rogoff, K. S. (2011). From Financial Crash to Debt Crisis. *American Economic Review, 101(5),* 1676–1706. doi:10.1257/aer.101.5.1676

33. Ristić, L. (2015). *Economics of agriculture*. Faculty of Economics, University of

Kragujevac, Kragujevac [In Serbian: Ristić, L. (2015). *Ekonomika poljoprivrede*].

34. Rozen, H., & Gejer, T. (2009). *Public finances*. Center for publishing at the Faculty of Economics in Belgrade, Belgrad. [In Serbian: Rozen, H., Gejer, T. (2009). *Javne finansije*].
35. Singh, S. K., & Rao, D. T. (2018). Is Monetary Policy Symmetrical in Its Effect on Sectoral Output?. *Economics, Management, and Financial Markets*, 13(1), 11-31. doi:10.22381/EMFM13120181.
36. Stanković, K. (2006). *Modern economic theories, principles and politics.* Faculty of Economics, University of Kragujevac, Kragujevac. [In Serbian: Stanković, K. (2006). *Savremene ekonomske teorije, principi i politika*].
37. Sekera, J. (2018). Missing from the mainstream: the biophysical basis of production and the public economy. *Economics, Management, and Financial Markets*, 13(3), 56-73.
38. Stiglic, J.E. (2013). *Free fall.* Academic book, Novi Sad. [In Serbian: Stiglic, J.E. (2013). *Slobodan pad*].
39. Taylor, L., & Kliestikova, J. (2018). The Operational Coherence of the Workforce-as-a-service Pattern: Digitally Mediated Service Work, the Contingency of On-demand Employment, and the Low-income Labor Market. *Psychosociological Issues in Human Resource Management*, 6(1), 178-183.
40. Tica, N., Zekić, V., Milić, D., & Đajić, D. (2011). Agricultural households in the system of value added tax. *Agroeconomics*, 51-52(2011), 32-39 [In Serbian: Tica, N., Zekić, V., Milić, D., Đajić, D. (2011). Poljoprivredna gazdinstva u sistemu popreza na dodatu vrednost. *Agroekonomika*].
41. Thiele, A. (2018). The independence of the ECB: justification, limitations and possible threats. *Journal of Self-Governance and Management Economics*, *6*(1), 98-121.
42. Todaro, M.P., & Smith, S.C. (2006). *Economic development*. Tajib Šahinpašić, Sarajevo. [In Serbian: Todaro, M.P., Smith, S.C. (2006). *Ekonomski razvoj*].
43. Value Added Taxual Law according to "Official Gazette RS ", no. 30/2018 [In Serbian: Zakon o porezu na dodatu vrednost prema "Sl. Glasnik RS", br. 30/2018].
44. Vujičić, M., & Ristić, L. (2006). *Economics of agriculture*. Interprint, Kragujevac. [In Serbian: Vujičić, M., Ristić, L. (2006). *Ekonomika poljoprivrede*].
45. Vukadin, E., & Labus, M. (2012). *Economic Policy for Lawyers*. Faculty of Law, University of Belgrade, Belgrade. [In Serbian: Vukadin, E., Labus, M. (2012). *Ekonomska politika za pravnike*].
46. Weisang, G., & Awazu, Y. (2008). Vagaries of the Euro: An Introduction to ARIMA Modeling. *The Bentley University Journal, 2(1),* 45-55. Retrieved from https://www.bentley.edu/sites/www.bentley.edu.centers/files/csbigs/weisang.pdf.
47. Wilson, J. (2010). *Essentials of Business Research: A Guide to Doing Your Research Project*. SAGE Publications, London.

48. World bank group. (2016). *Taking on inequality – Poverty and shared prosperity 2016,* The World bank, Washington.

49. Yaffee, R.A., & McGee, M. (2000). *Introduction to Time Series Analysis and Forecasting with Applications of SAS and SPSS*. Academic Press Inc, San Diego.

50. Yifu Lin J. (2012). *New structural economics: a framework for rethinking development and policy*. The world bank, Washington.

51. Zekić, S., Matkovski, B., & Kleut, Ž. (2016). IPARD funds in the function of development of rural areas of the Republic of Serbia, *Economic horizons,* 18(2), 169-180. [In Serbian: Zekić, S., Matkovski, B., Kleut, Ž. (2016). IPARD fondovi u funkciji razvoja ruralnih područja Republike Srbije, *Ekonomski horizonti*]. doi:10.5937/ekonhor1602169Z.

52. Zelenović, V., Vojinović, Ž., & Cvijanović, D. (2018). Serbian Agriculture Loans With The Aim of Improving The Current Situation. *Economics of Agriculture.* 65(1), 323-336. doi:10.5937/ekoPolj1801323Z.

Appendices

Table A1. ARIMA model in the case of Albania

Model Fit			**Model Statistics**		
Fit Statistic	**Mean**	**SE**	**Model**	**Number of Predictors**	**Stationary R-squared**
Stationary R-squared	.364	.148	p_debit-Model_1	2	.098
R-squared	.364	.148	suf_def-Model_2	2	.073
RMSE	2.466	2.235	gdp_pc-Model_3	2	.364
MAE	1.853	1.777	unemplo-Model_4	2	.043
Normalized BIC	.709	4.060	hd_index-Model_5	2	.308

ARIMA Model Parameters				
Model	Estimate	SE	T	Sig.
p_debit-Model_1	-9.051	57.830	-.157	.878
suf_def-Model_2	-20.408	15.345	-1.330	.205
gdp_pc-Model_3	41.473	.673	2.108	.041*
unemplo-Model_4	-3.721	23.756	-.157	.878
hd_index-Model_5	36.029	.312	.926	.049*

Source: Author's calculation, **Notes**: * p<0.05; ** p<0.01; *** p<0.001

Table A2. ARIMA model in the case of FYR of Macedonia

Model Fit			**Model Statistics**		
Fit Statistic	**Mean**	**SE**	**Model**	**Number of Predictors**	**Stationay R squared**
Stationary R-squared	.373	.294	p_debit-Model_1	2	.068
R-squared	.373	.294	suf_def-Model_2	2	.543
RMSE	3.562	4.530	gdp_pc-Model_3	2	.778
MAE	2.626	3.459	unemplo-Model_4	2	.131
Normalized BIC	.748	4.714	hd_index-Model_5	2	.344
ARIMA Model Parameters					
Model	Estimate	SE	T	Sig.	
p_debit-Model_1	-9.191	92.722	-.099	.922	
suf_def-Model_2	-.755	.226	-3.344	.005**	
gdp_pc-Model_3	-.833	.165	-5.050	.000***	
unemplo-Model_4	2.048	1.428	1.435	.173	
hd_index-Model_5	-.007	.003	-2.236	.042*	

Source: Author's calculation, **Notes**: * p<0.05; ** p<0.01; *** p<0.001

Table A3. ARIMA model in the case of Bosnia and Herzegovina

Model Fit			**Model Statistics**		
Fit Statistic	**Mean**	**SE**	**Model**	**Number of Predictors**	**S Stationary R- R-squared**
Stationary R-squared	.287	.143	p_debit-Model_1	2	.163
R-squared	.287	.143	suf_def-Model_2	2	.485
RMSE	2.358	1.998	gdp_pc-Model_3	2	.368
MAE	1.734	1.414	unemplo-Model_4	2	.144
Normalized BIC	.597	4.176	hd_index-Model_5	2	.274
ARIMA Model Parameters					
Model	Estimate	SE	T	Sig.	
p_debit-Model_1	1.679	1.456	1.153	.268	
suf_def-Model_2	1.533	.655	2.341	.035*	
gdp_pc-Model_3	2.122	.953	2.227	.043*	
unemplo-Model_4	1.596	1.257	1.270	.225	
hd_index-Model_5	1.251	.359	3.484	.048*	

Source: Author's calculation, **Notes**: * p<0.05; ** p<0.01; *** p<0.001

Table A4. ARIMA model in the case of Bulgaria

Model Fit			**Model Statistics**		
Fit Statistic	**Mean**	**SE**	**Model**	**Number of Predictors**	**Stationary R-squared**
Stationary R-squared	.324	.227	p_debit-Model_1	2	.511
R-squared	.324	.227	suf_def-Model_2	2	.224
RMSE	4.296	5.308	gdp_pc-Model_3	2	.092
MAE	3.256	4.107	unemplo-Model_4	2	.615
Normalized BIC	1.305	4.541	hd_index-Model_5	2	.177
ARIMA Model Parameters					
Model	Estimate		SE	T	Sig.
p_debit-Model_1	3.414		1.357	2.515	.025*
suf_def-Model_2	1.383		.277	1.382	.047*
gdp_pc-Model_3	.084		.331	.254	.803
unemplo-Model_4	-1.506		.366	-4.115	.001***
hd_index-Model_5	1.005		.004	1.008	.049*

Source: Author's calculation, **Notes**: * p<0.05; ** p<0.01; *** p<0.001

Table A5. ARIMA model in the case of Greece

Model Fit			**Model Statistics**		
Fit Statistic	**Mean**	**SE**	**Model**	**Number of Predictors**	**Stationay R squared**
Stationary R-squared	.624	.172	p_debit-Model_1	2	.698
R-squared	.624	.172	suf_def-Model_2	2	.707
RMSE	5.701	7.886	gdp_pc-Model_3	2	.572
MAE	3.839	5.499	unemplo-Model_4	2	.793
Normalized BIC	1.345	5.291	hd_index-Model_5	2	.352
ARIMA Model Parameters					
Model	Estimate		SE	T	Sig.
p_debit-Model_1	-266.974		73.614	-3.627	.003**
suf_def-Model_2	-7.839		8.222	2.549	.023*
gdp_pc-Model_3	29.932		11.744	-3.886	.002**
unemplo-Model_4	-83.054		13.448	-6.176	.000***
hd_index-Model_5	.750		.065	11.587	.000***

Source: Author's calculation, **Notes**: * p<0.05; ** p<0.01; *** p<0.001

Table A6. ARIMA model in the case of Romania

Model Fit			**Model Statistics**		
Fit Statistic	**Mean**	**SE**	**Model**	**Number of Predictors**	**Stationary R-squared**
Stationary R-squared	.367	.363	p_debit-Model_1	2	.000
R-squared	.367	.363	suf_def-Model_2	2	.954
RMSE	2.930	4.397	gdp_pc-Model_3	2	.493
MAE	2.270	3.556	unemplo-Model_4	2	.239
Normalized BIC	.002	4.352	hd_index-Model_5	2	.202

ARIMA Model Parameters				
Model	Estimate	SE	T	Sig.
p_debit-Model_1	.189	2.734	.069	.946
suf_def-Model_2	.957	.144	6.653	.000***
gdp_pc-Model_3	-.888	.319	-2.788	.015*
unemplo-Model_4	12.826	2.902	4.420	.041*
hd_index-Model_5	.410	.200	2.056	.049*

Source: Author's calculation, **Notes**: * p<0.05; ** p<0.01; *** p<0.001

Table A7. ARIMA model in the case of Serbia

Model Fit			**Model Statistics**		
Fit Statistic	**Mean**	**SE**	**Model**	**Number of Predictors**	**Stationary R-squared**
Stationary R-squared	.471	.252	p_debit-Model_1	2	.595
R-squared	.471	.252	suf_def-Model_2	2	.144
RMSE	6.982	11.387	gdp_pc-Model_3	2	.395
MAE	4.893	7.868	unemplo-Model_4	2	.183
Normalized BIC	1.123	5.785	hd_index-Model_5	2	.820

ARIMA Model Parameters				
Model	Estimate	SE	T	Sig.
p_debit-Model_1	-9.705	2.161	-4.491	.001***
suf_def-Model_2	-3.647	7.262	-1.879	.081
gdp_pc-Model_3	1.217	.431	2.822	.014*
unemplo-Model_4	4.314	1.730	-1.460	.203
hd_index-Model_5	.887	.040	22.173	.000***

Source: Author's calculation, **Notes**: * p<0.05; ** p<0.01; *** p<0.001

Table A8. ARIMA model in the case of Croatia

Model Fit			**Model Statistics**		
Fit Statistic	**Mean**	**SE**	**Model**	**Number of Predictors**	**Stationary R-squared**
Stationary R-squared	.294	.150	p_debit-Model_1	2	.087
R-squared	.294	.150	suf_def-Model_2	2	.381
RMSE	5.074	7.450	gdp_pc-Model_3	2	.431
MAE	3.939	6.034	unemplo-Model_4	2	.143
Normalized BIC	1.248	4.701	hd_index-Model_5	2	.326

ARIMA Model Parameters				
Model	Estimate	SE	T	Sig.
p_debit-Model_1	-1.398	7.000	.156	.878
suf_def-Model_2	-6.417	3.521	-2.693	.017*
gdp_pc-Model_3	-9.223	2.539	-2.608	.021*
unemplo-Model_4	1.778	1.107	-.126	.902
hd_index-Model_5	1.197	.294	4.068	.001***

Source: Author's calculation, **Notes**: * p<0.05; ** p<0.01; *** p<0.001

IMPACT OF AGRICULTURE ON SOIL POLLUTION IN BULGARIA

Hristina Harizanova-Bartos[1], Zornitsa Stoyanova[2],
**Corresponding author E-mail: h.harizanova@gmail.com*

A R T I C L E I N F O

Original Article

Received: *25 April 2019*

Accepted: *04 June 2019*

doi:10.5937/ekoPolj1902375H

UDC 630:332.368(497.2)

Keywords:

Agriculture, mechanisms, pollution, environment, Bulgaria

JEL: *Q1, Q5*

A B S T R A C T

This article proposes an interpretation of some statistical and empirical evidence of the impact of land pollution on agriculture and agriculture as pollutant. The new conditions concerning the quality of land and land pollution, together with the increasing demand for profitability of traditional agriculture, have led to problems of lack of sufficient farming lands and increased level of degraded soil quality. The land is characterized as a prime production factor in agriculture with own specifications and cadaster. The study emphasizes the contribution of the impact of agriculture on land usage in Bulgaria and the agriculture as affected by soil pollution. The parts of the article are as follows: 1) literature review concerning the connection of the agriculture as a soil/land pollutant and soil/land polluter; 2) Methodology is based on one-dimensional and two-dimensional distribution of data collected by own survey. 3) According to the collected data is made analysis and some general conclusions which can be used as policy recommendations.

Introduction

Land is one of our the most precious assets, and its use is multi-facetted, but the new conditions concerning the quality of land and land pollution, together with the increasing demand for profitability of traditional agriculture, have led to problems of lack of sufficient farming lands and increased level of degraded soil quality. The soils perform several functions as biomass production, water quality maintenance, biological habitat, physical infrastructure support, raw materials for human use, and maintaining cultural heritage. Some of these functions can be combined (Blum& Swaran, 2004). Bruulsema (2018) adds the soils are from significant importance not only for agricultural productivity, but also for the ecosystem services related to quality of water, air, and food. The author consider soils have benefits to human health, provide calories and protein, improves crop quality etc. Functions of the land and their implementation in

1 Hristina Harizanova-Bartos, assoc. prof. dr, UNWE, Sofia, Bulgaria,+3592/8195529, h.harizanova@gmail.com , ORCID ID https://orcid.org/0000-0001-5731-1326

2 Zornitsa Stoyanova, assoc. prof. dr, UNWE, Sofia, Bulgaria,+3592/8195529, e-mail: zstoyanova@unwe.bg ORCID ID https://orcid.org/0000-0002-9067-1064

planning sustainable land management includes best practices for reducing the effects of soil processes as degradation and the best practices for land use. One of the purposes of the usage of the land is for agriculture.

Bulgaria is well known with deep traditions in agriculture. The land of agricultural use is formed by arable land, perennial crops, permanent grassland with agricultural use (including highland pastures and grasslands with low productive potential), family gardens and farmland over five years. In 2017, land of agricultural use is 47.1% of total territory on Bulgaria (MAF, 2017). The sustainable usage of the land and keeping the recourse in good condition can be reached by proper policies and implementing good practices which will reduce the polluted land by agricultural activities.

The agricultural land as affected by pollution and a reason for land pollution

The land pollution caused by agriculture activities is mainly to the technologies which are used by the farms (Novotny, 1999). The transformation from small farms to agro-businesses structures leads to a revolution in productivity. In a study the author finds the relationship between the transformation of the type of agriculture activities, intensification of the production and population growth. Population size and density determine the demands for food and monetary income (Veldkamp, 1996). The sustainable use of the land is in prime sector for many countries, where they study and measure the quality of lands. The consequences by land pollution can be summarized as follows: degradation by land use conversion, increased erosion and soil loss, chemical pollution by fertilizers and pesticides and pollution from animal operations. Novotny (2005) made a link between the impact of subsidies and the level of polluted lands, explained by the fact that many countries determine what should be grown and how large the farms will be in order to get the highest amount of subsidies (Novotny, 2005). Some authors suggest that with the tightening environmental standards, farmers have to adapt practices in order to reduce the fertilization, restricting grazing time, exporting manure, covering slurry storage, applying slurry through injection into the soil, reducing young stock and restricting feed protein content etc. (Oenema et al., 2011). There is a contradiction between sustainable land use and the need for high input production which requires more energy, fertilizers and irrigation (Winfried et al., 2015). The authors conclude that for measuring land performance and the impact on agriculture further indicators should be included, targeting water resources, biodiversity and the atmosphere. The countries which are big pork and poultry producers with lack of standards or directives to regulate the common practice of adding Cu to animal feeds are facing problems and have a potential risk of soil copper pollution with animal manure use in agriculture (Xiong et al., 2010). Yooeun & Youn-Joo (2018) consider mulch from agricultural activities lead also to soil pollution. The authors consider this pollutant influence on soil ecosystem and the problem has been neglected. Pressure on land use and the application of more intensive farming practices, as well as the abandonment of land in some OECD countries creates a risk for landscape conservation. This is due to traditional farming practices, especially in some countries where the landscape is considered for a cultural heritage (OECD, 2004).

Other authors point that the different production structures are affecting the environment differently and some of them have the potential to modify the conditions, especially those of environment (Vasilescu, Cicea, Popescu, & Andrei, 2010). Furhermore (Andrei, Mieila & Panait, 2017; Dusmanescu, Andrei, J., & Subic (2014) point that the economic of the countries based fundamentally on on energy by fossil fuels, confining resources and issuing emissions. For future decreasing the levels of pollution the agriculture should use more energy from alternative sources.

Agriculture creates a risk for soil erosion through some practices such as land use change, soil treatment or excessive grazing. A large share of the fertile land changes its use and become non-fertile due to intensive agriculture, that lead to erosion and desertification. Agricultural activities contribute to the pollution of soils with toxic substances such as cadmium because of the use of mineral phosphate fertilizers or organic pollutants due to pesticides use (Kanianska, 2016).

The pressure on agricultural land also increased considerably due to the modernization of agriculture and mechanization, which poses a risk for the environment through soil compaction. Excessive use of machines, intensive farming, intensive grazing and inadequate soil management lead to its compaction. Soil contamination problems occur to varying degrees in almost all farming systems around the world. These kind of problems are particularly important when intensive mechanization for soil treatment is used (Soane & Ouwerker, 1994).

Modern agricultural techniques usually require the use of a large amount of fertilizers. Often many farmers use large quantities of mineral fertilizers or manure to protect young plants. This technique poses a risk for the environment, as young plants are unable to absorb part of the nitrogen. As a result, the nitrogen is released into the environment. This practice causes a breakdown of the acidity of the soil that affects the growth of the plants. If the acidity of the soil is high enough, there is a risk of release of ammonia, which increases the risk of acid rain (Litterman et al., 2003). Phosphate based fertilizers are used in addition to nitrogen fertilizers, which poses also a risk for the environment. Increasing the use of phosphate fertilizers leads to the accumulation of phosphorus in soils. This creates a risk of high concentrations of phosphorus and environmental pollution. Toxic effects of phosphorus are particularly risky for lakes, streams and other water sources as excessive phosphorus leads to eutrophication (Litterman et al., 2003). On the other hand, the result of polluted land is affecting strongly the agriculture. The pollution of the soils by heavy metals is a worldwide problem because these metals are indestructible and most of them have toxic effects on living organisms at certain concentrations (Bhuiyan et al., 2010).

In the scientific research the water pollution is linked with the quality of the soils (National Research Council, 1993). The link is by soil transfer of nitrates, phosphorus, pesticides, and salts from farming systems to surface water and groundwater which leads to loss of soil organic matter and polluted water.

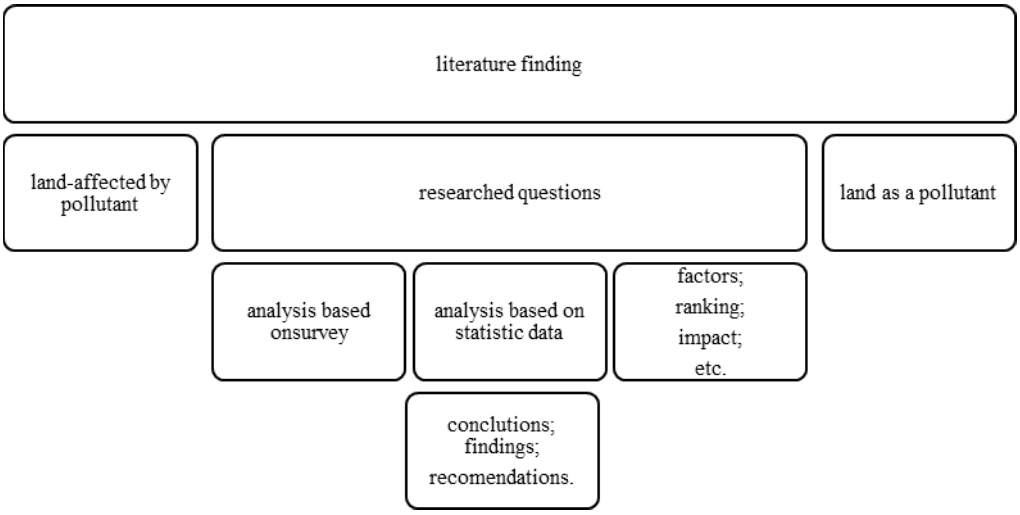
Materials and methods

The methodological framework in the study is based on literature finding, according to which is developed a questionnaire. Its aim is to evaluate the agriculture as a land polluter and pollutant. The proposed methodology was already used by evaluating the impact of agriculture on water and air. The gathered information will give the possibility to find the link between the sub branches of agriculture and land pollution. The collected data will show the rank (on sub sectoral level) of the highest land pollutant and the rank of the most affected subsectors from polluted land. The data is a part of scientific project: DN 15/8 11.12. 2017 Sustainable multifunctional rural areas: reconsidering agricultural models and systems with increased demands and limited resources.

The survey was held in 2018, and the interviewed target included agricultural experts among the government services, and non-government organizations as consultant agencies which have the specific knowledge for the effect of land pollution on the agricultural sector, and as well having a deep knowledge and expert view of the technologies in the sector and what is the current impact of the different types of agricultural activities on land pollution. On the other hand, the authors are trying to find specific mechanisms applied in agricultural sector which can bring sustainable land usage and profitable agriculture in Bulgaria. The sample size is 24 and the questionnaire includes closed and open questions. The five step Likert scale were used to evaluate the current condition in the studied topics.

The respondents had a special question which were revealed by the theoretical framework. The interviewed had to evaluated the impact of the agricultural sectors on soil pollution and agriculture as a victim of soil pollution. The main agricultural practices related to plant and livestock breeding are evaluated to find out their negative impact on soil resources. Respondents shared a view about voluntary and restricting measures related to reducing the negative impact of agricultural activities on soils respective to land pollution. The results are rather informative then quantify described and aimed to straighten the current knowledge of the land pollution by experts' own perception to what is the current willingness and readiness to adopt new practices to overcome the negative impact of the pollution. For deeper analysis in the future can be used more sophisticated models (Ren, Louie, and Peter Ren 2018) The framework of the study is presented on the Figure 1.

Figure 1. Methodological framework



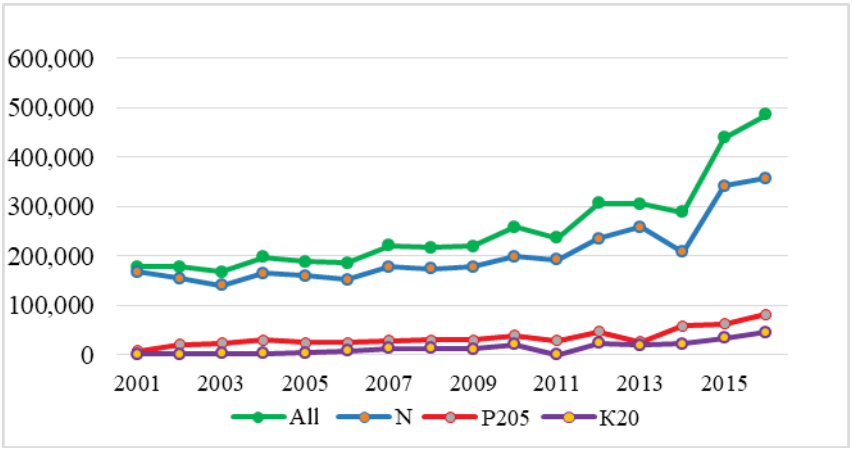
As a final part of the paper some general conclusions are proposed and compartments with sub-related resources.

Results and discussions

Impact of agriculture on land pollution

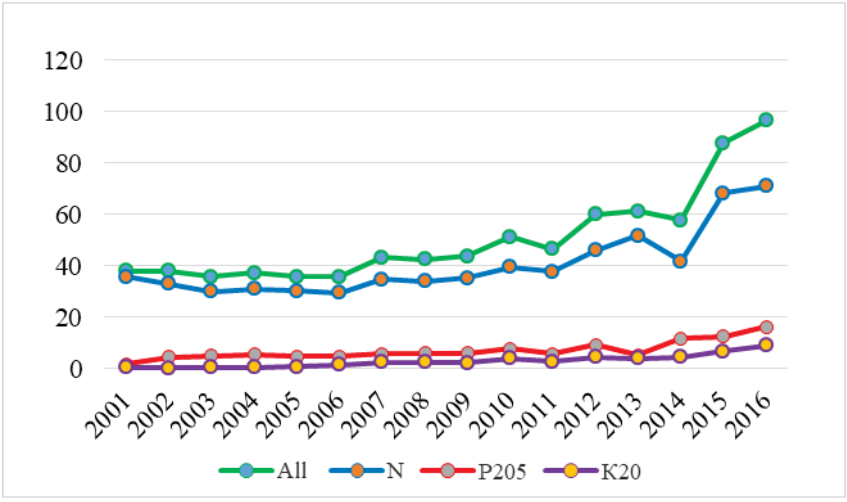
Due to the variety of relief, climatic, plant-geographic and geological conditions there is a wide variety of soils in Bulgaria. During the period 2005 - 2016 the soils in the country are in good ecological condition in terms of pollution with heavy metals, metalloids and persistent organic pollutants. In 2016 fertilizer and manure were used for the area of 4 469 950 ha, which represents 89% of the agricultural area during this year. In the same year (2016) 356 913 tonnes of nitrogen fertilizers (N), 82 566 tonnes of phosphorous fertilizers (P_2O_5) and 45 457 tonnes of potassium fertilizers (K_2O) were used in the country. There was an increase in the total amount of used fertilizers compared to 2015 (*Figure 2*). The increase of the nitrogen fertilizers used in 2016 is 4.5% more than those used in 2015. An increase of phosphorous fertilizers, amounts 30.7% in comparison with 2015. The use of potassium fertilizers (K_2O) also increased with 33.26 % from 34 112 tonnes used in 2015 to 45 457 tonnes in 2016 year. There is also increase in the used quantities of mineral fertilizers in kilograms per hectare (*Figure 3*).

Figure 2. Used quantities of mineral fertilizers in Bulgaria, in tones



Source: (MEW, 2018)

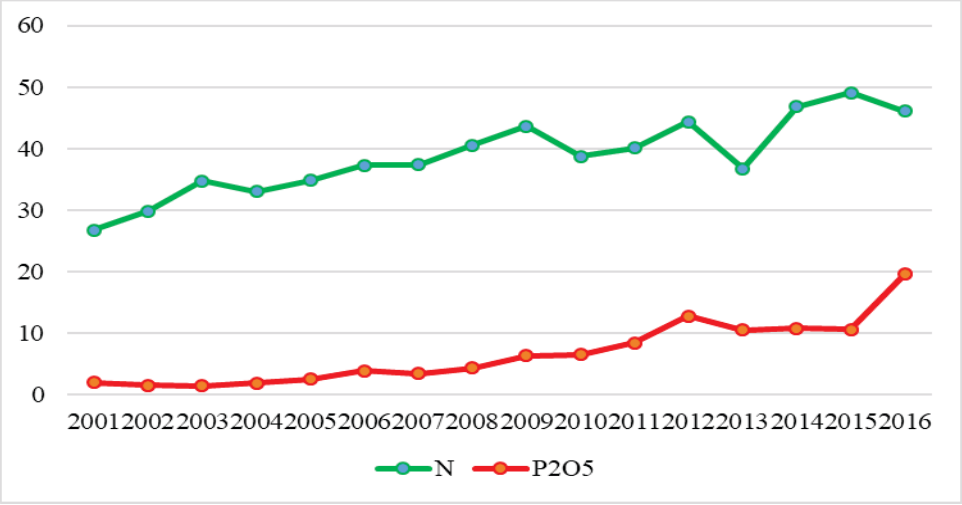
Figure 3. Used quantities of mineral fertilizers in Bulgaria, kg/ha



Source: (MEW, 2018)

Regarding the share of arable land treated with mineral fertilizers is established that there is an increase of manured areas 10.3% more compared to 2015 (total nitrogen and phosphorus). The highest increase of 86% is recorded for phosphorous fertilizer (P_2O_5) from 526.3 ha in 2015 to 979 ha in 2016 (*Figure 4*).

Figure 4. Share of utilized agricultural area manured with nitrogen and phosphorous fertilizers, %



Source: (MEW, 2018)

Analysis of current land pollution and effect on agricultural sector based on own survey

The main branches in Bulgarian's agriculture are represented in *Table 1* where as well is presented the land pollution impact on their development.

Table 1. Sectors affected by land pollution (%)

Sector	high impact	medium-high impact	medium impact	low impact	very low impact
Perennials and vines	17	46	29	4	4
Technical cultures	21	21	33	17	8
Grain production	29	25	33	8	4
Oil crops	33	33	21	8	4
Medical and aromatic crops	40	30	25	3	2
Vegetables	48	32	12	8	0

Source: own survey

The data in table 1 shows very negative impact the polluted soils are having on lands which are with vegetables and medical and aromatic crops. The opinion of the interviewees was that these two branches of agricultural sector are most vulnerable and the production will be with very bad quality and quantity. Second place with 66% cumulative impact are lands with oil crops, where as well the effect is significant. The perennials and vines are mostly pointed as medium affected by polluted lands.

Technical cultures are mentioned as the only sub branch which is not heavily affected by presents of pollutant land.

According to the gathered information about the level of polluted land on livestock breeding in Bulgaria the experts evaluated mostly side effects, as lack of grazing land, and the output by the crops.

In the other hand is interesting to examine the opposite influence. As is was argued in the first part of the paper the agricultural sector is negatively effecting the land with all practices and prepares which are used for cropping and livestock breading.

Table 2. Impact on land pollution – plant, %

Sector	high impact	medium-high impact	medium impact	low impact	very low impact
Medical and aromatic crops	0	0	0	63	38
Perennials and vines	25	29	29	17	0
Grain production	29	13	38	13	8
Oil crops	29	25	17	17	13
Vegetables	33	33	13	8	13
Technical cultures	38	38	17	4	4

Source: own survey

From the presented data could be made a conclusion that highest impact is observed by technical cultures and vegetables, where the accumulated percent is accordingly 76% and 66% (*Table 2*). The lowest impact is by medical and aromatic crops, where is pointed no negative impact.

The same measurement is obtained for livestock sector and is shown in *Table 3*.

Table 3. Impact on land pollution-livestock, %

Sector	high impact	medium-high impact	medium impact	low impact	very low impact
Cattle-breeding and buffalo-breeding	67	8	17	4	4
Sheep and goat breeding	33	29	21	17	0
Pig breeding	33	42	25	0	0
Poultry rising	25	42	25	4	4
Beekeeping	0	0	0	4	96
Rabbit breeding	21	21	25	25	8
Horse breeding	12	12	50	12	14

Source: own survey

Presented data in table 3 reveal the significant impact on land by cattle-breeding and buffalo-breeding, pig breeding and sheep and goat breeding. Cumulative percent of each of these sub branches is above 60%, and the highest pollutant is cattle-breeding and buffalo-breeding with 67%. Less influence on land is by beekeeping and horse breeding.

The experts had to evaluate specific measurements (voluntary – *Table 4* and restrictive- *Figure 5*) which can influence positively by reducing land pollution by agricultural activities.

By the collected data the possible effect is given as middle effect and almost all of the experts forecast middle impact of the chosen practices for evaluation. Investments in irrigation facilities for the optimal use of water resources and protect the soils is the only answer who is pointed as a stronger influence and is around 33%. The very low scoring ca be explained that these practices have been implemented in Bulgarian agriculture and for the future periods they will not bring high effect then what is already reached.

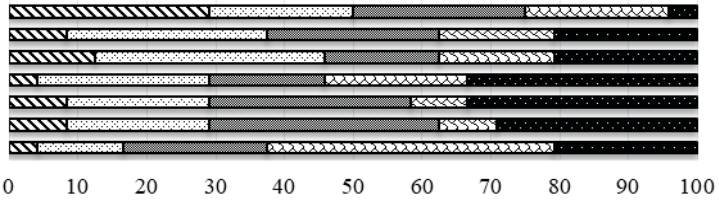
Table 4. Evaluation of the possible voluntary practices which can reflect on land pollution by agriculture, %

Practices	very low impact	low impact	medium impact	medium-high impact	high impact
Training of farmers to implement plant conservation measures	4	8	50	21	17
Development of rules for compliance with the good agricultural practices	4	0	58	17	21
Policies which motivate the compliance with the Nitrate Directive	4	8	33	33	21
Subsidizing bio products	8	8	25	38	21
Environmental practices beyond the standards of traditional agriculture	8	17	38	17	21
Policies which motivate the application of ecological practices	4	0	42	25	29
Investments in irrigation facilities for the optimal use of water resources and protect the soils	4	4	25	33	33

Source: own survey

According to obligatory mechanisms the results differ, and is observed more wide answers by the evaluated possibilities. From the shown information in Figure 5, we can conclude that most of the restrictive possibilities will impact on the land pollution. Highly evaluated payment of eco tax for non-compliance with the Nitrate Directive and preparation ecotax (paid by producer). Lowest or almost not further impact the experts evaluated enhanced control over applied farming practices and preparation ecotax (paid by producer).

Figure 5. Obligatory and restrictive mechanisms



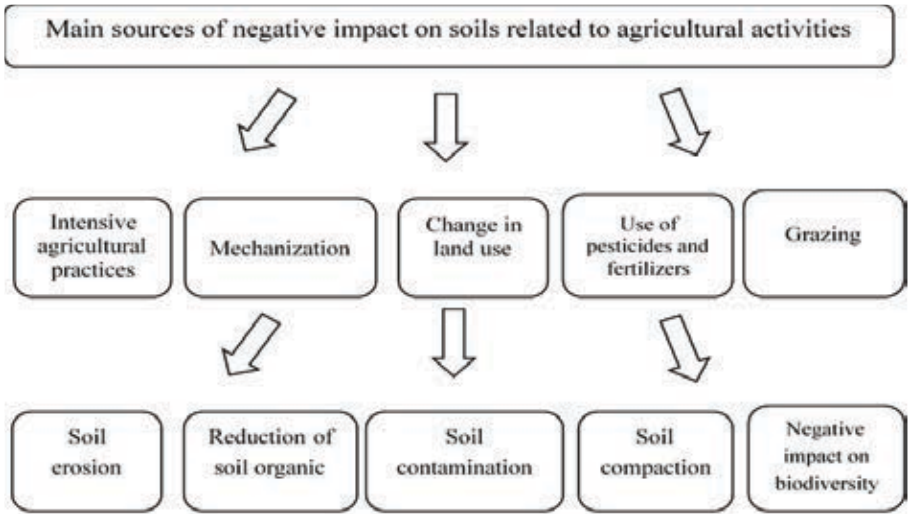
	Enhanced control over applied farming practices	Increasing fines for non-compliances with good agricultural practices	Payment of eco tax for non-compliance with the Nitrate Directive	Preparation ecotax (paid by producer)	Profit ecotax	Fee for issuing permits and controlling the discharge of waste water	Higher cost of irrigation water and irrigation facilities
very low impact	4	8	8	4	13	8	29
low impact	13	21	21	25	33	29	21
medium impact	21	33	29	17	17	25	25
medium-high impact	42	8	8	21	17	17	21
high impact	21	29	33	33	21	21	4

Source: own survey

Conclusions

On the basis of the conducted study were found the main sources of negative impact on soils arising from agricultural activities, the occurred problems for land and the possible solutions for reducing the negative impact (*Figure 6).*

Figure 6. Main sources of negative impact on soil related to agricultural activities



Possible solutions for soil protection from agrarian activities as the reduce of negative impact of contaminated soils on agriculture are related to the following measures: 1) preservation and restoration of soil quality; 2) performing recultivation activities; 3) application of control by change in land use. This measures could be realized from the farmers who can be encouraged to apply environmentally friendly and soil-friendly practices through state-compensation mechanisms.

To reduce soil degradation, different farming practices are possible. To limit soil erosion and loss of nutrients, it is necessary to maintain the soil cover. The good state of soil cover can improve soil fertility and reduce the risk of erosion. In this connection, it's possible to use cover crops to reduce soil erosion, green manure crops to help maintain soil organic matter and fertility and intermediate crops to restore residual nutrients to the soil and prevent the loss of nutrients in winter. At the same time, an activity for soil erosion prevention and nutrient loss is the variety of crop rotation and crop combinations that support soil micro-organisms, destroy plant pests, weeds and diseases.

To limit excessive grazing and the negative impact of this process on the soil is necessary to control the size of grazing, and the size must be consistent with the land's carrying capacity. This could be realized through state established requirements as grazing permissions for farmers. Each permit sets months for a grazing for one animal.

Among the possible measures to limit soil contamination is the application of integrated plant protection. In this respect, the use of bio fertilizers will help the increase in soil fertility. For their proper application is necessary the farmers to be informed for the properties of the soils, the physiological characteristics of the cultivated crops and the complex interactions between fertilizer and plants.

In regard to the policies for reducing the soil pollution processes, is important to be applied by the Ministry of agriculture and food control for compliance with good agricultural practices and environmental conditions. At the same time state support for farmers through compensatory payments for activities limiting the degradation and pollution processes is from significant importance.

Acknowledgements

The findings are part of scientific project DN 15/8 11.12. 2017 Sustainable multifunctional rural areas: reconsidering agricultural models and systems with increased demands and limited resources.

Conflict of interests

The authors declare no conflict of interest.

References

1. Andrei, J. V., Mieila, M., & Panait, M. (2017). The impact and determinants of the energy paradigm on economic growth in European Union. *PloS one*, 12(3), e0173282.
2. Bhuiyan, M., Parvez, L., Islam, M., Dampare, S., & Suzuki, S. (2010). Heavy metal pollution of coal mine-affected agricultural soils in the northern part of Bangladesh. *Journal of Hazardous Materials*, *173*(1-3), 384-392.
3. Blum, W. , & Swaran, H. (2004). Soils for sustaining global food production. *Journal of food science*, *69*(2), p.37-42.
4. Bruulsema, T. (2018). Managing nutrients to mitigate soil pollution. *Environmental pollution*, 243 (Part B), 1602-1605. doi:https://doi.org/10.1016/j.envpol.2018.09.132.
5. Dusmanescu, D., Andrei, J., & Subic, J. (2014). Scenario for implementation of renewable energy sources in Romania. *Procedia Economics and Finance*, 8, 300-305.
6. Kanianska, R. (2016). Agriculture and Its Impact on Land-Use, Environment,and Ecosystem Services. In A. Almusaed, *Landscape Ecology The Influences of Land Use and Anthropogenic Impacts of Landscape Creation.* IntechOpen.
7. Litterman, A., Onigbanio, T., & Soroka, T. (2003). *Environmental Impacts of Agriculture.* Princeton University.
8. MAF. (2017). *Final results for the crops and use of the territory of Bulgaria in 2017*, Agrostatistic N:334 [МЗХ,отдел Агростатистика N:334, (2017), БАНСИК 2017, Окончателни резултати за заетостта и използването на територията на България през 2017] , http://www.mzh.government.bg/MZH/Libraries/Земя_2017/R_A_334-PublicationBancik2017.sflb.ashx.
9. MEW. (2018). National Report on the Status and Environment of the Republic of Bulgaria. Sofia: MEW. [МОСВ. (2018). Национален доклад за състоянието и опазването на околната среда в Република България. София.] http://eea.government.bg/bg/soer/2016.
10. National Research Council. (1993). An Agenda for Agriculture *Soil and water quality: an agenda for agriculture*. National Academies Press. ISBN 0-309-04933-4.
11. Novotny, V. (1999). Diffuse pollution from agriculture—a worldwide outlook. *Water Science and Technology*, *39*(3), 1-13.
12. Novotny, V. (2005). Diffuse pollution from agriculture in the world. In *Proceedings from the International Workshop on Where Do Fertilizers Go*.
13. OECD. (2004). *Agriculture and the Environment: Lessons Learned from a Decade of OECD Work.* Paris: OECD Joint Working Party on Agriculture and the Environment.

14. Oenema, J., Van Keulen, H., Schils, R. L. M., & Aarts, H. (2011). Participatory farm management adaptations to reduce environmental impact on commercial pilot dairy farms in the Netherlands. *NJAS-Wageningen Journal of Life Sciences*, *58*(1-2), 39-48.
15. Ren, Louie, and Peter Ren (2018). "Applying a Combined Max-Min Simple Moving Average Trading Strategy to Market Indexes" *Economics, Management, and Financial Markets* 13(2): 11–23.
16. Soane, B., Ouwerker C. (1994). Soil compaction in crop production. *Developments in agricultural engineering, 11*.
17. Vasilescu, I., Cicea, C., Popescu, G., & Andrei, J. (2010). A new methodology for improving the allocation of crops cost production in Romania. *Journal of Food, Agriculture and Environment*, 8(2), 839-842.
18. Veldkamp, A., & Fresco, L. (1996). CLUE: a conceptual model to study the conversion of land use and its effects. *Ecological modelling*, *85*(2-3), 253-270.
19. Winfried E., Jasmin, S., & Georg, J. (2015). European land resources for the sustainable intensification of agriculture, Digital book of proceedings, *Soil And Agrotechnology In A Changing World,* Published by ISSAPP "Nikola Pushkarov" ISBN: 978-619-90560-0-4,13-17.
20. Xiong, X., Yanxia, L., Wei, L., Chunye, L., Wei, H., & Ming, Y. (2010). Copper content in animal manures and potential risk of soil copper pollution with animal manure use in agriculture. *Resources, Conservation and Recycling*, *54*(11), 985-990.
21. Yooeun, Ch., Youn-Joo, A. (2018). Current research trends on plastic pollution and ecological impacts on the soil ecosystem: A review. *Environmental pollution*, 240, 387-395. doi:https://doi.org/10.1016/j.envpol.2018.05.008.

EVALUATING THE EFFECTIVENESS OF ENVIRONMENTAL PROTECTION EFFORTS ON INCREASING THE CONVERGENCE BETWEEN THE EU AND ROMANIA - RETHINKING THE COMMON PROBLEMS

Jean Vasile Andrei[1], Rodica-Manuela Gogonea[2], Aurelia Patrascu[3], Marian Zaharia[4]

**Corresponding author E-mail: manuela.gogonea@gmail.com*

A R T I C L E I N F O

Original Article

Received: *11 May 2019*

Accepted: *25 May 2019*

doi:10.5937/ekoPolj1902389A

UDC 502:323.21(498:4-672EU)

Keywords:

convergence, environmental protection, energy consumption, investments, clusters analysis

***JEL**: H23; O44; P48; Q5.*

A B S T R A C T

The main aims of the paper are to asses and evaluate the effectiveness of environmental economics efforts on increasing the convergence between the EU and Romania in terms of environmental protection, from an economic perspective, using a cluster analysis applied for all the EU-28 Member States (MS). In the paper are constructed seven clusters considering five determinant and topic related variables by using Hierarchical Clustering methodology, starting from the hypothesis of identifying presumptive environmental economic patterns among all the EU-28 countries. The results obtained during the research confirm the existence of determinant and significant elements that shapes a proactive environmental protection policy by grouping the MS in appropriate clusters. The paper suggested also that, despite of important financial efforts related to environmental protection and resilience, there is still a small impact on GDP growth.

Introduction

Sustainable development is based on an effective environment policy that ensures optimal interaction between the economy and the environment. Specifically, the socio-economic development should be in a permanent process of continuity, provided it does

1 Jean Vasile Andrei, Assoc.prof.habil., Petroleum - Gas University of Ploiesti, Faculty of Economic Sciences, B-dul, Bucuresti, No.39, 100680, Ploiesti, Prahova, Romania, E-mail: andrei_jeanvasile@yahoo.com, ORCID ID: https:///orcid.org/0000-0002-8332-6537

2 Rodica-Manuela Gogonea, Assoc.prof, The Bucharest University of Economic Studies, 15-17 Dorobanti St., Sector 1, 010552 Bucharest, Romania, E-mail: manuela.gogonea@gmail.com

3 Aurelia Patrascu, Assoc.prof., Dean of the Faculty of Economic Sciences, Petroleum -Gas University of Ploiesti, B-dul Bucuresti, No.39, 100680, Ploiesti, Prahova, Romania, E-mail:patrascuaura@yahoo.com

4 Marian Zaharia, full professor, Faculty of Economic Sciences, Petroleum -Gas University of Ploiesti, B-dul Bucuresti, No.39, 100680, Ploiesti, Prahova, Romania, E-mail: marianzaharia53@gmail.com

not affect the environment, and it protects the natural resources necessary for human existence. As in literature (Clark, J. (2017), Panayotou, T. (2016) and Sachs, W. (2015), in contemporary and well functional economies environmental protection represents not only a major objective as political, societal and academic approach, but also it reunites the efforts in promoting economic resilience. Despite numerous technological changes, massive investments, and the new European environmental paradigm developments, environmental protection continues to be one of the most un-convergent policies and imposes numerous debates.

Staring from the assumption that an effort to promote and acquire a functional and active environmental protection implies both specific and complementary instruments and financial allotments both form the national and companies' budgets, the environmental protection efforts cause significant challenges, which need to be well oriented and evaluated as it is highlighted in (Hardisty, P.(2010), Choi, S., & Ng, A.(2011), Goodland, R.(1995), Spangenberg, J. H. (2005) and Labuschagne, C., Brent, A. C., & Van Erck, R. P. (2005).

Taking into account that the GDP is the most important indicator of economic growth (Huang, B. N., Hwang, M. J., & Yang, C. W. (2008), Costanza, R., Hart, M., Talberth, J., & Posner, S. (2009), Zilio, M., & Recalde, M. (2011), the changes analyzed for environmental protection expenditures as % in GDP (EPE) and total environmental investments as % in GDP (TEI) are the most significant.

Although the European Union has an environment strategy based on synergy, there are differences in the applicability of environmental policy regulations between constituent countries, a situation proven also by the analysis of the three indicators (ELP, EPE and TEI) for 23 EU countries.

According to Eurostat, (2017), the process of analyzing the percentage value fluctuations for both the environmental protection expenditures as % in GDP and for total environmental investments as% in GDP showed that in 2011, compared to 2002, six countries are experiencing a reduction: Luxembourg, Austria, Germany, Hungary, Portugal, and Slovenia. The growth trend of both indicators is registered for Estonia, UK, Sweden, Poland, Latvia, Romania, Croatia, Lithuania, and the Netherlands.

Taking into account the data available at the beginning of the research, the paper was mainly focused on the period 2002-2011 and on 23 out of 28 EU Member States. In the first part of the research we analyzed the evolution of the three indicators both at the EU level and for the 23 states included in the research.

The main objective of this paper is to identify and highlight the quantitative and qualitative aspects of EU Member States' policies on their spending and investment in environmental protection. Three indicators were used for this end: environmental protection expenditure as % in GDP (EPE), shares of environmental and labour taxes in total tax revenues from taxes and social contributions (ELP) and total environmental investments as % in GDP (TEI). On the other hand we try to identify the characteristics

of the evolution of the three indicators, and the extent to which quantitative assessments are statistically significant at the level of each country. From this perspective, the main research instrument used in carrying out the analysis on this paper was the Hierarchical Clustering methodology, which is employed to determine economic behavioral models among the EU-28 Member States in terms of environmental protection efforts, and to review the influence of the five (5) considered variables (environmental protection expenditure, greenhouse gas emissions, intensity of energy consumption, environmental investments, primary energy consumption and environmental and labour taxes) on designing the environmental protection behavior at the EU-28 level.

The second part of the research is a cluster analysis through which the groups have been formed and their main characteristics have been statistically determined and tested. In order to highlight the mutations determined by the economic evolutions and policies of the analyzed states for the cluster analysis, we chose years 2002 and 2011 (beginning and end of the analyzed period).

Research methodology

In this study the research methodology employed for achieving the main objectives is based on previous works in the field, improved and adapted to the specific goals followed as in (Gelder, 2014; Andrei et al., (2016), Zaharia and Gogonea, (2016); Jugănaru and Jugănaru, (2016), Rotaru T. (ed.), Badescu G., Culic I., Mezei E. & Murean C. (2006)

In order to achieve the objective of the first part of the research, the following matrix was developed:

$$\boldsymbol{X} = \left\| \boldsymbol{x}_{ijk} \right\|_{i=\overline{1,3}\boldsymbol{j}=\overline{1\boldsymbol{p}},\boldsymbol{t}=\overline{1,\boldsymbol{m}}} \tag{1}$$

In (1), i = 1 corresponds to the EPE variable, i = 2 corresponds to the ELP variable, and i = 3 corresponds to the TEI variable. Starting from the matrix X, for the p countries and the three indicators, the averages of the analyzed period and the matrix of the coefficients of variation (V) are determined (Rotariu, 2006):

$$\boldsymbol{V} = \left\| \frac{\boldsymbol{s}_{\boldsymbol{ij}}}{\overline{\boldsymbol{x}_{\boldsymbol{j}}}} \right\|_{\boldsymbol{i}=\overline{1,3}\boldsymbol{j}=\overline{1\boldsymbol{p}}}, \boldsymbol{s}_{\boldsymbol{j}}^2 = \frac{\sum_{\boldsymbol{t}=1}^{\boldsymbol{m}} \left(\boldsymbol{x}_{\boldsymbol{ijt}} - \overline{\boldsymbol{x}_{\boldsymbol{j}}} \right)^2}{\boldsymbol{m}-1}, \overline{\boldsymbol{x}_{\boldsymbol{j}}} = \frac{\sum_{\boldsymbol{t}=1}^{\boldsymbol{m}} \boldsymbol{x}_{\boldsymbol{ijt}}}{\boldsymbol{m}}. \tag{2}$$

Taking into account the values of the V matrix, we identified - for each one of the three indicators - the countries for which they provide a good characterization of the evolution during the analyzed period ( ), and the countries for which the indicators do not provide acceptable information.

Also, confidence intervals for the average values have been determined and tested statistically. The condition for accepting the assumption of the null hypothesis (H0_1:

the average is not statistically significant), is that the confidence interval ( ) limits would have different signs.

$$\Delta\bar{x}_{ij} = \bar{x}_j \pm Std.err_j \cdot t_{\frac{\alpha}{2},m-1}, \quad Std.err = \sqrt{\frac{s_j^2}{m}} \tag{3}$$

For a better picture of the evolution of the three indicators in the analyzed countries, the values of linear regression coefficients were determined, using ANOVA. Testing their statistical significance was done with the t (student) test. The condition of accepting the null hypothesis (H0_2: the value of the regression coefficient is not statistically significant) is:

$$-t_{\frac{\alpha}{2},m-2} < \frac{\hat{b}_j}{s_{\hat{b}_{ij}}} < t_{\frac{\alpha}{2},m-2}, \quad s_{\hat{b}_j} = \frac{\sum_{t=1}^{m}\left(x_{ijt} - \hat{x}_{ijt}\right)^2}{m-2} \Big/ \frac{1}{\sum_{t=1}^{m}\left(t - \bar{t}\right)^2}. \tag{4}$$

In the second part of the research two clusters analyses were carried out, the first one corresponding to the year 2002, and the second one corresponding to the year 2011. The analysis started from the matrices:

$$Y_{2002} = \left\| y_{2002ij} \right\|_{i=\overline{1,3}\,j=\overline{1,p}}, \quad Y_{2011} = \left\| y_{2011j} \right\|_{i=3\,j=\overline{1,p}} \tag{5}$$

On the matrix elements Y2002 and Y2011 the following transformation was applied (Zaharia et al., 2017):

$$z_{ij} = \frac{y_j - \bar{y}_i}{\sigma_i}, \quad where \quad \bar{y}_i = \frac{\sum_{j=1}^{p} y_j}{n}, \quad \sigma_i = \sqrt{\frac{\sum_{j=1}^{p}\left(y_j - \bar{y}_i\right)^2}{p-1}}. \tag{6}$$

Proximity Matrix was obtained using Euclidian distance (Rotariu, 2006; Zaharia et al., 2017):

$$W = \left\| w_{jl} \right\|_{j=\overline{1,p},\, l=\overline{1,p}}, \quad w_{jl} = \sqrt{\sum_{j=1}^{p}\left(z_l - z_j\right)^2}, i = \overline{1,3}, l = \overline{1,p}, j \neq i, k \neq i, w_{ii} = 0 \tag{7}$$

and for the distance between clusters, we used the Average Linkage method.

For the testing of the significance of the variables belonging to clusters, we used ANOVA, the null hypothesis H0 (cluster belonging of the analyzed variable is not statistically significant) being given by (Zaharia et al., 2017):

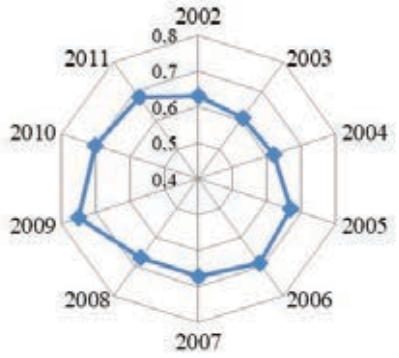
$$F_{stat} = \frac{\sum_{i=1}^{r}(\bar{y}_i - \bar{y}_0)^2 n_i \Big/ df_1}{\sum_{i=1}^{r}\sum_{j=1}^{n_i}(y_j - \bar{y}_i)^2 \Big/ df_2} < F_{\alpha,r-1,n-r} \quad equivalent\ to \quad Sig\_F > \alpha \tag{8}$$

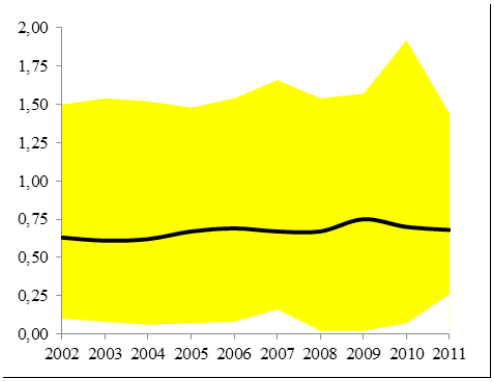
Significance level used was 95%. To generate the clusters and test the statistical hypothesis, the SPSS package was used. The method was chosen based on the premise that it has a high degree of applicability and it can be used in order to design significant groups in terms of indicator significance and displays.

Results and discussions

At the level of the European Union, between 2002 and 2011, the environmental protection expenditure as % in GDP (EPE), the share of environmental and labour taxes in total tax revenues from taxes and social contributions (ELP), and total environmental investments as % in GDP (TEI) had significantly different evolutions (Figures 1a, 2a, 3a).

Figure 1. Evolution of the value (a) and of the area of the value (b) of environmental protection expenditure as % in GDP (EPE), at European Union level in 2002-2011.



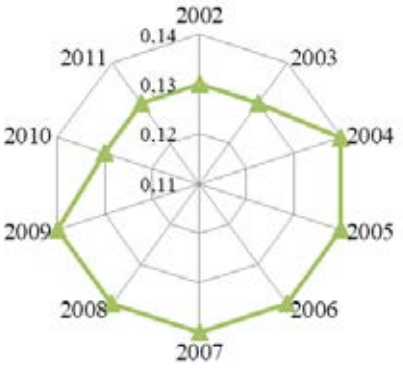


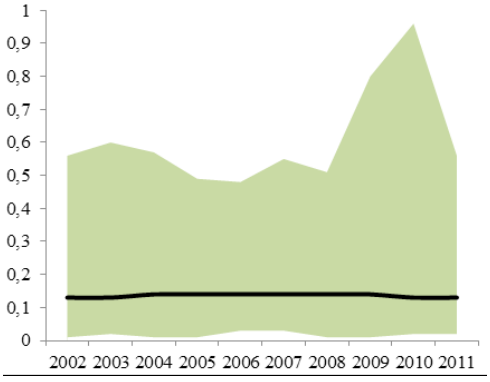
(a) **(b)**

Source: authors based on EUROSTAT (2017)

While the shares of environmental and labour taxes in total tax revenues from taxes and social contributions recorded maximum values (over 6.5%) between 2002 and 2005, and minimum values (6.03%) in 2008 and (6.37%) in 2011, the environmental protection expenditure as % in GDP reached the maximum values (over 0.7%) in 2009-2010, and the minimum values (0.62%) in the period 2002-2004. Compared to 2002, ELP decreased in 2011 by 6.59 % while EPE increased by 7.94%.

Figure 2. The evolution of the value (a) and of the area of the value (b) of total environmental investments as % in GDP (TEI), at European Union level in 2002-2011



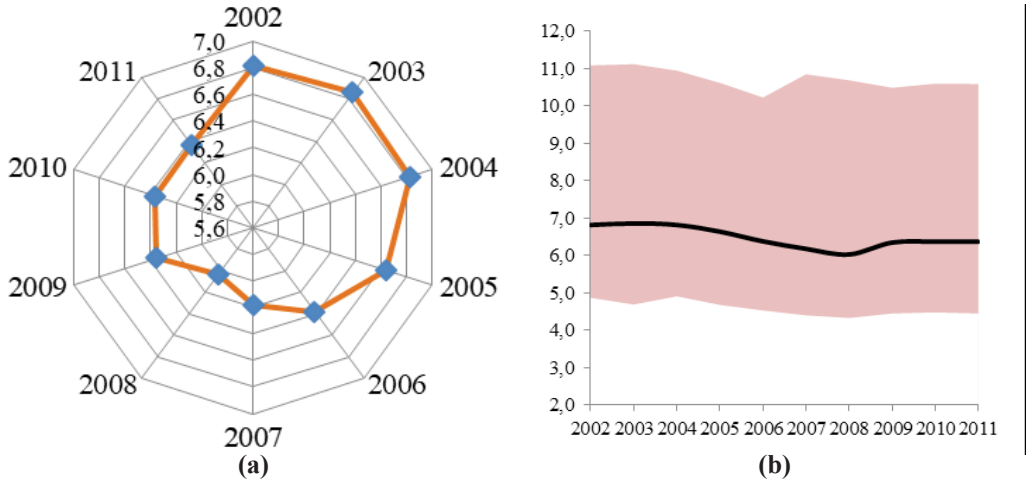


(a) **(b)**

Source: authors based on EUROSTAT (2017)

As regards total environmental investments as % of GDP, it recorded peak values in the period before the economic crisis, and even in its first year, namely in 2004-2009. Starting with 2010, the TEI decreased from 0.14 % to 0.13 %, reaching in 2010 the level it had reached in 2002.

Figure 3. - The evolution of the value (a) and of the area of the value (b) of shares of environmental and labour taxes in total tax revenues from taxes and social contributions (ELP), at European Union level in the period 2002-2011



(a) **(b)**

Source: authors based on EUROSTAT (2017)

These values characterize the European Union at a global level. They are annual average values and may hide contradictory developments at Member State level. In order to identify how the values recorded in the analyzed period of the three indicators at the level of each Member State we determined, in a first phase, the average values and the corresponding coefficients of variation.

The economic and social phenomena, as well as the conditions and policies adopted in the Member States, led to different evolutions of the three indicators, with changes in the variation ranges being more or less compact (Figure 1b, 2b, 3b). The narrowest of these and relatively convergent is the area of the values of the shares environmental and labour taxes in total tax revenues from taxes and social contributions. By contrast, the evolution of environmental protection as % in GDP and total environmental investments as % in GDP indicates a great diversity, mainly after the economic crisis.

The fact that the trajectories of the average values of the three indicators are in the first third of the evolution areas shows that in a significant proportion of the countries included in the analysis the evolutions of ELE, ELP and TEI were not affected by major disturbances.

At the level of the analyzed countries, the average environmental protection expenditure as % in GDP ranged between 0.13%, in Croatia, and 1.5% in the Netherlands. Value differences between countries can be explained based on the differences in the economic

structure (different proportions of the sectors of activity: industry, agriculture, services).

Of the 23 countries included in the analysis, for 95% confidence level, in eight countries (Belgium, Bulgaria, Latvia, Lithuania, Poland, Romania, Slovakia and United Kingdom) there was an increasing trend of environmental protection expenditure as % in GDP. In addition to this, for 90% confidence level, there is France and Malta. Of these, the most significant increase in environmental protection expenditure as % in GDP was recorded in Lithuania, with an annual growth of 0.129 percentage points, followed by Romania, with an annual increase of 0.088 percentage points.

On the other hand, for 95% confidence level, there have been decreasing trends in environmental protection expenditure as % of GDP in five countries (Germany, Luxembourg, Hungary, Austria and Slovenia). Of these, significant annual reductions in the values of this indicator were recorded in Hungary (-0.047 percentage points), Austria (-0.036 percentage points) and Slovenia (-0.032 percentage points). In the other eight countries (Estonia, Spain, Croatia, Italy, Netherlands, Portugal, Finland and Sweden), oscillating developments were recorded around the mean values, the highest value of the standard deviation of 0.1177 being registered in Italy. For these countries the values of the regression coefficients are not statistically significant for either 95% or 90% confidence level, assuming the null hypothesis (H0_2).

In the case of the EPL - the shares of environmental and labour taxes in total tax revenues from taxes and social contributions, the average values were between 4.58 (France) and 10.18 (Croatia). For 90% confidence level, the EPL registered an upward trend only in the Netherlands (with an annual growth of 0.023 percentage points) and Poland (with an annual increase of 0.026 percentage points). For 95% confidence level, the EPL recorded a decreasing trend in Italy, Malta, Hungary, Slovakia, Finland, and Sweden. Please note that for the other 15 countries, oscillating developments were recorded around the mean value, which means that the regression coefficient values are not statistically significant for either 95% or 90% confidence level, assuming the null hypothesis (H0_2).

For the third TEI indicator - total environmental investments at the level of the analyzed countries, the average values as % in GDP ranged between 0.03% in Sweden and 0.46% in Slovenia. In the analyzed period, 14 countries (Bulgaria, Estonia, Croatia, Italy, Latvia, Luxembourg, Malta, Netherlands, Austria, Poland, Romania, Finland, Sweden, and UK) had a growing trend for 95% confidence level. For the other 9 countries there were oscillating developments recorded around the mean values, with the highest value of standard deviation (0.3014) being registered in Lithuania. For these states, the values of the regression coefficients are not statistically significant for either 95% or 90% confidence level, assuming the null hypothesis (H0_2).

Given the evolution of the values of the three analyzed indicators (EPE, ELP and TEI), the 23 countries were grouped using the hierarchical cluster method while performing a comparative analysis of these groups in the years 2002 and 2011 to highlight the quantitative and qualitative differences for each cluster.

Choice regarding the number of clusters is based on the significant reduction of the Total Sum of Squared Error (Peeples, Matthew A., 2011) on the one hand, and on a better readability of the results, on the other hand. Under these circumstances, seven clusters resulted. The Fisher test (Table 1) highlights the fact that all three variables included in the analysis are significant in terms of cluster membership.

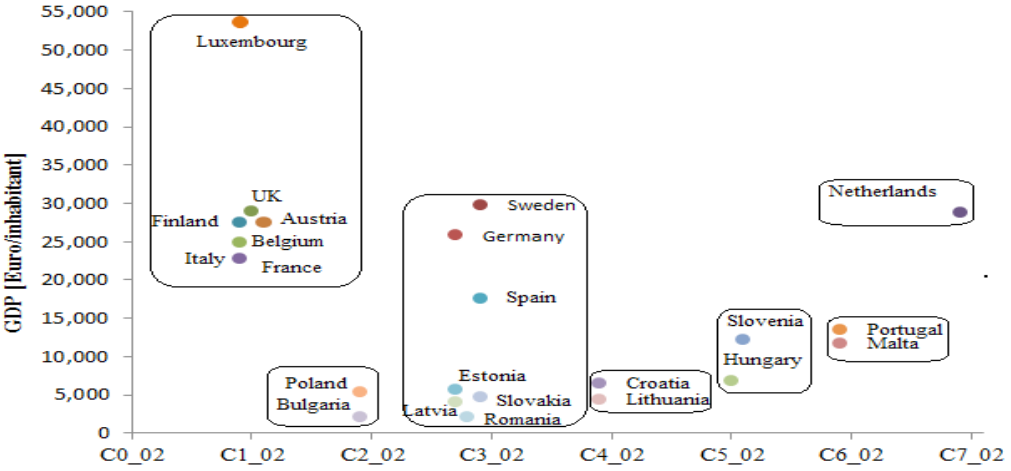
Table 1. Results of testing the hypothesis regarding the belonging of the variables EPE, ELP and TEI to clusters, using ANOVA

	df 1	df 2	$F_{0.05;4;24}$	Fstat		Sig.F
				2002	2011	
EPE	6	16	2.74	21.189	18.819	.000
ELT	6	16	2.74	9.757	11.791	.000
TEI	6	16	2.74	20.047	24.393	.000

Source: Authors' own computations

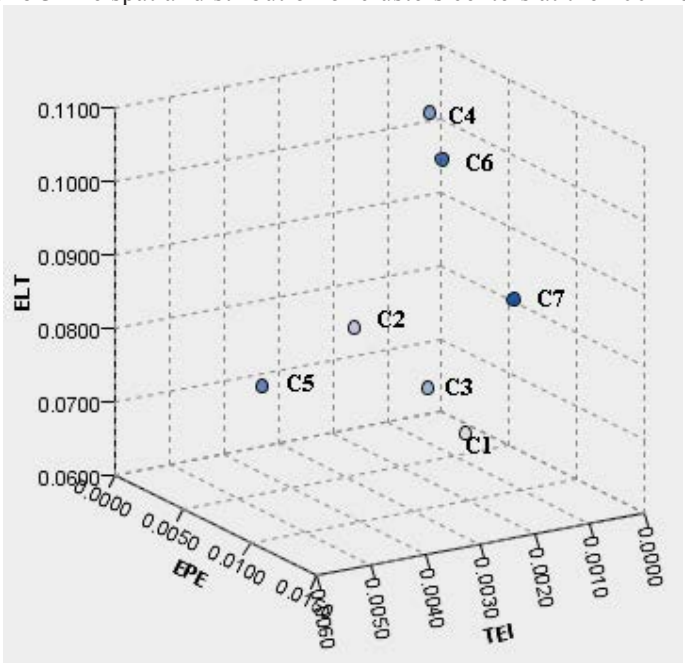
For the first year of the analyzed period, the grouping by clusters of the 23 analyzed countries, as well as their ranking according to GDP per capita, is shown in Figure 4.

Figure 4 - Grouping of countries by clusters according to the value of environmental protection expenditure as % in GDP (EPE), of the shares of environmental and labour taxes in total tax revenues from taxes and social contributions (EPL) and, of total environmental investments as % in GDP, in 2002.Source: authors based on EUROSTAT (2017)



Depending on the average values of the EPE, ELP, TEI variables recorded at cluster level the spatial distribution of clusters centers is shown in Figure 5.

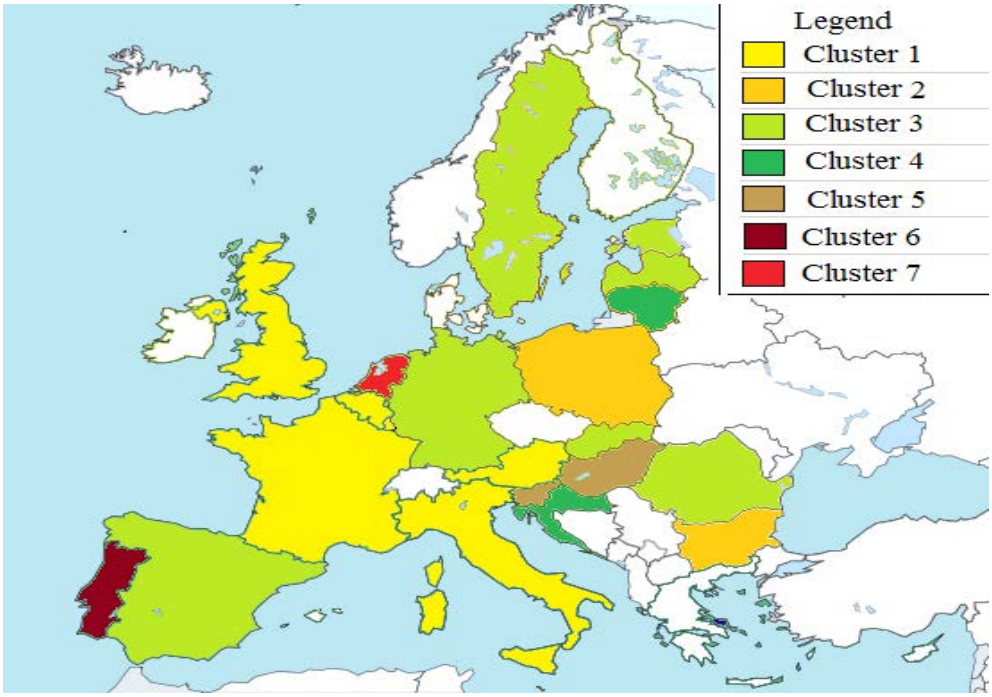
Figure 5 The spatial distribution of clusters centers at the 2002 level.



Source: authors` based on EUROSTAT (2017)

The most countries are concentrated in Cluster 1 (Belgium, France, Italy, Luxembourg, Austria, Finland, UK) and in Cluster three (Germany, Spain, Latvia, Romania, Slovakia, Sweden). In addition, four clusters include only two countries: C2 with Bulgaria and Poland, C4 with Croatia and Lithuania, C5 with Hungary, Slovenia, and C6 with Malta and Portugal. As far as the Netherlands is concerned, by the values of the average indicators analyzed, it is situated in a cluster by itself (C7). The territorial representation of the results is shown in Figure 6.

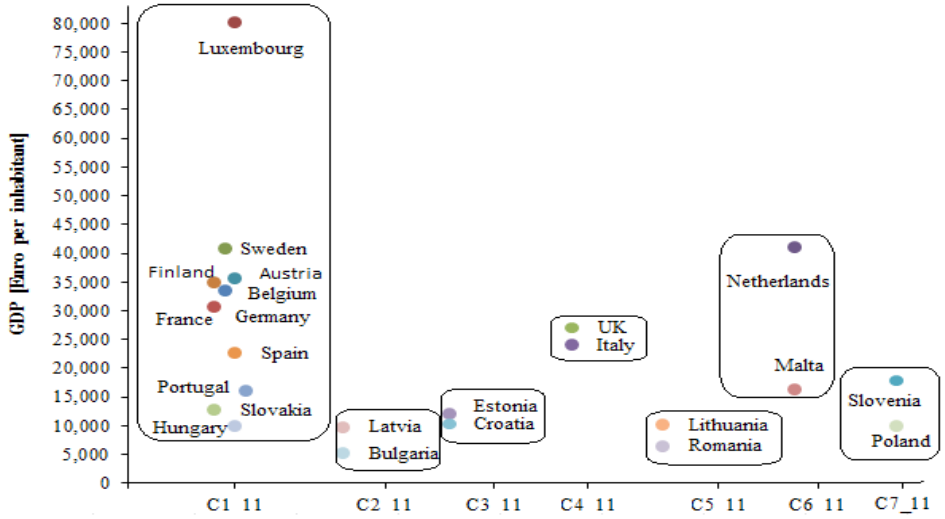
Figure 6. Territorial distribution of the clusters based on the values of environmental protection expenditures as % in GDP (EPE), of the shares of environmental and labour taxes in total tax revenues from taxes and social contributions (EPL), and of total environmental investments as % in GDP, recorded in 2002.



Source: authors based on EUROSTAT (2017)

At the end of the analyzed period, due to the economic evolutions and the peculiarities of the countries included in the analysis, the values of the three indicators underwent changes (presented in the first part of the article) which led to a reorganization of the clusters in 2011 compared to 2002 (Figure 7).

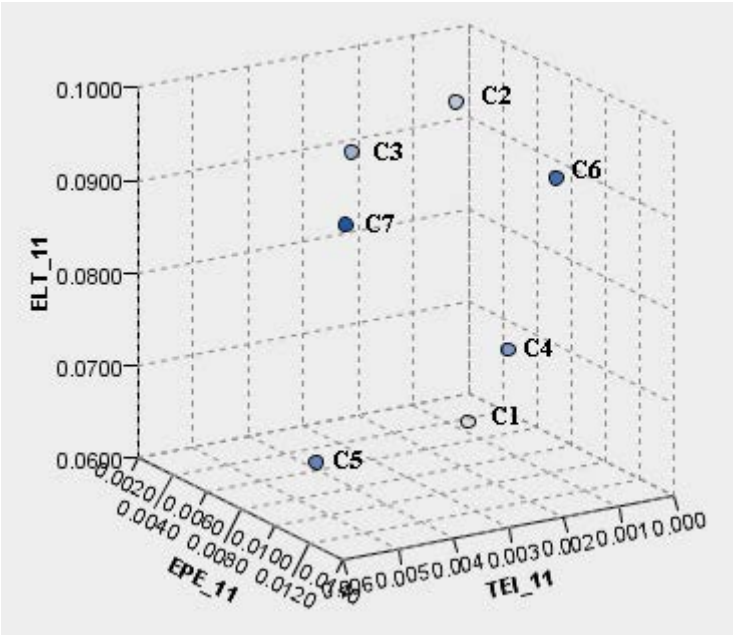
Figure 7 – Country grouping by clusters, according to the value of environmental protection expenditures as % in GDP (EPE), of the share of environmental and labour taxes in total tax revenues from taxes and social contributions (EPL), and of total environmental investments as % in GDP, in 2011



Source: authors based on EUROSTAT (2017)

At the 2011 level, the spatial distribution of clusters centres is shown in Figure 8.

Figure 8 The spatial distribution of clusters centers at the 2011 level.

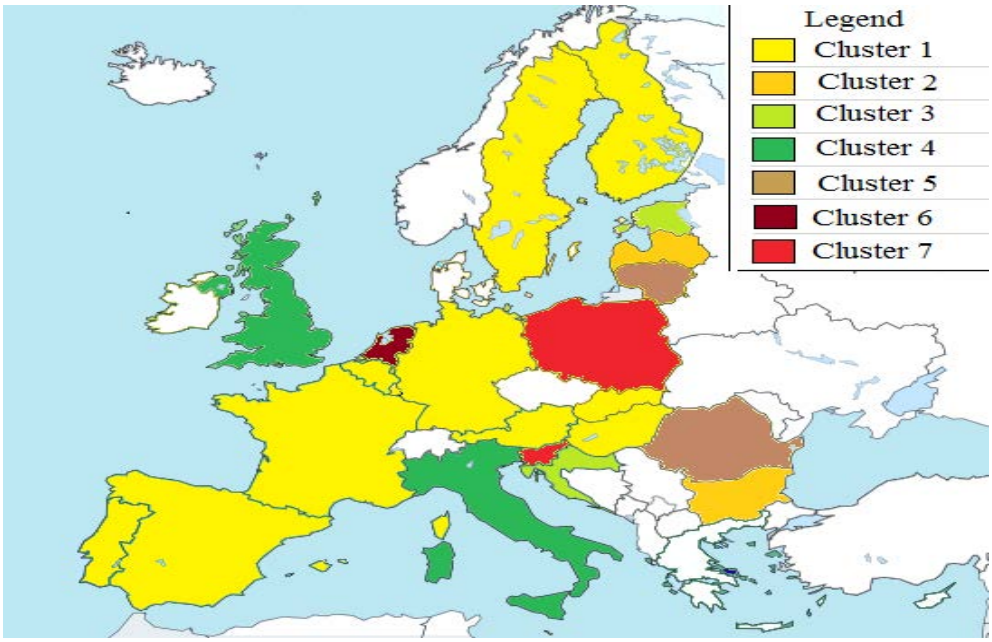


Source: authors based on EUROSTAT (2017)

The most significant cluster remains the first - C1 - with a concentration of 11 countries: Belgium, Germany, Spain, France, Luxembourg, Hungary, Sweden, Finland, Austria, Portugal, and Slovakia. All the other six clusters consist of two countries: C2 with Bulgaria and Latvia, C3 with Estonia and Croatia, C4 with Italy and UK, C5 includes Lithuania and Romania, C6 with Malta and Netherlands and C7 with Poland and Slovenia.

Figure 9 shows clearly the territorial distribution of these clusters, according to the values of environmental protection expenditures as % in GDP (EPE), of the share of environmental and labour taxes in total tax revenues from taxes and social contributions (EPL), and of total environmental investments as % in GDP

Figure 9- Territorial distribution of clusters based on values of environmental protection expenditure as % in GDP (EPE), of the shares of environmental and labour taxes in total tax revenues from taxes and social contributions (EPL) and, of total environmental investments as % in GDP, registered in 2011



. Source: authors based on EUROSTAT (2017)

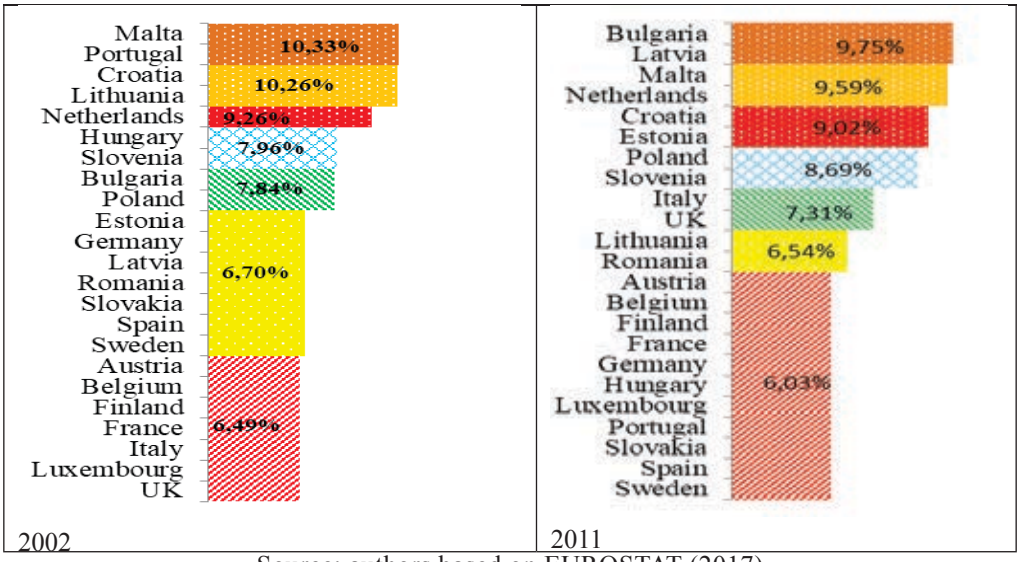
Each cluster indicates a specific political behavior with major influences on spending and investment in environmental protection. Thus, a profile of the countries in the seven clusters can be achieved, according to the environmental policy undertaken by governments in relation to the three indicators analyzed: EPE, ELP, and TEI.

As in Figure 5, the clusters obtained do not have the same composition in the two analyzed years. Belgium, France, Luxembourg, Finland, Austria are countries with similarities in terms of the indicators analyzed, which are in the same cluster (C1) both in 2002 and in 2011.Bulgaria, Estonia and Malta are countries that have retained

their cluster in both analyzed years. Portugal and Hungary are characterized by value oscillations of the indicators that favored switching from one cluster to another in 2011 compared to 2002.

In 2002, values in the Netherlands are significantly different from the other countries analyzed, and required a separate analysis of this country in terms of policy in the light of the three indicators. Concerning the composition of the clusters, the most significant changes in the number of countries are reported for the first and third clusters. The average percentage values determined by clusters of the indicator shares of environmental and labour taxes in total tax revenues from taxes and social contributions (ELP) are between 6.49% (2002) and 6.03% (2011) for cluster 1 and a maximum of 10.33% for cluster 6 in 2002, respectively 9.75% for cluster 2 in 2011 (Figure 10).

Figure 10 - Country grouping according to the average values of environmental and labour taxes in total tax revenues from taxes and social contributions



Source: authors based on EUROSTAT (2017)

The indicator shares of environmental and labour taxes in total tax revenues from taxes and social contributions corresponding to clusters over the two analyzed years highlights the changes in terms of structure and value. Significant decreases are recorded for C4 (-2.96%) and C5 (-1.42%) and less significant for C6 (-0.74%), C7 (-0.57%) and C1 (-0.46%). Increases are recorded at C3 (+ 2.31%) and C2 (+ 1.91%).

The evolution of the average percentages of the shares of environmental and labour taxes in total tax revenues from taxes and social contributions by clusters, according to figure 10, is the result of changes in the percentage values of the variable, by countries. Thus, significant for the analysis are the changes recorded by the countries that remain in the same cluster. The justification takes into account the fact that the cluster represents a level of hierarchy which allows for a clearer comparison of the analyzed variable in 2011 compared to 2002.

Belgium, France, Luxembourg, Austria, Finland (countries belonging to the EU-15 subgroup) are in C1 both in 2002 and 2011, indicating relatively close concerns and results in terms of the applied policy on the share of environmental and labour taxes in total tax revenues from taxes and social contributions. Of the five countries, Finland is the only country where we see a 4.51% increase in shares of environmental and labour taxes in total tax revenues from taxes and social contributions. For other countries, there are decreases: in Luxembourg ELT decreased by 9.92%, France by 8.62%, Austria by 4.21% and Belgium by only 2.46%.

Bulgaria, part of C2 for both years of analysis, has a 28.99% growth rate in shares of environmental and labour taxes in total tax revenues from taxes and social contributions in 2011 compared to 2002, thus landing the second place after Estonia (part of C3) with the highest growth rate (35.58%).

Maintained on the same level of clustering for both years of analysis, Malta, part of C6, is facing a fairly significant reduction process in the shares of environmental and labour taxes in total tax revenues from taxes and social contributions, namely 14.07% in 2011 compared to 2002.

Italy and the UK, part of C1 in 2002, which re-entered C4 in 2011, are down by 0.5% and 6.93% in the shares of environmental and labour taxes in total tax revenues from taxes and social contributions in 2011 compared to 2002. In 2011, in C1, six other countries joined the five countries that have maintained their position: Germany, Spain, Hungary, Sweden, Portugal, Slovakia, the decreases determined for shares of environmental and labour taxes in total tax revenues from taxes and social contributions being between a minimum rate of 2.18% (Hungary) and a maximum of 25.18% (Portugal, which holds the penultimate position in terms of reduced decrease of the ELT).

In 2002 Bulgaria joins Poland at a 6.57% growth rate, and Latvia in 2011, for which the share of growth of environmental and labour taxes in total tax revenues from taxes and social contributions in 2011 compared to 2002 is by 15.58%.

Shares of environmental and labour taxes in total tax revenue from taxes and social contributions for Romania, part of C3 in 2002 and C5 in 2011, decreased by 8.75% in 2011 compared to 2002. A decrease by 13.47% is recorded by Croatia (part of C_02 and C3_11) for shares of environmental and labour taxes in total tax revenues from taxes and social contributions in 2011 compared to 2002.

The largest decrease, by 35.95%, of shares of environmental and labour taxes in total tax revenue from taxes and social contributions in 2011 compared to 2002, was registered by Lithuania, which in 2002 was part of C4, and in 2011 it was a component of the C5 cluster. Also in C5, but in 2002, Slovenia corresponds to an increase of ELT by 9.78% in 2011 compared to 2002.

Netherlands was part of the last cluster in 2002 (C7) and the penultimate cluster (C6) in 2011, registering an increase by 4.10% in the share of environmental and labour taxes in total tax revenue from taxes and social contributions in 2011 compared to 2002.

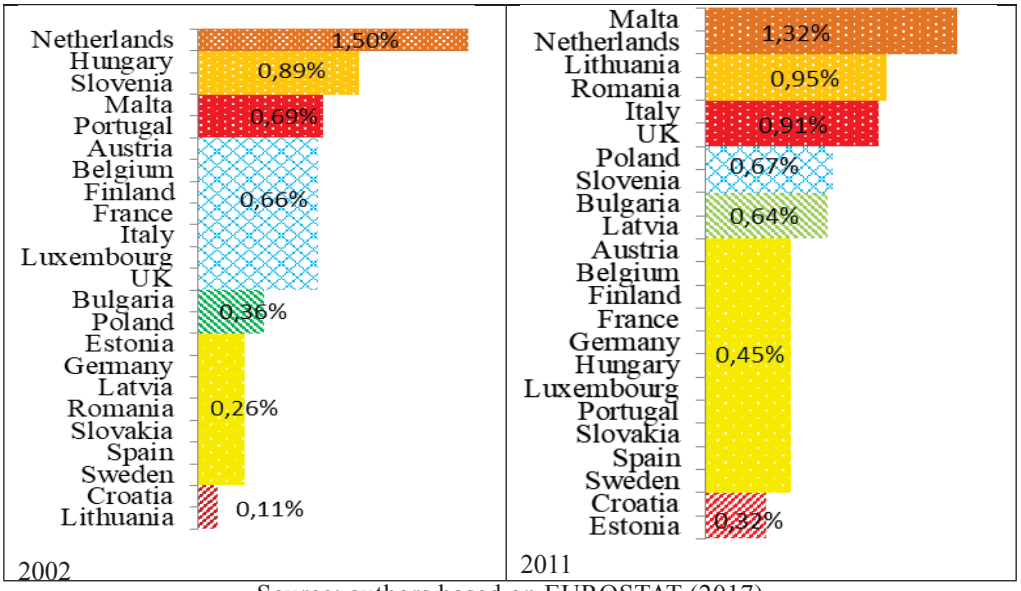
The process of analysing this indicator (shares of environmental and labour taxes in total tax revenues from taxes and social contributions) reflected the oscillations, in the form of relative increases or decreases, recorded by countries that remain in the same cluster, or changing their clusters in 2011 compared to 2002, being a consequence of the environmental strategies applied by their governments. Other fluctuating trends in the policy outcomes applied by the governments of the 23 EU countries for environmental protection are also highlighted by the environmental protection expenditure as % in GDP (EPE) indicator.

Compared with the shares of environmental and labour taxes in total tax revenues from taxes and social contributions, much lower percentage values for the 23 EU countries are recorded for environmental protection expenditure as % in GDP.

The average percentage values split by clusters of the indicator environmental protection expenditures as % in GDP are between minimum 0.11% (2002) corresponding to cluster 4, respectively 0.32% (2011) for cluster 3, and a maximum of 1.50% (in 2002 corresponding to cluster 7), respectively 1.32% (in 2011, in cluster 6), as shown in Figure 11.

The country grouping according to the average values of the environmental protection expenditures as % in GDP highlights for most clusters increases: in C4 by 0.80%, in C6 by 0.63%, in C2 by 0.28%, in C5 by 0.06%, and in C3 by 0.05% . These increases are also reflected in an increase of 0.11% in 2011 compared to 2002, recorded for environmental protection expenditure as % of GDP in all EU countries included in the analysis. For clusters C1 and C7, the decreases are quite insignificant, by only 0.21%, respectively by 0.84%.

Figure 11 – Country grouping according to average values of environmental protection expenditures as % in GDP recorded at cluster level.



Source: authors based on EUROSTAT (2017)

The study of changes in environmental protection expenditures as % in GDP per country, concerns mainly countries that are in the same cluster both in 2011 and in 2002. These countries have paces of change of EPE in different ways. Thus, for Belgium and Finland, environmental protection expenditures as % of GDP saw an increase by 20.69% and 3.51% in GDP, while Luxembourg and Austria faced a significant reduction of the indicator by 28.38% and 45.45% in GDP. France is the country to which corresponds the same percentage of 0.58% of EPE in GDP.

As with the previous indicator, Bulgaria (C2) shows an increase in environmental protection expenditure as % in GDP in 2011 compared to 2002 with 71.43 % in GDP, as does Estonia, whose growth rate is 6.90 % in GDP.

If for the previous indicator Malta (C6) recorded a decrease in 2011 compared to 2002, this time, for environmental protection expenditure as % of GDP, an increase of 39.53% in GDP was determined. The percentage value of 0.88% of the environmental protection expenditure as% of GDP for Italy is the same in 2002 and 2011. For the UK, environmental protection expenditure as % of GDP increases in 2011 compared to 2002 by 93.75 % in GDP.

Spain, Sweden, Slovakia are three countries in C1_2011 for which EPE increased in 2011 compared to 2002 by 4.00 %, by 3.13% and respectively 63.16% in GDP.

The evolution of the indicator environmental protection expenditure as % in GDP, as in the case of the indicator shares of environmental and labour taxes in total tax revenues from taxes and social contributions for other three countries in C1_2011 (Germany, Hungary, Portugal), is still decreasing. Decreases are by 21.43 % in GDP for Germany, 45.07 % in GDP in Hungary, and only 7.69% in GDP in Portugal.

Poland, a C2 component in 2002, recorded, just like the shares of environmental and labour taxes in total tax revenues from taxes and social contributions, a growth rate of the environmental protection expenditure as % in GDP but by 43.24%.

The most significant growth rates of environmental protection expenditure as % in GDP are determined for Romania (375.00% in GDP), part of C3_2002 and C5_2011, then for Latvia (277.78 % in GDP) belonging to C2 cluster, by 166.67 % In GDP for Croatia, part of C4_2002 and C3_2011.

If for shares of environmental and labour taxes in total tax revenues from taxes and social contributions, the highest decrease was recorded for Lithuania, in the case of environmental protection expenditure as % in GDP, for this country was calculated the highest GDP growth (840.00 %).

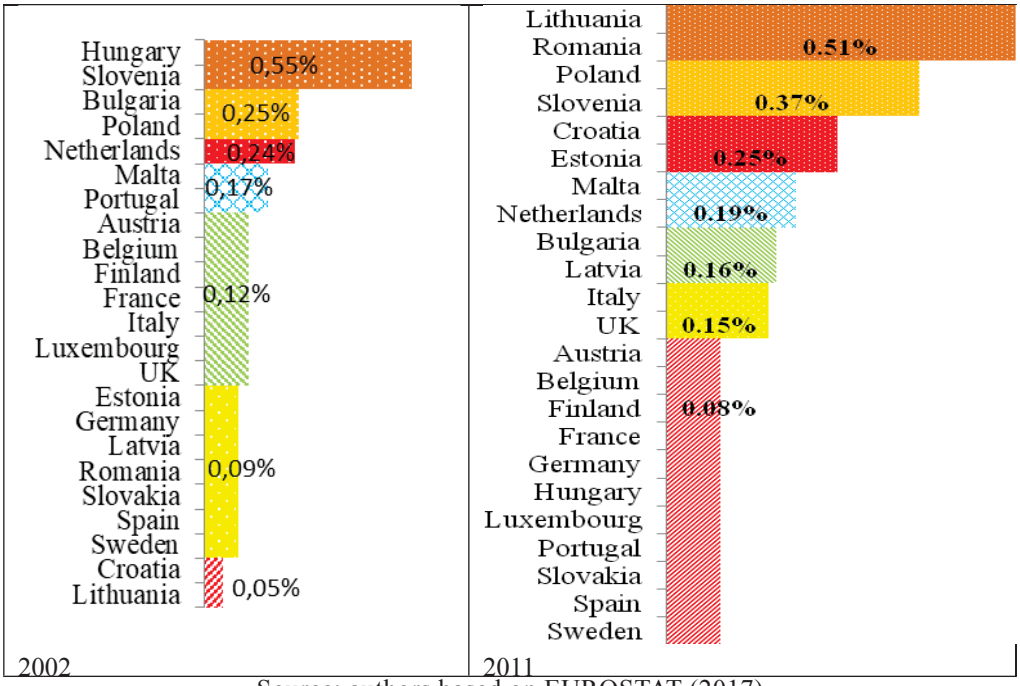
Environmental protection expenditures as % in GDP recorded in 2011, compared to 2002, a decline by 24.53% in GDP for Slovenia, and by 4.00% in GDP for the Netherlands. The analysis of the indicator environmental protection expenditure as % in GDP included the interpretation of the results obtained as a result of the clustering of the countries in 2002 and 2011. The determined average values allowed reflecting the

changes registered by the 23 EU member states in 2011 compared to 2002 by relatively oscillating ratios from country to country, and implicitly from one cluster to another.

In this context, the environmental protection analysis continued with the indicator: total environmental investments as % of GDP (TEI). This is another indicator with a significant impact on environmental protection, recording, as the environmental protection expenditure as % in GDP, low percentage values for all 23 countries included in the analysis.

Compared with the above-mentioned indicator (environmental protection expenditure as % in GDP), the average percentage values determined by clusters are significantly higher (Figure 12). Thus, the calculated percentage averages are situated in 2002 between a minimum for C4 by 0.05% in GDP and a maximum for C5 of 0.55% in GDP. In 2011, the average values of the total environmental investments as % in GDP range from 0.08% in GDP for C1 to 0.51% in 2011 in GDP for C5.

Figure 12 – Country grouping according to average values of the environmental protection expenditure as % in GDP



Source: authors based on EUROSTAT (2017)

Compared to the environmental protection expenditure as % of GDP, the third indicator included in the analysis (total environmental investments as % in GDP) also records an upward trend. The growth trend is lower by 0.02% in 2011 compared to 2002. The same trends were seen in the majority of clusters for total environmental investments as % of GDP decrease as those for environmental protection expenditures as % in GDP. Thus, C3, C7, C4 and C6 recorded increases in 2011 compared to 2002 by 0.16%, 0.13%,

0.10% and 0.03%. The most significant is for the total environmental investments as % in GDP, cluster two (C2) by 0.10% compared to C5 and C1, which had reductions in 2011 compared to 2002 by only 0.05% and 0.04%.

For all five countries of C1_2002 and C1_2011 there is a process of reducing the total environmental investments as % in GDP in 2011 as compared to 2002. The most significant decrease is recorded in Belgium, with 78.95% in GDP, followed by Austria with 33.33 % in GDP, France by 27.27 % in GDP, Finland by 14.29 % in GDP and Luxembourg by 5.00 % in GDP.

Bulgaria, the common component of C2 for 2002 and 2011, recorded the same percentage of 0.19 % in GDP. Estonia, component of C3 in 2002 and 2011, also shows a growth process, as in the case of the other two indicators analyzed, and thus, in 2011, the total environmental investments as % in GDP was increased by 84.62% higher compares with 2002.

The same decreasing oscillation as with the other two variables is also recorded for Malta. A state belonging to C6, both in 2002 and 2011, recorded a decrease of the total environmental investments as % in GDP by 25.00% in GDP.

The trend of keeping constant the percentage of total environmental investments as % in GDP is noticed; just as the environmental protection expenditure as % in GDP for Italy, but the percentage is lower, being placed at 0.18% in GDP.

In the UK, the growth in 2011 compared to 2002 of the percentage of total environmental investments as % in GDP is very high (300%) compared to the one of the previously analyzed indicator (EPE).

For cluster C1_2011, Sweden has an increase in total environmental investments as % in GDP by 100% in GDP in 2011 compared to 2002, while the other five countries are seeing decreases, as follows: Hungary with 75.00% in GDP, Portugal with 64.71 % In GDP, Slovakia with 46.15% in GDP, Germany with 33.33% in GDP, and Spain with 30.77% in GDP.

In C2_2002 Poland is included besides Bulgaria, a country for which the total environmental investments as % increased by 22.58 % in GDP. At the same time, in the same cluster, but for the next year of analysis (C2_2011), Latvia appears together with Bulgaria, Latvia, also with an increase of total environmental investments as % in GDP (as for the other indicators), of only 33.33% in GDP.

As with environmental protection expenditure as % in GDP, Romania, part of C3_2002 and C5_2011, recorded a growth process. However, this upward trend at the level of total environmental investments as % in GDP is excessive, with 1400% in GDP being mentioned (the first in the ranking of the 23 countries included in the analysis). A significant increase for total environmental investments as % in GDP is reported in 2011 as compared to 2002, and for Croatia, with a percentage of 550% in GDP.

Given that even in the case of environmental protection expenditure as % in GDP,

Lithuania is experiencing the highest growth. Even for total environmental investments as% in GDP, it can be mentioned that a similar situation appears for total environmental investments as % in GDP. Significantly higher growth (833.33%) of total environmental investments as % of GDP places this country on the second place as a growth pace among all 23 countries surveyed.

Slovenia, part of C5_2002 and C7_2011, saw a reduction in total environmental investments as % in GDP by 35.19% in GDP, in 2011 compared to 2002.

Component of C7_2002 and C6_2011, the Netherlands recorded an increase just like in the case of the shares of environmental and labour taxes in total tax revenues from taxes and social contributions, with 8.33% in 2011 compared to 2002.

Sweden is the country with the lowest percentages for total environmental investments as % in GDP both in 2002 and 2011. The highest percentage value (0.56%) was registered by Hungary in 2002 and by Lithuania in 2011.

The analysis of the evolution of the indicator total environmental investments as % in GDP by country and cluster was mainly highlighted by the growth or decrease rates calculated for each country. This reflected as well the country-specific changes within the same cluster or from one cluster to another, in 2011 compared to 2002.

In 2002 - 2011, all the value oscillations recorded by the three indicators (the environmental protection expenditure as % in GDP, the shares of environmental and labour taxes in total tax revenues from taxes and social contributions and total environmental investments as % in GDP), have resulted in significantly different changes in each country and, implicitly, from one cluster to another. These are the result of environmental policies that have been outlined and applied since the world economic crisis in 2008, in country, but also through the cohesion manifested within the European Union.

Conclusions

The analysis carried out in this paper aimed at creating an overall picture of the environmental protection efforts following the environmental policies established and adopted after the 2008 economic crisis. This aspect was highlighted as a result of the data collection from 2002 and 2011, for 23 EU countries, in terms of environmental protection expenditure as % of GDP (EPE), shares of environmental and labour taxes in total tax revenues from taxes and social contributions (ELT) and total environmental investments as % in GDP (TEI). The methodology for the use of the cluster method targeted the ranking of countries, aiming to highlight the levels at which they are situated in order to assess the convergence of environmental protection.

Although at the European Union level there is a common framework for environmental policies (Rome 1957, Maastricht 1993, Amsterdam 1999, and Lisbon 2009) and a series of joint Environmental Action Programs, there are significant differences across groups of countries, and there are seven clusters identified for each of the two years analysed.

The economic behaviour patterns of the 23 EU countries are highlighted by the percentage value fluctuations recorded in each indicator introduced in the analysis but also in the clusters formed in both years analysed. The seven formed clusters face more or less significant changes, both in terms of values and structure.

Clusters C1 and C3 recorded the most significant fluctuation in the number of countries included in their composition. If in 2002, C1 is comprised of 7 countries, in 2011 there are 11 countries, of which 5 are found in both years: Belgium, France, Luxembourg, Austria, Finland indicating not only a high degree of homogeneity in terms of environmental policy but also in the implementation of a tax reform in this area, thus being possible benchmarks for the applicability of political regulations in other states, taking into account, naturally, the specific socio-economic context of each country. The countries that left C1 in 2002 are Italy and the UK. They will appear in 2011 in C4. Germany, Spain, Sweden, Slovakia - components of the C3 cluster in 2002 will be found in the first cluster C1 in 2011.

In C1, as a whole, there were reductions in the average percentages by 0.2098 percentage points in environmental protection expenditure as % in GDP, 0.4659 percentage points in shares of environmental and labour taxes in total tax revenues from taxes and social contributions, and 0.0409 percentage points in total environmental investments as% in GDP.

In the case of cluster C3, the situation is reversed in the sense that, although the number of component countries decreased in 2011 (7 countries: Germany, Estonia, Spain, Latvia, Romania, Slovakia, Sweden) compared to 2002 (2 countries: Estonia, Croatia) the environment protection funds increased, percentage average values being higher by 0.0507 percentage points for environmental protection expenditures as % in GDP, 2.3107 percentage points for the shares of environmental and labour taxes in total tax revenues from taxes and social contributions, 0.1586 percentage points for total environmental investments as% in GDP.

The main feature of Clusters 2 and 6 is keeping a component country at the same level: Bulgaria for C2 and Malta for C6. Thus, in 2011, the funds for environmental expenditures in Bulgaria and Latvia compared to 2002 for Bulgaria and Poland experienced oscillations so that the average percentage value for environmental protection expenditure as % in GDP increased by 2.28 percentage points, for shares of environmental and labour taxes in total tax revenues from taxes and social contributions increased by 1.91, and for the total environmental investments as % in GDP it decreased by 0.095 percentage points. A similar situation was also observed for C6 in the sense that for Malta and the Netherlands the components C6_2011 compared to Malta, Portugal in C6_2002, two increases and a decrease in the average value were noticed: by 0.63 percentage points in environmental protection expenditure as % in GDP, by 0.025 percentage points in total environmental investments as % in GDP, and 0.745 percentage points in shares of environmental and labour taxes in total tax revenues from taxes and social contributions.

Clusters 4 and 5 have only two component countries in both years analyzed. However, their composition changed both in 2011 and in 2002. Environmental funds in Italy, UK (C4_2011) compared with those in Croatia, Lithuania (C4_2011) are facing two

increases in the average percentage values: by 0.795 percentage points in environmental protection expenditure as% in GDP, 0.1 percentage points in total environmental investments as % in GDP, and with a decrease of 2,955 points in shares of environmental and labour taxes in total tax revenues from taxes and social contributions.

For cluster 5, with Hungary and Slovenia in 2002, and Lithuania and Romania in 2011, the distribution of the amounts allocated for environmental protection on the three categories analyzed is slightly different from the previous ones: with an increase in the average value of 0.63 percentage points in the environmental protection expenditure as % in GDP and with two decreases – by 1.42 percentage points in the shares of environmental and labour taxes in total tax revenues from taxes and social contributions, and by 0.045 percentage points in total environmental investments as % in GDP.

In C7_2011 (Poland, Slovenia) compared to C7_2011 (Netherlands), the average percentage values for each cluster recorded decreases for environmental protection expenditure as % in GDP and share of environmental and labour taxes in total tax revenues from taxes and social contributions of 0.835 percentage points; and With 0.57 percentage points, respectively growth for total environmental investments as% in GDP by 0.125 percentage points.

At the level of all countries, the highest percentage for environmental protection, compared to the other two indicators, is for shares of environmental and labour taxes in total tax revenues from taxes and social contributions. Estonia is the country with the highest growth (35.58% in 2011 compared to 2002), while Lithuania faces major problems given the decrease by 35.95% in the shares of environmental and labour taxes in total tax revenues from taxes and social contributions. This gap can also be explained by the fact that in most of the countries of the EU-15 sub-group the implementation of environmental policies has been achieved much earlier, and in some Central and Eastern European countries the harmonization of domestic policies with the EU strategy has been superficial.

Limitations and Future Research Directions

The non-inclusion in the study of the other 5 countries of the European Union (Cyprus, Denmark, Greece, Ireland, and Switzerland) was due to the lack of data regarding the variables studied at their level, and this omission is a limitation for this research. Future research will look at the analysis of constraints environmental policy faces in emerging economies in Central and Eastern Europe.

Conflict of interests

The authors declare no conflict of interest.

References

1. Andrei, J., Mieila, M., Popescu, G., Nica, E., & Cristina, M. (2016). The impact and determinants of environmental taxation on economic growth communities in Romania. Energies, 9(11), 902.
2. Choi, S., & Ng, A. (2011). Environmental and economic dimensions of sustainability and price effects on consumer responses. Journal of business ethics, 104(2), 269-282.

3. Clark, J. (2017). Environmental Protection in Transition: Economic, Legal and Socio-Political Perspectives on Poland. Taylor & Francis.
4. Costanza, R., Hart, M., Talberth, J., & Posner, S. (2009). Beyond GDP: The need for new measures of progress. The pardee papers.
5. EUROSTAT (2017), available at: http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=ten00049
6. Gelder A., (2014). From Custer to Thermopylae: Last stand behavior in multi-stage contests. Games and Economic Behavior, 87(C), pp. 442-466.
7. Goodland, R. (1995). The concept of environmental sustainability. Annual review of ecology and systematics, 26(1), 1-24.
8. Hardisty, P.(2010). Environmental and economic sustainability. CRC Press, 2010.
9. Huang, B. N., Hwang, M. J., & Yang, C. W. (2008). Causal relationship between energy consumption and GDP growth revisited: a dynamic panel data approach. Ecological economics, 67(1), 41-54.
10. Jugănaru, I.D. Jugănaru, M.(2011). Clusters in Romanian Tourism. Ovidius University Annals, Economic Sciences Series, XI(1):1107-1111
11. Labuschagne, C., Brent, A. C., & Van Erck, R. P. (2005). Assessing the sustainability performances of industries. Journal of cleaner production, 13(4), 373-385.
12. Panayotou, T. (2016). Economic growth and the environment. The environment in anthropology, 140-148.).
13. Peeples, M. A. (2011) R Script for K-Means Cluster Analysis. [online]. Available: http://www.mattpeeples.net/kmeans.html. (July 13, 2016).
14. Rotariu, T., Bădescu, G., Culic, I., Mezei, E., & Murean, C. (2006). Metode statistice aplicate în tiinele sociale Iai: Editura Polirom
15. Rotaru T. (ed.), Badescu G., Culic I., Mezei E. & Murean C. (2006) Metode statistice aplicate în tiinele sociale, Ed. Polirom, Iai, pp. 272-303.
16. Sachs, W. (2015). Planet dialectics: Explorations in environment and development. Zed Books Ltd.
17. Spangenberg, J. H. (2005). Economic sustainability of the economy: concepts and indicators. International journal of sustainable development, 8(1-2), 47-64.
18. Zaharia, M., & Gogonea, R. M. (2016). A Cluster Analysis of Industrial Production Indices in Some European Countries and Turkey. Economic Insights-Trends & Challenges, 68(2).
19. Zaharia, M., Pătracu, A., Gogonea, M., Tănăsescu, A., & Popescu, C. (2017). A cluster design on the influence of energy taxation in shaping the new EU-28 economic paradigm. Energies, 10(2), 257.
20. Zilio, M., & Recalde, M. (2011). GDP and environment pressure: the role of energy in Latin America and the Caribbean. Energy Policy, 39(12), 7941-7949.

MODELING OF CRITICAL PROFITABILITY FACTORS: EMPIRICAL RESEARCH FROM FOOD INDUSTRY IN SERBIA

Jelena Tadić[1], Jelena Jevtić[2], Nikola Jančev [3]

**Corresponding author E-mail: jevticj.vts@gmail.com*

ARTICLE INFO

Original Article

Received: *20 May 2019*

Accepted: *04 June 2019*

doi:10.5937/ekoPolj1902411T

UDC 658.155[168.52:663/.664(497.11)

Keywords:

Profitability, critical success factors, food industry

***JEL**: D22, L25, L66*

ABSTRACT

The paper is motivated by practical and always current problem of increasing profitability as one of the organizational performances. Critical success factors (CSFs) answer the question about what drives growth, profitability, and success in company. The research presented in this paper was conducted on a sample of two hundred companies in the food industry of the Republic of Serbia. The aim of the research is whether and to what extent there is a link between the assumed critical success factors and profitability, as well as determining the contribution of critical factors to predicting profitability. Based on techniques of correlation and multiple regression analysis, it was found that the efficiency, innovation, quality and flexibility, as critical factors explain a statistically significant part of the variance in profitability reflected by indicators ROA, ROE and EBITDA margin.

Introduction

The importance of the food industry, as a sub-sector of the processing industry, is remarkable for the domestic economy. As one of the most important sectors of the economy, in 2017, the processing industry accounted for 15.1 percent of the gross domestic product of the Republic of Serbia, while the real growth rate of the manufacturing industry amounted to 4.8 percent (Statistical Office of the Republic of Serbia, 2018, p. 141). The food industry provides employment for 84.589 people and participates in total employment with 4.3 percent in 2017 (Statistical Office of the Republic of Serbia, 2018, p. 74). In 2017, the production of food products accounted for 10.3 percent of total exports of the Republic of Serbia (Statistical Office of the

1 Jelena Tadić, PhD, Tadex Advisory, Simeona Pišćevića 11/1, +38162540487, ajelena83@gmail.com https://orcid.org/0000-0003-1369-6329

2 Jelena Jevtić, MSc, Higher Medical and Business-Technological School of Applied Studies in Šabac, Hajduk Veljkova 10, Šabac, Serbia, +381649858608, jevticj.vts@gmail.com, https://orcid.org/0000-0003-3537-657X

3 Nikola Jančev, PhD, Higher Medical and Business-Technological School of Applied Studies in Šabac, Hajduk Veljkova 10, Šabac, Serbia, +381653324282, jancevn@gmail.com, https://orcid.org/0000-0003-1280-9184

Republic of Serbia, 2018, p. 309). In this way, the food industry is the lifeline of the national economy and the basis for conducting research.

Taking into account that one of the main objectives of every company is profitability (Pervan, M., Mlikota, M., 2013; Vuković, B., Jakšić, D., 2019), it is obvious why critical success factors (CSFs) model as determinant of companies' profitability have attracted the interest of academic research . There are many things going on daily that sometimes managers lose their sight on important things and on factors that can have influence on the bottom line. That is why critical success factors model comes into play in the strategic analysis of the organization (Alias, Z. et al., 2014; Kotula, M. et al., 2015). Critical success factors answer the question about what drives growth, profitability, and success in company. It is important for managers to understand the dynamics of the factors that drive profitability, and growth to take advantage of them to improve their competitive position. Critical success factors as any other strategic model is iterative and dynamic, managers who can use strategic models dynamically, creatively, and competitively will achieve superior performance.

The aim of the research is to investigate whether there is a link between the assumed critical factors and profitability, as well as determining the contribution of critical factors to predicting profitability expressed by return on assets (ROA), return on equity (ROE) and earnings before interest, taxes, depreciation and amortization (EBITDA) divided by total revenue (EBITDA margin).

Literature review

Profitability is the primary goal of all business ventures. Profitability indicates the earning power and business success of a company (Kimmel, P. et al., 2012). A business that is not profitable cannot survive. Conversely, highly profitable business has the ability to reward its owners with a large return on their investment. Measuring profitability is the most important measure of the success of the business. Many researches have shown that there are different methods that can be used to measure profitability. The two most common measurements for profitability appears to be return on assets – ROA (Barton, S.L., Gordon, P.J., 1988; Simerly, R.L., Li, M., 2000; Gill, A. et al., 2009; Shah, 2012; Ahmed Sheikh, N., & Wang, Z., 2013; Le, T.P.V. & Phan, T.B.N., 2017; Nunes, P.J.M. et al., 2009) and return on equity – ROE (Chaklader, B. & Chavla, D., 2016; Le, T.P.V. & Phan, T.B.N., 2017; Gill, A. et al., 2009; Abor, 2005). Return on assets (ROA) is an indicator of how profitable a company is relative to its total assets. ROA gives a manager, investor, or analyst an idea as to how efficient a company's management is at using its assets to generate earnings. According to Bettis (1981, p. 384), ROA is widely used by managers and other stakeholders, and is in many cases highly correlated with other measurements such as ROE. Le and Phan (2017, p. 714) measured profitability, defined as performance, as ROE in their study on capital structure and its effect on firm performance. Return on equity (ROE) is a measure of financial performance calculated by dividing net income by shareholders' equity. Because shareholders' equity is equal to a company's assets minus its debt, ROE

could be thought of as the return on net assets. Another important ratio of measuring profitability of the firms is EBITDA margin. EBITDA margin is an assessment of a firm's operating profitability as a percentage of its total revenue. Because EBITDA excludes interest, depreciation, amortization and taxes, EBITDA margin can provide an investor, business owner or financial professional with a clear view of a company's operating profitability and cash flow.

Our study is also well positioned within the theory of critical success factors. The theory of critical success factors is defined as "the limited number of areas in which results if they are satisfactory will ensure successful competitive performance for the organization" (Dinter, 2013). The concept of CSFs has been studied since the late 1970s (Lee, S., Ahn, H., 2008) and was first formally defined as the areas that a business should concentrate on to ensure competitiveness (Rockart, 1979). These may vary between industry sectors and even businesses (Hofer, C. W, & Schendel, D., 1978; Trkman, 2010), implying that the use of specific CSFs to evaluate business success resided with managers of firms (Rockart, 1979). The definition of CSFs was later refined and broadened as, "those characteristics, conditions, or variables that when properly sustained, maintained, or managed can have a significant impact on the success of a firm competing in a particular industry" (Leidecker, J.K., Bruno, A.V., 1984, p. 24). Another definition of CSFs was given by Boynton and Zmud (1984) as "those few things that must go well to ensure success". However, the concept of "success" is elusive and, oftentimes, poorly defined (Trkman, 2010). Moreover, success is highly context-dependent, stemming from a unique combination of advantages. At the most fundamental level, success in business is equated with financial criteria like profitability and number of employees.

Critical success factors may change over time, consistent with the changes in the company and the environment. Relevant literature identifies a wide range of key success factors: product quality, costs, customer satisfaction, manufacturing flexibility, innovation, employee satisfaction and brand awareness (Eaton, 2005, p. 47). In order to better understand the factors that affect the performance of enterprise, the following components (Tadić, J., Boljević, A., 2015, str. 28-29; Hayes, R. & Wheelwright, S., 1984; Foo, G., Friedman, D.J., 1992), will be analyzed:

- Quality. In addition to lower prices, customers demand higher quality products. On that basis, it can be said that quality is a critical element of revenue generation. Quality attributes include customer satisfaction (measured through the number of repeated purchases), the number of defective products per 1,000 units of product, consistency, and achievement of industrial standards. However, the concept of quality is much broader than the issues of products and services quality. It relates to the quality of all processes in the company, including the quality of key human resources – top management. Improvements in this area should contribute to a more efficient use of production resources, reducing the time required for production, reduce scrap, which will certainly have repercussions on the overall operating costs, cost of products, profitability and competitiveness of enterprise. It is the TQM concept, which is based on efforts to continuously improve quality and to deliver customers products and services of high quality on a consistent basis.

- Flexibility. As a critical success factor, represents an internal power of company, which is reflected both in effective time management of the production process, as well as timely and accurate shipment. The importance of time is reflected in the speed of launch, timely deliveries to customers, as well as the ability of company to adapt to the changing environment in the short term. Time as a key factor for success is closely linked to the issue of quality of all business processes in the enterprise.
- Employees. An organization's success and profitability depends upon the performance of its employees. Business leaders know that a high-performing workforce is essential for the achievement of strategic business goals. The concept of employee engagement in the organizations is gaining importance. Employee engagement can be a deciding factor for an organization's success in today's competitive world. High levels of employee engagement promote retention of talent, foster a sense of belongingness, improve organizational performance and increase the stakeholder value. Engaged employees are attached to the organization, enthusiastic about their work and take efforts beyond the employment contract. Thus, engaged employees can be seen as powerful source of competitive advantage.
- Efficiency. As an essential component of business performance of each company, efficiency consists of two components: the costs and revenue. As determinants of cost, there are expenditures size, purchase price and the percentage of waste. Volume of production and sales price represents proposed indicators of revenue.
- Innovation. As an important component of the strategy of differentiation, the goal of innovation is to increase the number of new products, reduce development time of new products and the identification of new markets and customers. Hence, research and development (R&D) represent one of the most important elements in the value chain. Indicators of this success factor are the time of launching a new product, the length of the development phase, the quick-change ability of product mix of the company. The most commonly used indicators of innovation are share of revenues from sales of new products in the total income, received awards etc.

Methodology

The aim of this study was to examine the relationship and influence of different critical success factors on profitability. For this purpose, we undertook an empirical study that included a sample of 200 companies in the food industry of the Republic of Serbia. The questionnaire survey was conducted in the period from October to December 2017. Within the group of critical factors, five independent variables are analyzed: quality, flexibility, employees, efficiency and innovation. Respondents rated the significance of critical factors on a scale of 1 to 100, and the results were later divided with 100, for easier interpretation. Descriptive statistics of success factors is presented in *Table 1.*

Table 1. Descriptive Statistics of success factors (drivers)

	N	Min	Max	Mean	Std. Deviation	Variance
Quality	200	,12	,97	,538	,212	,045
Flexibility	200	,14	,95	,485	,204	,042
Employees	200	,11	,95	,476	,210	,044
Efficiency	200	,18	1,00	,592	,214	,046
Innovation	200	,12	,96	,482	,225	,051

Source: Author's calculation

The highest mean value has efficiency (0,592), with minimum and maximum values ranging from 0,18 to 1,00. The smallest mean value has employees (0,476), with minimum and maximum values ranging from 0,11 to 0,95. This also mean that companies give the highest importance to efficiency and the smallest importance to employees as success factors. In order to determine the existence of linear dependence between the observed variables, the matrix of the scatter diagram was used. An equal distribution of points was determined. Thus, it can be concluded that linear dependence between critical factors does not exist. This, at the same time, means that critical factors can be used as regressors in the linear regression model.

One of the tasks in this study was related to the selection of indicators of profitability, with selected ROA (Return on Assets), ROE (Return on Equity) and EBITDA margin (Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA) divided by total revenue). The most important reason for choosing these indicators of profitability is that they are the ones most often used in foreign, but also in domestic business practice. Secondly, it is about yield indicators, and, as is known, investors are most interested in the yield on their investments. Within the group - profitability indicators, continuous dependent variables are displayed. Descriptive statistics of profitability indicators is presented in *Table 2*.

Table 2. Descriptive Statistics of profitability indicators

	N	Min	Max	Mean	Std. Deviation	Variance
ROA	200	-,342	,474	,052	,140	,020
ROE	200	-,321	,531	,084	,142	,020
EBITDA margin	200	-,290	,593	,124	,145	,021

Source: Author's calculation

ROA has a mean of 0,052, with minimum and maximum values ranging from -0,342 to 0,474. ROE has a mean of 0,084, with minimum and maximum values ranging from -0,21 to 0,531, while EBITDA margin has a mean of 0,124, with minimum and maximum values ranging from -0,290 to 0,593. Testing normality of distribution has been based on Kolmogorov-Smirnov and Shapiro-Wilkov test. The normality is shown to be statistically insignificant (accidental) deviation from the normality if the Sig. > 0.05 (Coakes, 2013,

p. 46). In all three cases, the significance is greater than 0.05, which shows that the assumption of the normal distribution is confirmed and can be accepted.

Starting from the basic subject and issues as well as the research goals of this paper, and taking into account recent scientific research on this topic, hypotheses that will be subject to testing are:

H_1: There is significant correlation between assumed drivers – critical factors and profitability.

H_2: Assumed drivers – critical factors have a significant contribution to the prediction of profitability.

In accordance with the defined hypotheses, Pearson correlation coefficient (r) and standard multiple regression analysis will be used. Statistical package SPSS IBM Statistics Version 21 will be used for the execution of selected statistical test.

Results and discussion

The relationship between critical factors and profitability, measured by indicators: ROA, ROE and EBITDA margin was investigated using the Pearson linear correlation coefficient (r) (*Table 3*.). Between the quality (as a critical factor) and profitability, measured using the ROA, ROE and EBITDA margin, a relatively poor positive correlation (Cohen, 1988, pp. 79-81) was calculated (r = 0.215, r = 0.228, r = 0.235) n = 200, p <0.01. It could be concluded that a low level of food quality and consumer satisfaction as a components of the success factor is followed by a low level of ROA, ROE and EBITDA margin. The quality explains 4.6% variance of ROA, 5.1% variance of ROE and 5.5% variance of EBITDA margin. Between flexibility and profitability, a relatively poor positive correlation was calculated (r=0,145, r=0,139, r=0,128) n=200, p<0,05, suggesting that untimely delivery and time extension of the production process as a components of the success factors is followed by a low level of ROA, ROE and EBITDA margin. The flexibility explains 2.1% variance of ROA, 1.9% variance of ROE and 1.6% variance of EBITDA margin. Between employees and profitability, insignificant positive correlation was calculated (r=0,027, r=0,030, r=0,025) n=200, p>0,05 (result is not statistical significant), suggesting that low level of employees satisfaction and training and development as a components of the success factors is followed by a low level of ROA, ROE and EBITDA margin. The employees explain 0.1% variance of ROA, 0.1% variance of ROE and 0.1% variance of EBITDA margin. Based on the study of the relationship between efficiency and profitability, the medium positive correlation was calculated (r=0,498, r=0,490, r=476) n=200, p<0,01, suggesting that partially low levels of costs and partly high levels of income as a components of the success factor, follow a partially high ROA, ROE and EBITDA margin. The efficiency explains 24.8% variance of ROA, 24.0% variance of ROE and 22.7% variance of EBITDA margin. Based on the study of the relationship between innovation and profitability, the medium positive correlation was calculated (r=0,349, r=0,337, r=0,322) n=200, p<0,01, suggesting that partial investment in the research

and development of new products and new technology as a components of the success factor, follow a partially high ROA, ROE and EBITDA margin. The innovation explains 12.2% variance of ROA, 11.4% variance of ROE and 10.4% variance of EBITDA margin.

Table 3. Correlation of critical factors with profitability indicators

		ROA	ROE	EBITDA margin
Quality	Pearson Correlation	,215**	,228**	,235**
	Sig. (2-tailed)	,002	,001	,001
Flexibility	Pearson Correlation	,145*	,139	,128*
	Sig. (2-tailed)	,040	,050	,072
Employees	Pearson Correlation	,027	,030	,025
	Sig. (2-tailed)	,708	,668	,723
Efficiency	Pearson Correlation	,498**	,490**	,476**
	Sig. (2-tailed)	,000	,000	,000
Innovation	Pearson Correlation	,349**	,337**	,322**
	Sig. (2-tailed)	,000	,000	,000
**. Correlation is significant at the 0.01 level (2-tailed).				
*. Correlation is significant at the 0.05 level (2-tailed).				

Source: Author's calculation

Excluding employees, as a critical factor, which is only slightly correlated with indicators of profitability, it can be concluded that is a Pearson correlation coefficient revealed a significant correlation with other critical factors and indicators of profitability. Therefore, between critical factors (except for employees) and profitability, a weak to medium strong positive correlation is calculated, and it can be concluded that the assumed hypothesis H_1 is accepted, i.e.: *There is significant correlation between assumed drivers – critical factors and profitability.*

As defined in the research plan, second hypothesis testing is enabled by applying multiple regression analysis. Multiple regression analysis is conducted by taking 5 individual variables (quality, flexibility, employees, efficiency, innovation) as predictor variables, and indicators of profitability (ROA, ROE, EBITDA margin) as dependent variables. Predictor variables construct the model of regression and explain 43.1% variance of ROA, 42.0% variance of ROE and 39.5% variance of EBITDA margin, as the R^2 value shows 0.431, 0.420, 0.395 (*Table 4.*). The robustness of the model (Coakes, 2013, p. 163) is provided by the ANOVA table (*Table 5.*) with F value 31,198 and low p value 0,000 for ROA, F value 29,793 and low p valued for ROE, F value 27,023 and low p value 0,000 for EBITDA margin. The variance inflation factor (VIF) of five variables for each profitability indicator is less than the traditional thumb rule value of 10 (Cohen, J., Cohen, P., West, S.G., Aiken, L.S., 2003, p. 425; Cohen, 1988).

Table 4. Model Summary[b]

	R	R Square	Adjusted R Square	Std. Error of the Estimate
ROA	,668[a]	,446	,431	,106
ROE	,659[a]	,434	,420	,108
EBITDA margin	,641[a]	,411	,395	,113
a. Predictors: innovation, employees, quality, efficiency, flexibility				
b. Dependent variables: ROA, ROE i EBITDA margin				

Source: Author's calculation

Table 5. ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
ROA	Regression	1,739	5	,348	31,198	,000[b]
	Residual	2,163	194	,011		
	Total	3,902	199			
ROE	Regression	1,747	5	,349	29,793	,000[b]
	Residual	2,275	194	,012		
	Total	4,002	199			
EBITDA margin	Regression	1,739	5	,348	27,023	,000[b]
	Residual	2,496	194	,013		
	Total	4,235	199			
a. Dependent variable: ROA, ROE, EBITDA margin						
b. Predictors: innovation, employees, quality, efficiency, flexibility						

Source: Author's calculation

Table 6. Coefficients of profitability indicators (ROA, ROE, EBITDA margin)

Model		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
ROA	(Constant)		-9,364	,000	-,490	-,320					
	Quality	,251	4,682	,000	,096	,235	,215	,319	,250	,994	1,006
	Flexibility	,207	3,842	,000	,069	,215	,145	,266	,205	,981	1,019
	Employee	,030	,552	,581	-,051	,090	,027	,040	,030	,988	1,013
	Efficiency	,485	9,032	,000	,247	,385	,498	,544	,483	,992	1,008
	Innovation	,342	6,351	,000	,147	,279	,349	,415	,339	,983	1,018
ROE	(Constant)		-8,502	,000	-,465	-,290					
	Quality	,263	4,856	,000	,105	,248	,228	,329	,262	,994	1,006
	Flexibility	,200	3,678	,000	,065	,214	,139	,255	,199	,981	1,019
	Employee	,034	,624	,533	-,049	,095	,030	,045	,034	,988	1,013
	Efficiency	,478	8,814	,000	,245	,387	,490	,535	,476	,992	1,008
	Innovation	,331	6,068	,000	,141	,276	,337	,399	,328	,983	1,018
EBITDA margin	(Constant)		-7,200	,000	-,426	-,243					
	Quality	,269	4,857	,000	,110	,259	,235	,329	,268	,994	1,006
	Flexibility	,187	3,366	,001	,055	,212	,128	,235	,186	,981	1,019
	Employee	,028	,512	,610	-,056	,095	,025	,037	,028	,988	1,013
	Efficiency	,464	8,382	,000	,241	,389	,476	,516	,462	,992	1,008
	Innovation	,317	5,697	,000	,134	,276	,322	,379	,314	,983	1,018

Source: Author's calculation

To compare the contribution of all independent variables, coefficients Beta will be used. In this case, the highest coefficient of beta has the efficiency (0.485, 0.478, 0.464), which means that the efficiency individually contributes most to the explanation of the dependent variable ROA, ROE and EBITDA margin, after deducing the variance explained by the other variable in the model. The company, which for 10 points increase the importance of the efficiency, on average, will increase ROA by 4.85%, ROE by 4.78% and EBITDA margin by 4.64%.

After efficiency, the following beta coefficients are for innovation (0.342; 0.331; 0.317), quality (0.251; 0.263; 0.269), flexibility (0.207; 0.200; 0.178) and employees (0.030; 0.034; 0.028). Since the significance of the first four factors is less than 0.05, it can be concluded that efficiency, innovation, quality and flexibility give a significant unique contribution to the prediction of the dependent variable ROA, ROE and EBITDA margin. The variable employees do not give a significant unique contribution to the prediction of the dependent variable ROA, ROE, EBITDA margin. Contrary to expectation, employees, as critical success factor were not found to have any significant effect on non-financial performance and financial performance in research of Lo and group of associates (2016, p. 383).

With multiple regression analyses were explored how well five different critical factors (quality, flexibility, employees, efficiency, innovation) predict the profitability, measured by ROA, ROE and EBITDA margin. Preliminary examination verified the assumptions of normality, linearity, atypical points, homogeneity of variance, independence of residuals, multicollinearity and singularity (Green, M., Salking, N., 2014, p. 238). Violation of assumptions are not been noted. On the basis of determining the strength of the impact of the assumed critical factors (quality, flexibility, employees, efficiency, innovation) on profitability, it can be concluded that efficiency, innovation, quality and flexibility have a significant impact on predicting profitability indicators: ROA $F(5, 194) = 31{,}198$, $p < 0{,}05$; ROE $F(5, 194) = 29{,}793$, $p < 0{,}05$; EBITDA margin $F(5, 194) = 29{,}793$, $p < 0{,}05$. Employees as a critical factor, on the other hand, are not a significant predictor of profitability indicators: ROA, ROE, EBITDA margin. Given that four of the five variables make a significant contribution to the prediction of dependent variables, i.e. profitability indicators, it can be concluded that the assumed hypothesis H_2 is accepted: *Assumed drivers – critical factors have a significant contribution to the prediction of profitability.*

Conclusions

This paper considers the relationship and contribution of critical success factors as the drivers for achieving profitability as one of the organizational performance in food industry of Serbia. This study can help managers in food industry to identify critical success factors, with which they can add most value to their business. In any organization, the most difficult and complex tasks are to facilitate decision-making at various levels and smooth functioning of management processes in order to achieve desired goals. The application of CSF theory helps in reducing this complexity. It

enables the organization to focus on the most important CSFs that lead to the successful achievement of their desired goals (Bai, C., Sarkis, J., 2013). The theory of CSF also acts as a tool for measuring the performance of an organization towards attaining their goals (Shankar, R., Gupta, R., Pathak, D.K., 2018, p. 207).

Contribution of the paper lies in the analysis of the issues that are crucial to the success of companies, and in establishing a set of critical success factors that determinable affect to the achievement of company performance. By comparing several critical success factors in a model, this study revealed the most significant critical success factors that can contribute to better organizational performance. Hence, this study has successfully developed some guidelines for scholars who are interested in this field to further test the relationships among these constructs and contribution of critical success factors to profitability.

The findings of this study suggest that, for the context of food industry in Serbia, efficiency, innovation, quality and flexibility as CSFs are positively related to profitability indicators: ROA, ROE, EBITDA margin. However, the results do not support any relationship between employees and profitability indicators. Efficiency and innovation are the most important factors for companies to improve their profitability, and therefore companies should prioritize their investments in these success factors.

Conflict of interests

The authors declare no conflict of interest.

Reference

1. Abor, J. (2005). The effect of capital structure on profitability: an empirical analysis of listed firms in Ghana. *The Journal of Risk Finance , 6*(5), 438-445.
2. Ahmed Sheikh, N., & Wang, Z. (2013). The impact of capital structure on performance. *International Journal of Commerce and Management, 23*(4), 354-368.
3. Alias, Z., Zawawi, E.M.A., Yusof, K., Aris, N.M. (2014). Determining Critical Success Factors of Project Management. *Procedia - Social and Behavioral Science, 153*(16), 61-69.
4. Bai, C., Sarkis, J. (2013). A grey-based DEMATEL model for evaluating business process management critical success factors. *International Journal of Production Economics, 146*, 281-292.
5. Barton, S.L., Gordon, P.J. (1988). Corporate Strategy and Capital Structure. *Strategic Management Journal, 9*(6), 623-632.
6. Bettis, R. (1981). Performance Differences in Related and Unrelated Diversified Firms. *Strategic Management Journal, 2*(4), 379-393.
7. Boynton, A.C., Zmud, R.W. (1984). An assessment of critical success factors. *Sloan Management Review, 25*(3), 17-27.

8. Chaklader, B. & Chavla, D. (2016). A Study of Determinants of Capital Structure through Panel Data Analysis of Firms Listed in NSE CNX 500. *Vision:The Journal of Business Perspective, 20*(4), 267-277.
9. Coakes, S. (2013). *SPSS 20.0 for Windows: Analysis without anguish.* New Jersey: Wiley Publishin, Inc.
10. Cohen, J. (1988). *Statistical power analysis for the behavioral science.* Hillsdale, New York: Lawrence Erlbaum Associates.
11. Cohen, J., Cohen, P., West, S.G., Aiken, L.S. (2003). *Applied Multiple Regression/ Correlation Analysis for the Behavioral Sciences* (3 ed.). New Jersey: Lawrence Erlbaum Associates.
12. Dinter, B. (2013). Success factors for information logistics strategy—an empirical investigation. *Decision Support Systems, 54*(3), 1207-1218.
13. Foo, G., Friedman, D.J. (1992). Variability and Capability: The Foundation of Competitive Operations Performance. *AT&T; Technical Journal, July/August*, 2-9.
14. Gill, A., Biger, N., Pai, C., Bhutani, S. (2009). The Determinants of Capital Structure in the Service Industry: Evidence from United States. *The Open Business Journal, 2*(1), 48-53.
15. Green, M., Salking, N. (2014). *Using SPSS for Windows and Macintosh: Analyzing and Understanding Data.* New York: Pearson Education, Inc.
16. Hayes, R. & Wheelwright, S. (1984). *Restoring Our Competitive Edge: Competing Through Manufacturing.* New York: John Wiley.
17. Hofer, C. W, & Schendel, D. (1978). *Strategy formulation: analytical concepts.* Saint Paul: West Publishing co.
18. Kimmel, P., Weygandt, J., Kieso, D. (2012). *Financial Accounting.* New Jersey: John Wiley.
19. Kotula, M., Ho, W., Kumar Dey, P., Lee, C.K.M. (2015). Strategic sourcing supplier selection misalignment with critical success factors: Findings from multiple case studies in Germany and the United Kingdom. *International Journal of Production Economics, 166*, 238-247.
20. Le, T.P.V. & Phan, T.B.N. (2017). Capital structure and firm performance: Empirical evidence from a small transition country`. *Research in International Business and Finance, 42*, 710-726.
21. Lee, S., Ahn, H. (2008). Assessment of process improvement from organizational change. *International Journal of Information Management, 45*(5), 270-280.
22. Leidecker, J.K., Bruno, A.V. (1984). Identifying and using critical success factors. *Long Range Planning, 17*(1), 23-32.
23. Lo, C.M., Wang, C.W., Wah, C.R.J., Ramayah, T. (2016). The critical success factors for organizational performance of SMEs in Malaysia: a partial least squares approach. *Review of Business Management, 18*(61), 370-391.
24. Nunes, P. J. M., Serrasqueiro, Z. M. & Sequeira, T. N. (2009). Profitability in Portuguese service industries: a panel data approach. *The Service Industries Journal, 29*(5), 693-707.

25. Pervan, M., Mlikota, M. (2013). What determines the profitability of companies: case of croatian food and beverage industry. *EKONOMSKA ISTRAŽIVANjA-ECONOMIC RESERACH, 26*(1), 277-286.

26. Rockart, J. (1979). Chief executives define their own data needs. *Harvard Business Review, 57*(2), 81-93.

27. Shah, S. (2012). Determinants of capital structure of leasing companies in Pakistan. *Applied Financial Economics, 22*(22), 1841-1853.

28. Shankar, R., Gupta, R., Pathak, D.K. (2018). Modeling critical success factors of traceability for food logistics system. *Transportation Research Part E, 119*, 205-222.

29. Simerly, R.L., Li, M. (2000). Environmental Dynamism, Capital Structure and Performance: A Theoretical Integration and an Empirical Test. *Strategic Management Journal, 21*(1), 31-49.

30. Statistical Office of the Republic of Serbia. (2018). *Statistical Yearbook.* Belgrade: Statistical Office of the Republic of Serbia.

31. Tadić, J., Boljević, A. (2015). Integration of Critical Success Factors in Order to Improve Performance of the Company. *Strategic Management, 20*(1), 26-33.

32. Trkman, P. (2010). The critical success factors of business process management. *International Journal of Information Management, 30*(2), 125-134.

33. Vuković, B., Jakšić, D. (2019). The effect of working capital management on profitability: evidence from southeast europe. *Economics of Agriculture -, 66*(1), 159-172.

EFFICIENCY ANALYSIS OF TRADITIONAL TEA FARMS IN IRAN

Z. Ghaderi [1], *M. H. Menhaj* [2], *M. Kavoosi-Kalashami* [3], *S. M. Sanjari*[4]

**Corresponding author E-mail: mmenhaj@guilan.ac.ir*

A R T I C L E I N F O

Original Article

Received: *25 May 2019*

Accepted: *08 June 2019*

doi:10.5937/ekoPolj1902423G

UDC 519.86:[631.1.017.3+663.9(55)

Keywords:

Production efficiency, data envelopment analysis, tea production, Guilan Province

***JEL**: Q12, C61, D22*

A B S T R A C T

This study aimed at analyzing technical, allocative and economic efficiency of tea farms in Fouman County of Guilan Province, Northern Iran. Data were collected through questionnaire and face-to-face interviews with 200 tea farmers in 2017. The data then were analyzed using descriptive statistics, data envelopment analysis (DEA), as well as correlation analysis. The average technical, allocative and economic efficiency, assuming constant return to scale in input-oriented model, were found to be 86, 71 and 61 percent respectively. These figures for variable return to scale were 87, 74 and 65 percent respectively. These results indicate that over 60 percent of the surveyed farms enjoyed scale efficiency. Of those socio characteristics affecting tea farmer's efficiency: age, educational level and family size had positive and significant correlation with technical efficiency. The findings suggest that, the elderly and better educated farmers combined their previous knowledge of farming adopting proper farming practices may achieve production efficiency.

Introduction

Tea (Camellia Sanseis) is one of the most important agricultural crops and the second most popular beverage after water across the world. Black tea was introduced into Europe in the early 16th century and gradually was popularized among all classes of people in the second half of the 19th century as a public soft drink (Moezi, 2009). In Iran, interests to grow tea were triggered because of the economic significance of

1 Z. Ghaderi, MSc of Rural Development, Department of Agriculutral Economics, University of Guilan, Iran, Phone: +989187890922, email: Zghaderi@gmail.com

2 M. H. Menhaj, Ph.D., Assistant Professor, Department of Agricultural Economics, University of Guilan, Iran, Phone: +989111377057, email: mmenhaj@guilan.ac.ir ORCID ID (https://orcid.org/ 0000-0001-8065-1361)

3 M. Kavoosi-Kalashami, Ph.D., Assistant Professor, Department of Agricultural Economics, University of Guilan, Iran, Phone: +989113317045, email: mkavoosi@guilan.ac.ir

4 S. M. Sanjari, MSc of Rural Development, Expert in charge, Iran Tea Organization, Lahijan, Iran, Phone: +989112446625, email: msanjari@gmail.com

this product in trade and its considerable share in imports. After several disperse and unsuccessful attempts, the first tea farm Iran was eventually founded in Lahijan County in 1900 (Iran Tea Company Publication, 1958). Since only central North of Iran has the suitable natural conditions and temperate climate, tea farming was developed extensively in these regions so that its acreage was increased from 1,000 hectare in 1933 to 30,000 hectares in 1973 (Iran Tea Company Publication, 1972). According to the World Food Organization (2017), Iran is the ninth largest tea producer in the world.

Since the late 1990 when the governmental monopoly started to abolish and tea production and marketing were assigned to the private sector, some tea farms have been withdrawn from the production cycle (Ghasemi, 2008). According to the agricultural census of the Statistical Center of Iran, the acreage of tea farms was 1,862 ha with 37,000 tea farmers in 2016 (Iran Statistical Center: Survey of Agriculture, 2016). According to data on green leaf delivered by tea farmers to the Tea Organization of Iran in 2017 (Iran Tea Organization, 2017) the acreage was 186.5 ha and the number of farmers was around 42,000. About 90 percent of tea farms are located in Guilan province and the rest in Mazandaran. Dry tea production has also increased from 70,000 t in 1993 to about 105,000 t in 2017 (Iran Tea Organization, 2017).

Despite its importance, Iranian tea farming is faced with a number of constraints which affect production efficiency and farmers livelihood. This industry is preforming blow its potential level. Yields and productivity are low due to rising production costs and improper agricultural practice. Addressing these issues requires adoption of policies and practices that may make headway to achieve reasonable production efficiency in this industry.

The notion of efficiency in agricultural sector is an interesting subject for empirical investigation. Productivity of agricultural production may be increased by efficient use of inputs. Agricultural production is the process of transforming inputs, such as capital, labor, seed, water, chemical fertilizer…, into goods and services. In this process, the ultimate objective of farm manager is output maximization, cost minimization, hence profit maximization. In this process, the manager should be concerned with efficiency in the use of inputs in order to achieve the objective.

There are two methods used in the literature for estimating production efficiency. First, stochastic frontier analysis (SFA), is an econometric approach that was simultaneously introduced by Aigner, Love and Schmidt (1977) as well as Meeusen and van den Broeck (1977). This method considers the subordinate relation between inputs and output and uses statistical techniques to estimate function parameters. The second method called data envelopment analysis (DEA) is a non–parametric approach or mathematical programming. This method is able to consider multiple inputs and output simultaneously, and inputs–output can be quantified using different units of measurements.

In recent years, there have been some studies conducted in Iran, considering production efficiency of agricultural crops, all using DEA methodology (Kazemi and Nikkhah, 2009; Mehrabi and Pakravan, 2009; Abedi et al., 2011; Amini et al., 2012; Zarra-Nezhad et al., 2012; Kavand et al., 2014).

In recent years, there have been some studies in estimating production efficiency of tea farms in major producing countries, all using Stochastic Frontier Analysis (Basnayake and Guarantee, 2002; Saigenji and Zeller, 2009; Baten et al., 2010; Hong and Yabi, 2015a; Hong and Yabi, 2015b).

Basnayake and Gunaratne (2002) analyzed production efficiency of tea farms in Sri Lanka. They found that, average technical efficiency was around 64 percent. This score indicates "there is scope of further increasing the output by 36 percent without increasing the level of inputs. The authors also considering socio-economic factors affecting this inefficiency concluded that older farmers appeared to be more efficient than younger farmers.

Saugenji and Zeller (2009) studied the impact of contract farming on production efficiency and household income of the tea small holders in North Western Vietnam. The results showed that, production was significantly higher under contract farming. It was also found that membership in communist party, played a significant role in participation of tea farmers in contract program.

Baten (2010), indicate that the average technical efficiency of Bangladesh tea farmers was around 59 percent. This implies that there is a high potential of 41 percent for better use of inputs and reduction of costs in tea industry of Bangladesh.

Hong and Yabi (2015a), conducted a research on enhancement of efficiency perspective of tea production in Vietnam. The results showed that, the appropriate use of technology (sound input application) may increase average production of tea leaves by 10.4 percent. The technical efficiency of the inputs, surveyed from the farms, on average varied in the range of 62.1 to 97 percent.

In another effect, Hong and Yabi (2015b) assessed the use of inputs in tea production identifying the influential factors in Vietnam tea industry. Based on the estimated average elasticity of production (0.323), it was noticed that the production factors were utilized inefficiently in all surveyed farms. With regard to socio-economic factors, they found that, experience had positive effect on technical efficiency in input output-oriented model. Farmers with much experience in tea farming can produce more output with given inputs as compared to those with less experience.

Van Ho et al. (2018) applied propensity score matching to control self-selection, in assessing profit efficiency of safe and conventional tea farming. The results of this study indicate that, the average profit efficiency of tea farmers was around 74 percent, suggesting 26 percent of profit was lost due to inefficient use of inputs.

Although tea is a promising crop not only for farmer's income but also for economy as whole. Until now there has been no obvious research concerned with efficiency of tea production, In Iran. The present study hopefully would fill this gap. The objective of this research is to assess different types of production efficiency in traditional tea farms of Iran using data envelopment analysis approach and correlation analysis. Based on technical details, the study will provide useful information on the method in which farm should utilize resources efficiently to produce tea in the surveyed region.

Materials and methods

Technical (TE) is be defined as the ability of a firm to maximize output from a given set of inputs. Allocative efficiency is the ability of a firm to use inputs in optimal proportions, resulting into maximum profit at minimum cost (Farell, 1957; Coelli et al., 2005).

The DEA is an analytical technique used for performance evaluation. It is a multifactor productivity exploration model used for assessing relative efficiencies of a homogenous set of decision making units (DMUS). The present study uses two main DEA models: CCR (Charnes-Cooper-Rhodes) and BCC (Baker-Charnes-Cooper). The CCR model is based on the assumption of constant return to scale (CRS) of the economic activities. The BCC model is based on the assumption of variable return to scale (VRS) of these activities. Assuming there are N DMUS, each of which uses K inputs and M outputs, then the relative efficiency score, is obtained by solving the following model.

CRS as (linear) mathematical programming, (nonparametric) model, was proposed by Charnes et al. (1918), which uses a "ratio-form" that defines "relative efficiency" as "ratio output to inputs" (Cooper et al., 2004).

$$
\begin{aligned}
&Max_{\mu,v}\,(\mu' y_i),\\
&s:\\
&v'x_i = 1,\\
&\mu' y_j - v'x_j \le 0, \quad j = 1,2,...,N\\
&\mu, v \ge 0,
\end{aligned}
\tag{1}
$$

Assuming that we have data on K inputs and M outputs for N farm units or DMUs; then, the values of inputs and outputs for the ith DMU is represented by vectors Xi and Yi. The matrix of K × N inputs, which is denoted as X, and the matrix of M × N outputs, which is denoted as Y, represents the data for all N DMUs. The objective of DEA is to build a nonparametric envelopment frontier function on a set of data, so that, all observations are placed on or below the production function frontier. The most optimal version of DEA is its fractional form. In this model, there is a tendency to obtain a ratio of all outputs to all inputs for all individual DMUs; e.g., $u' y_j / v' x_j$, in which u is a vector of M × 1 of output weight and v is a vector of K × 1 of input weight. Equation (1) represents a fractional programming model (also called quotient function). This model can be converted into linear programming model Eq. 3, for selection of optimal weights (Coelli et al., 2002).

The values of u and v, in objective function, i.e. Eq. (1), are determined under the condition that, the efficiency of the DUM is maximized with respect to the constraint assuming all measured efficiency scores should be smaller than or equal to 1. The fractional version of this objective function (Eq. 1) has shortcoming, that is, it has indefinite answers. To avoid this problem, the constraint vxi = 1 is added to the model.

$$
\begin{aligned}
&Max_{\mu,v}\,(\mu' y_i)\\
&s:\\
&v'x_i = 1,\\
&\mu' y_j - v'x_j \le 0, \quad j = 1,2,...,N\\
&\mu, v \ge 0,
\end{aligned}
\tag{2}
$$

Where the use of μ and v instead of v, u shows the variations. This equation is known as the incremental version of linear programming model.

The assumption of CRS is appropriate when all DMUs perform at optimal level (the flat portion of the long-run average cost curve). Imperfect competition generates financial limitations as well as some other problems that may result in a non-optimal performance of the DMU. Banker et al. (2005) proposed an extension of DEA with CRS assumption to calculate efficiency under variable return to scale.

Applying CRS when all DMUs do not function at optimal level will lead to incorrect measurement of TE, due to the impacts of scale efficiency (SE). On the other hand, applying VRS, allow us to measure TE which is free of SE impacts. To calculate efficiency under VRS assumption, one can include the constraint NIλ=1 (convexity) in Eq. (2) in order to adjust for linear programming role under constant return to scale (Coelli et al., 2002).

$$
\begin{aligned}
&Min_{\theta,\lambda}\,\theta,\\
&s:\\
&-y_i + Y\lambda \ge 0,\\
&\theta x_i - X\lambda \ge 0,\\
&N1'\lambda = 1\\
&\lambda \ge 0,
\end{aligned}
\tag{3}
$$

Where, N is N×1 vector of 1. This approach develops a cross convex shell that can strongly cover all data points in constant unit, setting the conical shell of CRS. As a result, TE scores obtained by this approach are larger than or equal to the scores obtained under constant return to scale.

If data on price is available and the objective is cost minimization or income maximization, it will be possible to measure both technical and allocative efficiencies. To calculate TE, cost minimization is ideally used by assuming variable return to scale in input-oriented DEA model, as shown in Eq. (2). Hence, in cost minimization model, Eq. (3) is used for determining allocation efficiency.

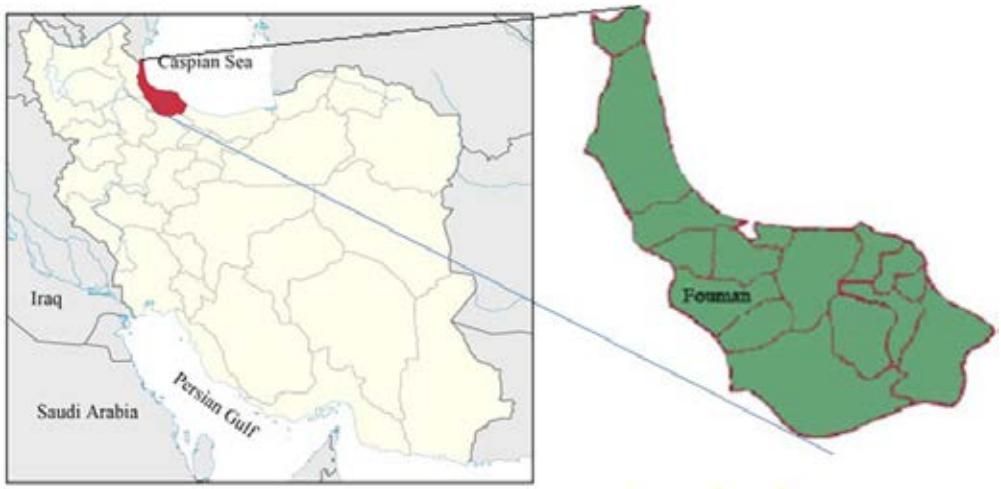
$$
\begin{aligned}
&Min_{\lambda, x_i^*}\ w_i' x_i^*, \\
&s: \\
&-y_i + Y\lambda \geq 0, \\
&x_i^* - X\lambda \geq 0, \\
&N1'\lambda = 1 \\
&\lambda \geq 0,
\end{aligned}
\tag{4}
$$

Where, wi is a vector of the input prices related to the ith DMU.

A number of advantages are linked with the use of DEA. Its strengths are that, multiple inputs and output can be considered simultaneously; inputs and outputs can be quantified using different units of measurements; and not demanding a hypothesis of any functional form for inputs and outputs.

The data and information required for this survey research were collected and questionnaire is completed by personal interview in Fouman county of Guilan province, Iran, for the production year 2017. The province is located within 36°27' north latitude and 48°53' and 50°34' east longitude. The land ranges from mountains with elevations more than 3000 meters to coastal areas below sea level.

Figure 1. Location of the survey region in the north central of Iran



Guilan is the first largest tea-planting and tea-producing province in Iran, with 1,862 hectare of tea farm, producing 420,000 tons in green leaf (105,000 tons black tea) per year (the study year). The suitable natural conditions and temperate climate make Guilan tea have natural quality throughout Iran. The location of surveyed region is displayed in Fig. 1. The required information related to various inputs use are: the average farm land measured in hectare; the average total working hours of labor (man-

day); the average amount of nitrogen fertilizer in kilogram per hectare and the average amount of phosphate fertilizer in kilogram per hectare. For the ease of computation, reduce errors and save time, a simple random sampling method was used to determine sample size and the tea plantations were chosen randomly from the surveyed region. This method is expressed as below.

$$n=\frac{N(s\times t)^2}{(N-1)d^2+(s\times t)^2} \tag{6}$$

Where, n, is the required sample size; s, is the standard deviation; t, the t-student statistic at the $p<0.05$ level; N, is the population size; and d is the error terms.

Results and Discussions

Data Envelopment Analysis was used to determine the production efficiency of 200 tea's farming units, which are the DMUs for this research, using the input – oriented approach with constant as well as variable return to scale. The results are presented in table 1 through 5.

Table 1. Output and inputs used level (per ha)

Inputs	Average	S.D.	MIN	MAX
Land (ha)	0.74	0.83	0.1	8
Labor (man-day)	42.88	48.11	12	270
Nitrogen fertilizer (kg)	448.66	498.77	60	4800
Phosphate fertilizer (kg)	104.5	83.15	50	500
Grade 1 green leaf (kg)	2314.75	3047.14	100	32000
Grade 2 green leaf (kg)	3329.5	3047.14	300	35000

The farm size is the total land area devoted to tea production by farming unit, during the period of study, expressed in hectares. It has been observed that, the average tea farm size is around 0.74 ha, ranging from 0.1 to 8 ha, revealing vast variation in farm size, among tea farm holders. This result reveals the tea farmers in the surveyed region mostly engaged in smaller sized farms, often achieving greater income per hectare and are more technically efficient than the larger sized farms. One could argue that, this might result from the direct supervisory and daily oversight roles of the owner. Thus, on the other hand, however, the owner of a large farm often has more capital and could take advantage of the economy of scale to achieve higher return and efficiency. Therefore, the influence of farm size on efficiency is predicted to be either positive or negative.

The average human labor per hector, including hired and family labors was 42.88 men – days. The score ranges from 12 men–days to 270 men–days, indicating that tea farming activities are highly labor intensive.

Fertilizer is considered as important inputs to increase tea yield. Its use is expected to have a positive effect on efficiency, if the recommended quantities are applied under the demanding soil condition (Njeru, 2010). When the use is contrary to the recommended practice or does not consider the soil fertility condition, it could lead to inefficiency in tea production. In this study, the average fertilizer level was 445.66 kg/ha. There was a high variation in the amount of fertilizer application per hectare, with the range from 60 to 4,800 kilograms. This finding may substantiate the quotation cited by Njeru, which, states that, the use of chemical fertilizer could have positive or negative impact on the efficiency of this input on the cultivated soil. The result is consistent with finding by Hong Nguyen B. and Yabe M. (2015)

As depicted in Table 2, the of average technical, allocative and economic efficiencies scores were 86, 71 and 61 percent respectively, assuming constant return to scale. This Table also reports the lowest scores for these three concepts were around 64, 24 and 20 percent respectively. The economic implication of the technical efficiency score (86) implies that, there is still scope of further increasing the output by 14 percent without increasing the amount of inputs.

Table 2. Statistical results of technical, allocative and economic efficiency assuming constant return to scale

Efficiency type	Average	Standard Deviation	Minimum	Maximum
Technical	0.86	0.08	0.64	1
Allocative	0.71	0.21	0.24	1
Economic	0.61	0.19	0.20	1

Table 3 presents, the average of technical, allocative and economic efficiency scores, respectively, assuming variable return to scale. The calculated scores for technical efficiency reveal that, the surveyed farmers can reduce the amount of inputs by 13 percent without losing the current levels of output.

Table 3. Statistical results of technical, allocative and economic efficiency assuming variable return to scale

Efficiency type	Average	Standard Deviation	Minimum	Maximum
Technical	0.87	0.08	0.65	1
Allocative	0.74	0.18	0.30	1
Economic	0.65	0.17	0.28	1

The frequency percent distribution of technical, allocative and economic efficiency assuming constant return to scale and increasing return to scale are presented in Table 4 and Table 5. In Table 4, the highest frequency score of technical efficiency was 58 for 0.85-1 interval. The score for allocative efficiency was 36 for interval 0.85-1, and for economic efficiency 34, for interval 0.37-0.53.

Table 4. Frequency (%) distributions of technical, allocative and economic efficiency assuming constant return to scale

Efficiency type	0.37-0.53	0.53-0.69	0.69-0.85	0.85-1
Technical	0	3.5	38.5	58
Allocative	30	9.5	24.5	36
Economic	34	18	37	11

Assuming variable return to scale, the highest frequency distributions of technical, allocative and economic efficiency were 52, 33.5 and 30 for intervals 0.85-1, 0.85-1, and 0.37 – 0.53 respectively (Table 5). The results for scale efficiency show that, the average scale efficiency for surveyed farms was 97 percent and the lowest scare was 77 percent. It was also found that 41.5 percent of surveyed farms had an increasing return to scale; 44.5 percent had diminishing return to scale, and 14 percent had constant return to scale.

Table 5. Frequency (%) distributions of technical allocative and economic efficiency assuming variable return to scale

Efficiency type	0.37-0.53	0.53-0.69	0.69-0.85	0.85-1
Technical	0	8.5	39.5	52
Allocative	29	9.5	28	33.5
Economic	30	28.5	24.5	17

For policy implications, it is useful to determine which socio-economic characteristics of farmer's have impact on production efficiencies of tea farms in the surveyed region. The socio economic factors chosen for this study were: tea farmer's age (AGE), educational level (EDU) on an ordinal scale of reading and writing literacy (Level 1), elementary school (Level 2), intermediate school (Level 3), diploma (Level 4), associate degree (Level 5) and bachelor degree (Level 6) , family size (FS), and neighbors and acquaintances participation in tea farming practice (COP) on an ordinal scale of very low (Leve l1), low (Leve l2), moderate (Level 3) , high (Level 4) , and very high (Level 5) . The descriptive statistics of these variables are given in Table 6.

Table 6. Descriptive statistics of the variables influencing technical efficiency score

Variable	Average	Standard deviation	Minimum	Maximum
AGE	53.48	10.96	27	80
EDU	1.77	1.77	1	6
FS	4.16	1.47	2	8
COP	3.68	0.68	1	5

Age of the tea farmer is defined in years. In this research the impact of age on farming efficiency is positive; as such, older farmers appeared to be more efficient than younger farmers. This may be due to their proper managerial skills, which they have learnt over

time. This study found the correlation between tea farmer's age and technical efficiency is significant and positive at P <0.01 Level. This result is consistent with the finding of Basnayake et al. (2002).

The positive effect of education on the production efficiency of farming units had been established by Coelli and Battese (1996). Basnayake et al. (2002) and Hong and Yabe (2015) also confirmed the positive effect of proper schooling on efficient use of resourse of tea farms. This study also found the correlation between tea farmer's educational level and technical efficiency significant and positive at P<0.01 level.

The family size refers to the number of individuals that are the resident in the owner of tea farm's house. In this study we found that, the impact of family size on technical efficiency is positive. This indicates that, farmers with large family size are able to support their labor requirement for farming operation, more readily and perform these operations at appropriate time.

Table 7. Correlation between technical efficiency score and descriptive variables

Variable	Coefficient of correlation	Probability level
AGE	0.147	0.019
EDU	0.267	0.00
FN	0.141	0.024
COP	-0.125	0.039

Neighbors and acquaintances participation in tea farming practice had negative and significant effect on technical efficiency. This result indicates that, when farmers do not have reliable labor at appropriate time, they are confronted with low production efficiency.

Table 8. Input savings to achieve technical efficiency

Variable	CRS	VRS
Land	-18.47	-17.77
Labor	-12.53	-10.93
Nitrogen fertilizer	-48.83	-46.53
Phosphate fertilizer	-30.23	-27.99

The results in Table 8 indicate that in the case of constant return to scale showed that on average, inefficient units with a 12.52 percent reduction in labor use can reach the efficiency frontier. This number, for the case of variable return to scale is 10.93. The results in table 3 also indicate that in the case of constant return to scale on average inefficient units with a 48.83 percent reduction in nitrogen may reach the efficiency frontier. This number for the case of variable return to scale is 43.53.

Conclusions

There is a considerable argument with the notion that, an effective economic development plan, depends on promoting productivity and output growth in agricultural sector. Tea as a promising crop boosts farmer's earning and the national economy of producing countries.

Tea production in Iran is generally characterized by small- sized farms. As such is the case for the surveyed region Fouman, located in Guilan province north of Iran with an average being 0.74 ha in size. This industry has a key role in generating extra earning and seasonal jobs in the study region.

The present study used Data Envelopment Analysis (DEA) to determine efficiency of tea production in the Fouman County of Guilan Province, Iran, using filed survey data obtained from 200 tea farms spread over this County during 2016–2017. The study also characterized tea farmers into social and economic classes and evaluates their impact on resource use efficiency.

Results of this research clearly indicate that, the average technical efficiency score of tea production in this region is around 86 percent, with wide variation among farmers ranging from 64 percent to 100. This suggests that, there are considerable opportunities for tea farmers to increase their productive allocative and economic efficiencies.

In order to achieve efficiency in inefficient tea farming units, the results indicate that, the farmers should save nitrogen fertilizer more than 40 percent and phosphate fertilizer more than 30 percent (table 8). Since the most of these chemicals are obtained from overseas, and given the fact that foreign exchange rate is rapidly increasing, this reveals that, the efficiency of tea production is vulnerable to changes in price of chemical fertilizers. In order to overcome this problem, we suggest that the government should take course of actions on following issues: intensifying quantity control of chemical fertilizers circulated in the markets; regulating and balancing the supply and demand of fertilizers; regulating the chemical fertilizer imports through tariff policies as well as, support policies to improve the capacity of the distribution system to ensure that fertilizers are circulated from production and import sites to the tea farms.

The results of this study clearly revealed that, in order to achieve efficiency in inefficient tea farm units, the farmers should save nitrogen fertilizer more than 40 percent as well as phosphate fertilizer more than 30 percent. Since the most amounts of chemical fertilizers are supplied from overseas and given the fact that foreign exchange rate is increasing; this means that, the efficiency of tea production is vulnerable to changes in prices of chemical fertilizer. In order to overcome this problem, we suggest that the government should take course of actions on following issues:

Intensifying quantity control of chemical fertilizer circulated in the markets; regulating and balancing the supply and demand of fertilizers; regulating the chemical fertilizer imparts through tariff policies as well as support policies to improve the capacity of the distribution system to ensure that fertilizers are circulated from production and import to the farms. The study found that a positive correlation between education level and

TE. Therefore, years of education should have a positive impact on better managerial agricultural practices.

This research achieved important finding that change tea farmers opinion. Generally, the farmers often think that the best way to have more output is by using inputs as much as possible. In fact, the results indicate that, the farmers in surveyed region (Fouman) should make an effect on reducing inputs (as indicated in Table 8), which will save them production cost.

According to the results, the effect of family size on the efficiency of tea farming is positive. Therefore, if the farmer by virtue of its large size supply part of the labor requirement for the farming practice to reduce reliance on hired labor, it becomes possible to invest the unspent funds in other areas of the farm business to enhance efficiency.

According to the results, older (aged) farmers were more efficient than younger farmers. This may be due to their good managerial skills, which they have learnt over time. Hence the younger farmers should be encouraged to work with older farmers.

Educated farmers are found to be more efficient than the uneducated farmers. This may be because their knowledge, gained from education has provided them a background to take proper decisions. It would be easier for them to grasp the information provided them by the experts. Therefore, it is necessary to increase educate facilitates.

The mean technical efficiency of the tea farmers in the surveyed region is 87 percent, with wide variation among farmers, ranging from a minimum of 65 a maximum of 100 percent (Table 3). Such a considerable difference between the minimum and maximum technical efficiency, indicates that, it is possible to increase the current level of output by 13 percent, given fixed inputs; i.e., at the same level of technology, this gap may be reduced through improved technical efficiency. Thus to increase the tea production in the survey region, authorizes of the Iran Tea Organization are recommended to increase the level of farmers' knowledge through promotional services center.

The result of socio-economic characteristics such as: age, educational level, family size as well as neighbors and acquaintances participation in tea farming practice on technical efficiency, showed that: there exist a positive and statistically significant relationship between tea farmers' age and efficiency, i.e. as the age increases the efficiency increases. The relationship between tea farmers' level of education and their technical efficiency is positive, i.e. as higher the number of years of school the farmer has had in formal education, the higher the technical efficiency. Thus, the tea farmer's age and level of education is directly related to their technical efficiency. There exist a negative and statically significant correlation between the participation of neighbors and acquaintances in farming practice with technical efficiency; hence, according to this result it seems timely access to the labor requirement for necessary farming practice at proper time is very important in achieving technical efficiency. Therefore, this founding suggests the development of mechanization should be considered as a major strategy for planner of policy makers.

Conflict of interests

The authors declare no conflict of interest.

References

1. Abedi, M., Mohamadi, H., & Ghafari, M. (2016). Efficiency and profitability of trout farming industry in Fars Province, Iran, *Journal of Agricultural Economics*, 5(2): 93-123. (Persian)
2. Aigner, D., Lovell, C.A.K., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production functions models. *Journal of Econometrics*. 6(1): 21-37.
3. Amini, S.H. Yazdani, S., Chizari, A.H. & Borjujeni, P.A. (2012). Measuring the efficiency of industrial dairy cattle breeding farms, using data envelopment analysis: A case in Southern Tehran Province, Iran. *Agricultural Economic Research*, 4(1): 105-122. (Persian).
4. Ghasemi, A. (2008). Effect of Structural Reforms in the Tea Industry, Journal of Commercial Reviews, 7(4): 25-39.
5. Van Ho, B., Nanseki, T. & Chomei, Y. (2018). Profit efficiency of tea farmers: case study of safe and conventional farmers in Northern Vietnam, *Environmental development and sustainability*. 4(4): 1-19.
6. Banker, R.D., Charnes, A., & Cooper, W.W., (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis, *Management Sciences,* 30(3): 1078-1092.
7. Basnyake, B. M. J. K. & Gunaratne. L. H. P.,(2002). Estimation of technical efficiency and it's determinants in the tea small holding sector in the mid country wet zone of Sri Lanka, *Sri Lankan Journal of Agricultural Economics*, 4(1): 137-150.
8. Baten, A., Kamil, A.A., & Haque, M.A. (2010). Productive efficiency of tea industry: A stochastic frontier approach, *African Journal of Biotechnology*, 25(2): 3808-3816.
9. Charnes, A., Copper, W.W. & Rhodes, E, (1978). Measuring the efficiency of decision making units, *European Journal of Operation of Research*, 2(3): 429-444.
10. Coelli, T.J., Rao, D.S.P, O'Donnell, C.J., & Battese, G.E., (2005). An introduction to efficiency and productivity analysis, *Springer Science and Business Press*.
11. Coelli T.J. & Battese, G.E. (1996). Identification of factors which influence the technical inefficiency of Indian farmers, *Australian Journal of Agricultural Economics*, 40(2): 103-108.
12. Cooper, W.W., Seiford, L.M. & Zhu, J. (2004). Data envelopment analysis: models and interpretations." In: Cooper, W.W., Seiford, L.M. and Zhu, J. (eds.) hand book on data envelopment, analysis, Kluwer Academic Publisher, Boston, 2004: 1-34.
13. Farrel, M.J, (1957). Measurement of productive efficiency. *Journal of the Royal Statistical Society*. 1(1): 233-240.

14. Moezi, Gh. (2009). Tea through Time, Abzian Publishing Press. (In Persian)
15. Hong, N. B. & Yabe, M., (2013). Resource use efficiency of tea production in Vietnam: Using Translog SFA model, *Journal of Agricultural Sciences*; 7(9): 160- 176.
16. Hong, N.B. & Yabe, M. (2015). Profit efficiency of tea production in the Northern Mountainous Region of Vietnam, *Journal of the International Society for Southeast Asian Agricultural Sciences*, 21(1): 1-17.
17. Iran Statistical Center: Survey of Agriculture, (2016).
18. Iran Tea Organization Data Base, (2017).
19. Iran Tea Organization, (2017). Report of tea production.
20. Iran Tea Report, Iran Tea Company Publication, (1958).
21. Iran Tea Report, Iran Tea Company Publication, (1972).
22. Kavand, H. Kalbali, A. & Sebohai, M. (2014). Application of data envelopment analysis, considering efficiency of saffron production, *Journal of Saffron Technology and Cultivation*, 2(1): 17-29. (In Persian)
23. Kazemi, M. & Nikkha, R. (2009). Application of data envelopment analysis in measuring and analyzing relative efficiency of wheat cultivation: Case of Khorasan-e Razavi, Iran. *Agricultural Economics and Development*, 23(2): 87-94. (In Persian)
24. Mehrabi, H. & Pakravan, M.R. (2009). Estimating efficiencies and return to scale of sunflower producers in Khoy Township, Iran. *Agricultural Economic and Developmen*t, 23(2): 95-102. (In Persian).
25. Meeusem, W., & van den Broeck, J. (1977). Efficiency estimation from Cobb-Douglas production functions with composed error. *International Economic Review*, 5(3): 435-444.
26. Nguyen, H. P., Wattanachai, P., Kasem, S., Nguyen. T. Q., Dang, V. T., Nguyen, X. C., & Luong, T. N. V. (2015). Comparison among chemical, GAP and organic method for tea cultivation in Vietnam, *Journal of Agricultural Technology*, 11(8): 1713-1730.
27. Njeru, J. (2010). Factors influencing Technical Efficiencies among Selected Wheat Farmers in Uasian Gishu District, Kenya. AERC Research Paper 206, *African Economic Research Consortium*, Nairobi, Kenya.
28. Saigenji, Y. & Zeller, M. (2000). Effect of contract farming on tea production in the Northern Mountainous region of Vietnam, *Economic Conformance*, Beijing, China.
29. World Food Organization, (2017). Database statistics.
30. Zarra-Nezhad, M., Bavarsad, B., & Noroozi, M. N. (2012). Study of technical efficiency of rice farmers in Iran: a case of Kohghiluyeh and Boyer-Ahmad province, *Quarterly Journal of Quantitative Economics*, 8(4): 43-125.

A BUSINESS MODEL IN AGRICULTURAL PRODUCTION IN SERBIA, DEVELOPING TOWARDS SUSTAINABILITY

Mila Zecevic[1], Lato Pezo[2], Marija Bodroza-Solarov[3], Tea Brlek[4], Jelena Krulj[5], Jovana Kojić[6], Boško Marić[7]

**Corresponding author E-mail: latopezo@yahoo.co.uk*

ARTICLE INFO

Original Article

Received: *03 February 2018*

Accepted: *11 June 2018*

doi:10.5937/ekoPolj1902437Z

UDC 005.22:[338.432:502.131.1(497.11)

Keywords:

business model, agricultural production, Cobb-Douglas, Artificial Neural Network, Serbia

JEL:C15

ABSTRACT

Agricultural production is a Serbian main economic sector, presenting a base for the food industry. By analysing the public available data of the agriculture sector, applying a newly developed business model it is possible to assess the current situation and to realize the relation between variables, which can also be used for prediction of future trends in agricultural production and food industry. Within this paper an attempt was made to develop a novel artificial neural network model for better understanding the relation between the observed parameters and to estimate the efficiency in sustainability achievement and sector potential The well-known Cobb-Douglas production model was compared to the newly developed model. The presented models could be used to achieve the transformation towards a circular bioeconomy, by developing the national strategies for sustainable agricultural production, with the aim of better utilization of resources and reduction of wastes.

1 Mila Zecevic, PhD student, Faculty of Economics, University of Ljubljana, Kardeljeva Ploščad 17, 1000 Ljubljana, Slovenia, zecevic.mila@yahoo.com

2 Lato Pezo, PhD, Institute of General and Physical Chemistry, University of Belgrade, Studentski Trg 12 - 16, 11000 Beograd, Serbia, +381 11 3283 185, latopezo@yahoo.co.uk, https://orcid.org/0000-0002-0704-3084

3 Marija Bodroza-Solarov, PhD, Institute of Food Technology Novi Sad, University of Novi Sad, Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia, +381 21 485 3771, marija.bodroza@fins.uns.ac.rs, https://orcid.org/0000-0001-8151-6276

4 Tea Brlek, PhD, Institute of Food Technology Novi Sad, University of Novi Sad, Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia, +381 21 485 3751, tea.brlek@fins.uns.ac.rs

5 Jelena Krulj, PhD, Institute of Food Technology Novi Sad, University of Novi Sad, Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia, +381 21 485 3798, jelena.krulj@fins.uns.ac.rs, https://orcid.org/0000-0001-7348-3961

6 Jovana Kojić, academic position, Institute of Food Technology Novi Sad, University of Novi Sad, Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia, +381 21 485 3798, jovana.kojic@fins.uns.ac.rs, https://orcid.org/0000-0002-8816-9892

7 Boško Marić, PhD student, Institute of Food Technology Novi Sad, University of Novi Sad, Bulevar Cara Lazara 1, 21000 Novi Sad, Serbia, +381 21 485 3797, bosko.maric@fins.uns.ac.rs, https://orcid.org/0000-0003-4264-8086

Introduction

Since 2012 the EU is oriented towards higher sustainability of agricultural production to improve cost-effectiveness, process efficiency and green credentials. In doing so, in 2012 the EU Commission adopted a strategy named "Innovating for sustainable growth: A bioeconomy for Europe", with the main aim to "radically change its approach in production, consumption, processing, storage, recycling and disposal of biological resources" (The Bioeconomy Strategy, 2012). In the strategy revision in 2017, its efficiency was assessed as positive, while the emphasis on its increasing relevance in modern European society (European Commission, 2017). The main sector of Serbian economy is agricultural and food industry. Serbia should, like other EU countries aspire to achieve a sustainable production in all aspects, especially in agriculture, and to enter a transition into bioeconomy, as much as possible. The key to achieve transformation towards a circular bioeconomy is to develop national strategies for sustainable agricultural production, with the aim of better utilization of resources and reduction of wastes. Increasing sustainability, as a main point in the bioeconomy, can lead to positive environmental and social impact followed by economic growth (Pfau et al, 2014, Ramcilovic-Suominen and Pülzl, 2016). Bioeconomy is set to use renewable resources in all areas (Johnson and Altman, 2014) which are highly available from agricultural production. Agricultural production presents the base for the food industry as well for bioenergy (biomass), which present Serbia's window of opportunity in developing bioeconomy. Therefore possible market opportunity for agriculture can be through value added products in traditional sectors, such as food production and the establishment of non-food markets in the field of bioenergy, which can boost rural areas (EuropaBio, 2011; Zabaniotou et al., 2017). To achieve the set goals it is essential to evaluate the country's potential in the main sectors of economy by analysing inputs and outputs of production. To ensure food security and resource efficiency the EU has set a goal to establish a bioeconomy until 2050 (Kalt et al, 2016). Therefore EU countries have analysed their own potentials and opportunities in establishing bioeconomy such as Germany (Efken et al, 2016), Austria (Kalt et al, 2016), The Netherlands (Heijman, 2016), and some have launched bioeconomy initiatives including France, Germany, The Netherlands, Sweden and Finland (Loiseau et al, 2016).

The European Bioeconomy Panel has defined that the establishment of the bioeconomy, requires precise data on the biomass availability as an essential base which can help estimate the dependence of bio-based products (Henning et al, 2016). It is of great importance to define where the county stands in the transition to a circular economy, and the starting point is sustainable agricultural production. Therefore, we have analysed this sector to see where Serbian opportunities are, which division has the perspective, and which needs to be boosted.

A mathematical approach has been used to evaluate the agricultural sector. A similar

approach assessing the efficiency of the bioeconomy in Latvia has been used by Muizniece et al, 2016. A comprehensive study of various mathematical techniques in treatment of the traditional agricultural production economics topics is presented by Debertin, 2012. The used mathematical tools focus on the neoclassical mathematical models, and the specific importance is devoted to Cobb-Douglas production function.

The estimate of the agricultural production using the three basic factors of production in Canada is presented by Echevarria, 1998. Within this study, the Cobb-Douglass function is characterised as a useful tool for macroeconomic, growth, and development studies. In the study performed by Yuan, 2011, the analysis of variation in agricultural inputs and outputs and their relations in Hebei Province of China was investigated using Cobb-Douglas production function. The elasticity indexes in the Cobb-Douglas function is in detail described in the article written by Pandey et al., 1982, in which the annual time series data for the period 1950-76 are used to estimate the price elasticity of aggregate Australian agricultural supply. In the paper written by Vanzetti and Quiggin, 1985, the investment analysis is identified at the microeconomic level, by considering the basis of individual decisions, and tested empirically at the aggregate level.

In a study written by Randall, 2008, the Cobb-Douglas function is used to indicate the sustainability of the agricultural production in Australia. The influence of environmental factors regarding agro-economical production is studied by Thampapillai, 2011. Recently, Cobb-Douglas production function was also used for assessing productivity and efficiency of agriculture in developing countries, including India (Mishra & Das, 2017; Ghoshal & Goswami, 2017) and Nigeria (Biam, Okorie & Nwibo, 2016).

Artificial neural network mathematical models are a computational approach used in nowadays computer science in many research disciplines, including economics. This model is based on a collection of neural units (so called artificial neurons), which are connected with each other, enabling their effect by the activation of connected neural units. In a study performed by Ribeiro and Oliveira, 2011, artificial neural network (ANN) model was used for prediction of prices in an economical model in the sugar-alcohol sector. The effects of the social welfare of the apple import in New Zealand are discussed in a paper by Cook, et al., 2011. In this study a demonstration of an economic framework, which takes into account both the gains from trade and the costs of invasive species outbreaks, can inform decision-makers when making decisions.

The environmental effect, as very important one in agricultural production, and the influence of such parameters can be described using the ANN model. For instance, the influence of El Nino on the market dynamics of major vegetable oil prices is discussed in a study performed by Ubilava and Holt, 2013, using the ANN model. Some of the recent researches using ANN model include assessments of biodiesel production (Maran & Priya, 2015), sunflower seed yields (Zeng et al., 2017) and waste cooking oil (Soji-Adekunle et al., 2018).

The focus points in this paper were agricultural inputs and outputs from the year 2007 to 2013. The goal of this paper is to provide an assessment and comparison between two models, agricultural input-output potential model based on Cobb-Douglas production function and Artificial Neural Network model. Furthermore, the main influence factors affecting the agricultural output in Serbia are investigated in both models. This has created a business model for agricultural production as a tool in achieving sustainability more efficiently and more quickly, allowing us to perceive the current condition as well as to foresee the economic trends in the near future. The method has been developed to assess the potential of the initial economical sector (agriculture) in Serbia. The main aim of the paper was to provide better understanding of the two models used to estimate the efficiency in sustainability achievement and sector potential, as well as their comparison.

Materials and methods

Data collection

The economic statistics data for Serbia from 2007 to 2013, including:agricultural productivity, agricultural value added, crop production index, employment in agriculture, fertilizer use and food production index were obtained from the Global Economy site (www.theglobaleconomy.com) and FAO (www.fao.org). The output data used in the models were: *GDP* share agriculture (*GDPA*), overall agricultural output (*AOUT*), agricultural goods output (*AGOUT*), crop production (*CROP*), the production of cereals (including seeds) (*CER*), the production of industrial crops (*ICRO*), the production of forage plants (*FOR*), the production of vegetables and horticultural products (*VEG*), the production of potato (including seeds) (*POT*), the production of fruits (*FRU*) and wine (*WINE*), other crop products (*OCRO*), the overall animal production (ANIP), the production of animals (*ANIM*), the production of cattle (*CATT*), the production of pigs (*PIG*) and equines (*EQU*), the production of sheep and goats (*SHEEP*), the production of poultry, (POUL) the overall collection of animal products (*ANIMP2*), milk products (*MILK*), eggs production (*EGG*), other animal products (*OANI*) and agricultural services (*ASERV*). The output data were obtained from Serbian economic statistical yearbooks (2007 to 2013). The summary of the collected data is presented in Supplement material, Tables S1 and S2.

Agricultural input-output potential model

In economic theory, the Cobb-Douglas production function is widely used to represent the relationship between the amounts of multiple inputs, as well as the amount of the output that can be created using these inputs. The original Cobb-Douglas production function was developed and statistically tested between 1927 and 1947. Its formulation was the following:

$$Y = A \cdot L^{\beta} \cdot K^{\alpha}, \quad (1)$$

where K represents capital, L symbolizes labour, and A represents the contribution of any input other than capital and labour to the total output. The term A can also represent the contribution technological efficiency can have to the total output (Cobb & Douglas, 1928).

In time, numerous modifications of this formula emerged. Namely, its relative simplicity of calculation makes it very useful and convenient from the mathematical point of view. However, this method received many critics because of its inability to incorporate any deeper knowledge of technology, engineering or management (Houthakker, 1955).

These disadvantages became more emphasized with years, as the importance of knowledge in these areas for economic calculations only grew in the past decades. This also explains the number of modifications this formula has in contemporary economics. In this research, in order to include all the relevant factors in the agricultural field in economics, Cobb-Douglas production function was slightly adjusted as well.

Within here developed model, agricultural input factors include: agricultural productivity (*APRO*), agricultural value added (*AVAL*), employment in agriculture (*EMP*), fertilizer use (*FER*) and food production index (*FPI*). The relation of agricultural output and input can be expressed as, Yuan, 2011; Apostolov, 2016; Kalt et al., 2016; Muizniece, et al., 2016:

$$Y = f\left(APRO, AVAL, EMP, FER, FPI\right) \quad (2)$$

In economics, the Cobb-Douglas production function is widely used to represent the relationship of an output to inputs and it can be represented as:

$$Y = A \cdot APRO^{\alpha} \cdot AVAL^{\beta} \cdot EMP^{\gamma} \cdot FER^{\delta} \cdot FPI^{\lambda} \quad (3)$$

Eqn. (2) can be changed to the following form:

$$\ln Y = A + \alpha \cdot \ln APRO + \beta \cdot \ln AVAL + \gamma \cdot \ln EMP + \delta \cdot \ln FER + \lambda \cdot \ln FPI \quad (4)$$

Where α, β, γ, δ and λ, are the output elasticities of agricultural productivity, agricultural value added, employment in agriculture, fertilizer use and food production index, respectively, while Y is the output of the developed model. If the sum $\alpha + \beta + \gamma + \delta + \lambda<0$, the output is decreasing, and if $\alpha + \beta + \gamma + \delta + \lambda>0$, then the observed output is increasing over the years.

ANN modelling

A multi-layer perceptron model (MLP), which consisted of three layers (input, hidden and output) was used for modelling. This model has been proven as a quite capable of

approximating nonlinear functions (Hu &Weng, 2009; Karlović et al., 2013). Before the calculation, both input and output data were normalized in order to improve the behaviour of the ANN. During this iterative process, input data are repeatedly presented to the network (Grieu et al., 2011; Pezo et al., 2013). Broyden-Fletcher-Goldfarb-Shanno (BFGS) algorithm was used, as an iterative method for solving unconstrained nonlinear optimization problems in ANN modelling.

Coefficients associated with the hidden layer (weights and biases) are grouped in matrices W_1 and B_1. Similarly, coefficients associated with the output layer are grouped in matrices W_2 and B_2. It is possible to represent the neural network, by using matrix notation (Y is the matrix of the output variables, f_1 and f_2 are transfer functions in the hidden and output layers, respectively, and X is the matrix of input variables) (Kollo& von Rosen, 2005):

$$Y = f_1(W_2 \cdot f_2(W_1 \cdot X + B_1) + B_2) \quad (5)$$

Weights (elements of matrices W_1 and W_2) are determined during the ANN learning cycle, which updates them using optimization procedures to minimize the error between network and experimental outputs (Trelea et al., 1997; Pezo et al., 2013), according to the sum of squares (SOS) and BFGS algorithm, used to speed up and stabilize convergence (Basheer&Hajmeer 2000). The coefficients of determination were used as parameters to check the performance of the obtained ANN model.

Sensitivity analysis

Sensitivity analysis is a widely accepted technique used in the decision theory for exploring the effects of the uncertainties in the observed parameters of a developed model (Montaño& Palmer, 2003). Neural networks can perform an approximation to experimental results, which could be partially noisy and partially imprecise data, so sensitivity analysis is necessary to check if the neural network could behave erroneously (Taylor, 2006). On the basis of the developed ANN model, sensitivity analysis was performed in this work, in order to more precisely check the influence of input variables on the observed outputs. The infinitesimal amount (+0.0001%) has been added to each input variable, in 10 equally spaced individual points encompassed by the minimum and maximum of the training data.

Results

The input and output data are presented in Supplement material, Tables S1 and S2.

Cobb-Douglas production function

When observing output elasticities, it is also important to make a difference between the coefficients that are elastic (>1) and the ones with inelastic (<1) characteristics. In general, elasticity shows the relationship between the change in output and the change in input used. Elastic relationships show bigger impact of input change on the output change compared to the ones that are inelastic (Baye, 2009).

The regression coefficients we obtained as the results of a calculation (Table 1) show the dominance of inelastic coefficients. Inelastic regression coefficients suggest that the change in output that is triggered by the change in observed input is small.

By examining the data from Table 1, we can also conclude that certain regression coefficients are elastic for most of the output categories. Agricultural productivity output elasticity (α) and food production index (λ) have an elastic relationship with output change for most of the output categories listed in Table 1. Such results imply that the change in inputs directly related with these regression coefficients (inputs: agricultural productivity and food production index) can have larger effect on output changes than the changes in inputs whose regression coefficients (elasticities) show lower values (i.e. regression coefficients that are inelastic).

It is however important to emphasize that the inelastic relationships do not represent the lack of the relationship or influence of inputs directly related to inelastic coefficients. While the individual effect of the change in inputs on change in the total output can be considered small, the influence these coefficients have on output change when combined is not to be neglected, which is shown in the calculation as well.

ANOVA was conducted for obtained models, and output variables were tested against the impact of input variables (Supplement material, Table S3). ANOVA analysis revealed that *FER* is the most important variable for *GDPA* calculation, while *APRO* is the most important for the prediction of: *AOUT*, *AGOUT*, *CROP*, *CER*, *ICRO* and *FOR*, while *AVAL* is the most important for *VEG* calculation.The influences of *APRO*, *AVAL*, *EMP* and *FER* are very influential for *POT* evaluation, while the impact of *APRO*, *FER* and *FPI* are important for *FRU*, *WINE* and *OCRO* calculation. *ANIP*, *ANIM* and *PIG* are influenced by *APRO*, according to the developed model. The most important variables for calculation of *EQU* and *POUL* are *APRO*, *EMP*, *FER* and *FPI*. The output variable *SHEEP* is mostly affected by *APRO*, *EMP* and *FER*. The input variables *APRO*, *FER* and *FPI* are the most important for the prediction of *ANIP2*, *MILK* and *EGG*. The prediction of *OANI* is mostly affected by *APRO*, while the calculation of *ASERV* is influenced by *APRO* and *EMP*.

The coefficient of determination (r^2) for Cobb-Douglas production functions were rather good (0.654–1.000) (Supplement material, Table S3), indicating that some other model (ANN model, for instance) would improve the validity of the model.

Discussions

The regression coefficients for the Cobb-Douglas production functions are shown in Table 1. Within this table, the sum of the specific regression coefficients is shown, and the sign of these sums indicates the trend of that specific output. The negative sums of regression coefficients are obtained for: *GDPA*, *ICER*, *FOR*, *VEG*, *POT* and *SHEEP*, while the positive trends are noticed for the following outputs: *AOUT*, *AGOUT*, *CROP*, *CER*, *FRU*, *WINE*, *OCRO*, *ANIP*, *ANIM*, *CATT*, *PIG*, *EQU*, *POUL*, *ANIP2*, *MILK*, *EGG*, *OANI* and *ASERV*.

The growth in the production of fruits and grape (vine) (Table 1), in the observed time period, is the result of the current agricultural development strategy issued by the Serbian Ministry of Agriculture (Official Gazette, 2014). This strategy is based on the analysis of the world market needs, agro-ecological predetermination of Serbia for growing fruits and vines, as well as bilateral agreements on the privileged status in trade relations (for instance with Russia). This production generates also a significant amount of waste (by product) which can be reused in the sense of circular bioeconomy. The scientific studies in Serbia also show an interest in this particular group of agricultural products valorising their waste in added value products. These wastes have been suggested to be implemented in food products to improve the nutritional value and enhance storage stability, due to the content of antioxidant compounds (Tumbas-Saponjac et al, 2014, Cetojevic-Simin et al, 2015, Tumbas-Saponjac et al, 2016).

Unfortunately vegetable production, in the contrast to the fruit is showing a decrease (Table 1). This is caused by a shorter shelf life of this product compared to fruits, thus making it impossible to be as attractive as fruit in the world market. Storage and perseverance of vegetables (which would prolong its shelf life) are also challenging. The technological systems are often not available or appropriate to handle the amounts of the products supplied. This is especially true when we talk about small producers, which rarely have adequate equipment to store perishable goods and potentially transport them to distant areas. Therefore, the producers are faced with a limitation in the domestic market mainly. However, the domestic market is small, and its purchasing power is low. Therefore, waste is not uncommon when we talk about vegetable and its production in Serbia. Scientific efforts have been made to valorise such waste in a similar manner as fruit wastes (Belovic et al, 2015, Stajcic et al, 2015).

As can be seen from the table 1 industrial crop production has a negative trend in the analysed time period, while the areas under main industrial crops (sugar beet and sunflower) are decreasing. Production of industrial plants such as sugar beet is becoming more risky and less profitable due to decreasing of sugar price in the market, which is caused by increased imports of sugar cane from non EU countries. Sunflower as the second most represented industrial plants in the Serbian agricultural production, was until recently the most profitable production in Serbia. Due to harmonization of

Serbian laws to EU legislation in the process of integration in EU, Serbia was forced to open the market, thus jeopardizing the edible oil industry in the country. Now, the edible oil industry is not prepared to pay the same price as before, thus placing a farmer in a less attractive position.

Cereals (namely wheat and corn) have a positive trend, which is evident from the table 1. They fill in the gap in agricultural production caused by decrees of industrial crop production. In Southern Europe, small farms are still dominant. This is also true for Serbia, with minor differences (Official Gazette, 2014). Namely, according to the data collected in the Census of Agriculture 2012, in the Republic of Serbia there are 631,522 farms, which use 3,437 million hectares of agricultural land. From the total number of listed farms, only 3.1% reaches over 20 ha in size, covering 44% of the total country's utilized agricultural area (hereinafter UAA). On the other side, 5 or less hectar farms are the most present ones, accounting for 77.7% of the total number of listed farms, and covering 25.2% of the UAA. The aforementioned differences between Serbia and other Southern Europe countries is in the share of farms that are 2-10 hectars large. These shares are higher in Serbia, where 43% of farms and 35.3% of UAA belongs to this category (Official Gazette, 2014). Impoverished small agricultural producers who own under 10 ha of land, which are present with more than 40% in the overall agricultural production in Serbia (Official Gazette, 2014), are turning to production of more "stable" crops with less risks and lower investments. The residual analysis showed that the mean of residuals were equal to zero, and the standard deviation was between $2.3 \cdot 10^{-3}$ and $1.5 \cdot 10^{-1}$. These results showed a good approximation to a normal distribution around zero with a probability of 95% ($2 \times SD$), which means a good generalization ability of the developed model for the range of observed experimental data.

The quality of the model fit was tested in Table 2, and coefficients of determination (r^2) value should be higher for better fitting of the model to the collected data (Arsenović et al., 2013).

Table 1. Regression coefficients for the Cobb-Douglas production functions

	GDPA	*AOUT*	*AGOUT*	*CROP*	*CER*	*ICER*	*FOR*	*VEG*
Mean/Interc.	5.502	1.493	1.470	3.059	3.063	-0.460	6.345	11.302
α	-0.138	1.918	1.946	1.959	2.203	3.028	1.433	1.176
β	0.221	-0.003	0.005	-0.078	0.366	-0.411	-0.482	-2.047
γ	-0.428	0.688	0.686	0.393	0.401	0.461	0.305	0.136
δ	-0.301	0.230	0.228	-0.046	-0.165	0.149	-0.135	-1.372
λ	0.120	-1.759	-1.811	-1.748	-2.379	-3.563	-1.857	-0.456
SUM	-0.526	1.074	1.054	0.479	0.425	-0.338	-0.736	-2.562
	POT	*FRU*	*WINE*	*OCRO*	*ANIP*	*ANIM*	*CATT*	*PIG*
Mean/Interc.	-1.112	-2.401	-11.016	-1.111	-4.131	-6.365	-3.439	-11.388
α	2.837	2.099	-0.615	-0.972	1.902	1.922	1.443	2.167
β	-1.038	0.412	0.694	0.086	0.219	-0.004	0.155	-0.189
γ	-1.982	0.541	1.393	0.951	1.335	1.544	1.010	2.453
δ	-0.946	0.752	1.143	0.850	0.853	0.793	0.744	0.938
λ	-0.336	-2.328	3.356	1.806	-1.928	-1.576	-1.230	-1.801
SUM	-1.466	1.475	5.969	2.720	2.381	2.680	2.122	3.570
	EQU	*SHEEP*	*POUL*	*ANIP2*	*MILK*	*EGG*	*OANI*	*ASERV*
Mean/Interc.	-26.266	7.168	-10.985	-1.007	0.284	-4.798	-19.699	-2.505
α	2.814	0.845	2.736	1.887	1.661	2.146	4.474	0.837
β	0.604	-0.182	0.416	0.737	0.815	0.657	-0.768	-0.326
γ	5.785	-0.652	0.566	0.853	0.735	1.416	-1.213	0.816
δ	4.707	-0.354	1.002	0.985	0.861	1.350	0.762	0.296
λ	-7.543	-0.312	-2.218	-2.795	-2.537	-3.504	-2.216	0.238
SUM	6.367	-0.654	2.503	1.667	1.535	2.066	1.038	1.861

* α, β, γ, δ and λ - the output elasticities of agricultural productivity, agricultural value added, employment in agriculture, fertilizer use and food production index, respectively. *GDPA* - GDP share agriculture, *AOUT* - overall agricultural output, *AGOUT* - agricultural goods output, *CROP* - crop production, *CER* - the production of cereals (including seeds), *ICRO* - the production of industrial crops, *FOR* - the production of forage plants, *VEG* - the production of vegetables and horticultural products, *POT* - the production of potato (including seeds), *FRU* - the production of fruits, *WINE* - the production of wine, *OCRO* - other crop products, *ANIP* - the overall animal production, *ANIM* - the production of animals, *CATT* - the production of cattle, *PIG* - the production of pigs, *EQU* - the production of equines, *SHEEP* - the production of sheep and goats, *POUL* - the production of poultry, *ANIMP2* - the overall collection of animal products, *MILK* - milk products, *EGG* - eggs production, *OANI* - other animal products and *ASERV* - agricultural services.

Artificial neural network

The acquired optimal neural network model, showed a good generalization capability to experimental data, and can be used to predict the accurate output for a broad range of the input parameters. According to ANN performance, it was noticed that the optimal number of neurons in the hidden layer is 6, when using it for the prediction of output variables: *GDPA*, *AOUT*, *AGOUT*, *CROP*, *CER*, *ICRO*, *FOR*, *VEG*, *POT*, *FRU*, *WINE*, *OCRO*, *ANIP*, *ANIM*, *CATT*, *PIG*, *EQU*, *SHEEP*, *POUL*, *ANIMP*2, *MILK*, *EGG*, *OANI* and ASERV (network MLP 5-6-24).

The goodness of fit, between the data obtained from the Serbian economic statistical yearbooks and ANN model calculated outputs, represented as ANN performance (sum of r^2), are shown in Table 2.High values of $r^2$for both models were obtained (overall 1.000 for ANN model, compared to 0.654–1.00 for Cobb-Douglas production functions).

The ANN model had an insignificant lack of fit tests, which means that all the models represented the data satisfactorily. A high r^2 is indicative that the variation was accounted and that the data fitted satisfactorily to the proposed model (Montgomery, 1984; Madamba, 2002).

Table 2. The comparison of coefficients of determination obtained for Cobb-Douglass production (CB) function and the ANN model

Output	CB	ANN	Output	CB	ANN	Output	CB	ANN
GDPA	0.993	1.000	POT	0.983	1.000	EQU	0.946	1.000
AOUT	0.946	1.000	FRU	0.992	1.000	SHEEP	0.764	1.000
AGOUT	0.945	1.000	WINE	0.983	1.000	POUL	0.926	1.000
CROP	0.945	1.000	OCRO	0.654	1.000	ANIP2	1.000	1.000
CER	0.953	1.000	ANIP	0.958	1.000	MILK	1.000	1.000
ICER	0.972	1.000	ANIM	0.921	1.000	EGG	0.999	1.000
FOR	0.858	1.000	CATT	0.924	1.000	OANI	0.953	1.000
VEG	0.958	1.000	PIG	0.941	1.000	ASERV	0.997	1.000

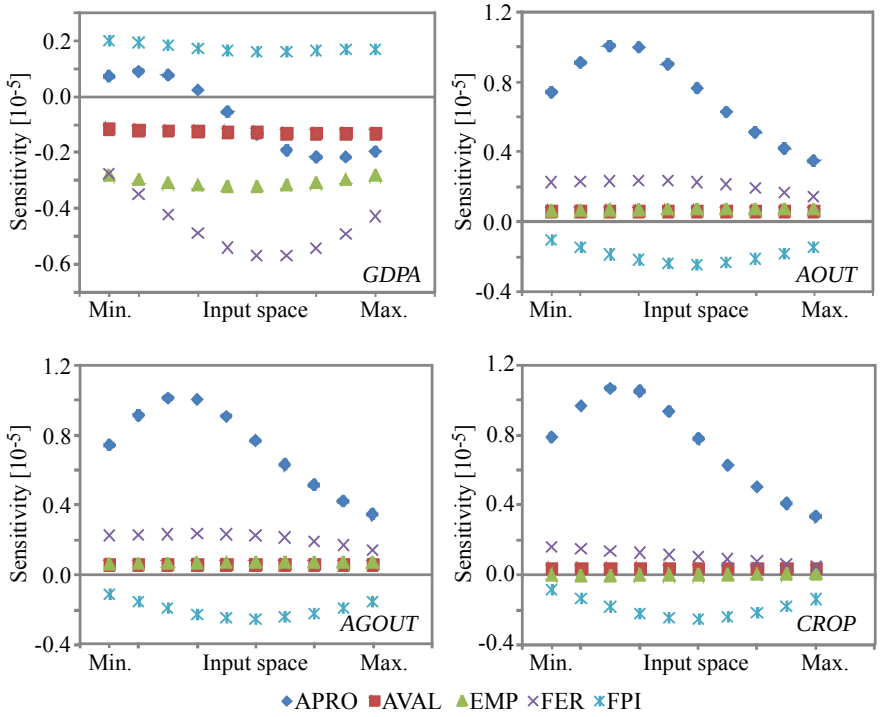
GDPA - GDP share agriculture, *AOUT* - overall agricultural output, *AGOUT* - agricultural goods output, *CROP* - crop production, *CER* - the production of cereals (including seeds), *ICRO* - the production of industrial crops, *FOR* - the production of forage plants, *VEG* - the production of vegetables and horticultural products, *POT* - the production of potato (including seeds), *FRU* - the production of fruits, *WINE* - the production of wine, *OCRO* - other crop products, *ANIP* - the overall animal production, *ANIM* - the production of animals, *CATT* - the production of cattle, *PIG* - the production of pigs, *EQU* - the production of equines, *SHEEP* - the production of sheep and goats, *POUL* - the production of poultry, *ANIMP2* - the overall collection of animal products, *MILK* - milk products, *EGG* - eggs production, *OANI* - other animal products and *ASERV* - agricultural services.

ANN models were used to predict output variables very well, i. e., the predicted output values were close to the desired values, in terms of r^2 value (Pezo et al., 2013; Chattopadhyay&Rangarajan, 2014).

Sensitivity analysis

The influence of the input variables at a specific position in the input space, over the output variables, were tested by sensitivity analysis. It indicates how sensitive is the response variable calculated to the observed domain of input variables. Sensitivity values are actual first-order derivatives evaluated at specific centile points for each input variable. For each input, the derivative is taken with respect to the target at ten evenly spaced locations with the observed minimum and maximum values. The exact values are calculated by the Taylor formula (Turanyi& Tomlin, 2014). The influence of the input over the output variables, i.e. calculated changes of output variables for infinitesimal changes in input variables, as well as the importance of an input variable at a given point in the input space are shown in Figure 1.

Figure 1. Sensitivity analysis of business model in agricultural production in Serbia



GDPA - GDP share agriculture, *AOUT* - overall agricultural output, *AGOUT* - agricultural goods output, *CROP* - crop production, *APRO* - agricultural productivity, *AVAL* - agricultural value added, CPI – crop production index, *EMP* - employment in agriculture, *FER* - fertilizer use and *FPI* - food production index.

Sensitivity analysis showed that *FER* is the most important variable for *GDPA* calculation, while *APRO* is the most important for the prediction of: *AOUT*, *AGOUT* and *CROP* output variables. The influence of changes in *FER* on *GDPA* is most obvious in the centre of the input space for *FER* (near 140), while the influence of changes in

APRO on *AOUT*, *AGOUT* and *CROP* is most intensive closer to the minimum of the input space for *APRO* (close to 5000).

Conclusions

Despite the fact that Cobb-Douglas production function is widely used method for examining production trends and input contribution to the output, Artificial Neural Network seems to be more accurate indicator of trends in agricultural production in this particular research. This newly developed business model can also be effectively used for prediction of future trends in agricultural production in Serbia.

Using this model, a positive trend has been recorded in the overall agricultural production. Nevertheless, a negative trend is present in the most important output - GDP. The negative trend in GDP of agriculture's share in total nation's GDP can have different causes. One of the reasons may be the inability of the agricultural sector to follow the development path of other, more lucrative economy areas. Obsolete technology applied in agriculture, and lack of investments in the area can be the cause of this fall as well.

Determining the cause of this decrease, and establishing systems to support agricultural GDP is of utmost importance in order to prevent further deterioration in this area of output. If nothing is changed, this negative trend can furthermore lead to decrease in other segments of output in agricultural production observed in this research.

On the other hand, growing trend in fruit production is partially a result of national agricultural strategy and Serbian agro-ecological predetermination for growing of fruits, which is in accordance with world market needs in this area. Therefore, Serbia possesses a great potential for development of value added products in the food industry through valorisation of wastes from this agricultural production. Also, this study presents a good base for the next phase of research where, based on the production trends an overview of generated by-products (wastes) can be perceived, enabling the further step in the transformation towards a circular bioeconomy, by developing the national strategies for sustainable agricultural production.

Acknowledgements

This article is written within the project III 46005, funded by the Serbian Ministry of Education, Science and Technological Development.

Conflict of interests

The authors declare no conflict of interest.

References

1. Apostolov M. (2016). Cobb–Douglas production function on FDI in Southeast Europe, *Journal of Economic Structures*, 5(10), 1-28. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2706657.

2. Arsenović, M., Pezo, L., Stanković, S., Radojević, Z. (2015). Factor space differentiation of brick clays according to mineral content: Prediction of final brick product quality. *Applied Clay Science*, 115, 108–114. doi.org/10.1016/j.clay.2015.07.030.

3. Basheer, I. A., Hajmeer, M. (2000). Artificial neural networks: fundamentals, computing, design, and application. *Journal of Microbiological Methods*, 43, 3–31. doi.org/10.1016/S0167-7012(00)00201-3.

4. Baye, M.R. (2009). Managerial Economics and Business Strategy. McGraw Hill, 82-92. ISBN-13: 978-0073375960, ISBN-10: 0073375969.

5. Belović, M. M., Gironés-Vilaplana, A., Moreno, D. A., Milovanović, I. LJ., Novaković, A. R., Karaman, M. A., Ilić, N. M. (2016). Tomato (*Solanum Lycopersicum* L.) Processing Main Product (Juice) and By-Product (Pomace) Bioactivity Potential Measured as Antioxidant Activity and Angiotensin-Converting Enzyme Inhibition. *Journal of Food Processing and Preservation*, 40, 1229–1237. doi.org/10.1111/jfpp.12707.

6. Biam, C. K., Okorie, A., & Nwibo, S. U. (2016). Economic efficiency of small scale soyabean farmers in Central Agricultural Zone, Nigeria: A Cobb-Douglas stochastic frontier cost function approach. *Journal of Development and Agricultural Economics*, 8(3), 52-58.

7. Cetojevic-Simin, D., Velicanski , A., Cvetkovic, D., Markov, S., Cetkovic, G., Tumbas Šaponjac, V., Vulic, J., Canadanovic-Brunet, J., Djilas, S. (2015). Bioactivity of Meeker and Willamette raspberry (*Rubusidaeus* L.) pomace extracts. *Food Chemistry*, 166, 407–413. 10.1016/j.foodchem.2014.06.063.

8. Chattopadhyay, P. B., Rangarajan, R. (2014). Application of ANN in sketching spatial nonlinearity of unconfined aquifer in agricultural basin. *Agricultural Water Management*, 133, 81–91. doi.org/10.1016/j.agwat.2013.11.007.

9. Cobb, C. W. Douglas, P. H. (1928). A Theory of Production. American Economic Review, 18,139–165. http://www2.econ.iastate.edu/classes/econ521/Orazem/Papers/cobb-douglas.pdf.

10. Cook, D. C., Carrasco, L. R., Paini, D. R., Fraser, R. W. (2011). Estimating the social welfare effects of New Zealand apple imports. *The Australian Journal of Agricultural and Resource Economics*. 55, 599–620. doi.org/10.1111/j.1467-8489.2011.00558.x.

11. Debertin, D. L. Agricultural Production Economics, (Second Edition, Amazon Createspace, 2012, ISBN-13 978-1469960647.

12. Echevarria, C. (1998). A Three-Factor Agricultural Production Function: The Case of Canada. *International Economic Journal*, 12 (3), 63-75. doi.org/10.1080/10168739800000029.

13. European Association for Bioindustries (EuropaBio). (2011). Building a Bio-based Economy for Europe in 2020. European Association for Bioindustries: Brussels,

Belgium. http://www.scirp.org/(S(oyulxb452alnt1aej1nfow45))/reference/ReferencesPapers.aspx?ReferenceID=1919890

14. European Bioeconomy Panel. (2014). 2nd Plenary Meeting, Summary of Discussions, 12–13 February. https://ec.europa.eu/research/bioeconomy/pdf/bioeconomy-panel-summary-2nd-meeting_en.pdf
15. European Commission. (2012). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Innovating for Sustainable Growth: a Bioeconomy for Europe. COM: Brussels, Belgium. http://ec.europa.eu/research/bioeconomy/pdf/bioeconomycommunicationstrategy_b5_brochure_web.pdf
16. European Commission. (2017). Expert Group Report. Review of the EU Bioeconomy Strategy and its Action Plan. COM: Brussels, Belgium.
17. Ghoshal, P., & Goswami, B. (2017). Cobb-Douglas Production Function For Measuring Efficiency in Indian Agriculture: A Region-wise Analysis. *Economic Affairs*, 62(4), 573-579.
18. Grieu, S., Faugeroux, O., Traoré, A., Claudet, B., Bodnar, J. L. (2011). Artificial intelligence tools and inverse methods for estimating the thermal diffusivity of building materials. *Energy and Buildings*, 43, 543–554. doi.org/10.1016/j.enbuild.2010.10.020.
19. Heijman, W. (2016). How big is the bio-business? Notes on measuring the size of the Dutch bio-economy, *NJAS - Wageningen Journal of Life Sciences*, 77, 5-8. doi.org/10.1016/j.njas.2016.03.004.
20. Hennig, C., Brosowski, A., Majer, S. (2016). Sustainable feedstock potential – a limitation for the bio-based economy?, *Journal of Cleaner Production*, 123, 200-202. doi.org/10.1016/j.jclepro.2015.06.130.
21. Houthakker, H.S. (1955). The Pareto Distribution and the Cobb–Douglas Production Function in Activity Analysis. *The Review of Economic Studies*, 23 (1), 27–31. doi.org/10.2307/2296148.
22. Hu, X., Weng, Q. (2009). Estimating impervious surfaces from medium spatial resolution imagery using the self-organizing map and multi-layer perceptron neural networks. *Remote Sensing of Environment*, 113, 2089–2102. doi.org/10.1016/j.rse.2009.05.014.
23. Johnson, T.G. Altman, I. (2014). Rural development opportunities in the bioeconomy. *Biomass Bioenergy*, 63, 341-344. doi.org/10.1016/j.biombioe.2014.01.028.
24. Kalt G., Baumann M., Lauk C., Kastner T., Kranzl L., Schipfer F., Lexer M., Rammer W., Schaumberger A., Schriefl E. (2016). Transformation scenarios towards a low-carbon bioeconomy in Austria, Energy Strategy Reviews, 13-14, 125-133. https://www.energyagency.at/fileadmin/dam/pdf/projekte/klimapolitik/Del.5.2_Transformation_scenarios_towards_a_low-carbon_bi.pdf

25. Karlović, S., Bosiljkov, T., Brnčić, M., Ježek, D., Tripalo, B., Dujmić, F., Džineva, I., Skupnjak, A. (2013). Comparison of artificial neural network and mathematical models for drying of apple slices pretreated with high intensity ultrasound. *Bulgarian Journal of Agricultural Sciences*, 19, 1372–1377. http://www.agrojournal.org/19/06-30.pdf.

26. Kollo, T., von Rosen, D. (2005). Advanced multivariate statistics with matrices. Dordrecht: Springer. ISBN 978-1-4020-3419-0.

27. Loiseau, E., Saikku, L., Antikainen, R., Droste, N., Hansjürgens, B., Pitkänen, K., Leskinen, P., Kuikman, P. Thomsen, M. (2016). Green economy and related concepts: An overview. *Journal of Cleaner Production*, 139, 361-371. doi.org/10.1016/j.jclepro.2016.08.024.

28. Madamba, P. S. (2002). The Response Surface Methodology: An Application to Optimize Dehydration Operations of Selected Agricultural Crops. *LWT - Food Science and Technology*, 35, 584–592. doi.org/10.1006/fstl.2002.0914.

29. Maran, J. P., & Priya, B. (2015). Comparison of response surface methodology and artificial neural network approach towards efficient ultrasound-assisted biodiesel production from muskmelon oil. *Ultrasonics Sonochemistry*, 23, 192–200. doi:10.1016/j.ultsonch.2014.10.019

30. Mishra, A. K., & Das, L. (2017). Total factor productivity with Cobb-Douglas production function in agriculture: A Study in Cuttack district, Odisha. *South Asian Journal of Marketing & Management Research*, 7(8), 20-25.

31. Montaño, J. J., Palmer, A. (2003). Numeric sensitivity analysis applied to feedforward neural networks. *Neural Computing & Applications*, 12, 119–125. 12: 119–125. doi.org/10.1007/s00521-003-0377-9.

32. Montgomery, D. C. (1984). Design and analysis of experiments. (2nd ed.). New York: John Wiley and Sons. ISBN: 978-0-471-72756-9.

33. Muizniece, I., Timma L., Blumberga, A., Blumberga, D. (2016). The methodology for assessment of bioeconomy efficiency. *Energy Procedia*, 95, 482 – 486. doi.org/10.1016/j.egypro.2016.09.072

34. Pandey, S., Piggott, R. R., Macaulay, T. G. (1982). The elasticity of aggregate Australian agricultural supply: estimates and policy implications. *Austialian Journal Agricultural economics*, 26 (3), 202-219. http://onlinelibrary.wiley.com/doi/10.1111/j.1467-8489.1982.tb00413.x/pdf.

35. Pezo, L. L., Ćurčić, B. Lj., Filipović, V. S., Nićetin, M. R., Koprivica, G. B., Mišljenović, N. M., Lević, Lj. B. (2013). Artificial neural network model of pork meat cubes osmotic dehydration. *Hemijska industrija*, 67, 465–475. http://scindeks.ceon.rs/article.aspx?artid=0367-598X1303465P

36. Pfau, S.F., Hagens, J.E., Dankbaar, B., Smits, A.J.M. (2014). Visions of Sustainability in Bioeconomy Research. *Sustainability*, 6, 1222-1249. doi:10.3390/su6031222.

37. Ramcilovic-Suominen, S, Pülzl H. (2017). Sustainable development – A 'selling point' of the emerging EU bioeconomy policy framework? *Journal of Cleaner Production*, doi:10.1016/j.jclepro.2016.12.157

38. Randall, A. (2008). Is Australia on a sustainability path? Interpreting the clues. *The Australian Journal of Agricultural and Resource Economics*, 52, 77–95.http://ageconsearch.umn.edu/record/117742/files/j.1467-8489.2008.00407.x.pdf.

39. Republic of Serbia Strategy of Agriculture and Rural Development of the Republic of Official Gazette 85/2014, Serbia 2014 - 2024, (2014).

40. Ribeiro, C. O., Oliveir, S. M. (2011). A hybrid commodity price-forecasting model applied to the sugar–alcohol sector. *The Australian Journal of Agricultural and Resource Economics*, 55, 180–198. 10.1111/j.1467-8489.2011.00534.x.

41. Soji-Adekunle, A. R., Asere, A. A., Ishola, N. B., Oloko-Oba, I. M., & Betiku, E. (2018). Modelling of synthesis of waste cooking oil methyl esters by artificial neural network and response surface methodology. *International Journal of Ambient Energy*, 1–10.doi:10.1080/01430750.2017.1423378

42. Stajčić, S., Ćetković, G., Čanadanović-Brunet, J., Djilas, S., Mandić, A., Četojević-Simin, D. (2015). Tomato waste: Carotenoids content, antioxidant and cell growth activities, *Food Chemistry*, 172, 225-232. doi: 10.1016/j.foodchem.2014.09.069.

43. StatSoft, Inc. STATISTICA (data analysis software system), version 10.0. Available from: http://www.statsoft.com/ (2010).

44. Taylor, B. J. (2006). Methods and procedures for the verification and validation of artificial neural networks. New York: Springer Science & Business Media. ISBN 978-0-387-29485-8.

45. Trelea, I. C., Raoult-Wack, A. L., Trystram, G. (1997). Note: Application of neural network modelling for the control of dewatering and impregnation soaking process (osmotic dehydration). *Food Science and Technology International*, 3, 459–465. doi.org/10.1177/108201329700300608.

46. Tumbas Saponjac, V., Girones-Vilaplana, A., Djilas, S., Mena, P., Cetkovic, G., Moreno, D.A., Canadanovic-Brunet, J., Vulic, J., Stajcic, S., Krunic, M. (2014). Anthocyanin profiles and biological properties of caneberry (Rubusspp.) press residues. *Journal of Science of the Food and Agriculture*, 94, 2393–2400. doi.org/10.1002/jsfa.6564.

47. Tumbas Šaponjac, V., Ćetković, G., Čanadanović-Brunet, J., Pajin, B., Djilas, S., Petrović, J., Lončarević, I., Stajčić, S., Vulić, J. (2016). Sour cherry pomace extract encapsulated in whey and soy proteins: Incorporation in cookies. *Food Chemistry*, 207, 27–33. doi.org/10.1016/j.foodchem.2016.03.082.

48. Turanyi, T., Tomlin, A. S. (2014). Analysis of Kinetics Reaction Mechanisms. Berlin Heidelberg: Springer. ISBN 978-3-662-44562-4.

49. Ubilava, D., Holt, M. (2013). El Nino southern oscillation and its effects on world vegetable oil prices: assessing asymmetries using smooth transition models, *The Australian Journal of Agricultural and Resource Economics*, 57, 273–297. doi. org/10.1111/j.1467-8489.2012.00616.x

50. Vanzetti, D., Quiggin, J. (1985). A comparative analysis of agricultural tractor investment models, *Australian Journal of Agricultural Economics*, 29 (2), 122-141. doi.org/10.1111/j.1467-8489.1985.tb00652.x

51. Yuan Z. (2011). Analysis of agricultural input-output based on Cobb–Douglas production function in Hebei Province, North China. *African Journal of Microbiology Research*, 5 (32), 5916-5922. doi.org/10.5897/AJMR11.961.

52. Zabaniotou, A., Rovas, D., Delivand, M. K., Francavilla, M., Libutti, A., Cammerino, A. R., & Monteleone, M. (2017). Conceptual vision of bioenergy sector development in Mediterranean regions based on decentralized thermochemical systems. *Sustainable Energy Technologies and Assessments*, 23, 33-47. doi. org/10.1016/j.seta.2017.09.006

53. Zeng, W., Xu, C., Zhao, G., Wu, J., & Huang, J. (2017). Estimation of Sunflower Seed Yield Using Partial Least Squares Regression and Artificial Neural Network Models. Pedosphere. doi:10.1016/s1002-0160(17)60336-9

Suplement material

Table S1. Input values for the Agrotechnical model, collected from the Global Economy site

	APRO (USD)	*AVAL (billion USD)*	*CPI (-)*	*EMP (%)*	*FER (kg/ha arable land)*	*FPI (-)*
2007	4343.35	3.42	90.39	20.71	152.99	97.32
2008	4888.54	4.28	103.30	25.02	114.09	100.62
2009	4858.93	3.49	108.77	23.71	143.11	106.77
2010	5374.52	3.44	103.39	22.10	115.80	101.37
2011	5693.10	4.27	106.07	21.09	126.20	104.23
2012	4893.95	3.14	75.58	20.88	171.38	91.96
2013	6208.40	3.69	107.75	21.16	154.84	108.51

APRO - agricultural productivity, *AVAL* - agricultural value added, CPI – crop production index, *EMP* - employment in agriculture, *FER* - fertilizer use and *FPI* - food production index.

Table S2. Output values for the Agrotechnical model, obtained from the Serbian economic statistical yearbooks

Year	*GDPA*	*AOUT*	*AGOUT*	*CROP*	*CER*	*ICRO*	*FOR*	*VEG*
2007	10.51	330174	320756	217274	90749	26549	12761	22585
2008	10.99	417832	407406	278825	134575	32309	14147	24879
2009	10.21	407851	396221	265101	110384	30737	14586	28753
2010	10.89	466811	455753	328981	146733	44619	17601	42902
2011	11.38	519960	509125	359103	175221	46655	17184	27246
2012	9.76	502684	491597	324451	138325	52806	18693	28986
2013	10.16	544442	531469	358223	157155	51487	16626	27375
Year	*POT*	*FRU*	*WINE*	*OCRO*	*ANIP*	*ANIM*	*CATT*	*PIG*
2007	8318	33929	21795	587	103482	69001	21439	32955
2008	8314	39324	24758	521	128581	87759	24736	46734
2009	9747	37040	33316	538	131119	95853	26700	51192
2010	17695	41159	17873	399	126772	89606	24797	45392
2011	17870	50860	23713	355	150022	102774	29059	48768
2012	12342	53932	18925	443	167146	113463	31377	58642
2013	19102	58404	27535	540	173246	118893	32407	60983
Year	*EQU*	*SHEEP*	*POUL*	*ANIP2*	*MILK*	*EGG*	*OANI*	*ASERV*
2007	129	6524	7954	34482	25352	8288	842	9418
2008	118	6771	9401	40821	30397	9704	721	10426
2009	105	7363	10523	35266	25480	8649	1137	11630
2010	61	8516	10839	37166	26943	8608	1615	11058
2011	61	9315	15572	47248	34212	10810	2226	10834
2012	377	7801	15266	53684	36777	14678	2229	11087
2013	203	8121	17179	54353	38018	13395	2940	12973

GDPA - GDP share agriculture, *AOUT* - overall agricultural output, *AGOUT* - agricultural goods output, *CROP* - crop production, *CER* - the production of cereals (including seeds), *ICRO* - the production of industrial crops, *FOR* - the production of forage plants, *VEG* - the production of vegetables and horticultural products, *POT* - the production of potato (including seeds), *FRU* - the production of fruits, *WINE* - the production of wine, *OCRO* - other crop products, *ANIP* - the overall animal production, *ANIM* - the production of animals, *CATT* - the production of cattle, *PIG* - the production of pigs, *EQU* - the production of equines, *SHEEP* - the production of sheep and goats, *POUL* - the production of poultry, *ANIMP2* - the overall collection of animal products, *MILK* - milk products, *EGG* - eggs production, *OANI* - other animal products and *ASERV* - agricultural services.

Table S3 ANOVA calculation of collected data (sum of squares)

	GDPA	*AOUT*	*AGOUT*	*CROP*	*CER*	*ICRO*	*FOR*	*VEG*
APRO	0.001	0.140	0.144	0.146	0.185	0.350	0.078	0.053
AVAL	0.002	0.000	0.000	0.000	0.005	0.007	0.009	0.162
EMP	0.003	0.007	0.007	0.002	0.002	0.003	0.001	0.000
FER	0.006	0.003	0.003	0.000	0.002	0.001	0.001	0.117
FPI	0.000	0.027	0.029	0.027	0.050	0.112	0.031	0.002
	POT	*FRU*	*WINE*	*OCRO*	*ANIP*	*ANIM*	*CATT*	*PIG*
APRO	0.307	0.168	0.014	0.036	0.138	0.141	0.079	0.179
AVAL	0.042	0.007	0.019	0.000	0.002	0.000	0.001	0.001
EMP	0.059	0.004	0.029	0.014	0.027	0.036	0.015	0.090
FER	0.056	0.035	0.081	0.045	0.045	0.039	0.034	0.055
FPI	0.001	0.048	0.100	0.029	0.033	0.022	0.013	0.029
	EQU	*SHEEP*	*POUL*	*ANIP2*	*MILK*	*EGG*	*OANI*	*ASERV*
APRO	0.302	0.027	0.286	0.136	0.105	0.176	0.763	0.027
AVAL	0.014	0.001	0.007	0.021	0.026	0.017	0.023	0.004
EMP	0.503	0.006	0.005	0.011	0.008	0.030	0.022	0.010
FER	1.381	0.008	0.063	0.060	0.046	0.114	0.036	0.005
FPI	0.504	0.001	0.044	0.069	0.057	0.109	0.043	0.001

GDPA - GDP share agriculture, *AOUT* - overall agricultural output, *AGOUT* - agricultural goods output, *CROP* - crop production, *CER* - the production of cereals (including seeds), *ICRO* - the production of industrial crops, *FOR* - the production of forage plants, *VEG* - the production of vegetables and horticultural products, *POT* - the production of potato (including seeds), *FRU* - the production of fruits, *WINE* - the production of wine, *OCRO* - other crop products, *ANIP* - the overall animal production, *ANIM* - the production of animals, *CATT* - the production of cattle, *PIG* - the production of pigs, *EQU* - the production of equines, *SHEEP* - the production of sheep and goats, *POUL* - the production of poultry, *ANIMP2* - the overall collection of animal products, *MILK* - milk products, *EGG* - eggs production, *OANI* - other animal products and *ASERV* - agricultural services.

APRO - agricultural productivity, *AVAL* - agricultural value added, CPI – crop production index, *EMP* - employment in agriculture, *FER* - fertilizer use and *FPI* - food production index.

VEGETABLE PRODUCTION IN SAUDI ARABIA: PROTECTION COEFFICIENTS AND RELATIVE EFFICIENCY

*Raga Mohamed Elzaki Ali[1] *, Maha Abdelfattah Ibrahim Saied[2] and Momtaz Nagy Mohamed Elsebaei [3]*

** Corresponding author E-mail: rmali@kfu.edu.sa*

ARTICLE INFO

Original Article

Received: *22 March 2019*

Accepted: *10 June 2019*

doi:10.5937/ekoPolj1902457E

UDC 658.5.012.7:[338.432:634(532)

Keywords:

PAM, Winter Vegetables, Cost Benefit Ratios.

***JEL**: Q10, Q17, Q18*

ABSTRACT

This research investigated the protection coefficients and relative efficiency of winter vegetables by using the domestic and tradable inputs of some selected winter vegetables in Saudi Arabia to explore the economic incentives of local vegetables. The data was analyzed using gross margin and Policy Analysis Matrix (PAM) approach. The outcomes of this research revealed that the eggplant constitutes a highest gross margin as compared to other local vegetables. Moreover, the private price of potato output is more than their parity price. The producers of tomato crops are nearly protected. However, during the study period, the producers of tomatoes, zucchini, and ladyfingers were subsidized and largely competitive on their exports. Furthermore, the study indicated that the government supported eggplant and cucumber vegetables. The research suggests for establishment of international trade collaboration to reduce fees and removal of policy distortions to rise the incentives for vegetable producers.

Introduction

The Kingdom of Saudi Arabia (KSA) is an industrial country; the agricultural production remains as a substitute sector after other economic sectors, such as the petrol sector.

1 Department of Agribusiness and Consumer Science, College of Agriculture and Food Science, King Faisal University, AlAhsa, Hofuf, Saudi Arabia, 31982 and Department of Rural Economics and Development, Faculty of Animal Production, University of Gezira, Sudan, telephone:+966535541089, e-mail: rmali@kfu.edu.sa, ORCID-ID (https://orcid.org/0000-0002-4993-8505?lang=en).

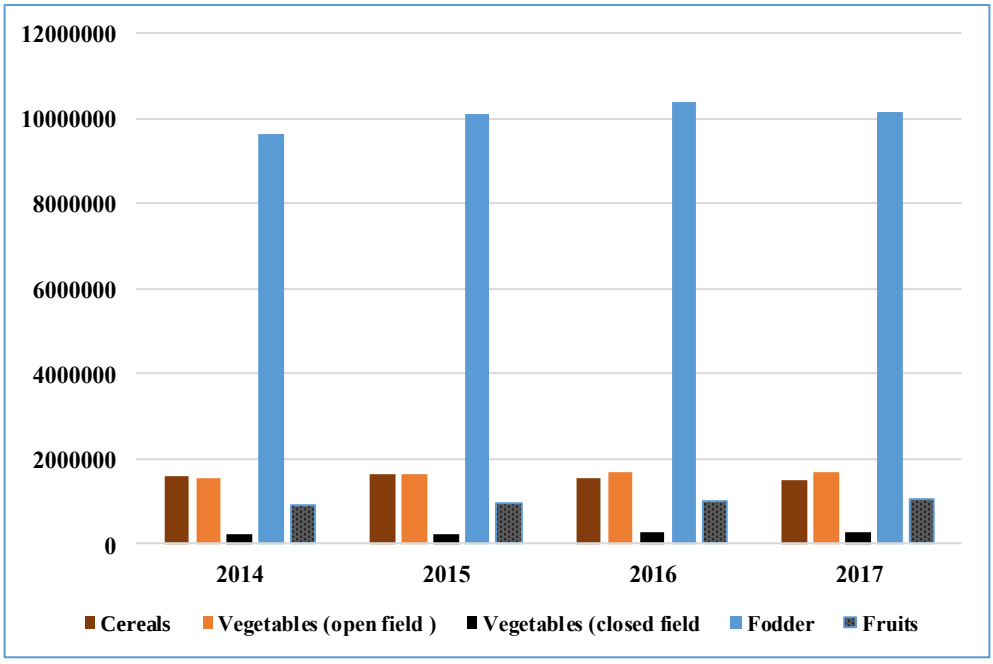
2 Department of Agribusiness and Consumer Science, College of Agriculture and Food Science, King Faisal University, AlAhsa, Hofuf, Saudi Arabia, 31982 and Department of Agricultural Economics, Faculty of Agriculture, Ain Shams University, Cairo, Egypt, e-mail: msaied@kfu.edu.sa, ORCID- ID (https://orcid.org/0000-0001-7779-8004)

3 Department of Agribusiness and Consumer Science, College of Agriculture and Food Science, King Faisal University, AlAhsa, Hofuf, Saudi Arabia, 31982 and Department of Agricultural Economics, Faculty of Agriculture, Ain Shams University, Cairo, Egypt, e-mail: melsebaei@kfu.edu.sa, ORCID ID (https://orcid.org/0000-0002-8308-5868)

The agricultural holdings land in KSA is estimated as more than 34.2 Donum[4] (GAoS, 2018), whereas the total cultivated areas was estimated as one million ha in 2017 (MoEWA 2017) and the total cultivated areas of the vegetable production estimated as 432.8 thousand Donum (GAoS, 2017).

In previous years, the percentage share of GDP acquired from agricultural production (crops, forestry, and fishery) has declined from 2.7% in 2016 to 2.5% in 2017 (MoEWA, 2018). Figure 1 reveals that fodder production constitutes the highest production through (2014 – 2017), this is allied with high activities practicing in the country, while vegetable (closed field) production is estimated to have lower production during the same period (MoEWA, 2018).

Figure 1. Total crop production (ton), KSA, 2014/2017.

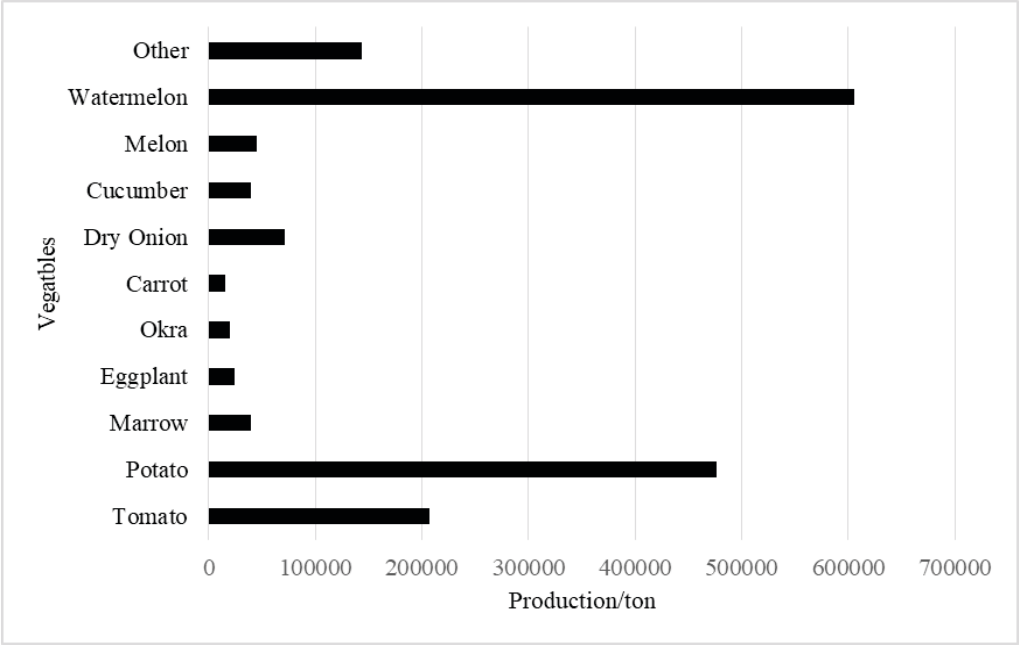


Source: MoEWA, 2018

The most common cultivated vegetables in KSA are tomatoes, potatoes, zucchini, eggplant, okra, carrots, dry onion, cucumber, melon, and watermelon. Figure 2 shows that watermelon comprises the highest production in comparing with other cultivated vegetables and these might be peripherally attributed to the increase of watermelon demand or enhancement of production technologies for watermelon, whereas carrots constitute the lowest production.

4 One donum=1000 square meter, =0.247acre.

Figure 2. Total production of vegetables of open field (ton), KSA, 2017.



Source: MoEWA, 2017

However, as the population increases, the consumption of agricultural crops increases. Keeping in view the gradually increasing population of KSA, the government is making intensive efforts through five-year development plans to develop the agricultural sector (MoEP, 2018). The goals of Saudi Arabia government are seriously involved in the agriculture industry, so, Saudi Arabia government is engaged to practise advanced technologies for crop production to directly satisfy the local demands for food commodities and likewise to fill a gap of food security. At present, the winter vegetable crops in KSA involve various challenges such as economic, climate, and social factors. Most economic factors facing vegetable production are raised because of world prices of vegetables items, as KSA is obviously influenced by the world financial crisis. Besides other economic challenges such as fluctuations of some prices of inputs (the imported fertilizers and seeds) and the price competition of the local production with the imports. The climate factors can be addressed as changing and rising in annual temperatures, sandstorms, and lack of rainfall, which directly or indirectly affect vegetable production. Even though the country has developed infrastructure and other facilities, vegetable production persistently face low productivity per unit area with high costs of production. Besides, the scarcity of water is considered to be the most challenging factor of agricultural production in the country. Moreover, the water demand for agricultural purposes is approximately 84% of the total water demand (MoWE, 2015). The social factors in vegetable production can be categorized as poor management, insufficient extension services, and lack of awareness towards implementation of modern technologies of the cultural practices.

The key goal of this study is to analyse productivity and profitability of winter vegetables and compare the vegetables according to rates of cost benefit ratios (CBRs). Besides, the study examines the economic incentives through analysing the PAM for winter vegetables, focusing on protection coefficients of winter vegetables and ranking them according to relative efficiency (comparative advantages) by using domestic and tradable inputs of some selected winter vegetables in Saudi Arabia.

Literature Reviews

Engaging in an efficient use of resources is a major area of concern across the world. However, most countries are searching for more sustainable practices to save money and to be more competitive (Albornoz and Geraldo, 2018). Numerous PAM approach studies have attempted to analyse the co-efficient and relative efficiency on agricultural crops (e.g. oil and vegetables crops, cereals, and cash) in the world. Rahman et al. (2016) used the PAM approach for maize in Bangladesh, reporting that maize production is competitive in Bangladesh and can be a good substitute for maize import, even when the international price of maize varies slightly, and further indicated that maize is profitable at the farm. Recently, Rashid and Matin's (2018) study using PAM for selected pulse crops found that revenue and input transfer were negative, which indicated that government policies negatively affect pulse producers and implemented an input subsidy policy in the crop sector to offset the higher cost of production.

Furthermore, research performed by Quddus and Mustafa (2011) in Pakistan to measure the advantages of most production crops, reported that the efficiency of economics for the production of wheat did not receive any protection and the prices received by farmers were below the import parity prices. Moreover, it confirmed that cotton production is efficient in term of economic prices. Similarly, Javed et al. (2006) argued that cotton crop is taxed in Pakistan. Temesgen et al. (2014) using PAM to analyse rice in Ethiopia, committed that the net effect of policy intervention is reduced profitability of rice production, and a removal of policy distortions would substantially increase profitability and rice farmers would receive lower revenue than they would have in the absence of policy distortions. Moreover, Yao (1997a) found that rice has an obvious comparative advantage over its rival crops, however Hoang and Tran (2019) study the comparative advantages of alternative crops of rice, coconut, and pomelo using PAM and confirmed that, pomelo fruit obtains the strongest competitiveness followed by coconut and rice; respectively. Scheiterle and Birner (2018) used the PAM approach to examine the comparative advantage of maize production in Ghana and confirmed that maize crop has the prospective to increase productivity to safeguard food security**.** Moreover Lateef et al. (2017), applying the PAM approach for analysing the influence of investment in agricultural scientific research on some cereal crops, argued that the investment was profitable for domestic producers of the wheat.

Fang and Beghin (2000) stated that fruits and vegetable markets are free markets in China with no explicit price distortions. A previous study performed by Atiya (2007) examined competitiveness and comparative advantages of tomatoes in Syria,

measuring that the tomato sector is fairly protected and has benefited from the subsidies concerning irrigation and the protection of the local production by imposing high tariff quota on tomato imports, according to the agricultural calendar. Ul-Mulk and Khan (2013) investigated PAM of winter vegetables and established that pea production is nationally profitable for import substitution; however, it is not profitable for export promotion. Furthermore, Arsanti and Bohme (2008) clarified that vegetable farming is profitable with regard to the private and social profits, as well as competitive and comparative advantages.

Research Methods

Study Area and Data Collection

The present study was conducted in the Al-Hasa region (in western KSA) where a bulk of the crop production is cultivated in this region. In the Al-Hasa region, rainfall occurs in the winter season; consequently, the study selected winter vegetables (open filed system), named as tomatoes, eggplants, zucchini, cucumber, ladyfinger, and potatoes to satisfy the study objectives. The study depends on secondary data, which are collected from the relevant institutions interrelated to current study during the 2016 – 2017 season. The information and data covering the winter vegetables is collected to achieve the objectives of the study. Specific data used for constructing a PAM table were collected that comprised the information on both tradable and non-tradable inputs. Tradable inputs comprise the inputs which can be traded internationally in the world market (imported fertilizers, pesticides, insecticides, etc.) while the non-tradable inputs are mainly domestic factors that are not traded internationally (labour items, land, local capital, etc.). Stoforos et al. (2000) revealed that most inputs come in as a mixture of some tradable and non-tradable components and must be disaggregated into their respective tradable and non-tradable components. This study assembles the data regarding the outputs of vegetables, imported inputs items (seeds, labour, water, fertilizers, etc.) and market prices for inputs and outputs with the supplementary data such as exchange rate, import, and export tariffs.

Analytical Techniques

Several techniques of data analysis are applied in this study. Dynamic tool approves to estimate both vegetable productivity and gross margin (GM). The gross margin approach is a common dynamic approach to estimate crop profit. The gross margin formula estimates by subtracting the total variable costs of winter vegetables from gross revenues as exposed in equation (1).

$$(1)\quad GM_w = P_u Q_u - \sum P_i Q_i = GR_w - \sum TVC_w$$

Whereas:

GM_w = Gross margin for winter vegetables.

P_u= Price of output produce and Q_uQ_u = the total quantity of output produce per hectare.

P_i = price of input used (i) and Q_iQ_i = quantity of inputs used (i).

GR_w = Gross revenues for winter vegetables calculated by multiplying the out quantity of yield produced by individual winter vegetable by unit price.

TVC_w = Total variable costs for winter vegetables are calculated by multiplying the quantity of vegetable inputs by unit prices. The vegetable net returns are estimated by subtracting the total cost of vegetables from the vegetable gross revenues, as shown in equation (2):

$$(2)\quad VNR_w = GR_w - TC_W$$

Whereas: VNR_w = winter vegetables net reruns, TC_W = Total cost of winter vegetables. Moreover, the study aims to estimate the CBR of vegetables. Thus, CBR is computed as:

$$(3)\ CBR = \frac{GR_w}{TC_W}$$

To achieve the objective of the study for estimating the vegetable protection coefficients and relative efficiency, the table of PAM approach constructs and analyses by GAMS software program syntax. Priyanka et al. (2015) confirmed that PAM is a widely modified policy research analysis, which is a computational framework, developed by Monke and Pearson (1989) and amplified by Masters and Winter-Nelson (1995), for input measuring by using production efficiency, advantage comparative, and the government interventions degree. In addition, the PAM tool assists investigators with conveying the distortions and inefficiencies of a policy, thereby, to suggest the required policy changes for profitability of an industry or a sector or a country (Paulraj et al., 2015). Table 1 shows a PAM model constructed in this study following the basic technique established by Monke and Pearson (1989).

Table 1. Origination of PAM table

Prices (Accounts)	Revenue	Value of Inputs		Profit (surplus in SR)
		Input cost (tradable input)	Domestic costs (non-tradable inputs)	
Private	A	B	C	N
Social	D	E	F	O
Divergences (policy transfer)	G	H	I	P

Prices (Accounts)	Revenue	Value of Inputs		Profit (surplus in SR)
		Input cost (tradable input)	Domestic costs (non-tradable inputs)	
*Note: Private profit: N=A-(B+C); Social profit: O=D-(E+F); output transfer: G=A-D; Input transfer: H=B-E; Factor transfer: I=C-F; Net policy transfer: P=N-O. Nominal protection coefficient (NPC) on tradable outputs (NPCO) = A/E, on tradable inputs (NPCI) = B/F. Effective protection coefficient (EPC) = (A - B)/(E - F). Domestic resource cost ratio (DRC) = F/ (D-E). Private profit coefficient (PPC) = (A -B - C)/(E - F - G).				

Source: Monke and Pearson (1989).

Kanaka and Chinnadurai (2013) stated that the private price is actually the market price, and concerning the social price, assuming social prices would be difficult. Meanwhile, the most difficult accountabilities for PAM construction are estimating social prices for inputs and outputs (Yao 1997b). To compute social prices in this study, the world prices—import price in terms of cost of insurance and freight (CIF) prices for importable and the export prices in terms of free on board (FOB) prices for exportable) are used as the reference prices in the study. These two prices are converted to local price, Saudi Riyal (SR) at the shadow exchanges rate using the foreign exchange rate in $ (1$ = 3.75 RS). Monke and Pearson (1989) stated that world (social) prices denote the government's choice to permit consumers and producers to import, export, or produce commodities domestically, moreover, Sabaouhi et al. (2011) argued that social prices are constraints that limit the agricultural policy, which can affect the quantities that are imported or exported.

Table 1 addresses the important indicators for policy analysis such as: nominal protection coefficient (NPC) used to estimate the vegetable coefficient and domestic resource cost (DRC) and private profit coefficient (PPC) indicators, which are used to estimate the relative efficiency of winter vegetables in this study. Masters and Winter-Nelson (1995) define DRC as the shadow value of non-tradable factor inputs used in an activity per unit of tradable value added. The NPC calculates for both output (NPCO) and input (NPCI) items. Furthermore, the study used the effective protection coefficient (EPC) to measure the total effects of policy intervention in both input and output markets.

Results and Discussion

The results in Table 2 reflect that the total cultivated areas are highly significant with the vegetable productions ($r = 0.98$, at level $p < 0.01$), as well as tomatoes estimate the highest share of cultivated area (56.5%), hence, the highest share of production (57.8%) as compared to the winter vegetables. Whereas, cucumber records the lowest share of cultivated areas and production (0.8% for both). This result supports that the increasing in the total cultivated areas is linked to additional production of vegetables. Nevertheless, eggplant constitutes the highest productivity per hectare (22.6/ton/ha), while ladyfinger comprises the lowest productivity per ha: (15.3 ton/ha) during the study period. Likewise, the study's result exposes a slightly dissimilar area of productivity with winter vegetables.

Table 2.Comparison analysis of winter vegetables productivity in Al-Hasa Region, 2015/2016.

Winter vegetables	Cultivated areas	% share of cultivated areas	Production /ton	% share of production	Productivity ton / hectare*	Price of ton in SR
Tomatoes	497	56.5	9350	57.8	18.8	1200
Eggplant	98	11.1	2211	13.7	22.6	1000
Zucchini	131	15	2139	13.2	16.3	1300
Cucumber	7	0.8	137	0.8	19.6	1400
Ladyfinger	129	14.6	1973	12.2	15.3	1500
Potatoes	17	2	366	2.3	21.5	1400
Total	879	100	16176	100	r = 0.98 ** , (p<0.01)	

Source: MoAEW (2017) and authors calculations.

It is obvious that from Table 3, the eggplant estimates a higher gross margin (SR 12296) while the zucchini and the ladyfingers comprised the lowest gross margins, SR 8981 and SR 8565, respectively. According to the CBRs values, the cucumber estimated a higher CBR (2.52), while the eggplant comprised the lowest CBR (1.70).

Table 3. Gross margins balance and CBR of winter vegetables in Al-Hasa Region in SR**.**

Winter vegetables	Variables cost (SR / ton)	Returns (SR/ ton)	Gross margins (SR)	Total cost (SR)	Net returns (VNR_w)	CBR
Tomatoes	10630	22575.45	10630	11752	10823.45	1.92
Eggplant	12296	22561.22	12296	13258	9303.22	1.70
Zucchini	8981	21226.72	8981	9020	12206.72	2.35
Cucumber	10862	27400	10862	10862	16538	2.52
Ladyfinger	8565	22941.86	8565	9582	13359.86	2.39
Potatoes	12918	30141.18	12918	13452	16689.18	2.24

Source: MoAEW (2017) and authors calculation.

Production Coefficients of Winter Vegetables

Fang and Beghin (2000) clarified that the three coefficients used to compare the extent of policy transfers or policy incentives between the agricultural commodities are named as NPCI, NPCO, and EPC. Additionally, these coefficients measure the degree of policy transfer from product market output and tradable input policies (Ul-Mulk and Khan 2013). The outcome values of production coefficients of winter vegetables in this study are illustrated in the Table 4; the values of NPC are diverging among the winter vegetables. The NPCO values are less than one for most of the winter vegetables (83%), which indicates that the private price of outputs of the tomatoes, eggplant, zucchini, cucumber, and ladyfinger is less than their parity, and hence, the vegetable producers are negatively protected for their production. Whereas, the potatoes estimate NPC > 1 (for both input and output), indicating that potato producers were receiving more than the world reference price due to subsidy supplied by the government to potato producers. Likewise, this shows that the private price of potato output is more than its parity price;

hence, the producers of potatoes are positively protected for their production. Rebollar-Rebollar et al. (2011) argued that production of potatoes in the southwest of the State of Mexico was profitable and competitive. Subsequently, the study results revealed that the NPCO of tomatoes is close to one, suggesting that tomato producers are nearly protected through the existing policy.

Table 4. Production coefficients of winter vegetables in Al-Hasa region (2016/2017).

Winter vegetables	Protection coefficients		
	NPCO	NPCI	EPC
Tomatoes	0.90	0.17	0.172
Eggplant	0.33	1.39	1.38
Zucchini	0.65	0.52	0.51
Cucumber	0.70	1.16	1.17
Ladyfinger	0.31	0.31	0.30
Potatoes	2.80	1.01	1.01

Source: GAMS Model results.

During the study period, the tomatoes, the zucchini, and the ladyfingers show NPC < 1 (for both inputs and outputs), which indicates that the producers of these vegetables are subsidized and had been largely competitive on exportable basis. Furthermore, the eggplant and the cucumber imply NPCI > 1, thus suggesting that the government policies are direct to reduce the input costs and reduce the average market prices of producers of theses vegetables to the level below the world prices, which indicates that the government provides efforts to support eggplant and cucumber vegetables. The declining value of EPC indicates an increasing rate of competitiveness of crops and may plausibly due to adoption of advanced production technology (Kanaka and Chinnadurai 2013). From Table 4, the EPC_s values are greater than 1 for the eggplant (1.38), cucumber (1.17) and potatoes (1.01), which suggests that government policies provide positive incentives to these vegetable producers in the regions, specifically, the eggplant vegetable (EPC = 1.38).

Relative Efficiency of Winter Vegetables

It is clear that from the Table 5, the PPC values for eggplant (1.40), cucumber (1.17), ladyfinger (1.30) and potatoes (1.01) are much greater than the respective competing other vegetables, which indicates that there are comparative advantages in producing other vegetables, rather than eggplant, cucumber, ladyfinger, and potatoes. Likewise, this indicates that the cost of resources of these vegetables, such as land, labour, and capital, when valued at their private or social shadow prices, exceeds the value added when measured at its opportunity cost. Furthermore, this result indicates that eggplant, cucumber, ladyfingers, and potatoes were produced inefficiently in the region during the study (PPC_s >1). Elzaki et al. (2011), argued that the cereal crops in Sudan are produced inefficiently, as their DRC and PPC values are greater than one.

Table 5. Relative efficiency and ranking of winter vegetables in Al-Hasa region, 2016/2017.

Vegetables	Indicators		Ranking of vegetables DRC or PPC < 1	
	DRC	PPC	DRC	PPC
Tomatoes	**0.79**	**0.17**	**5**	**1**
Eggplant	**0. 31**	**1.40**	**3**	**6**
Zucchini	**0. 69**	**0.51**	**4**	**2**
Cucumber	**0. 26**	**1.17**	**2**	**4**
Ladyfinger	**2.90**	**1.30**	**6**	**5**
Potatoes	**0.14**	**1.01**	**1**	**3**

Source: GAMS Model results

The different resulted values of the DRC in the Table 5 confirms that the DRC values rely on the decisions made around the agricultural policy intervention and adjustment instruments toward the studied winter vegetables. From the study results, the use of domestic factors of the ladyfingers is socially not profitable (DRC>1), so, this indicates that the costs of the ladyfingers are more than foreign costs or savings. So, the ladyfinger should not be produced domestically and should be imported instead. However, the other winter vegetables show social profitability (DRC<1). This indicates that the winter vegetables (tomatoes, eggplant, zucchini, cucumber, and potatoes) should be produced domestically and should be exported, rather that imported. The study accomplished by FAO (2004) estimated the comparative advantages of Syrian agro-food commodity and confirmed that in terms of return to domestic factors invested at the social price, olives, tomatoes and oranges have the lowest DRC. Al-Hiary (2015) found that the domestic resource cost (DRC) for olive crops was greater than one, and that there is no efficiency in the use of the local resources, therefore, there is no comparative advantage for production of olive crops in Jorden.

According to the PPC, the priority values for cultivating winter vegetables are motivated by ranking with declining order. Therefore, the vegetable producers are directed to produce tomatoes, zucchini, potatoes, cucumber, ladyfingers, and eggplant accordingly, which is supported by the PAM results in Table 5.

Concluding Remarks

The study concluded that the private price of outputs of the tomatoes, eggplant, zucchini, cucumber, and ladyfinger is less than its parity; hence, the vegetable producers are negatively protected for their production. Moreover, the potato producers were receiving more than the world reference price due to subsidy supplied by the government to the potato producers, and producers of potatoes are positively protected for their production. The tomato producers are nearly protected through the existing government policy. The study also concluded that the eggplant, cucumber, ladyfingers, and potatoes are produced inefficiency in the region during study period, furthermore, according to the

PPC, the priority of values for cultivating winter vegetables is motivated by ranking with declining order, therefore, the vegetable producers are directed to produce tomatoes, zucchini, potatoes, cucumber, ladyfingers, and eggplant accordingly. The improvement of the suitable agricultural policy towards the improvement of the production operations is highly needed. It is also desirable to strengthen the international trade cooperation that aims to reduce the fees and facilitate vegetable production, and the removal of policy distortions to raise incentives for the producers is highly recommended for increasing the production of the winter vegetables.

Acknowledgment

The authors greatly extend thanks to Deanship of Scientific Research at King Faisal University, Al-Ahsa, Saudi Arabia for financial support under Nasher track grant number (186038). In addition, the authors thanks the Ministry of Environment, Water and Agriculture, (MoEWA) in KSA for providing secondary data; special appreciation is expressed to the members of technical unit in the ministry.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Al-Hiary, M.A. (2015). *Assessing competiveness of Jordanian olive production policy analysis matrix* (PAM), https://www.researchgate.net/publication/281030415_.
2. Arsanti, I.W. and Böhme, M.H. (2008). *Evaluation of Profitability and Competitiveness of Vegetable Farming Systems In Upland Areas of Indonesia*. J. Acta Hortic. 794: 49-54, https://doi.org/10.17660/ActaHortic.2008.794.5
3. Atiya, B. (2007). *Competitiveness and comparative advantage of tomato in Syria.* The Mediterranean Conference of Agro-Food Social Scientists. Barcelona, Spain, April 23rd - 25th, 2007. http://www.econ.core.hu/doc/felhiv/MEDCON-Full Program pdf
4. lzaki, RM, Elamin E. and H. SA. (2010). *Poverty and agricultural development in Sudan*. International journal of Sudan Research, 1(1): 65-081. http://www.wasd.org.uk/download/poverty-and-agricultural-development-in-sudan/
5. Fang, C. and Beghin, J. C. (2000). *Food Self-Sufficiency, Comparative Advantage, and Agricultural Trade: A Policy Analysis Matrix for Chinese Agriculture*. CARD Working Papers. 270. http://lib.dr.iastate.edu/card_workingpapers/270
6. Food Agricultural Organization. FAO. *Assistance for capacity building through enhancing operation of the national Agricultural Policy Centre.* FAO Projects GCP/SYR/006/ITA and TCP/SYR/29006 (A). Retrieved from http://www.fao.org/3/ad923e/ad923e00.htm (2004).
7. The Food and Agriculture Organization of the United Nations (FAO), *Statistics and Information Branch*. Fisheries and Aquaculture Department. Retrieved from www.fao.org/fishery/statistics/en (August, 2018).

8. General Authority of Statistic GAoS .(2017). *Agricultural census*, 2017. Riyadh. KSA. https://www.stats.gov.sa/en/22
9. General Authority of Statistic GAoS. 2018. *Agricultural Census, 2018*. Riyadh, KSA. https://www.stats.gov.sa/en/22.
10. Hoang, V. V. and Tran, K. T. (2019) Comparative Advantages of Alternative Crops: A Comparison Study in Ben Tre, Mekong Delta, Vietnam. AGRIS on-line Papers in Economics and Informatics. 11(1): 35-47. DOI 10.7160/aol.2019.110104.
11. Javed, M.S.; Hassan, S.; Adil, S.A and Ghafoor, A .2006. *Comparative advantage of cotton production & its policy implication in Pakistan.* Pak. J. of Agri. Sci. (43) 3: 193-196.
12. Kanaka, S and Chinnadurai, M .(2013). *The policy analysis matrix of rice cultivation in India*. European J. of Physi. and Agric. Sci. 1(1): 8-19.
13. Lbornoz, C. A and Geraldo, L. F. (2018). *Trajectory Design for Efficient Crop Irrigation with a UAV*. DOI: 10.1109/CCAC.2017.8276401
14. Scheiterle, L. and Birner, R. (2018). *Assessment of Ghana's Comparative Advantage in Maize Production and the Role of Fertilizers. Sustainability*. 10(11), 4181; https://doi.org/10.3390/su10114181.
15. Lateef, M .A ;.Kasar, A. D and A. A. Mudhi . (2018). *Investment priorities in the agricultural scientific research in Iraq using policy analysis matrix approach cereals crops (Rice Amber Al Baraka Buhooth2, Corn Synthetiic Genotype Fajer 1, And Wheat Buhooth).* The Iraqi Journal of Agricultural Sciences. 48 (3): 797-811.
16. Sabaouhi, M.; Ghanbari, A.; Tavassoli, F. R. A. and Esmaeilian, Y. (2011). *Economic evaluation and Applications of the Policy Analysis Matrix of sole and intercropping of leguminous and cereals Case study: Shirvan city-Iran.* African Journal of Biotechnology. 10(78): 17948-17953. http://www.academicjournals.org/AJB
17. Masters, W. A., & Winter-Nelson, A. E. (1995). *Measuring the comparative advantage of agricultural activities: Domestic resource costs and the social cost-benefit ratio*. American Journal of Agricultural Economics, 77(2), 243-250. https://doi.org/10.2307/1243534
18. Ministry of economic planning. MoEP, (2018). *Summary and Priorities of the Tenth Development Plan (2015-2019*). Riyadh, Saudi Arabia. https://www.mep.gov.sa/en/
19. Ministry of Environment, Water and Agriculture. MoEWA. (2017). *Statistical Books.* Riyadh, KSA. https://www.stats.gov.sa/en/929-0
20. Ministry of Environment, Water and Agriculture .MoEWA. (2018). *Statistical Yearbook of 2017*. Agriculture, water and environment, Issue Number: 53, chapter 5, Riyadh, KSA. https://www.stats.gov.sa/en/929-0
21. Monke, E. and Pearson, S. (1989). *The Policy Analysis Matrix for Agricultural Development*; Cornell University: Ithaca, NY, USA, 1989; ISBN 0-8014-9551-2.
22. Ministry of water and electricity. MoWE.2015. *Statistical report*. Centre of statistics and information. Ministry of water and electricity, Riyadh, KSA.

23. Quddus, M. A. and Mustafa, U. (2011). *Comparative Advantage of Major Crops Production in Punjab: An Application of Policy Analysis Matrix.* Lahore Journal of Economics, Department of Economics, The Lahore School of Economics, vol. 16(1): 63-94.

24. Mulk. U. Sardar and Khan,M.. (2013). *Comparative advantage and competitiveness of pea crop in Khyber Pakhtunkhwa*. Sarhad J. Agric. 29(2): 299-306.

25. Paulraj, A. P., Chandrasekaran, M. and Easwaran, N. (2015*). Policy analysis matrix approach: Applications, strengths and weaknesses*. Agric. Research J. 52(3): 2395-1435.

26. Rahman, S.; Kazal, M.M.H.; Begum, I.A.; Alam, M.J. (2016). *Competitiveness, Profitability, Input Demand and Output Supply of Maize Production in Bangladesh*. Agriculture. https://doi.org/10.3390/agriculture6020021

27. Rashid, M. D A. and Matin, MA. (2018). *The policy analysis matrix of pulse crops production in Bangladesh*. Bangladesh J. of Agric. Research. 43(1):18-24.109-123. DOI: 10.3329/bjar.v43i1.36185

28. Rebollar-Rebollar, S.; Morales-Hernández, J. L.; Hernández-Martinez, J.; Guzmán-Soria , E. and Rebollar-Rebollar, A. (2011). *Profitability of Potato (Solanum tuberosum L.) Crop in the Southwest of the State of Mexico*. Tropical and Subtropical Agroecosystems. 14 (3): 919-925. www.revista.ccba.uady.mx/ojs/index.php/TSA/article/view/1055/608

29. Stoforos C., Kavcic S., Erjavej E., Mergos G. (2000) A*gricultural policy analysis model for Slovenian agriculture*. in: Giannias D.A. (ed.), Mergos G. (ed.). Selected readings on economies in transition. Chania : CIHEAM, p. 91-102. (Cahiers Options Méditerranéennes; n. 44). http://om.ciheam.org/om/pdf/c44/00800090.pdf

30. Temesgen, Y.; Tilahun D. and Belay, B. (2014). *Production Expansion, Competitiveness and Comparative Advantage of Upland Rice Production: Case of Fogera and Libokemekem Plain in Ethiopia*. The International Journal of Applied Economics and Finance, 8: 43-50.DOI: 10.3923/ijaef.2014.43.50

31. Yao, S. (1997a). *Comparative Advantages and Crop Diversification: A Policy Analysis Matrix for Thai Agriculture*. Journal of Agricultural Economics 48 (2): 211-222. https://doi.org/10.1111/j.1477-9552.1997.tb01146.x

32. Yao, S. (1997 b). *Rice Production in Thailand seen Through a Policy Analysis Matrix.* Food Policy. 22 (6): 547–560. https://doi.org/10.1016/S0306-9192(98)00007-4

BENCHMARKING AGRICULTURAL AND OTHER ENVIRONMENTAL PERFORMANCES OF CENTRAL AND EAST EUROPEAN COUNTRIES

Vladimir Radivojević[1], Bojan Krstić[2], Miloš Krstić[3], Miloš Petković[4]

**Corresponding author E-mail: vladimir.radivojevic@ymail.com*

A R T I C L E I N F O

Original Article

Received: *26 May 2019*

Accepted: *13 June 2019*

doi:10.5937/ekoPolj1902471R

UDC 005.32:[338.43+574(4-191.2:4-11)

Keywords:

environmental performances, agricultural performances, CEE countries, top 16 Europan countries

***JEL**: Q18, Q56, O57*

A B S T R A C T

Enhancing agricultural and other environmental performances has become an essential part of sustainable development policy in countries around the globe. Although Europe is considered as a global leader in the environmental competitiveness, the national economies within Europe region achieve different results in this field. The purpose of this paper is to evaluate current agricultural and other environmental performances of sixteen Central and East European (CEE) countries, but also to identify critical determinants for its improvement in the future period. The research is conducted through comparative analysis, benchmarking method, and correlation analysis. The data basis includes the Environmental Performance Index (2018). The research findings suggest the inferiority of CEE countries in the comparison with the best-ranked European countries. The paper contributes to the sustainability literature and could serve as a practical guide in the process of formulating the development policies connected with agricultural and other environmental performances in CEE countries.

1 Vladimir Radivojević, PhD, Research Associate, Head of Financial Services, Ministry of Defense of the Republic of Serbia, Regional centre Niš, Beogradska street, 18000 Niš, Serbia, +381 18 456 1926, vladimir.radivojevic@ymail.com, ORCID ID https://orcid.org/0000-0002-3928-0623

2 Bojan Krstić, PhD, Full Professor, University of Niš, Faculty of Economics, Trg Kralja Aleksandra Ujedinitelja no. 11, 18000 Niš, Serbia, +381 18 528 685, bojan.krstic@eknfak.ni.ac.rs, ORCID ID https://orcid.org/0000-0003-4597-6819

3 Miloš Krstić, PhD, Research Associate, University of Niš, Faculty of Science and Mathematics, Višegradska street no. 33, 18000 Niš, Serbia, +381 18 453 68 99, krsticmilo3@gmail.com, ORCID ID https://orcid.org/0000-0002-5256-8613

4 Miloš Petković, MSc, Teaching Assistant, Singidunum University, Faculty of Business in Belgrade, Danijelova street no. 32, 11000 Belgrade, Serbia, +381 11 30 93 220, mpetkovic@singidunum.ac.rs, ORCID ID https://orcid.org/0000-0002-1989-0504

Introduction

The entire humanity's existing system depends on the well-being of the environment. Clean air, water, plants, and food are preconditions for human health and prosperity. The main characteristic of the relationship between the environment and humanity is their interdependence. The environment affects the humanity, as well as humanity affects the environment. Consequently, the symbiosis of these interdependent categories is very important for mutual development.

Current environmental problems arise mostly from the expanding need for industrialization as a prerequisite for achieving economic growth, but also from the increasing need for urbanization as a necessity of the modern age population around the world. Furthermore, a growing global trend of industrialization and urbanization particularly in the last two decades has led to serious environmental problems worldwide. Global warming, air pollution, acid rain, urban sprawl, waste disposal, and water pollution are only some of them. These environmental problems have a significant impact on every human, plant, and animal life, no matter which part of the world or nation belongs to.

There is a clear strategic commitment of each country that advocates the concept of sustainable development to improve its environmental performance. Governmental regulations, economic measures, and applying environmental management strategies in the corporations are widespread tools that are used for this purpose in the contemporary business environment. Also, there are great efforts around the world in educating people about the importance of their small actions in the achieving national and global environmental goals. However, the awareness and the ability to implement these measures is not the same in all countries. Due to disparities in the achieved level of economic and social development, there are significant differences in agricultural and other environmental performances of particular countries.

The European Union (EU) has integrated environmental issues into the *Common Agricultural Policy* in order to suppress the risk of environmental degradation and improving the sustainability of agrarian ecosystems. According to the European Commission (2018), the *Common Agricultural Policy beyond 2020* with the budget of €365 billion in the period 2021-2027 provides principles that are compatible with environmental requirements, but also measures that promote the development of agricultural practices preserving the environment and safeguarding the countryside. The interdependence of agriculture and environment in the EU stems from the fact that even three out of the nine specific objectives in the future agriculture policy of the EU will refer to the environment and climate, through covering the issues such as climate change, natural resources (water, soil, and air), biodiversity, habitats, and landscapes.

The purpose of this paper is to determine the achieved level of Central and East European (CEE) countries regarding to agricultural and other environmental performances. The research methodology is based on the benchmarking method, i.e. on the evaluation of all environmental performances of CEE countries in comparable perspective with

European countries that achieve best results in this field. The aim is to identify critical factors for environmental development in CEE countries, and to establish a dynamic framework for each of these factors from the aspect of their urgency. An additional goal of the research is to examine the correlation between the results achieved by CEE countries regarding to agricultural and environmental performances. The research findings are useful for all those who influence the formulation and implementation of the agricultural and environmental policy in CEE countries.

The paper is structured in four segments. Theoretical background and literature review dealing with the environmental sustainability, its interdependence with other economic and social variables, but also the methodologies for its evaluating are presented in the first segment. The methodology and data basis are explained in the second segment. The results and discussion are submitted in the third segment. The final segment of the paper contributes conclusions.

Theoretical background and literature review

Environmental sustainability as a crucial element of sustainable development occupies a central place in considering the long-term perspective of human survival and progress. Due to such important role in the general sustainability of humanity, there is a vast economic literature on the different aspects of the environmental policy and performances. Some of them refer to the country (Jin, Zhou, Zhou, 2014; Ilić, Krstić, Jovanović, 2017; Radivojević, Krstić, Stanišić, 2018) or corporate (Wagner, Schaltegger, 2004; Gunarathne, Lee, 2015; Lisi, 2015; Dixon-Fowler et al., 2017, Latan et al., 2018; Arbolino et al., 2018) environmental performances and the methodology for evaluation of the development level in this field (Dietz, Rosa, York, 2007; York, 2009; Bogićević, Domanović, Krstić, 2016; Dizdaroglu, Yigitcanlar, 2016; Hallstedt, 2017; Fraccascia, Giannoccaro, Albino, 2017; Maceno et al., 2018). Some of them survey interdependence of environmental sustainability with other economic and social variables.

Numerous theoretical and empirical studies examine the relationship between environmental sustainability and economic growth (Bo, 2011; Ahmed, Long, 2012; Almeida et al., 2017). The theory of Kuznets (1955) termed „Environmental Kuznets Curve Hypothesis“ (EKC hypothesis) is one of the most influential theories when it comes to the relationship between these categories. The main conclusion of the EKC hypothesis proves that the relationship between economic growth and its environmental impacts is not linear, and it could be illustrated by an inverted U-shaped curve. An essential reason for such interdependence of these categories is reflected in the idea that „economic growth causes negative ecological impacts that initially tend to increase as the economy grows, until they reach a turning point, where the environmental damage stabilizes and begins to fall while economic growth continues“ (Almeida et al., 2017, p. 119).

Similar results are obtained in the studies that test the relationship between various pollutants and economic variables such as income, economic growth, and economic development. For example, the impact of economic growth on CO_2 emissions is

examined in various countries (Zhao et al., 2013), Pakistan (Ahmed, Long, 2013), Mongolia (Ahmed, 2014), and Australia (Marques, Fuinhas, Leal, 2018). Jha and Murthy (2003) consider interdependence between global environmental degradation and economic development in 174 countries. Li et al. (2014) emphasize the relationship between farmland conversion and economic growth in post-reform China. Lopez and Mitra (2000) examine the implications of corruption and rent-seeking behavior by the government for the relationship between pollution and growth. The results of all these studies confirm the existence of the EKC hypothesis among the variables both in the long-run and short-run. Similar research findings are summarized in the study of Mukherjee and Chakraborty (2013) when it comes to the relationships among environmental quality, human development, and political and governance regimes in a cross-country framework.

Continuous monitoring and evaluating agricultural and other environmental performances at different levels are important preconditions for the implementation of appropriate measures and policies for its improvement. There is a large body of literature attend to the measuring these performances. One of the widely accepted methodologies for evaluating environmental performances (that includes agriculture as one of its issues) of countries is based on the Environmental Performance Index. It is a composite index developed by environmental experts at the Yale University and Columbia University, which ranks countries around the globe according to policy objectives, issue categories, and indicators corresponding to environmental health and ecosystem vitality.

Methodology and data basis

The purpose of this paper is to evaluate the agricultural and other environmental performances of CEE countries. The research is conducted through benchmarking the performances of CEE countries with the performances of European countries that achieved the best results in environmental sustainability. Evaluating of agricultural and environmental performances and formulating policy and strategies using the benchmarking method is a challenging task for researchers. It is valuable method that allows the national economy to identify critical factors that contribute to superior performances. The ambition of benchmarking method in this paper is to establish a framework within which indicators and best practices would be examined in order to determine issue categories of CEE countries' environmental performances that can be improved.

The group of CEE countries consists of following sixteen countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech R., Estonia, Hungary, Latvia, Lithuania, Montenegro, N. Macedonia, Poland, Romania, Serbia, Slovak R., and Slovenia. A benchmark group of countries is composed of following sixteen best-ranked European countries in terms of environmental performances: Austria, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Luxembourg, Malta, Norway, Spain, Sweden, Switzerland, and the United Kingdom.

The data basis for the research consists of the secondary data of the *Environmental Performance Index (EPI)* published by *Yale Center for Environmental Law and Policy of Yale University and Center for International Earth Science Information Network of Columbia University* in the annual report (2018). The 2018 EPI ranks 180 countries on 24 environmental performance indicators within 10 issue categories (that are grouped in two policy objectives – „Environmental health" and „Ecosystem vitality") as follows:

Environmental health:

[1] Air quality (that has 3 indicators),

[2] Water and sanitation (2 indicators),

[3] Heavy metals (1 indicator),

Ecosystem vitality:

[4] Biodiversity and habitat (6 indicators),

[5] Forests (1 indicator),

[6] Fisheries (2 indicators),

[7] Climate and energy (5 indicators),

[8] Air pollution (2 indicators),

[9] Water resources (1 indicator), and

[10] Agriculture (1 indicator).

Using these EPI metrics provides identifying and understanding best policies and practices in top-ranked economies in order to formulate the guidance for CEE countries that aspire to achieve high environmental performances in the future.

Results and discussions

In order to evaluate the environmental performances of CEE countries, it is presented the data about the rank and score of EPI (2018) for all CEE countries in *Table 1*. Beside the score and global rank of CEE countries according to EPI as a composite index, *Table 1*. shows the rank of each country in the isolated group of CEE countries, but also the score and global rank of these countries according to Environmental health and Ecosystem vitality as two EPI policy objectives.

Table 1. The score and rank of CEE countries according to the EPI (2018)

Country	EPI score (0-100)	EPI global rank (out of 180)	Rank on the list of isolated group of CEE countries	Environmental health		Ecosystem vitality	
				Score	Global rank	Score	Global rank
Slovak R.	70.60	28	1	63.87	89	75.08	3
Lithuania	69.33	29	2	72.57	57	67.18	21
Bulgaria	67.85	30	3	69.60	66	66.68	24
Czech R.	67.68	33	4	68.69	69	67.01	22
Slovenia	67.57	34	5	72.34	58	64.40	33
Latvia	66.12	37	6	72.80	54	61.66	49
Albania	65.46	40	7	65.67	82	65.32	30
Croatia	65.45	41	8	67.04	77	64.39	34
Hungary	65.01	43	9	57.67	107	69.90	12
Romania	64.78	45	10	58.67	105	68.85	15
Estonia	64.31	48	11	73.24	51	58.35	59
Poland	64.11	50	12	58.71	104	67.72	18
Montenegro	61.33	65	13	72.61	55	53.81	87
N. Macedonia	61.06	68	14	67.43	74	56.82	64
Serbia	57.49	84	15	61.18	100	55.03	77
Bosnia and Herzegovina	41.84	158	16	63.87	89	27.15	179

Source: 2018 Environmental Performance Index Report

The data presented in *Table 1.* indicate that all CEE countries except Bosnia and Herzegovina are achieved the score of EPI that places them in the first half of global ranking. The situation is similar in the case of the score of CEE countries in two EPI policy objectives. Namely, the score of Ecosystem vitality puts Bosnia and Herzegovina in the place that is before the last (179th place of 180 observed countries). Also, Hungary, Romania, Poland, and Serbia have poorer performances in terms of Environmental health than the first half of the global list.

Slovak R. as 28th country in the EPI global ranking reaches the highest score in the CEE group (70.60). This country records particularly impressive performances in the Ecosystem vitality of EPI, where it achieved 3rd best score in the global terms (75.08). Slovak R. is followed by second-ranked Lithuania (69.33), and third-ranked Bulgaria (67.85). The first three CEE countries are followed by Czech R. (67.68), Slovenia (67.57), Latvia (66.12), Albania (65.46), Croatia (65.45), Hungary (65.01), Romania (64.78), Estonia (64.31), Poland (64.11), Montenegro (61.33), N. Macedonia (61.06), Serbia (57.49), and Bosnia and Herzegovina (41.84).

With the aim to estimate the agricultural and other environmental performances of CEE countries in the comparative perspective, the authors decided to present the results of the best-ranked European countries according to these performances in the global terms. It is indicative that the 16 best-ranked European countries are at the same time

16 best-ranked countries in the world. *Table 2.* shows the scores of top 16 Europan countries in all ten issue categories within the EPI.

Table 2. The scores of top 16 European countries in the issue categories within the EPI (2018)

Country	Air quality (I_1)	Water and sanitation (I_2)	Heavy metals (I_3)	Biodiversity and habitat (I_4)	Forests (I_5)	Fisheries (I_6)	Climate and energy (I_7)	Air pollution (I_8)	Water resources (I_9)	Agriculture (I_{10})	*EPI score*	*EPI global rank*
Switzerland	91.06	99.99	87.77	84.20	47.40	-	90.55	98.70	99.67	43.87	*87.42*	*1*
France	95.97	97.22	83.29	96.25	25.08	57.71	70.46	96.82	95.56	67.77	*83.95*	*2*
Denmark	99.16	97.78	88.30	94.48	12.74	50.75	67.56	71.00	98.45	67.02	*81.60*	*3*
Malta	94.40	100.00	48.74	87.77	-	56.49	67.04	57.32	100.00	32.62	*80.90*	*4*
Sweden	92.84	96.88	100.00	81.00	5.53	53.76	86.80	64.17	98.49	55.12	*80.51*	*5*
United Kingdom	94.43	100.00	93.09	96.69	6.90	42.16	63.06	82.87	99.82	57.34	*79.89*	*6*
Luxembourg	93.62	99.30	88.55	96.54	18.77	-	58.53	61.82	99.76	38.06	*79.12*	*7*
Austria	82.21	94.63	91.08	91.69	27.60	-	62.79	86.31	99.08	71.34	*78.97*	*8*
Ireland	95.78	100.00	73.18	88.63	8.78	71.14	54.16	87.23	91.19	61.94	*78.77*	*9*
Finland	99.00	100.00	100.00	89.25	5.98	61.11	62.33	49.10	97.01	49.97	*78.64*	*10*
Iceland	98.55	100.00	86.99	75.77	-	39.30	61.96	49.11	94.47	59.78	*78.57*	*11*
Spain	94.07	100.00	61.27	95.66	8.95	43.14	67.77	69.34	99.71	29.74	*78.39*	*12*
Germany	84.09	96.74	100.00	96.92	34.99	47.71	55.47	93.30	99.65	61.21	*78.37*	*13*
Norway	97.14	99.65	96.44	88.96	22.08	68.73	63.58	24.76	96.11	28.51	*77.49*	*14*
Belgium	88.63	96.09	58.60	95.70	15.61	46.69	63.81	79.02	98.08	47.61	*77.38*	*15*
Italy	80.56	100.00	70.23	94.10	30.96	37.99	65.14	88.55	97.53	49.03	*76.96*	*16*
Average score of top 16 group	*92.59*	*98.64*	*82.97*	*90.85*	*19.38*	*52.05*	*66.31*	*72.46*	*97.79*	*51.31*	-	-

Source: 2018 Environmental Performance Index Report

Table 2. presents impressive results of top 16 European countries in the environmental performances. With 16 countries in the world's top 16, Europe region is an undisputed leader in the environmental performances. Switzerland convincingly reaches the highest global score of EPI (87.42), while France record second-best score (83.95), and Denmark third-best score (81.60) of EPI. The first three European countries are followed by Malta (80.90), Sweden (80.51), United Kingdom (79.89), Luxembourg (79.12), Austria (78.97), Ireland (78.77), Finland (78.64), Iceland (78.57), Spain (78.39), Germany (78.37), Norway (77.49), Belgium (77.38), and Italy (76.96). The supremacy is also evident in the fact that even seven countries in the Europe top 16 group achieved a maximum score of 100 in the Water and sanitation issue (Malta, United Kingdom, Ireland, Finland, Iceland, Spain, and Italy), three in Heavy metals issue (Sweden, Finland, and Germany), while Malta reached that score in Water resources issue.

Considering the previous analysis, it is obvious that the comparison of environmental performances of any group of countries with the top 16 European countries leads to the conclusion about the inferiority of the first one. However, such a comparison allows the identification of possibilities for improvement in the group of inferior countries.

Accordingly, *Table 3.* shows the scores of CEE countries in the issue categories within the EPI in the comparison with the top 16 European countries.

Table 3. The scores of CEE countries in the issue categories within the EPI in the comparison with the top 16 European countries (2018)

Country	Air quality (I_1)	Water and sanitation (I_2)	Heavy metals (I_3)	Biodiversity and habitat (I_4)	Forests (I_5)	Fisheries (I_6)	Climate and energy (I_7)	Air pollution (I_8)	Water resources (I_9)	Agriculture (I_{10})	*EPI score*	*EPI rank*
Slovak R.	59.42	69.62*	87.21#	94.31#	17.09	-	74.21#	79.51#	89.95*	61.53#	*70.60*	*28*
Lithuania	77.97*	58.51	86.63#	93.83#	7.75	57.83#	62.46*	59.73	93.49*	62.01#	*69.33*	*29*
Bulgaria	68.49*	71.26*	74.15	93.39#	34.38#	62.17#	56.04*	52.91	93.93*	43.68	*67.85*	*30*
Czech R.	65.77*	69.98*	98.82#	94.96#	17.18	-	54.65	57.07	95.77*	62.17#	*67.68*	*33*
Slovenia	71.25*	70.59*	97.00#	95.78#	30.87#	-	51.16	49.85	88.50*	34.85	*67.57*	*34*
Latvia	77.66*	60.62	82.78*	92.05#	3.67	50.65	42.89	84.31#	96.30*	45.68*	*66.12*	*37*
Albania	65.47*	66.56	62.89	75.37	23.36#	58.25#	68.36#	86.07#	80.73*	22.61	*65.46*	*40*
Croatia	64.07	70.01*	87.84#	95.25#	34.36#	54.55#	54.41	43.23	86.58*	47.68*	*65.45*	*41*
Hungary	52.30	66.26	75.88	91.70#	11.64	-	61.68*	75.22#	93.42*	69.15#	*65.01*	*43*
Romania	57.37	59.90	68.25	90.80*	27.82#	48.86	68.53#	71.20*	83.95*	48.15*	*64.78*	*45*
Estonia	78.87*	58.45	88.82#	92.39#	4.56	76.04#	33.62	54.29	96.42*	40.75	*64.31*	*48*
Poland	53.04	69.23*	69.29	96.37#	14.26	42.66	64.33*	72.30*	92.35*	43.37	*64.11*	*50*
Montenegro	69.28*	78.61*	79.89*	73.77	30.77#	36.18	46.85	59.22	81.67*	10.57	*61.33*	*65*
North Macedonia	66.43*	69.16*	70.11	64.85	30.62#	-	63.85*	56.99	52.07	35.99	*61.06*	*68*
Serbia	56.67	69.73*	68.53	49.84	38.66#	-	61.77*	59.76	60.49	52.95#	*57.49*	*84*
Bosnia and Herzegovina	60.37	71.54*	63.39	26.93	49.31o	-	26.80	30.79	0	33.09	*41.84*	*158*
The highest score in CEE group	*78.87 Eston.*	*78.61 Mont.*	*98.82 Czech*	*96.37 Poland*	*49.31 B&H*	*76.04 Eston.*	*74.21 Slovak*	*86.07 Alban.*	*96.42 Eston.*	*69.15 Hung.*	-	-
Average score of CEE group	*65.28*	*67.50*	*78.84*	*82.60*	*23.52*	*54.13*	*55.73*	*62.03*	*80.35*	*44.64*	-	-
The highest score in top 16 group	*99.16 Den.*	*100.00 7 coun.*	*100.00 3 coun.*	*96.92 Germ.*	*47.40 Switz.*	*71.14 Ireland*	*90.55 Switz.*	*98.70 Switz.*	*100.00 Malta*	*71.34 Austria*	-	-
Average score of top 16 group	*92.59*	*98.64*	*82.97*	*90.85*	*19.38*	*52.05*	*66.31*	*72.46*	*97.79*	*51.31*	-	-

Source: 2018 Environmental Performance Index Report

Legend:

Indicates that the score is below the average score of the CEE group.

* Indicates that the score is above the average score of the CEE group.

\# Indicates that the score is above the average score of top 16 European countries.

0 Indicates that the score is above the score of the best country in the group of top 16 European countries.

Data showed in *Table 3.* indicate the domination of top 16 European countries over the CEE countries in terms of environmental performances. CEE countries achieved a better average score than top 16 European countries in two (Forests and Fisheries) out of ten EPI issue categories. Top 16 European countries reached a higher average score in another eight issue categories. The biggest lag of CEE countries is recorded in Water and sanitation issue (even 31.14), followed by Air quality (27.31), and Water resources

(17.44) issues. Furthermore, there is not CEE country which reaches the average score of top 16 European countries in these three issues.

On the other hand, at least three CEE countries achieved a better score than the average score of top 16 European countries in another seven issues. The minimum number of three CEE countries have higher score in Climate and energy issue, while a maximum number of the ten CEE countries reach better result in Biodiversity and habitat issue category. Moreover, Bosnia and Herzegovina recorded the score above the best country in the group of top 16 European countries in Forests issue.

The conclusions of previous analysis provide a useful foundation for identification of critical issue categories of EPI for each CEE country, but also for the determination of its improvement priorities in terms of time. There are two important notes for further analysis. First, each issue category of EPI in which CEE country achieved score that is below the score of the best country in the group of top 16 European countries is considered as a critical issue category. Second, there are three priority levels when it comes improvement of critical issue categories. The first priority level includes issues which score is below the average score of CEE countries. The improvement of these issues is urgent. The second priority level consists of issues which score is between the average score of CEE countries and the average score of top 16 European countries. The third priority level introduces issues which score is between the average score of top 16 European countries and the score of the best-positioned European country. *Table 4.* specifies the critical issues of EPI in CEE countries according to priority levels.

Table 4. Specification of the EPI critical issues in CEE countries according to priority levels

Country	The first priority level	The second priority level	The third priority level	Total number of critical issues
Slovak R.	I_1, I_5	I_2, I_9	I_3, I_4, I_7, I_8, I_{10}	9
Lithuania	I_2, I_5, I_8	I_1, I_7, I_9	I_3, I_4, I_6, I_{10}	10
Bulgaria	I_3, I_8, I_{10}	I_1, I_2, I_7, I_9	I_4, I_5, I_6	10
Czech R.	I_5, I_7, I_8	I_1, I_2, I_9	I_3, I_4, I_{10}	9
Slovenia	I_7, I_8, I_{10}	I_1, I_2, I_9	I_3, I_4, I_5	9
Latvia	I_2, I_5, I_6, I_7	I_1, I_3, I_9, I_{10}	I_4, I_8	10
Albania	I_2, I_3, I_4, I_{10}	I_1, I_9	I_5, I_6, I_7, I_8	10
Croatia	I_1, I_7, I_8	I_2, I_9, I_{10}	I_3, I_4, I_5, I_6	10
Hungary	I_1, I_2, I_3, I_5	I_7, I_9	I_4, I_8, I_{10}	9
Romania	I_1, I_2, I_3, I_6	I_4, I_8, I_9, I_{10}	I_5, I_7	10
Estonia	I_2, I_5, I_7, I_8, I_{10}	I_1, I_9	I_3, I_4, I_6	10
Poland	I_1, I_3, I_5, I_6, I_{10}	I_2, I_7, I_8, I_9	I_4	10
Montenegro	I_4, I_6, I_7, I_8, I_{10}	I_1, I_2, I_3, I_9	I_5	10
N. Macedonia	I_3, I_4, I_8, I_9, I_{10}	I_1, I_2, I_7	I_5	9
Serbia	I_1, I_3, I_4, I_8, I_9	I_2, I_7	I_5, I_{10}	9
Bosnia and Herzegovina	I_1, I_3, I_4, I_7, I_8, I_9, I_{10}	I_2	-	8

Paradoxically, Bosnia and Herzegovina as the worst-ranked country in the CEE group has the least critical issues of EPI (8 critical issues in total) in comparison with other countries within this group (*Table 4.*). When it comes to Forests issue, Bosnia and Herzegovina achieved a better result than the best-positioned country in the group of top 16 European countries. However, this country has the largest number of critical issues in the first priority level (7 critical issues), i.e. the most of environmental performances that need to be urgently improved in order to increase its rank in the CEE group of countries. All other CEE countries have a maximum critical issues (9 or 10 critical issues depend on the number of EPI issues observed in a particular country).

Slovak R. as the best-ranked country in the CEE group has the least critical issues in the first priority level (2 critical issues). This country has the same number of critical issues in the second priority level, while third priority level includes 5 critical issues. It means that Slovak R. needs urgent actions in Air quality and Forests issues in order to reach the average score of CEE countries. After the achieving that goal, Slovak R. should improve Water and sanitation and Water resources issues with the aim to meet the average score of the top 16 European countries. When mentioned target is accomplished, the priority should be to improve Heavy metals, Biodiversity and habitat, Climate and energy, Air pollution, and Agriculture issues in order to reach the results of the best-ranked country in the top 16 European group. Each CEE country should set a framework for improvement of environmental performances as it described in the case of Slovak R.

The data presented in *Table 3.* and *Table 4.* show that Air pollution issue needs urgent actions in ten out of sixteen CEE countries. The Heavy metals and Agriculture issues require improvement in the short term in eight CEE countries. Seven CEE countries have Air quality, Forests and Climate and energy issues in the first priority level. The Water and sanitation needs urgent actions in six CEE countries, while Biodiversity and habitat issue in five countries from this group. Lastly, four out of sixteen CEE countries have Fisheries issue in the first priority level, while Water resources require improvement in the short term in three CEE countries.

CEE countries recorded a lower average score in the Agriculture issue category than top 16 European countries for 6.67, which is not much lagging compared to the other issue categories (see *Table 3.*). Also, data from *Table 4.* show that the Agriculture issue is in the first priority level in eight CEE countries, in the second priority level in three CEE countries, and in the third priority level in five CEE countries. It is indicative that five out of six worst-ranked CEE countries (Estonia, Poland, Montenegro, N. Macedonia, and Bosnia and Herzegovina) have Agriculture issue in the first priority level. It could be considered as a potential indicator of significant correlation between the Agriculture issue and EPI scores of CEE countries.

In order to examine correlation between the scores achieved by CEE countries in the Agriculture issue category and EPI, the method of Pearson's correlation analysis is applied (*Table 5.*).

Table 5. Pearson's correlation coefficient between scores of CEE countries in the Agriculture issue category and EPI (2018)

		EPI	Agriculture
EPI	Pearson's Correlation	1	0.355(**)
	Sig. (2-tailed)		.177
	N	16	16
Agriculture	Pearson's Correlation	0.355(**)	1
	Sig. (2-tailed)	.177	
	N	16	16
** Correlation is significant at the 0.05 level (2-tailed)			

Source: Author's calculation (SPSS 24)

The value of Pearson's correlation coefficient of 0.355 presented in *Table 5.* indicates a relatively weak correlation between the scores of CEE countries in the Agriculture issue category and EPI in 2018. However, the result of correlation analysis is not statistically significant (Sig. 2-tailed 0.05).

Conclusions

This paper aims to analyze agricultural and other environmental performances of CEE countries in the comparable perspective. Research findings suggest that most countries in Central and East Europe achieve above-average results in the global competitiveness of the agriculture and environment. Precisely, all CEE countries except Bosnia and Herzegovina are reached the score of EPI (2018) that places them in the first half of global ranking. The analysis of the achieved scores in two EPI policy objectives indicates similar results. Only Bosnia and Herzegovina is positioned in the second half of global ranking according to the Ecosystem vitality, while Hungary, Romania, Poland, and Serbia have poorer performances in terms of Environmental health than the first half of the global list.

The best-positioned country in the CEE group is Slovak R., which occupies 28th place in the world with the EPI score of 70.60. This country records particularly impressive performances in the Ecosystem vitality of EPI, where it achieved 3rd best score in the global terms (75.08). On the opposite, Bosnia and Herzegovina with the EPI score of 41.84 is convincingly the worst-ranked CEE country in the world (158th place). This country achieves a better score than the average of the CEE group in only two out of ten issue categories (Water and sanitation and Forests). Between these extremes (Slovak R. and Bosnia and Herzegovina) are positioned other CEE countries in the following order: Lithuania (69.33), Bulgaria (67.85), Czech R. (67.68), Slovenia (67.57), Latvia (66.12), Albania (65.46), Croatia (65.45), Hungary (65.01), Romania (64.78), Estonia (64.31), Poland (64.11), Montenegro (61.33), N. Macedonia (61.06), and Serbia (57.49).

The results of the applied benchmarking method indicate the inferiority of CEE countries in the comparison with the top 16 European countries. CEE countries achieved a better average score than top 16 European countries in only two (Forests and Fisheries) out of ten EPI issue categories. The biggest lag of CEE countries is recorded in Water and sanitation issue (even 31.14), followed by Air quality (27.31) and Water resources (17.44) issues.

Beside mentioned results, the benchmarking method serves as framework for identification of possibilities for improvement of environmental performances in each CEE country, but also for determination of urgency or time priority in its improvement. The analysis shows that Air pollution issue needs urgent actions in ten CEE countries, while Heavy metals issue requires improvement in the short term in eight CEE countries. Such as Heavy metals issue, Agriculture is in the first priority level in eight CEE countries, but also in the second priority level in three CEE countries, and in the third priority level in five CEE countries. Briefly, the research findings of applied benchmarking provide the formulation of national strategies, actions, and their time frame for each CEE country in order to improve its agricultural and other environmental performances in the future.

Finally, the results of correlation analysis indicate a relatively weak correlation between the scores of CEE countries in the Agriculture issue category and EPI in 2018.

Acknowledgements

Paper is a part of research within the project no. 179066 entitled „Improving the competitiveness of the public and private sector by networking competences in the process of European integration of Serbia“, financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

Conflict of interests

The authors declare no conflict of interest.

References

1. Ahmed, K. (2014). Environmental Kuznets curve for CO_2 emission in Mongolia: An empirical analysis. *Management of Environmental Quality: An International Journal*, *25*(4), 505-516. https://doi.org/10.1108/MEQ-03-2013-0017
2. Ahmed, K., & Long, W. (2012). Environmental Kuznets Curve and Pakistan: An empirical analysis. *Procedia Economics and Finance*, *1*, 4-13. https://doi.org/10.1016/S2212-5671(12)00003-2
3. Ahmed, K., & Long, W. (2013). An empirical analysis of CO2 emission in Pakistan using EKC hypothesis. *Journal of International Trade Law and Policy*, *12*(2), 188-200. https://doi.org/10.1108/JITLP-10-2012-0015
4. Almeida, T.A.d.N., Cruzb, L., Baratab, E., & García-Sánchez, I.M. (2017). Economic growth and environmental impacts: An analysis based on a composite index of environmental damage. *Ecological Indicators*, *76*, 119-130. http://dx.doi.org/10.1016/j.ecolind.2016.12.028
5. Arbolino, R., De Simone, L., Carlucci, F., Yigitcanlar, T., & Ioppolo, G. (2018). Towards a sustainable industrial ecology: Implementation of a novel approach in the performance evaluation of Italian regions. *Journal of Cleaner Production*, 178, 220-236. https://doi.org/10.1016/j.jclepro.2017.12.183
6. Bo, S., 2011. A literature survey on Environmental Kuznets Curve. *Energy Procedia*, *5*, 1322-1325. https://doi.org/10.1016/j.egypro.2011.03.229

7. Bogićević, J., Domanović, V., & Krstić, B. (2016). The role of financial and non-financial performance indicators in enterprise sustainability evaluation. *Ekonomika*, *62*(3), 1-13. doi:10.5937/ekonomika1603001B

8. Dietz, T., Rosa, E.A., & York, R. (2007). Driving the human ecological footprint. *Frontiers in Ecology and the Environments*, *1*, 13-18.

9. Dixon-Fowler, H.R., Ellstrand, A.E., & Johnson, J.L. (2017). The role of board environmental committees in corporate environmental performance. *Journal of Business Ethics*, *140*(3), 423-438. https://doi.org/10.1007/s10551-015-2664-7

10. Dizdaroglu, D., & Yigitcanlar, T. (2016). Integrating urban ecosystem sustainability assessment into policy-making: Insights from the Gold Coast City. *Journal of Environmental Planning and Management*, 59, 1982-2006. http://dx.doi.org/10.1080/09640568.2015.1103211

11. European Commission. Agriculture and the environment: Introduction, Retrieved from https://ec.europa.eu/agriculture/envir_en (April 20, 2019).

12. European Commission (2018). EU Budget: the Common Agricultural Policy beyond 2020. Fact Sheet, Retrieved from http://europa.eu/rapid/press-release_MEMO-18-3974_en.pdf (April 20, 2019).

13. Fraccascia, L., Giannoccaro, I., & Albino, V. (2017). Rethinking resilience in industrial symbiosis: Conceptualization and measurements. *Ecological Economics*, 137, 148-162. http://dx.doi.org/10.1016/j.ecolecon.2017.02.026

14. Gunarathne, N., & Lee, K.-H. (2015). Environmental Management Accounting (EMA) for environmental management and organizational change. *Journal of Accounting and Organizational Change*, *11*(3), 362-383. https://doi.org/10.1108/JAOC-10-2013-0078

15. Hallstedt, S.I. (2017). Sustainability criteria and sustainability compliance index for decision support in product development. *Journal of Cleaner Production*, 140, 251-266. http://dx.doi.org/10.1016/j.jclepro.2015.06.068

16. Ilić, I., Krstić, B., & Jovanović, S. (2017). Environmental performances of agriculture in the European Union countries. *Economics of Agriculture*, *64*(1), 41-55.

17. Jha, R., & Murthy, K.V.B. (2003). An inverse global environmental Kuznets curve. *Journal of Comparative Economics*, *31*(2), 352-368. https://doi.org/10.1016/S0147-5967(03)00042-8

18. Jin, J., Zhou, D., & Zhou, D. (2014). Measuring environmental performance with stochastic environmental DEA: The case of APEC economies. *Economic Modelling*, *38*, 80-86. https://doi.org/10.1016/j.econmod.2013.12.017

19. Kuznets, S. (1955). Economic growth and income inequality. *American Economic Review*, *45*, 1-28.

20. Latan, H., Jabbour, C.J.C., Jabbour, A.B.L.d.S. Samuel Fosso Wamba, S.F., & Shahbaz, M. (2018). Effects of environmental strategy, environmental uncertainty and top management's commitment on corporate environmental performance: The role of environmental management accounting. *Journal of Cleaner Production*, *180*, 297-306. https://doi.org/10.1016/j.jclepro.2018.01.106

21. Li, Y., Chen, C., Wang, Y., & Liu, Y. (2014). Urban-rural transformation and farmland conversion in China: The application of the environmental Kuznets Curve. *Journal of Rural Studies*, *36*, 311-317. https://doi.org/10.1016/j.jrurstud.2014.10.005
22. Lisi, I.E. (2015). Translating environmental motivations into performance: The role of environmental performance measurement systems. *Management Accounting Research*, *29*(1), 27-44. https://doi.org/10.1016/j.mar.2015.06.001
23. Lopez, R., & Mitra, S. (2000). Corruption pollution, and the Kuznets environment curve. *Journal of Environmental Economics and Management*, *40*(2), 137-150. https://doi.org/10.1006/jeem.1999.1107
24. Maceno, M.M.C., Pawlowski, U., Machado, K.S., & Seleme, R. (2018). Environmental performance evaluation - A proposed analytical tool for an industrial process application. *Journal of Cleaner Production*, *172*, 1452-1464. https://doi.org/10.1016/j.jclepro.2017.10.289
25. Marques, A.C., Fuinhas, J.A., & Leal, P.A. (2018). The impact of economic growth on CO_2 emissions in Australia: The environmental Kuznets curve and the decoupling index. *Environmental Science and Pollution Research*, *25*(27), 27283-27296. https://doi.org/10.1007/s11356-018-2768-6
26. Mukherjee, S., & Chakraborty, D. (2013). Is environmental sustainability influenced by socioeconomic and sociopolitical factors? Cross-country empirical analysis. *Sustainable Development*, *21*(6), 353-371.
27. Radivojević, V., Krstić, B., & Stanišić, T. (2018). Environmental sustainability: Implications and limitations in Western Balkan countries. *Journal of Sustainable Development*, *2*(1), 23-35.
28. Wagner, M., & Schaltegger, S. (2004). The effect of corporate environmental strategy choice and environmental performance on competitiveness and economic performance: An empirical study of EU manufacturing. *European Management Journal*, *22*(5), 557-572. https://doi.org/10.1016/j.emj.2004.09.013
29. York, R. (2009). The Challenges of Measuring Environmental Sustainability: Comment on „Political and Social Foundations for Environmental Sustainability". *Political Research Quarterly*, *62*(1), 205-208.
30. Zhao, F., Xu, M., Zheng, Y., Wong, M.H.G., & Chi, Y. (2013). Improving the environmental Kuznets curve for evaluating the relationships between carbon dioxide emissions and economic development. *Journal of Food, Agriculture and Environment*, *11*(2), 1193-1199.
31. Yale Center for Environmental Law & Policy of Yale University, Center for International Earth Science Information Network of Columbia University (2018). 2018 Environmental Performance Index Report, Retrieved from https://epi.envirocenter.yale.edu/epi-topline (April 15, 2019).

VEGETABLE PRICES IN SERBIA – TENDENCIES AND FORECASTING

Šumadinka Mihajlović[1], Nataša Vukelić[2], Nebojša Novković[3], Beba Mutavdžić[4]

**Corresponding author E-mail: vukelicn@polj.uns.ac.rs*

A R T I C L E I N F O

Original Article

Received: *05 June 2019*

Accepted: *15 June 2019*

doi:10.5937/ekoPolj1902485S

UDC 338.5.01:635.1/.8(497.11)

Keywords:

vegetables, price, Serbia, forecasting

***JEL**: C53 Q11*

A B S T R A C T

The subject of this paper is analysis of the tendencies and forecast of the prices of most significant vegetable crops in Serbia: potato, bean, tomato, pepper, onion, cabbage and watermelon. The aim of the paper is to forecast the absolute prices of the studied vegetables. Time series analysis of vegetable prices expressed in euro per ton (2002-17) was performed by means of descriptive statistics, while adequate ARIMA models were used for price forecasting (2018-22). The analysis of the studied vegetable crops showed that bean had the highest average annual price, while watermelon had the lowest. The price of tomato showed the highest fluctuations over the years, while the lowest were for onion and cabbage. All vegetable crops showed a tendency of absolute increase in prices expressed in euro. Based on the foregoing, it can be concluded that the market position of vegetables is generally improving, but oscillations will continue to occur.

Introduction

Vegetable production is one of the most intensive branches of plant production, and along with grain production, it is one of the most intensive branches of arable land production. This is confirmed both by the yields produced per unit of area, i.e. the amount of organic matter produced annually per unit of area, and by achieved economic

1 Šumadinka Mihajlović, Mr.Sci., Ph.D. student, University of Novi Sad, Faculty of Agriculture, Serbia, Phone: +38163287971, E-mail:mihajlovic.sumadinka@gmail.com, https://orcid.org/0000-0003-0670-786X

2 Nataša Vukelić, Ph.D., Assistant Professor, University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, Phone: +381214853392, E-mail: vukelicn@polj.uns.ac.rs, Serbia ORCID ID (https://orcid.org/0000-0001-7516-9204)

3 Nebojša Novković, Ph.D., Full Professor, University of Novi Sad, Faculty of Agriculture, Trg D. Obradovica 8, Novi Sad, Serbia, Phone: +38162200132, E-mail: nesann@polj.uns.ac.rs, https://orcid.org/0000-0003-2419-5765

4 Beba Mutavdžić, Ph.D., Associate Professor, University of Novi Sad, Faculty of Agriculture, Trg D. Obradovica 8, Novi Sad, Serbia, Phone: +38162200133, E-mail: bebam@polj.uns.ac.rs, https://orcid.org/0000-0002-7631-0465

effects. Bearing in mind the importance that this branch of agriculture has in both the production and economic sense for producers as well as for agriculture as a whole, it is justified to expect its further development. The subject of the research in this paper is analysis of the tendencies and forecast of the prices of most significant vegetable crops in Serbia: potato, bean, tomato, pepper, onion, cabbage and watermelon. The aim of the paper is to use time series analysis of vegetable prices from the past period as a basis for forecasting the absolute prices of these vegetables expressed in euro for the future period and forecasting economic (market) conditions for production of these crops.

There are numerous examples of applying quantitative and qualitative methods in analysing, modelling, forecasting and planning of production and economic characteristics of agricultural products and inputs in agriculture. Bannikova et al. (2018) analyzed the alternatives of development of the Russian vegetables market concerning the changes of the level and structure of production and consumption of vegetables. The main objectives of the research were to collect and analyze data of the Russian market of vegetable production, modeling and scenario forecasting vegetables market, a substantiation of directions of development of the market. Mutavdžić et al. (2007) analysed the tendencies and forecast the movements in price parities of fattening pigs and commercial maize. Novković et al. (2008) analysed the possibilities for future development of vegetable production in Serbia and Vojvodina using the SWOT analysis. Vukelić, Novković (2009) analysed the economic results of milk production on large family farms. Husemann, Novkovic, (2014) defined a quantitative model for managing a multifunctional farm. Mutavdžić et al. (2010) focused on forecasting of price parities of the main field crops based on time series analysis and the application of the ARIMA model. Mutavdžić et al., (2017) analysed quarterly movements of wheat and maize retail prices in Serbia and the Republic of Srpska in the period 2010-15. By applying the method of ratio to the overall quarterly average, the results showed that the prices of grains in the Republic of Srpska are higher. Ivanišević et al. (2015) analysed the movements of tomato prices in Serbia using the method of descriptive statistics, followed by forecasting its value in the future period based on time series analysis. Jasinthan et al. (2015) by using a Markov chain model analyzed and predicted vegetable price movement in Jaffna. Novković, Mutavdžić (2016) performed the analysis of bean prices in Serbia by means of descriptive statistics. On the basis of these results, an adequate ARIMA model was applied to forecast the movements of bean prices for the following period. Mutavdžić et al.(2011) analysed the tendencies in development of vegetable production in Serbia, concluding that in the period 2001-10 the total vegetable production in Serbia significantly increased, primarily as a result of intensification of production, i.e. yield increase. The study showed the following average annual increase in production: pea 56%, pepper 26%, carrot 20%, potato 18%, cucumber 17%, cabbage and kale 13%, watermelon 12%, tomato and onion 5% and garlic 2%. Increasing trends in production were found for the following vegetables: tomato, pea, onion, pepper, bean, carrot and cucumber. Decreased trends in production were determined for potato, watermelon and garlic, while cabbage and kale showed the

general tendency of stagnation in production. Novković et al. (2013) focused on the analysis and tendencies of development of vegetable production in Vojvodina. In the period 2001-10 the harvested areas of the studied vegetables were reduced for almost all vegetable crops, except for pea, pepper and garlic, for which the harvested area was slightly larger compared to the previous decade. The yields of all studied vegetable crops increased (except for tomatoes) and the total vegetable production significantly increased as a result of intensification of production.

Materials and methods

The research methods applied in this paper were selected based on the described subject and aim of the research. The statistical methods included descriptive statistics and time series analysis. Descriptive statistics was used for analysis of the vegetable prices in the studied period. Forecasting of the vegetable prices was carried out using the ARIMA models, based on time series analysis. Time series analysis was conducted using the prices of seven major vegetable crops in Serbia (potato, bean, tomato, pepper, onion, cabbage and watermelon). The average annual vegetable prices in the analysis were converted into euro per tonne to enable comparison with foreign countries and to reduce the factor of domestic inflation. The absolute vegetable prices were analysed for the period 2002-17, starting thus from the year when euro entered into circulation. Conversion of the prices into euro was carried out according to the average annual exchange rate of euro based on the data of the National Bank of Serbia. Since there were shorter time series, the forecast of the vegetable prices was made for a period of five years: 2018-2022. The series of studied phenomena in this paper were either taken entirely or formed on the basis of statistical publications of the Statistical Office of the Republic of Serbia. Statistical software used for the analysis of the collected data included Statistica 10, Eviews 3.1 and SPSS.

Results

Analysis and forecast of potato prices

The average potato price in the period 2002-17 was 183.3 EUR/t. The price ranged from 84.5 EUR/t in 2005 to 249 EUR/t in 2013. The coefficient of variation was relatively high: 27%. The average annual price of potato had a rather pronounced tendency of growth, at an average annual rate of 3.83%. Such relatively high growth rate of potato price is an indicator of the improvement of its absolute position on the market. The analysis and forecasting model shows that potato price in a certain year is significantly influenced by random processes from the preceding two periods (Table 1).

On the basis of the estimated model, potato prices for the period 2018-22 were forecast (Table 2), indicating that in the following five year-period potato price will fluctuate over the years (which was also the case in the analysed period). These findings are illustrated by a graphical representation of potato price movements (Figure 1).

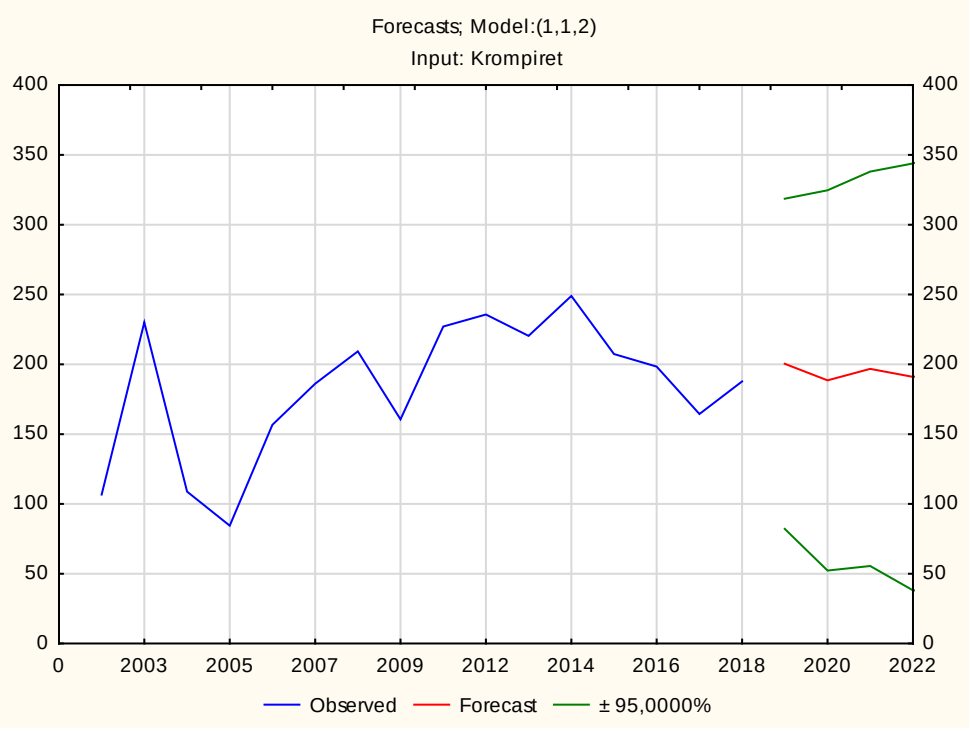
Table 1. Model parameters for forecasting potato prices

Paramet.	Input: Krompiret: Transformations: D(1) Model:(1,1,2) MS Residual= 2943,9					
	Param.	Asympt. Std.Err.	Asympt. t(12)	p	Lower 95% Conf	Upper 95% Conf
p(1)	-0,694871	0,379337	-1,83180	0,091904	-1,52138	0,131634
q(1)	-0,266954	0,333751	-0,79986	0,439339	-0,99414	0,460227
q(2)	0,552352	0,226873	2,43463	0,031465	0,05804	1,046666

Table 2. Forecast of potato prices (2018-22)

CaseNo.	Forecasts; Model:(1,1,2) Input: Krompiret: Start of origin: 1 End of origin: 16			
	Forecast	Lower 95,0000%	Upper 95,0000%	Std.Err.
17	200,3884	82,17182	318,6050	54,25735
18	188,5011	52,30655	324,6956	62,50860
19	196,7612	55,50266	338,0198	64,83283
20	191,0215	38,15485	343,8881	70,16053
21	195,0099	35,97128	354,0485	72,99324

Figure 1. Changes in potato prices



Analysis and forecast of bean prices

In the analysed period, the average annual price of bean was 1,333.6 EUR/t, ranging from 948.4 EUR/t in 2004 to 2,213.2 EUR/t in 2014. The coefficient of variation was, similarly to potato, moderately high amounting to 28.5%. The absolute average annual price of bean also showed a tendency of increase, but it was slightly lower compared to potato. The average annual growth rate of bean was 1.33%, which means that bean showed the tendencies of slight improvement of its absolute price (economic) position on the market. Bean production is characterised by oscillations, which is reflected also in the prices of this crop. Bean price in a certain year is influenced by the price from the preceding year, and it is statistically significantly influenced by a random process from the preceding two years (Table 3).

Table 3. Model parameters for forecasting bean prices

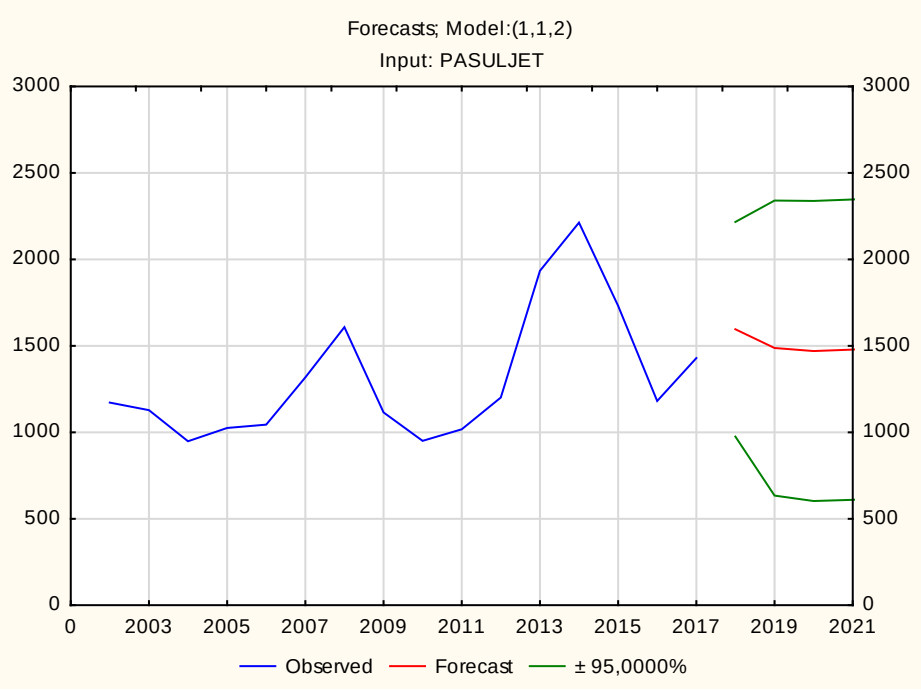
Paramet.	Input: PASULJET: Transformations: D(1) Model:(1,1,2) MS Residual= 79536,					
	Param.	Asympt. Std.Err.	Asympt. t(11)	p	Lower 95% Conf	Upper 95% Conf
Constant	17,18598	18,88401	9,100810E-01	0,382289	-24,3774	58,74939
p(1)	0,27152	0,32447	8,368215E-01	0,420501	-0,4426	0,98567
q(1)	0,32940	0,00000	2,011084E+16	0,000000	0,3294	0,32940
q(2)	0,67050	0,00000	5,039653E+32	0,000000	0,6705	0,67050

The estimated model provided the forecast values of bean prices for the five-year period (Table 4), showing that bean price will alternatively decline and grow over the years. The graphical representation of changes in bean prices is given in Figure 2.

Table 4. Forecast of bean prices (2018-22)

CaseNo.	Forecasts; Model:(1,1,2) Input: PASULJET: Start of origin: 1 End of origin: 16			
	Forecast	Lower 95,0000%	Upper 95,0000%	Std.Err.
17	1596,261	975,5357	2216,986	282,0215
18	1487,382	634,5705	2340,194	387,4682
19	1470,339	602,8603	2337,818	394,1321
20	1478,231	609,6779	2346,785	394,6203
21	1492,894	624,2604	2361,527	394,6566

Figure 2. Changes in bean prices



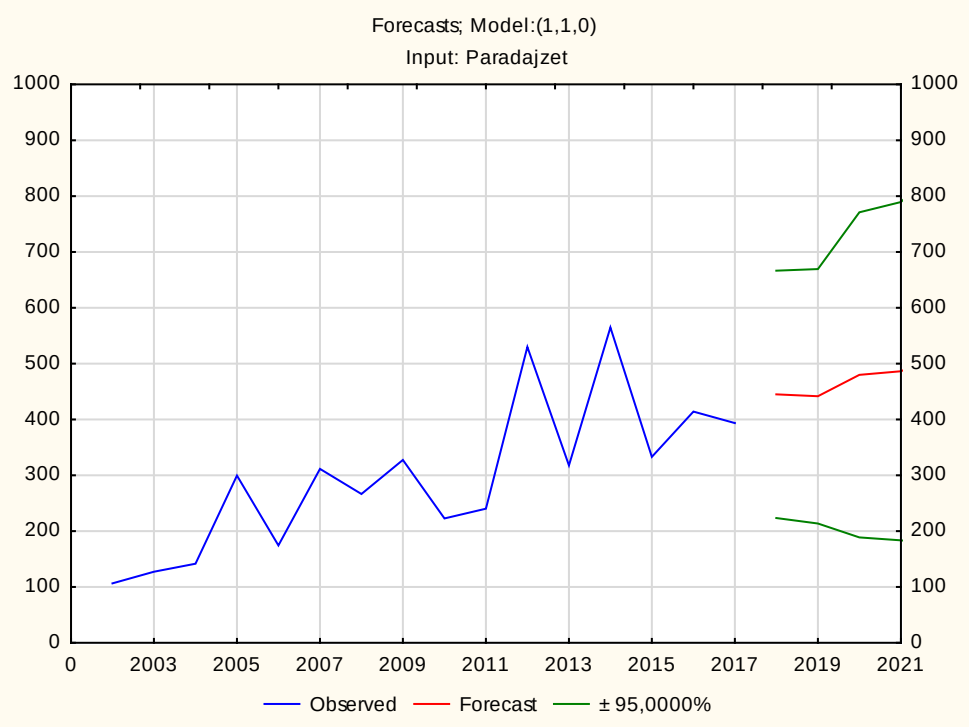
Analysis and forecast of tomato prices

The average annual price of tomato in the analysed period was 298.2 EUR/t. The price varied within the range of 106.6 EUR/t in the first year of the analysed period (2002) to 564.9 EUR/t in 2014. The coefficient of variation of the average annual tomato price was extremely high amounting to 44.6%. The average annual rate of price change was the highest for tomato compared to other analysed vegetable crops, amounting to 9.1%. This means that tomato had the most pronounced tendency of price growth of all analysed vegetable crops, i.e. it had the tendency of the greatest improvement of economic (price) conditions for its production. Unlike the potato prices, the forecast price of tomato in the following five years showed a tendency of increase. The forecast values were obtained on the basis of the estimated model (Table 5), which shows that tomato price in a current year is significantly influenced by its price in the preceding year. The tendency of increasing prices in the following period is illustrated graphically (Figure 3).

Table 5. Forecast of tomato prices (2018-22)

CaseNo.	Forecasts; Model:(1,1,0) Input: Paradajzet Start of origin: 1 End of origin: 16			
	Forecast	Lower 95,0000%	Upper 95,0000%	Std.Err.
17	444,9676	223,4167	666,5184	102,5523
18	441,5752	213,7784	669,3720	105,4435
19	479,8995	188,7984	771,0006	134,7460
20	486,4824	183,6015	789,3633	140,1987
21	517,2167	175,6456	858,7877	158,1078

Figure 3. Changes in tomato prices



Analysis and forecasting of pepper prices

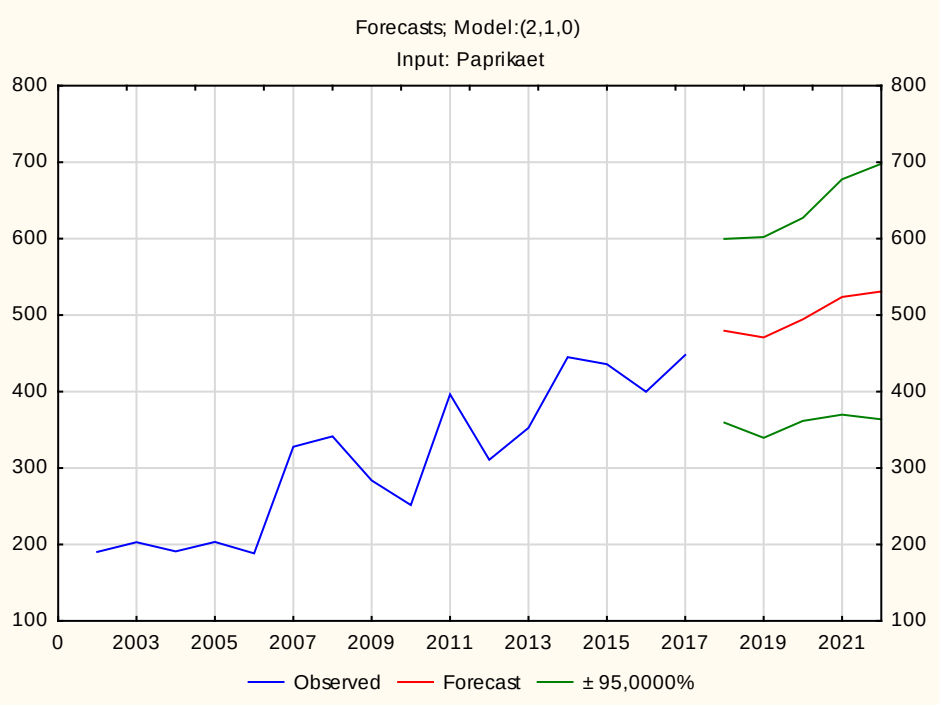
In the analysed period, the average annual price of pepper was 310.5 EUR/t. The price varied within the range from 188.3 EUR/t in 2006 to 447.8 EUR/t in the last year of the analysed period (2017). The coefficient of variation of the average annual price of pepper was high, amounting to 31.3%. The average annual rate of change in pepper prices was very high and amounted to 5.87%. This means that pepper also had a significant tendency of absolute improvement of its economic position. Pepper price in a certain period was, as was the case with most other analysed vegetable crops, influenced by its

prices in the preceding two years. The estimated model forecast pepper prices for the following five years (Table 6), showing that pepper price is expected to continuously increase over the years to the end of the forecast period (by 2022). The movements of pepper prices are given in Figure 4.

Table 6. Forecast of pepper prices (2018-22)

CaseNo.	Forecasts; Model:(2,1,0) Input: Paprikaet: Start of origin: 1 End of origin: 16 Forecast	Lower 95,0000%	Upper 95,0000%	Std.Err.
17	479,5019	359,3420	599,6619	55,14926
18	470,8765	339,5894	602,1637	60,25628
19	494,4590	361,6839	627,2341	60,93921
20	523,7226	369,7675	677,6776	70,66005
21	530,8480	363,7849	697,9110	76,67618

Figure 4. Changes in pepper prices



Analysis and forecast of onion prices

The average annual price of onion in the observed period amounted to 178.2 EUR/t, ranging from 119 EUR/t in 2004 to 270.7 EUR/t in 2011. The variation coefficient of the average annual price of onion was moderately high (but the lowest compared to

other analysed vegetables) and it amounted to 22%. The average annual rate of change in onion price was positive and amounted to 1.63%. This means that onion had a slight tendency of price increase in the analysed period, i.e. there was a tendency of slight improvement in the economic (price) conditions for its production.

Based on the prices in the period 2002-17, the estimated model showed that onion prices in an observed year were significantly influenced by the prices from the preceding two years. On the basis of the model, forecasting of onion prices was made for the period 2018-22 (Table 7), indicating that onion prices will continuously increase over the years during the forecast period. This is illustrated by graphical representation of price movements in the analysed and forecast period (Figure 5).

Table 7. Forecast of onion prices (2018-22)

	Forecasts; Model:(2,1,0) Input: Crniluket: Start of origin: 2 End of origin: 15			
CaseNo.	Forecast	Lower 95,0000%	Upper 95,0000%	Std.Err.
16	189,2947	154,1689	224,4205	15,76465
17	193,8105	135,6749	251,9461	26,09157
18	195,5434	131,2175	259,8693	28,86979
19	196,0136	130,0927	261,9345	29,58564
20	197,8529	128,2964	267,4094	31,21731

Analysis and forecast of cabbage prices

In the analysed period, the average annual price of cabbage was 158.8 EUR/t. The price ranged from 80.5 EUR/t in 2004 to 212.5 EUR/t in 2007. The coefficient of variation of the average annual price of cabbage was moderately high and amounted to 22.3%. The average annual rate of change in cabbage price was slightly positive and amounted to 1.48%. This means that cabbage had a slight tendency of absolute improvement of its economic (price) position. Cabbage price in a certain year was statistically significantly influenced by prices from the preceding period. Based on the estimated model, price movements were forecast for the following five years (Table 8), showing that the price of cabbage will fluctuate over the years, i.e. it will alternatively decrease and increase. These tendencies are confirmed by the graphical representation of price movements in the analysed and forecast period (Figure 6).

Figure 5. Changes in onion prices

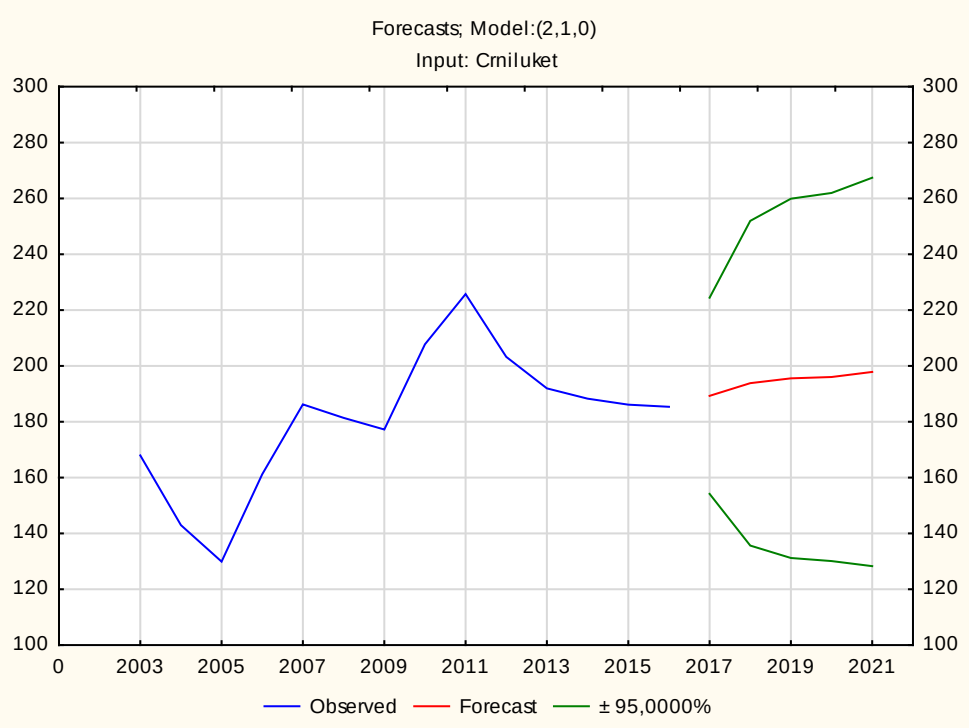
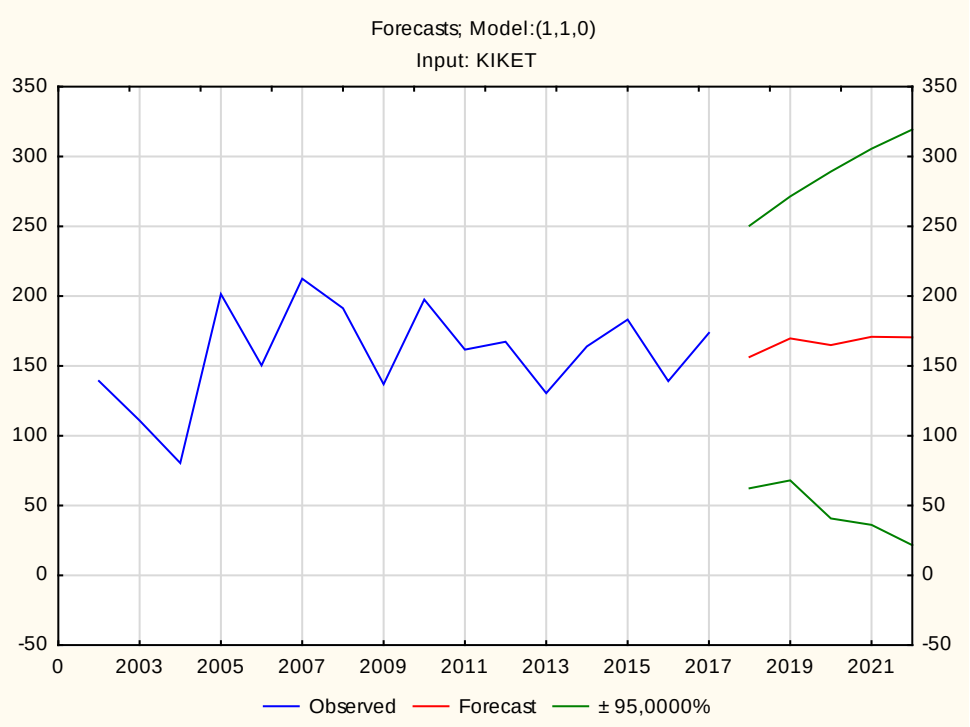


Table 8. Forecast of cabbage prices (2018-22)

CaseNo.	Forecasts; Model:(1,1,0) Input: KIKET Start of origin: 1 End of origin: 16 Forecast	Lower 95,0000%	Upper 95,0000%	Std.Err.
17	156,3881	62,31970	250,4565	43,54276
18	169,6683	67,96312	271,3735	47,07769
19	164,9611	40,75553	289,1666	57,49276
20	170,8477	36,16592	305,5294	62,34202
21	170,4950	21,63835	319,3516	68,90334

Figure 6. Changes in cabbage prices



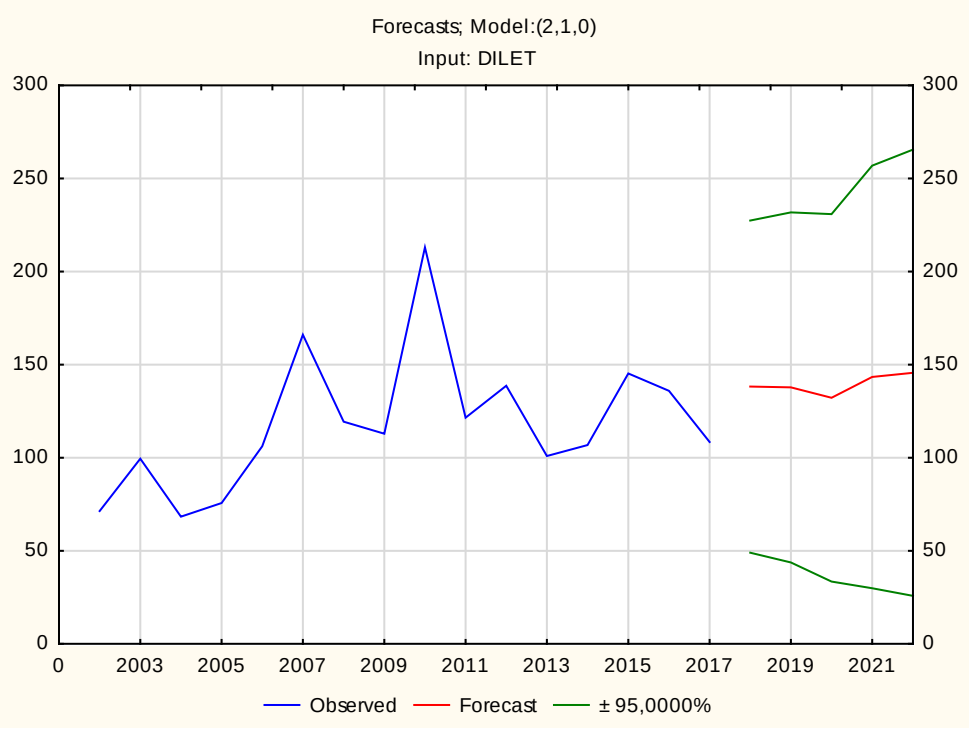
Analysis and forecast of watermelon prices

The average annual price of watermelon was 118.1 EUR/t. The price of watermelon varied from 68.4 EUR/t in 2004 to 213 EUR/t in 2010. The variation coefficient of the average annual price of watermelon was moderately high, amounting to 31.1%. The average annual rate of change in watermelon price was moderately high, amounting to 2.84%. This means that watermelon had a pronounced tendency of absolute improvement of its economic (price) position. The estimated model for analysing and forecasting watermelon prices showed that the price in a certain year was influenced by prices from the preceding two years, while the influence of the price from the previous year was statistically significant. On the basis of the estimated model, price movements of watermelon were forecast for the following five-year period (Table 9), showing that in the initial years the price will have a decreasing tendency, i.e. it will decrease in the first three years of the forecast period, while in the last two years of this period it is expected that watermelon price will increase. The indicated characteristics of watermelon price movements, especially the forecast values, are confirmed by the graphical representation of these movements (Figure 7).

Table 9. Forecast of watermelon prices (2018-22)

CaseNo.	Forecasts; Model:(2,1,0) Input: DILET : Start of origin: 1 End of origin: 16 Forecast	Lower 95,0000%	Upper 95,0000%	Std.Err.
17	138,1975	48,98740	227,4075	40,94434
18	137,7790	43,75934	231,7986	43,15177
19	132,1873	33,50217	230,8725	45,29308
20	143,3726	29,86298	256,8823	52,09703
21	145,6496	25,77610	265,5231	55,01780

Figure 7. Changes in watermelon prices



Discussion and Conclusion

The analysis which included seven vegetable crops indicated that in the period 2002-17 in Serbia bean had the highest average annual price, while watermelon had the lowest average annual price. The highest price fluctuations on the annual basis were found for tomatoes, while onion and cabbage had the lowest fluctuations (twice as low). All vegetable crops showed the tendency of absolute increase in prices expressed in euro. By far the highest average annual growth rate was found for tomato, whereas it was

the lowest for beans. Considering the prices of individual vegetable crops in the period 2018-22, the results of the forecast are as follows:

The price of potato will fluctuate over the years (which was also the case during the observed period). The price of this crop will range from 200 EUR/t in 2018 to 191 EUR/t in 2021.

The average price of bean will alternatively decline and grow over the years, within the range from 1.596 EUR/t in 2018 to 1.470 EUR/t in 2020.

Unlike the prices of potatoes and beans, the forecast price of tomato shows a tendency of increase from 441 EUR/t in 2019 to 517 EUR/t in 2022.

Continuous price growth was forecast for pepper throughout the whole forecast period: from 470 EUR/t to 530 EUR/t in 2022.

Continuous price growth was also forecast for onion: from 189 EUR/t in 2018 to 198 EUR/t in 2022.

The forecast values of cabbage price show that there will be minor oscillations over the years, i.e. the price will alternatively increase and decrease, but with a positive tendency. The price of cabbage will range from 156 EUR/t in 2018 to 170 EUR/t in 2022.

The price of watermelon will have a tendency of decrease in the initial years (the first three years of the forecast period), while in the last two years the price is expected to increase. The price of this crop will vary from 132 EUR/t in 2020 to 145 EUR/t in 2022.

Based on presented analysis, it can be concluded that the market position of vegetables is generally improving, but there will still be fluctuations and variability of their prices over the years.

Conflict of interests

The authors declare no conflict of interest.

References

1. Bannikova V. N, Onezhkina N. O., Agalarova G. E., Tenishchev V. A. (2018): Forecasting the tendencies of the Russian vegetables market development, *Journal of Business and Retail Management Research (JBRMR)*, 13 (1), 148 – 155.
2. Husemann, Ch., Novkovic, N. (2014): Farm management information systems: A case study of on a German multifunctional farm, *Economics of Agriculture 61 (2)*, (269-552), 441-453.
3. Ivanišević, A., Mutavdžić, B., Novković, N., Vukelić, N. (2015): Analysis and prediction of tomato price in Serbia, *Economics of Agriculture 62 (4)* (899-1178), 951-961.

4. Jasinthan, P., Laheetharan, A., Satkunanathan, N. (2015): A Markov Chain Model for Vegetable Price Movement in Jaffna , *Sri Lankan Journal of Applied Statistics,* Vol (16-2), 93-105.
5. Mutavdžić B., Drinić Lj., Novaković , T., Vaško Ž., Novković, N. (2017): The Comparative Analysis of Grain Prices in Serbia and Republic of Srpska, Book of Abstracts, 6th International Symposium on Agricultural Sciences, University of Banja Luka, February 27 – March 2, 2017 Banja Luka, Bosnia and Herzegovina, ISBN 978-99938-93-41-7, 54.
6. Mutavdžić B., Novković, N., Nikolić-Đorić E., Radojević, V. (2007): Analysis and prediction of pig price parity – maize, *Conteporary Agriculture 1-2*, 177-181. [*in Serbian*: Мутавџић Б., Новковић, Н., Николић-Ђорић Е., Радојевић, В. (2007): Анализа и предвиђање паритета цена свиње - кукуруз].
7. Mutavdžić Beba, Novković N., Ivanišević D. (2011): Tendencies of vegetable development in Serbia, *Agroznanje 12 (1)*, University of Banja Luka, Faculty of Agriculture, 23-31. [*in Serbian*: Мутавџић Беба, Новковић Н., Иванишевић Д. (2011): Тенденције развоја повртарства у Србији].
8. Mutavdžić, B., Novković, N., Ivanišević, D. (2010): Prediction of parity of prices of basic agricultural products, AroSym, Faculty of Agriculture East Sarajevo, Jahorina, 176-182. [*in Serbian*: Мутавџић, Б., Новковић, Н., Иванишевић, Д. (2010): Предвиђање паритета цена основних ратарских производа].
9. Novković N., Ilin Ž, Janošević M., Mutavdžić B. (2008): Importance of vegetable production for the multifunctional rural development, Multifunctional agriculture and rural development, IEP, Book I, Belgrade, 141-148. [*in Serbian*: Новковић Н., лин Ж, Јаношевић М., Мутавџић Б. (2008), Значај производње поврћа за мултифункционални рурални развој, зборник радова међународног научног скупа, Мултифункционална пољопривреда и рурални развој III“].
10. Novković, N., Mutavdžić B. (2016): Analysis and forecasting of bean prices in Serbia, Proceedings of papers: Policy and Economics for Sustainable Agricultural and Rural Development, AAEM 10th International Conference, 12-14 May, Ohrid, Association of Agricultural Economists of the Republic of Macedonia, 195-203.
11. Novković, N., Mutavdžić B., Ilin, Ž., Ivanišević, D. (2013): Potato Production Forecasting, *Agroznanje 14 (3)*; Banja Luka, 345-355.
12. Vukelić N., Novković, N. (2009): Economic results of milk production on large households, *Economics of Agriculture, 56,* 99-110 [*in Serbian*: Вукелић Н., Новковић, Н. (2009), Економски резултати производње млека на крупним сељачким газдинствима].

INSTITUTIONAL CHALLENGES OF POVERTY REDUCTION AND HOUSEHOLD COPING MECHANISMS IN EASTERN HARARGHE, EASTERN ETHIOPIA

Abadi Teferi Alemaw[1], *Alem Mezgebo Hailu*[2]

**Corresponding author E-mail: ateferi44@gmail.com*

ARTICLE INFO

Original Article

Received: *10 January 2019*

Accepted: *15 June 2019*

doi:10.5937/ekoPolj1902499A

UDC 338.1:316.344.23(63-11)

Keywords:

Institutional challenges, Poverty reduction, Probit model, Coping mechanisms

***JEL**: O17, O19, O35, O38, O43*

ABSTRACT

This study examines the institutional challenges of poverty and its coping mechanism in eastern Ethiopia. A sample of 800 households was randomly selected and interviewed from three local administratives namely: Dirree-Xiyyaara, Biiftuu-Gadaa and Hawwi-Gelan. The descriptive statistics indicate that majority of the households reported that they: do not feel secured on the current land ownership status; perceive that their family members, relatives, and communities do not help to them to fight poverty; do not trust in the local or woreda authorities; perceive that their local authorities are not accountable; think that their local authorities are not transparent; perceive that their local authorities are not participatory; and know that their local authorities demand bribe to provide services to the community. Similarly, the econometric result of the probit regression illustrates that distance to the nearest market center, saving culture and saving amount, land ownership status and active participation in social networks significantly determine poverty status of the households in the study areas.

Introduction

Poverty is conceivably the most serious challenge facing the people, governments and development practitioners in developing countries, especially in sub-Saharan Africa (SSA). Three fourths of the poor in the developing world live in rural areas, and rural poverty remains high and persistent-51% in SSA-while the absolute number of poor people increased since 1993 (World Bank (WB), 2008). Poverty is defined from an array of human deprivations in terms of health, education and income (UNDP, 1996).

1 Abadi Teferi Alemaw, Department of Agricultural Economics, Adigrat University, Adigrat, Ethiopia, Email: ateferi44@gmail.com, https://orcid.org/0000-0003-4121-3734

2 Alem Mezgebo Hailu, Department of Agricultural Economics, Adigrat University, Adigrat, Ethiopia, Email: deway12@gmail.com

Ethiopia, being a sub-Saharan country, is one of the poorest countries in the world by any standard. The Ethiopian Ministry of Finance and Economic Development (MoFED) examines that poverty is a serious challenge confronting Ethiopia, the most prevalent and pervasive social problems of the country (MoFED, 2011; 2012). Cognizant of this reality, Ethiopian is investing heavily to reduce poverty and promote social development. As a result, the proportion of public spending on pro-poor sectors has increased from 57% in 2004/05 to two-third in 2016/17 (UNDP Ethiopia, 2018).

However, Ethiopia still has relatively low rates of educational enrollment, access to sanitation, and attended births. In 2011, for example, 87% of the population was measured as Multidimensional Poverty Index (MPI) poor, which means they were deprived in at least one third of the weighted MPI indicators. This put Ethiopia as the second poorest country in the world when using the MPI approach (OPHDI 2014). Likewise, WHO (2010) pointed out that while 38% of the population has access to safe water, only 12% of the population has adequate sanitation in 2010. In the same year, 48.5 % of the rural population and 23.9% the urban population suffered from chronic malnutrition. These all indicate that Ethiopia as a country has a long way to strive and a challenging assignment to reduce poverty thereby eradicate it for once and for ever.

Here, one might pose a question in this regard if the government is the only concerned body to fight poverty in the country as the determinants of poverty especially at household level are multifaceted and multi-dimensional. The study of determinants of poverty at household level deserves thorough investigation. Admittedly, there are a number of empirical literatures on the determinants (predominantly socio-economic) of poverty among smallholder farmers in Ethiopia.

Eastern Hararghe *zone*[3] located in eastern Ethiopia, the focus of this study, is one of the chronically poor and famine prone parts of the country for a long period. According to the CSA (2007), the zone was populated by a total of 2.724 million habitants. A significant proportion of the population in almost all woredas in the zone live in a situation of chronic food insecurity -unable to meet basic needs, lack productive resources and highly depend on relief programmes (Degefa and Tesfaye, 2008; WB, 2014). Ayalneh (2011) asserted that eastern Hararghe highlands are characterized by more intensive, but small scale farmland holdings producing largely for the market with cash crops, for example, khat, constituting an important part in the landscape; and that poverty in the zone is location-specific, depends on access to irrigated land (not land per se) and access to non-farm income. A study by Ayalneh et al. (2008) also found that while household wellbeing is negatively affected by household size, age of household head, involvement in governance, social and production related networks is also found to be strongly associated with the probability of a household be poor.

The aforementioned studies have tried and contributed to the existing literature on the determinants of poverty in the country at large and the study area in particular. Majority

3 *Zone is the third-level administrative division in Ethiopia.*

of these studies either focused on the demographic and socio-economic determinants of poverty. Nevertheless, it is believed that poverty is not merely characterized by the traditional demographic and socio-economic determinants but also by the institutional characters of the people. According to North (1999) institutions are composed of i) formal rules (laws and constitutions), ii) informal constraints (conventions, codes of conduct, and norms of behavior), and iii) their enforcement to provide a frame work of incentives that shape economic, political and social organizations. Todaro and Smith (2006) declared that low labor productivity and thereby poverty in developing countries is strongly linked with such institutions as land tenure system, the attitude of people towards work and self-improvement, the discipline of citizens and administrators. Moreover, the prospect of people in developing countries to get out of poverty might be constrained by corruption, inefficiency of the public sector to provide services and in effective legal system (Thirlwall, 2006). Hence, it is imperatives and it is time which needs a paradigm shift in investigating the determinants of poverty from the perspective of the institutional characteristics of households.

The present study, therefore, aims to supplement the literature by examining the institutional determinants of poverty and the coping mechanisms in eastern Hararghe zone, eastern Ethiopia, and thereby provide an important insight to the efforts the government and the people exert in fighting poverty. The study is guided by the hypothesis: "institutional determinants don't affect the households' poverty status in the study areas."

Research Methodology

Study area, sample size and sampling techniques

The study area-Eastern Hararghe is located in Oromia region, eastern Ethiopia. The eastern Hararghe zone, even though, it is found in Oromia region, both the Dire Dawa city administration and the Harari people region within the zone. This implies that there are three different administrations-eastern Hararghe, Dire Dawa city administration and the Harari people region. A two-stage sampling technique was used to select sample respondents. First, one representative *kebele* was randomly picked to obtain a sample of respondents from each of the three administrations. The *kebeles* are *Dirree-Xiyyaara* (from Harari region), *Biiftuu-Gadaa* (from eastern Hararghe) and *Hawwi-Gelan* (from Dire Dawa). Second, given the total number of the study area, 800 sample households were selected. The sample allocation was 260 from eastern Hararghe and Harari each, and 280 from Dire Dawa based on the assumption that farmers in the area are more or less homogenous.

Types and tools of data collection

The study used both primary and secondary data. Primary data were collected from smallholder farm household heads through structured interview schedule. The interview questionnaire was first written in English but was later translated to *Afan-oromo*, a

local language of the communities in the study areas. The procedures of collecting the necessary data were briefed to the data enumerators. Focus group discussion (FGD) and key informant interview were also conducted to supplement the findings drawn from the interview.

Data analysis procedures

Both descriptive and econometric statistics were used to analyze data. Descriptive statistics were used to provide a summary statistics related to the general characteristics of the respondents, using minimum, maximum, mean and standard deviation while frequency and percentage were employed to analyze data related to the institutional challenges of poverty reduction. On the other hand, the data obtained from the focus group discussions, and key informants was qualitatively and narratively described to enrich and illustrate a qualitative conclusion.

To explore the institutional correlates of poverty, the study used probit econometrics model. Probit model models is often used when a dependent variable takes one of a number of discrete values and simulations can conveniently demonstrate how much the likelihood of being poor is reduced if an exogenous variable such land ownership were to change (Ayalneh *et al*., 2005). Binary response models (e.g. probit, logit) are used where poverty is considered as a "yes" or "no" decision (Greene, 2002).The dependent variable which was used with probit model is the poverty status of the households, taking the values 1 or 0. The value 1 indicates a household is poor while the value 0 indicates a household is non-poor. For the sake of this paper, a household is defined poor when household daily per calorie consumption is below the poverty line (expenditure is insufficient to meet the food and other basic needs of all household members). In this study, the poverty line in terms of daily kilocalorie per adult is estimated to be 2200 kilocalorie per day per adult equivalent (UNU, WHO & FAO, 2004).

Following Menard (2002), the probit Model for the log odds of whether a household is poor or non-poor is specified as follows:

$$Y_i = \beta' X + \varepsilon_i \quad \ldots\ldots (1)$$

Where: Y_i is the dependent variable of the model (binary probit analysis), has dichotomous in nature representing the household's poverty status; and X is vector of explanatory variables; β' is a vector of parameters to be estimated and ε_i is the error term assumed to be normally distributed. Thus, the binary variable can be defined as:

$$s_i = \begin{cases} 1 \; if \; Y_i \leq Z \\ 0, otherwise \end{cases}$$

Where; s_i is the social economic status and the Z is the poverty line. The binary model then equals:

$$\Pr(s_i = 1) = F(Z - \beta' X) \quad (2)$$

F is the cumulative normal probability density function.

Result and Discussions

Descriptive analysis of institutional challenges of poverty reduction

The descriptive statistics indicates that 44.25% of the sample households were found to be poor. To examine institutional challenges of poverty reduction in the study area, we raised some questions that are related to the institutions. And we examined the perception of the sampled household heads (both poor and non-poor, we used the pooled for analysis purpose) toward the institution in the way of the out of poverty.

Dummy variables: Table 1 shows that 68 % of the sampled households reported that they do not feel secured on the current land ownership status; while about half the sampled households reported that they perceive that their family members, relatives, and communities help them in moving out of poverty (during challenges). Again we asked the households if they trust the local or municipal and half of the sampled households reported that they do not trust the local or municipal authorities while about 52 % of them reported they perceive that their local authorities are not accountable. Further, about 55 % of the sampled households said that they perceive that their local authorities are not transparent. Table 1 indicates that about 54 % of the sampled households in the study area perceive that their local authorities are not participatory. Table 1 further shows that around 82 % of the households in the study area reported that they perceive that their local authorities demand bribe, while only about 26 % of the sampled households in the study area have received welfare or public assistance. This finding is in line with what was stated by other authors (Todaro and Smith, 2006; Thirlwall, 2006). Furthermore, Table 1 indicates that the second tier institutions namely Development banks, MFI, NGOs, and ECX are not available to the 66, 80, 96 and 98 % of the sampled households respectively in the study area.

Table 1. Institutional challenges of poverty reduction-dummy variables

S.No	Items	Poverty Status					
		Non-poor		Poor		Pooled (%)	
		Yes	No	Yes	No	Yes	No
1.	Do you feel secured on the current land ownership?	128	318	128	226	32	68
2.	Do you perceive that your family members, relatives, and communities helpful?	214	232	182	172	49.5	50.5
3.	Do you trust in the local or municipal authorities?	218	228	182	172	50	50
4.	Do you perceive that your local authorities are accountable?	208	238	174	180	47.75	52.25

S.No	Items	Poverty Status					
		Non-poor		Poor		Pooled (%)	
		Yes	No	Yes	No	Yes	No
5.	Do you perceive that your local authorities are transparent?	192	254	166	188	44.75	55.25
6.	Do you perceive that your local authorities are participatory?	192	254	170	184	45.25	54.75
7.	In your opinion, do the local governments demand bribe from you?	84	362	60	294	18	82
8.	Have you or has anyone in your family ever received welfare or public assistance?	132	314	74	280	25.75	74.25
9.	Second-tier institutions are available in your locality(deve bank)	122	324	154	200	34.5	65.5
10.	Second-tier institutions are available in your locality(mfi)	92	354	72	282	20.5	79.5
11.	Second-tier institutions are available in your locality (NGOs)	26	420	10	344	4.5	95.5
12.	Second-tier institutions are available in your locality (ECX)	14	432	6	348	2.5	95.3

Source: Authors' calculations

Likert scale variables: Table 2 shows the likert scale type questions we asked the respondents. Table 2, thus, shows that in the struggle to come out of poverty for the households in study areas, 63%, 75%, 64%, and 77 % of the sampled household responded that internal conflict, ethnic tensions, lack of law & order and religious malpractices respectively influence the farmers very little. Further, according to Table 2, in struggle to come out of poverty for the households in study areas 5, 1, 18, 0.25 % of the sampled household responded that internal conflict, ethnic tensions, law and order and religion influence affected them very much, respectively. It can be concluded, therefore, that either there are minimal impacts of internal conflict, ethnic tensions, lack of law & order and religious influence in the study areas.

Table 2. Institutional challenges of poverty reduction-likert scale variables

S.No	Items	Poverty Status		
		Non-poor	Poor	Pooled (%)
1.	**Factors that affect you in struggle to come out of poverty (internal conflict)**			
	Very Little	274	232	63.25
	Little	30	8	4.75
	Not Known	102	66	21
	Much	18	32	6.25
	Very Much	22	16	4.75

S.No	Items	Poverty Status		
		Non-poor	Poor	Pooled (%)
2.	**Factors that affect you in struggle to come out of poverty (ethnic tensions)**			
	Very Little	316	280	74.5
	Little	12	4	2
	Not Known	98	58	19.5
	Much	14	12	3.25
	Very Much	6	0	0.75
3.	**Factors that affect you in struggle to come out of poverty (law and order)**			
	Very Little	266	244	63.75
	Little	26	16	5.25
	Not Known	34	26	7.5
	Much	26	18	5.5
	Very Much	94	50	18
4.	**Factors that affect you in struggle to come out of poverty (religious influence)**			
	Very Little	328	292	77.5
	Little	0	0	0
	Not Known	108	62	21.25
	Much	8	0	1
	Very Much	2	0	0.25

Source: Authors' calculations

Econometric results analysis

Table 3 shows the results of the econometric model we applied that is the probit regression result. For the sake of estimation we included the demographic and socio-economic determinants in addition to the institutional challenges of poverty in the Probit model. Variables those significantly determine the poverty status of the households in the study areas are only discussed as follows.

Demographic, socio-economic determinants of poverty

Education of the household head: Table 3 indicates that education of household headed negatively affects poverty of the household at less than 1% significant level. This implies that households with higher years of schooling of the household heads have lower probability of being poor. The result has the strong policy implications signaling that better education improves the living standard of the households. This can be explained in multiple dimensions as education has multiple roles in the life of the society. By increasing the productivity of the household education can help produce more that go beyond the amount that suffices for basic needs. Education help understand cause of poverty and how to overcome it. Education is easily diffusible that spreads to the members of the family from the household head this in turn help the family act accordingly to improve their well-being.

Family size: the regression result indicates that higher family size positively and significantly determines poverty at less than 1% level of significance. This finding implies that the more the family sizes the higher the probability of the being poor in the study area. This finding may be explained in the way that all resources that are available to the household are shared among the member of the households. Thus, as the number of the household member increases the percapita recourses including food declines. This may put these households in poverty status.

Tropical livestock unit: the result indicates that tropical livestock unit negatively affects poverty of the household significantly at less than 10 percent significant level. This implies that households with higher livestock unit have lower probability of being poor. The policy implications of the result is that empowering household with the livestock will accelerate the rate of poverty reduction the major objective that country is striving for. Those households with higher livestock have an opportunity to use the products of these livestock eight by selling or consuming or both. Either of the action reduces the probability of being poor by contributing to the consumption of the household. By selling these livestock products households purchase others that they are lacking that boasts the living standard of the households.

Institutional determinants of poverty

Distance to the nearest main market place: the Probit regression indicates that distance to the nearest market center positively contributes to the poverty level of the households in the study area. This implies that as the households get far from the nearest market center their probability of being poor increases. This is in line with (Pernilla, 2001) that the well-functioning markets are important in the process of reducing poverty. This may due to the fact that households located to the nearest market have opportunities to easily and frequently take their products and purchase essential resources that contribute to their wellbeing relative to those households located far from the market center.

Land ownership status: Cornwall (2000) states that apart from the traditional citizenship new forms of citizenship have been articulated that go beyond national identities that grant a bundle of state-supported social and economic rights-and legal equality. Accordingly landownership status is a good example of these new forms of citizenship to include issues of agency and an expanded spectrum of rights to farmers. In our study sites, land ownership status negatively affects the poverty level of households at 5 percent level of significance. This implies as the farmer is entitled to his/her land, the probability of being poor decreases significantly.

Amount of saving: the probit regression further indicates that households' saving level negatively determines the poverty status of the household level significantly at 5 percent significance level. This result implies that if households save more and invest their probability of being poor will be lower. In fact, saving earns the households interest rate and if this is spent on the welfare of the households it improves the wellbeing of the households.

Participation in social networks (informal institutions: such as *iddir, iqub*.): For North (1990), informal institutions are such as customs, traditions and conventions. We saw if being a member of social networks has an impact in being poor or otherwise. Accordingly, Table 3 shows that the probability of being poor in the study areas decreases when the farmer is a member of social formal institutions such as *iddir* and *iqub* at 1% level of significance.

Table 3. Probit regression results

Poverty status of the household	**Coef/Z**
Sex of household head	0.085(0.38)
Age household head in years	0.004(0.56)
Education of household head in years of schooling.	-0.061(3.11)**
Family size	0.104(3.27)**
Tropical livestock unit	-0.092(1.85)***
Land size of the household	0.325(1.26)
Quality of land of the household	-0.061(0.41)
Land ownership status	0.291(2.78)**
Access to credit facilities	0.037(0.20)
improved seed use for the major agricultural products	-0.009(0.06)
Distance to the nearest main market place	0.059(2.61)**
Active participation in any of social network *(iddir, iqub.)*	0.127(0.89)*
Quantity of fertilizer used (DAP and UREA) in KG	-0.000(0.53)
Amount of saving	-0.000(2.43)**
Distance to medical services	-0.029(1.24)
Constant	-1.131(2.33)*
Number of observations	800
Log likelihood	-119.51146
LR chi2(16)	104.81
Prob>chi2	0.0000

* $p<0.01$; ** $p<0.05$;***$p<0.1$

Source: Authors' calculation

Poverty coping mechanisms of the of the households

It is assumed that households use different coping mechanisms to overcome the challenges of poverty. Accordingly, households were provided with an interview schedule to comment on coping mechanisms they employ with to tackle poverty. In this regard, three broad coping mechanisms were identified. These are self-insurance, community-based, and external help were considered. Each of these is again composed of multiple sub-mechanisms as they are presented in Table 4.

Table 4, therefore, displays the results of the type of coping mechanisms the households use to cope up with poverty in the study areas. However, respondents are observed not to respond to some of the questions, so the total number of respondents in Table 4 may vary from the 800 sample respondents. Accordingly, 79 % of the households reported that they use two or more combination of the self-insurance coping mechanisms to

overcome challenges of poverty. 8.5 % of the households in this category use their own fund (saving) to overcome the challenges of poverty. Also, Table 4 indicates out of the total sample households that opt for community based help as a means of coping mechanism, 44 % of them reported that they use two or more of combination of the community-based help coping mechanism to overcome challenges of poverty. Further, about 17 % of the households in this category borrow money from their relatives, friends, and others without interest to overcome the challenges of poverty. Additionally, Table 5 shows of the total sample households that opt for external help, 85 % of the respondents responded that they use two or more of the combination of the external help coping mechanism to overcome challenges of poverty in the study areas.

Table 4: Coping mechanisms of the of the households

S.No	Coping mechanisms	Poverty Status of the Household		
		Non-poor	Poor	Pooled (%)
1.	**How did your household cope with the poverty (self-insure)?**			
	Own Funds, Saving	50	18	8.5
	Calling In Debts	8	4	1.5
	Re-Sowing	18	0	2.25
	Selling Livestock	6	2	1
	Selling Assets and eating less	22	6	3.50
	Spend Less On Clothing	2	0	0.25
	Spend Less On School	6	0	0.75
	Defer Expenses	2	18	2.5
	Additional Job	2	8	1.25
	Combinations of two or more of the above	330	298	78.5
2.	**How did your household cope with the poverty (community-based)?**			
	Livestock Sharing	4	0	0.02
	Sharecropping	2	4	0.04
	Donations From Relatives, Friends And Private Persons	26	22	0.30
	Borrowing with interest from community organizations	4	0	0.02
	Borrowing without interest from relatives, friends or private persons	14	14	17.28
	Combinations of two or more of the above	32	40	44.44
3.	**How did your household cope with the poverty (external)?**			
	Work For PSNP	6	2	0.01
	Emergency Food Aid	2	2	0.03
	Assistance From Farmers Cooperatives	0	2	0.01
	Assistance From Government	4	0	0.03
	Assistance From NGOs	0	2	0.01
	Combinations of two or more of the above	102	12	85.07

Source: Authors' calculations

Conclusion and Recommendations

This study examines the institutional challenges of poverty and its coping mechanism in eastern Ethiopia. For the achievement of objective of the study, 800 farmers selected from three local administrates namely *Dirree-Xiyyaara* (from Harari administrative), *Biiftuu-Gadaa* (eastern Hararghe) and *Hawwi-Gelan* (from Dire Dawa) were interviewed. To analyze the collected data, both descriptive and econometrics analysis were used. The descriptive statistics result indicates that 44 percent of the households are categorized 'poor'. The descriptive statistics also indicate that majority of the households reported that they: do not feel secured on the current land ownership status; perceive that their family members, relatives, and communities do not help to them to fight poverty; do not trust in the local or woreda authorities; perceive that their local authorities are not accountable; think that their local authorities are not transparent; perceive that their local authorities are not participatory; and know that their local authorities demand bribe to provide services to the community.

The econometric result of the probit regression shows that of the demographic and socio-economic determinants of poverty used in the regression, education of the household head, family size, and tropical livestock unit statistically and significantly determine the poverty status of the households in the study area. The econometric result of the probit regression further shows the institutional (formal and informal) factors of poverty in the study area. Distance to the nearest market center positively contributes to the poverty level of the households in the study area. Saving culture level negatively determines the poverty of the household level significantly. Land ownership status and active participation in social networks (iddir, iqub) are also observed to negatively and significantly correlate to being poor in the study area. The guiding hypothesis was rejected, therefore, at 5% level of significance.

As far as households' poverty coping mechanisms are concerned, 79 % of them use more than one combination of the self-insurance coping mechanisms; out of the total sample households that opt for community based help 44 % of them use more than one combination of the community based help coping mechanisms; and out of the total sample households that opt for external help 85 % of them use more than one combination of the external help coping mechanism to overcome challenges of poverty. In the struggle to come out of poverty for the households in study area internal conflict, ethnic tensions, law and order and religion influence have lower impact. Furthermore, the second tier institutions: Development bank, MFI, NGOS, and ECX are not available to the majority of the sampled households in the study area.

Based on the findings of the study to reduce the poverty of the households in the study area, the following policy options are recommended:

- ✓ **Expanding the education services:** The challenges of poverty may be reduced by expanding the educational services to the study area. This can be achieved through providing training to the households that increase their literacy and numeracy through either formal or informal mechanisms; and encouraging the households to send their children to school and follow them to for effective school attendance.

- ✓ **Market expansion to the local areas:** Institutions should be introduced to the study area as the fundamental idea is institutions are what make a market function well. By expanding market service to all households' poverty challenges of the study area will be reduced. This can be achieved by establishing market institutions that may deal with agricultural inputs and agricultural outputs) markets; and creating market institutions that deal with the consumer goods to the local areas.
- ✓ **Encouraging social networks:** If people are bold enough to reserve their social values and networks, farm production and productivity might increase so that the struggle to reduce poverty can be accelerated.
- ✓ **Enlarging the coping mechanism:** By expanding and making efficient the available coping mechanism may also reduce the poverty status of the study area.

Acknowledgements

The authors would like to acknowledge the enumerators for the effort they made to collect the survey data. The administrative units of the study area also deserve special thanks for providing the necessary support throughout the period of this study.

Conflict of interests

The authors declare no conflict of interest.

References

1. Asmamaw, E., (2004.). Understanding Poverty: The Case of Ethiopia.A Paper Presented at *The Gambia AAPAM Roundtable Conference*, Banjul, The Gambia, April 19 - 23, 2014.
2. Ayalneh. B., Hagedorn, K., & Korf, B. (2008). Analysis of poverty and its covariates among smallholder farmers in eastern Hararghe highlands of Ethiopia Quarterly Journal of International Agriculture 44 (2005), No. 2; DLG-Verlag Frankfurt.
3. Ayalneh, B. (2011). Analysis of poverty and its covariates among smallholder farmers in the Eastern Hararghe highlands of Ethiopia. Journal of Development and Agricultural Economics Vol. 3(4), pp. 157-164, April 2011, Retrieved from http://www.academicjournals.org/JDAE (June 20, 2018)
4. Ayalneh, B., Konrad, H., & Benedikt, K. (2005). Determinants of poverty in rural Ethiopia. Quarterly Journal of International Agriculture 44 (2005), No. 2: 101-120
5. Brown, T., & Teshome, A. (2007). Implementing Policies for Chronic Poverty in Ethiopia. Background paper for The Chronic Poverty Report 2008-09. Manchester, UK: Chronic Poverty Research Centre (CPRC).
6. Central Statistical Agency (CSA) (2007). Central Statistics Agency, National Population Census, Addis Ababa.
7. Cornwall, A. (2000). Beneficiary, consumer, Citizen: Perspectives on Participation for Poverty Reduction. Sida Studies No. 2. Stockholm, Sweden: Sida.

8. Degefa, T., & Tesfaye, T. (2008). Linkages between Water Supply and Sanitation and Food Security: A case study in four villages of East Hararghe zone, Oromia region. Working paper: Research-inspired Policy and Practice Learning in Ethiopia and the Nile region (RiPPLE).
9. Dercon, S., & Krishnan, P. (1998). Changes in Poverty in Rural Ethiopia 1989-1995: Measurement, Robustness Tests and Decomposition. Centre for the Study of African Economies Working Paper: 98/07.
10. Dercon, S. (1999). Ethiopia- Poverty Assessment Study. Report Prepared for IFAD/ WorldBank
11. Devereux, S., & Sharp, K. (2003). Is Poverty Really Falling in Rural Ethiopia? Paper to be Presented at the Conference Staying Poor: Chronic Poverty and Development Policy at the University of Manchester, 7 - 9 April 2003.
12. Ethiopian Health and Nutrition Research Institute (EHNRI) (2000). Food Composition Table for Use in Ethiopia. Ethiopian Health and Nutrition Research Institute, Addis Ababa , Ethiopia.
13. Federal Democratic Republic of Ethiopia (FDRE) (2002). Ministry of Finance and Economic Development (MoFED):- Ethiopia: Sustainable Development and Poverty Reduction Program. July, 2002 Addis Ababa Ethiopia.
14. Fekadu, B., & Mequanent, M. (2010). Determinants of Food Security among Rural Households of Central Ethiopia: An Empirical Analysis. Quarterly Journal of International Agriculture 49 (2010), No. 4: 299-318.
15. Foster, J., Greer. J., & Thorbecke, E. (1984). A Class of Decomposable Poverty Measures. Econometrica, 52 (3): 761-766.
16. Gebrehiwot, W., & Fekadu, B. (2012). Rural household livelihood strategies in drought-prone areas: A case of Gulomekeda District, eastern zone of Tigray National Regional State, Ethiopia. Journal of Development and Agricultural Economics Vol. 4(6), pp.158-168, Retrieved from http://www.academicjournals.org/JDAE (August 17, 2017)
17. Greene, W.H. (2002). Econometric Analysis.5th edition. Engelwood Cliffs, NJ: Prentice Hall.
18. Kanbur, R., & Squire, L. (1999). The Evolution of Thinking about Poverty: Exploring the Interactions. Paper presented at Symposium on Future of Development Economics in Perspective held in Dubrovnik, 13-14 May, 1999.
19. Ministry of Finance and Economic Development, Ethiopia (MoFED) (2011). Growth and Transformation Plan 2010/11-2014/15-volume I, Addis Ababa Ethiopa.
20. Ministry of Finance and Economic Development, Ethiopia (MoFED) (2012). Ethiopia's Progress Towards Eradicating Poverty: Interim Report on Poverty Analysis Study (2010/11). Addis Ababa, Ethiopia: pp 1-16.
21. North, D. C. (1991). Institutions. The Journal of Economic Perspectives, Vol. 5, No. 1: 97-112.

22. North, D.C. (1999). Institutions, Institutional Change and Economic Performance. London; New York; Melbourne: Cambridge University Press.
23. Oxford Poverty and Human Development Initiative (2014). Global Multidimensional Poverty Index Databank.OPHI, University of Oxford.
24. Pernilla, S. (2001). Institutions and Poverty Reduction-An introductory exploration. Sida Studies No 9. Stockholm, Sweden: Sida.
25. Ravallion, M. (1992). Poverty Comparisons: A Guide to Concepts and Methods. Living Standards Measurement Study Working Paper No. 88, the World Bank.
26. Ravallion, M. (2008). Poverty Lines. In The New Palgrave Dictionary of Economics, 2nd edition, ed. Larry Blume and Steven Durlauf.
27. Ravallion, M. & Datt, G. (1995). Growth and Poverty in Rural India. Policy Research Working Paper 1405, World Bank.
28. Thirlwall, A. (2006). Growth and Development with Special Reference to Developing Countries, 8th edition. Palgrave Macmillan, New York, USA.
29. Todaro, M., & Smith, S. (2006). Economic Development. 9th ed. Addison-Wesley series in economics, New York, USA.
30. UNDP Ethiopia (2018). Ethiopia's Progress towards Eradicating Poverty: "Implementation of the Third United Nations Decade for the Eradication of poverty (2019-2027). Paper presented on the Inter-Agency Group Meeting. Addis Ababa, Ethiopia.
31. UNU, WHO & FAO. (2004). Human energy requirements: Report of a joint FAO/ WHO/UNU expert consultation, Rome, October 17-24. *FAO Food and Nutrition Technical Report Series 1.*
32. World Bank (2008). World development report 2008: Agriculture for development, World Bank.
33. World Bank (2013). Ethiopia Economic Update II: Laying the foundation for achieving middle income status.
34. World Bank (2014). Ethiopia: Priorities for Ending Extreme Poverty and Promoting Shared Prosperity. Systematic Country Diagnostic. Report No: 100592-ET.

NEW VARIETIES OF PLANTS AND LEGAL PROTECTION OF BREEDER'S RIGHT – THE UPOV CONVENTION AND ITS MAJOR ECONOMIC CONSEQUENCES

Uroš Ćemalović[1], Milica Petrović[2]

**Corresponding author E-mail: contact@uroscemalovic.com*

A R T I C L E I N F O

Review Article

Received: *03 December 2018*

Accepted: *05 May 2019*

doi:10.5937/ekoPolj1902513C

UDC 347.77[633/635:575

Keywords:

breeder's right, intellectual property, new varieties of plants, UPOV Convention

JEL: *K32, Q57*

A B S T R A C T

The International Convention for the Protection of New Varieties of Plants (UPOV Convention) represents the most comprehensive international legal mechanism in this field. In spite of the fact that the UPOV Convention introduces only certain minimal common rules regarding the so called breeder's right, the efficiency and the level of acceptance of the entire UPOV system have had numerous economic and social benefits: significant increase of productivity, transparent and just mechanism for rewarding scientific effort and investment in research, important incentive for international trade of new varieties of plants and undisputed impact on agricultural and horticultural development. This paper provides a targeted analysis of the important provisions of the UPOV convention (notion of breeder, grant of breeder's right and its content) and examines some of its major economic consequences. It argues that the UPOV convention remains an effective international legal mechanism for the protection of new varieties of plants.

Introduction

The introduction of new varieties of plants (including fruits and vegetables, but also other agricultural and ornamental plants) is beneficial from agricultural, economic and social point of view. As it was pertinently pointed out in theory, the benefits of new plant varieties include, but are not limited to "higher yield, resistance to pests and diseases, tolerance to stresses (…), greater efficiency in the use of inputs, improved harvestability and crop quality" (Sanderson, 2007). From an evolutionary perspective, the quintessence of breeding is "man's power of accumulative selection: nature gives successive variations;

1 Uroš Ćemalović, Ph.D., Research Associate, Institute of European Studies, Trg Nikole Pašića 11, 11000 Belgrade, Serbia; Phone: + 381 63 203 305, E-mail: contact@uroscemalovic.com, https://orcid.org/0000-0002-0760-9703.

2 Milica Petrović, LL.M. candidate, Graduate Student Instructor, Faculty of economy and judiciary, Mitropolita Petra 8, 11000 Belgrade, Serbia; Phone: +381 60 367 1682; E-mail: milica3500@gmail.com, https://orcid.org/0000-0002-7528-7179.

man adds them up in certain directions useful to him. In this sense he may be said to make for himself useful breeds" (Darwin, 1860). Without any pretention to minimize the importance of biological, botanic and other natural sciences-related aspects of breeding new varieties of plants, the main perspective of this paper will be legal-economic, while the new value created in the process of breeding will be seen as an intangible, intellectual creation and, consequently, the subject of intellectual property rights (IPRs). Seen under this angle, the process of breeding a new variety of plant (or discovering and developing an existing one) is very often a result of a serious scientific research, which, in principle, includes not only long-lasting effort of highly competent teams, but also important investments. On the international level, the first legal act that introduced a specific mechanism for the protection of breeders' rights was the International Convention for the Protection of New Varieties of Plants (known under the French acronym UPOV Convention)[3], signed in December 1961 (came into force in August 1968). Half a century of its existence in the international legal system has brought up a creation of a new, specific IPR, with important economic and social consequences. This paper provides a targeted analysis of the UPOV convention (its legal specificity, global relevance, scope and the most important provisions) and examines some major economic consequences of the legal framework introduced by the UPOV convention.

Materials and methodology

Taking into consideration the object of the analysis (international normative framework and its enforcement), the content analysis and comparative legal method will be used as the main toll, completed with teleological analysis (normative framework) and impact assessment (economic outcomes). For the purposes of the analysis of the legal specificity, global relevance and scope of the UPOV Convention, data used originates from three major institutional sources (IUPNVP, AIPO, EU). As for the notion of breeder under the UPOV Convention, the possibilities of divergent interpretation have led to the semantic and teleological analysis of both French and English versions of Article 41. Regarding the grant of breeder's right and its content, due to the limited space, the content analysis will be reduced to Articles 5-9, 14, 15 and 20 of the UPOV Convention. Moreover, other non-binding acts will also be taken in account, such as explanatory notes (as referenced in respective chapters). The issue of balancing between public and private interests will not be examined in detail, given that, by its scope, it does not concern exclusively the new varieties of plants. Finally, the analysis of the economic outcomes of the UPOV Convention is based on data used originates from both independent and institutional sources, with a focus on multi-annual statistical overviews.

3 One of the main consequences of this Convention was the creation of so called *International Union for the Protection of New Varieties of Plants* or, in French, *Union internationale pour la protection des obtentions végétales* (UPOV). Besides its well-known (traditionally undoubted, but now somewhat fading) importance in international diplomatic and conventional relations, the reason why French acronym prevailed can be found in Art. 41 of the Convention, providing that „This Convention shall be signed in a single original in the English, French and German languages, the French text prevailing in case of any discrepancy among the various texts".

Results and discussions

The UPOV convention, as the most comprehensive international legal mechanism for the protection of new varieties of plants, introduces the minimal common rules regarding the conditions for the protection of breeders' rights and the prerogatives it implies. Moreover, the Convention establishes the International Union for the Protection of New Varieties of Plants (IUPNVP) and gives to the applicants for breeder's right certain important prerogatives, applicable in all other states signatories of the Convention. Therefore, besides its legal specificity, global relevance and scope, the issues to be addressed in the examination of the UPOV Convention are, on the one hand, the notion of the breeder and, on the other, the conditions for the grant of breeder's right and its content.

Given the specificity of the object of protected right, the legal mechanism for the protection of new varieties of plants, notwithstanding its important specificities, belongs to the multifaceted system of intellectual property rights. In other words, a new plant variety can theoretically also be an object of patent application, but different countries all over the world have had fundamentally different approaches concerning the patentability of plant varieties. For example, in 1980 the United States Supreme Court ruled that utility patents could apply to life forms, while, in Europe, the European Patent Office "has ruled that plant varieties are not patentable, although it has also held that transgenic methods and plants are not *per se* unpatentable (while) DNA sequences and aminoacid sequences corresponding to the peptides or proteins produced by a naturally occurring organism are unpatentable in a number of countries including Brazil, Cameroon, Colombia, Cuba, Guatemala and Uzbekistan" (Boettiger, Graff, Pardey, Van Dusen, Wright, 2004). Moreover, the development of international legal mechanisms aiming to guarantee an IPR-related protection of genetic resources is a sensitive and complex issues (Perdue, 2017). In any case, if one country allows both breeders' rights and patent protection for plants, such "overlaps in protection are resolved in the relevant jurisdiction, and not by UPOV" (Seville, 2016). However, demanding and long-lasting procedure for grant of a patent have additionally underlined the need for a specific mechanism for the legal protection of new varieties of plants, guaranteeing a reward for scientific effort and investment in research. The UPOV Convention was an adequate international response. As of October 13, 2017, the IUPNVP had 75 members, out of which 73 states, the African Intellectual Property Organisation (AIPO) and the European Union (EU). Both the AIPO and the EU operate "a plant breeders" rights system which covers the territory of 17 member States (for the AIPO) and 28 member States (for the EU). Consequently, the UPOV convention is applicable in 118 states and represents widely accepted and internationally relevant mechanism for the protection of new varieties of plants. Every member state of the IUPNVP disposes of a certain number of so called "contribution units", ranging from 0,2 (for the majority of members, including AIPO) to 5 (EU, France, Germany, Japan and the United States of America), while certain members have 0,25 (Brazil), 0,5 (Argentina, China, Czech Republic, Denmark, Hungary, Israel, Poland, Russian Federation, Slovakia and Turkey), 0,75 (Austria and Mexico), 1 (Australia, Canada,

Finland, Ireland, New Zealand, Norway and South Africa), 1,5 (Belgium, South Korea, Sweden and Switzerland), 2 (Italy, Spain and United Kingdom) or 3 contribution units (Netherlands). In any case, two main features of the UPOV Convention are: 1) the introduction of common harmonised rules according to which its contracting parties "grant and protect breeders' rights" (Art. 2 of the UPOV Convention) and 2) the establishment of the IUPNVP, guaranteeing to the nationals or residents (for natural persons) of a contracting party – and to the registered offices (for legal entities) within the territory of a contracting party – prerogatives such as, for example, the national treatment or, for the applicants for the grant of breeder's right in one member state, 12 months lasting right of priority for any subsequent application concerning the same plant variety in all other member states of the IUPNVP.

For the good application of the UPOV Convention, it is essential to define the exact meaning of the notion of breeder. To do so, one should refer to both English and French versions of the Convention, not only because its Article 41 provides that "the French text (is) prevailing in case of any discrepancy among the various texts", but also given that the English version itself seems to encompass the two possible meanings of the notion of breeder. In Article 1 of the Convention, which provides the list of definitions "for the purposes of this Act", the "breeder" is defined as: 1) "person who bred, or discovered and developed, a variety" or 2) "the person who is the employer of the aforementioned person or who has commissioned the latter's work, where the laws of the relevant Contracting Party so provide", or 3) "the successor in title of the first or second aforementioned person, as the case may be". Given that the second and the third elements do not give rise to any interrogations regarding the notion of breeder (core element of the definition), here the focus will be on the first, crucial element of the definition. Moreover, adequate and stable definition of what the UPOV Convention understands under the notion of "breeder" also makes possible to define the person who is either breeder's employer, the person who has commissioned the breeder's work, or successor in title "of the first or second aforementioned person".

Textual and logical analysis of the core element of the definition indicates that the English version of the UPOV Convention implies the existence of both narrow and broad meaning of the word "breeder". In the narrow meaning, a breeder is the person who bred a (new) plant variety, while in the broad meaning, a breeder can also be the person who discovered and developed a plant variety, provided that the conditions related to discovering and developing should be fulfilled cumulatively. At this stage, referring to the French version of the Convention can be useful for better understanding of the notion of breeder. For the broad meaning of this notion, the French text uses the word *obtenteur*, which can literally be translated as "the one who obtained", notion that – notwithstanding the possibility of legitimate criticism from the semantic point of view – elegantly encompasses the two possibilities: *obtenteur* is both a person who 1) bred or 2) discovered and developed a variety. On the other hand, for the narrow meaning of the notion of breeder – which, in English version, derives from the participle (bred) of the verb 'to breed' – the equivalent French word would be

créateur, given that the French text, in the place where the English version uses the word 'bred', employs the word *créé*. Consequently, the use of French version of the UPOV Convention translated into English would lead to the following definition: the person who "obtained" a plant variety is either the one who "created" a new variety, or the one who discovered and developed an existing[4] one. In other words, "the discoverer of a new plant variety growing in the wild does not qualify the person as the 'creator' of new plant variety (given that) discovery alone is not enough to warrant protection under UPOV" (Sanderson, 2017), because "a breeder is more than a mere introducer of a discovered plant variety" (Lightbourne, 2016). A discoverer can only be considered as breeder in the broad sense if the discovery is accompanied with certain intellectual (scientific) effort that has led to the development of such plant variety. *A contrario*, a person who actually obtained a new plant variety – which can be done "through changing the deoxyribonucleic acid (DNA) of a plant via mutations" (Sanderson, 2017) – is a breeder in the narrow sense, given that the work of such a person led to the creation of a variety that can be maintained[5]. In any case, "it bears noting that, like patents, the UPOV conventions have no global or absolute standard for determining novelty" (Mgbeoji, 2006). At this point, the issue of the notion of breeder meets another important matter – conditions the UPOV Convention requires for the grant of breeder's right and the content of this right.

The entire Chapter III (Articles 5-9) of the UPOV Convention is dedicated to the conditions to be fulfilled in order to grant breeder's right. All the four explicit conditions are related to the variety itself, which should be 1) new, 2) distinct, 3) uniform and 4) stable. In spite of the fact that Article 5-2 provided that "the grant of the breeder's right shall not be subject to any further or different conditions", the wording of this provision indicates the existence of the other three conditions. *Primo*, the variety should be "designated by a denomination" according to strict and detailed rules established by Article 20 of the UPOV Convention (including, for example: characteristics of the denomination, its registration, prior rights of third persons, rules related to information among the authorities of contracting parties, obligation to use the denomination, indications used in association with denominations). Concerning the principles for variety denomination defined by the UPOV Convention, they "were to a large extent informed by the existing principles and practices in botany, horticulture and taxonomy, (while) the underlying principles of all of the rules around variety denomination are to ensure that plant names are freely available for use and not confusing" (Sanderson, 2017). *Secundo*, the applicant for breeder's right should comply "with the formalities provided for by the law of the Contracting Party with whose authority the application

4 It should be noted that the novelty, for the purposes of the UPOV Convention, entirely depends on the commercialisation and does not require the absolute uniqueness or originality.

5 According to Art. 22-1(b)(i) of the UPOV Convention, „each Contracting Party may cancel a breeder's right granted by it if, after being requested to do so and within a prescribed period, (i) the breeder does not provide the authority with the information, documents or material deemed necessary for verifying the maintenance of the variety."

has been filed" (Art. 5-2 of the UPOV Convention). These formalities certainly cannot be considered as "conditions of protection" *stricto sensu* – and, consequently, should not influence the interpretation of the four explicit conditions – but without their fulfilment the right would not be granted. *Tertio*, the applicant should pay "the required fees" (Art. 5-2 of the UPOV Convention). Concerning the formalities required by the authorities of each contracting party to the UPOV Convention, the internal national legal or administrative rules cannot impose to the nationals (or registered legal entitles) of other parties the conditions and/or additional requirements that are not applicable to their own nationals or legal entities (the principle of national treatment). Given that a more detailed inquiry of the conditions for the grant of the breeder's right related to the distinctness, uniformity and stability would demand significant extra-legal escapades, here the focus will be on the novelty of a variety.

Besides the intangible nature of the object of the protection, one of the most significant similarities of breeder's rights and some other IPRs are the conditions for the grant of the right. However, even if the patent law also requires that a patentable invention must show an element of novelty, the novelty criterion for plant breeders' rights is significantly different, because "under UPOV it is defined in connection with the commercialisation of a plant variety, (while) the distinctiveness criterion (under UPOV) is fairly similar to the novelty criterion of patent law, since it requires that the protected variety must be clearly distinguishable from any other variety whose existence is a matter of common knowledge at the time of filing the application" (Kiene, 2011). More precisely, the commercialisation-related novelty required by the UPOV Convention, besides the general rule demanding that "propagating or harvested material of the variety has not been sold or otherwise disposed of to others, by or with the consent of the breeder, for purposes of exploitation of the variety" (Art. 6-1 of the UPOV Convention), has two time and territory-related conditions: 1) in the territory of the country of filing the application – that the material of the variety has not been "sold or otherwise disposed of" earlier than one year counting from the day of application and 2) in the territory of all other contracting parties – that the same material has not been "sold or otherwise disposed of" earlier than four years (six years in the case of trees and vines) before the same date. It is particularly important to underline that the two aforementioned conditions are cumulative. In order to make easier the application and interpretation of the rules related to the novelty of plant variety, in August 2009, the office of the IUPNVP has issued the *Explanatory Notes on Novelty Under the UPOV Convention*. Besides presenting the evolution of the provisions of the UPOV Convention dedicated to novelty, this document brings an indicative list of acts which "may be considered not to result in the loss of novelty", like, for example: trials of the variety not involving sale or disposal of to others, sale or disposal of to others without the consent of the breeder or the same sale or disposal that forms part of an agreement transferring rights to the successor in title.

The UPOV Convention belongs to the complex set of rules for international IPR protection and, consequently, the breeder's right has important similarities with other IPRs. The right guaranteed to the breeder who has successfully fulfilled the conditions

detailed in the last section is, basically, a time-limited exclusive right (legally guaranteed monopoly). This exclusive right is granted because the breeder should be rewarded for his intellectual and any other effort and investment, while the entire business community has to be motivated to invest in research and creating new (or developing existing) plant varieties. On the other hand, the public interest is protected by the fact that breeder's rights are limited in time. In other words, "any policy involving the protection of IPRs has to balance two sets of competing interest: the public interest in immediate and widespread dissemination (…) and the private interest of individual creators, seeking maximum opportunity to earn returns from their inventions" (Brossard, Shanahan, Nesbitt, 2007). In any case, breeder's exclusive right – very much alike numerous other IPRs – comprises two general prerogatives: 1) to exploit independently her/his right during the period of its registration (which cannot be shorter than 20 years) and 2) to (dis)allow to others certain acts of economic exploitation of her/his right. Article 14 of the UPOV Convention comprises a list of acts "in respect of the propagating material of the protected variety" that require the authorization of the breeder. Without entering in a more detailed analysis of these acts, it should be noted that they include, among others, production or reproduction, offering for sale, selling or other marketing, exporting and importing. There are also certain exceptions to the breeder's right, covering, for example, the acts "done privately and for non-commercial purposes" (Art. 15-1-i of the UPOV Convention) and "acts done for experimental purposes" (Art. 15-1-ii of the UPOV Convention). This and above-mentioned exceptions are compulsory, given that every contracting party should introduce them in their national legal systems. The same Article also comprises a third compulsory exception: "acts done for the purpose of breeding other varieties" and, with certain exceptions, "other acts in respect of such other varieties". The UPOV Convention also allows to the contracting parties to introduce some other (optional) exceptions, "in order to permit farmers to use for propagating purposes, on their own holdings, the product of the harvest which they have obtained by planting, on their own holdings, the protected variety" (Art. 15-2). In any event, after the expiration of breeder's right, the plant variety that used to be covered by breeder's exclusive right falls into the public domain and can be freely exploited. The balancing between, on the one hand, the private interest of the breeder to exploit as long as possible the variety he/she bred (or discovered and developed) and, on the other hand, the public interest to have permanent, free and unlimited access to plant varieties, is not always easy to find.

In spite of the fact that the UPOV system has been accused of "lacking transparency, being unaccountable and misusing its influence" (Sanderson, 2017), there is a broad consensus among researchers and in theory that a functional system for the protection of plant breeder's rights can significantly contribute to the economic growth and incentivize "plant breeding research by increasing returns on investments" (Prifti, 2015). In a more general context, legally guaranteed rights on new plant varieties – as it is the case of many other IPRs – tend to be "central to the innovation that drives economic growth" (Rimmer, 2011). Some recent studies have shown that the overall

impact of the implementation of breeder's rights in a developing country, such as Vietnam, have had an undoubted positive implications, given that "the total sectoral income increase offered by plant breeding successes for major arable crops since the UPOV membership amounts to more than USD 2.3 billion (and) the yearly income of Vietnamese farmers has increased by over 24 percent since 2006" (Noleppa, 2017). In the same vein, the another example of an emerging economic power confirms the same conclusion: the legislative and regulatory changes introduced after Brazil became a member of the International Union for the Protection of New Varieties of Plants (May 1999) contributed to the increase of competition between breeders and the productivity of soya bean over a less than decade increased from 2.200 kg/ha to 3.300 kg/ha (Stroschon, 2012).

It is self-evident that the entire international legal framework dedicated to the protection of new varieties of plants is particularly beneficial for countries (or regions) with developed scientific, research and economic potentials. Moreover, the countries that allow dual protection of plant varieties by both patent law and UPOV-based breeder's right are, most often, those who are economically well developed, offering to their researchers to use a heavy-weight patent protection, leaving "virtually no exception for farmers and plant breeders" (Ravi Srinivas, 2015). On the other hand, there is no significant discord among researchers (Vaver, 2006) that the UPOV Convention, as a set of minimal common international legal rules for the protection of breeders' rights, contributes to the increase of productivity and can incentivise the international trade of new varieties of plants (Phillips, Khachatourians, 2001). However, "in light of effective international solutions being slow to eventuate" (Butterfield, 2018), the important positive economic effects are still to be expected. Concerning the possible increase in the price of seed, experts from developing countries pointed out that it "has been normally defended by the argument that the increase is offset by the advantages the farmer would reap because of the increased productivity of the new varieties (given that) the profits to the farmer would outweigh the cost due to the propensity of the private sector to release new varieties" (Prasad, 1995). It, however, remains to establish if and to which extent the UPOV system contributes to better economic results of small and medium plant growers and farmers from developing countries. Not only productivity itself, but also numerous other aspects related to the crops can considered as relevant from producers' point of view; according to some, these are growing cycle, disease resistance and ease of husbandry (Stroschon, 2012).

The positive economic effects of the entire set of breeders' rights largely depends on the functional system of compensation in the case of violation of the prerogatives of the rightful holder of plant variety protection. The UPOV Convention itself does not procure any specific provisions regarding liability, damage compensation or any other rule allowing to determine the procedure applicable when a violation of breeder's right requires legal mechanisms in order to recompense every real or potential damage caused to breeder's interests and prerogatives. In the absence of internationally accepted legal mechanisms, all member states to the UPOV Convention are free – provided that

they do not violate other provisions of the Convention – to set up their own national rules for damage compensation. In numerous countries, the general rules on civil liability and damage compensation are also applicable in case of violation of breeder's right. Moreover, given that the rights covering new varieties of plants belong to the more general set on national and international legislation on IPR protection, damage compensation applicable in case of violation of some other IP-related rights can, *mutatis mutandis*, be applied to liability for plant breeder's right infringement. What particularly counts here is the intangible nature of the object of IPR and the existence of two specific types of undue exercise of an IPR that could lead to infringement: "act of denigration that requires an alleged infringement to be circulated to third parties" (Heath, 2007) and the undue exercise of an IPR "as such (…) as an act of unduly interfering with a competitor's business" (Heath, 2007). Applied to plant breeder's right, both the possibility of unlawful circulation to the others and of undue interfering are not only theoretically possible, but also present in practice. In any case, there is a broad consensus in theory that "climate change will increase the importance of new plant varieties that can adapt to changing climatic conditions" (Condon, Sinha, 2013). In such a context, the economic importance of the development on new plant varieties and of the adequate legal protection in case of violation of breeder's rights can hardly be overestimated.

One of the best ways to estimate the real economic impact of the legal framework set by the UPOV Convention is the analysis of the number of applications and titles granted, especially when done in comparison with another internationally recognised mechanism, such as the one existing within the European Union. EU's Community plant variety office (CPVO), according to its annual report for 2017, have received 3.422 applications, which represents a significant increase when compared to last year's results. In percentage, this increase of 3,7% represents the second highest number in received applications during past six years. Nevertheless, there have been some minor changes when it comes to the number of applications per crop sector. In 2017, the highest increase was registered in fruit sector (69 applications) and ornamental sector (233 applications), while the situation is quite different in other sectors, such as vegetable sector or agricultural sector, in which the number of applications is decreasing. Moreover, the most active applicants are the entities from EU member states. The Netherlands have taken the first place, by sending more than 1.352 applications, which makes one third of all the applications received. As for the countries outside the EU, the highest number of applications came from the United States (265) and Switzerland (149). This is due to the fact that applicants outside the EU have to have a representative registered in the Union, which can be done either by forming a daughter company or by taking an external agent. As for the number of guaranteed rights, it has grown up to 2.865. This result shows the second highest number ever guaranteed by the CPVO during one year. According to the CPVO's official data, out of 47.638 rights guaranteed, 25.913 are still in force (54,4% of initially granted rights).

Table 1. Number of applications and titles granted by the CPVO

Year	Number of applications	Number of titles granted
2013	3.297	2.706
2014	3.626	2.684
2015	3.111	2.844
2016	3.299	2.980
2017	3.422	2.865

Source: Community plant variety office, Annual report for 2017

When it comes to the similar statistical parameters within the UPOV system, the analysis of the Plant variety protection statistics for the period 2013-2017 shows that, in year 2017, the number of received applications was at its highest with 18.306 applications, out of which 12.685 were successful, which is the increase of about 18% in the number of given titles when compared to year 2013.

Table 2. Number of applications and titles granted in the UPOV system

Year	Number of applications	Number of titles granted
2013	17.788	10.052
2014	15.511	11.566
2015	15.017	12.409
2016	16.455	12.550
2017	18.306	12.685

Source: International Union for the Protection of New Varieties of Plants, Plant variety protection statistics for the period 2013-2017 - revision

The comparative analysis of data regarding both UPOV and CPVO clearly indicates that, in spite of the setback over relatively short period of time (for the CPVO year 2015 and, to some extent, 2016; for the UPOV, the period 2014-2016) the number of applications and titles granted increases again from 2016. However, only within the UPOV system, the results for year 2017 are better than those for year 2013, both in terms of number of applications and granted rights.

Conclusions

The International Convention for the Protection of New Varieties of Plants (UPOV Convention) is a widely accepted international legal mechanism for the protection of the rights of persons who either bred a (new) plant variety or who discovered and developed an (existing) one. Its two main features are, on the one hand, the introduction of the minimal common rules regarding the conditions for the protection of breeders' rights (harmonisation of national legislations) and, on the other, the creation of the International Union for the Protection of New Varieties of Plants, providing to the applicants for breeder's right certain important prerogatives, applicable in all other signatories of the Convention. Concerning the harmonisation of national legislations

introduced by the UPOV Convention, particularly worth mentioning are the provisions of the Convention dedicated to the notion of breeder, the grant of breeder's right and the content of such right. The progressive harmonisation of national legislations have certainly had positive economic effect, contributing to the better conditions for more substantial international trade. However – as it is the case of many other intellectual property rights – the added value and real economic impact of the UPOV Convention still critically depends on the efficient national legal mechanisms for its enforcement.

Conflict of interests

The authors declare no conflict of interest.

References

1. Boettiger S., Graff G., Pardey P., Van Dusen E., Wright, B. (2004). *Intellectual Property Rights for Plant Biotechnology: International Aspects*, in: Christou P. and Klee, H. (Eds.), "Handbook of Plant Biotechnology", John Wiley & Sons, Ltd., Chichester, 1089-1113.
2. Butterfield, B. (2018). "The potential role of climate change litigation in furthering the mitigation objectives of the Paris Agreement", *Asia Pacific Journal of Environmental Law* 1-2018, Edward Elgar Publishing, 29-49.
3. Brossard, D., Shanahan J., Nesbitt T. (2009). *The Media, the Public and Agricultural Biotechnology. Seeds of Change*. Ed. Jay Kesan - CABI, Oxfordshire.
4. Christou, P. and Harry Klee, H. (Eds.) (2004). *Handbook of Plant Biotechnology*. John Wiley & Sons, Ltd., Chichester.
5. Condon, B., Sinha, T. (2013). *The Role of Climate Change in Global Economic Governance.* Oxford University Press, Oxford.
6. Darwin, C. (1860). *Origin of Species*, 2nd British edition, London.
7. Heath, C. (2007). *The interface between competition law and intellectual property in Japan,* in: Anderman S. (Ed.), "The Interface Between Intellectual Property Rights and Competition Policy", Cambridge University Press, Cambridge, 250-311.
8. Kiene, T. (2011). *The Legal Protection of Traditional Knowledge in the Pharmaceutical Field*. Waxmann Verlag, Münster.
9. Lightbourne. M. (2016). *Food Security, Biological Diversity and Intellectual Property Rights.* Routledge, Oxon.
10. Matthews, Duncan and Zech, Herbert (Eds.) (2017). *Research Handbook on Intellectual Property and the Life Sciences*. Edward Elgar, Cheltenham.
11. Mgbeoji, I. (2006). *Global Biopiracy: Patents, Plants, and Indigenous Knowledge*. UBC Press, Vancouver.
12. Noleppa, S. (2017). *The socio-economic benefits of UPOV membership in Viet Nam: An ex-post assessment on plant breeding and agricultural productivity after ten years (Executive Summary),* HFFA Research Paper 03/2017, Berlin.

13. Perdue, D. (2017). "Patent Disclosure Requirements Related to Genetic Resources: The Right Tool for the Job?", *Biotechnology Law Report* 6-2017, Mary Ann Liebert, New York, 285-296.
14. Phillips, P., Khachatourians, G. (2001). *The Biotechnology Revolution in Global Agriculture: Innovation, Invention and Investment in Canola Industry.* CABI Publishing, Oxon.
15. Prasad, J. (1995). *Dunkel Proposals and Indian Agriculture*, in: Krg Nair, Ashok Kumar (Eds.), "Intellectual Property Rights", Allied Publishers Limited, New Delhi.
16. Prifti, V. (2015). *The Breeder's Exception to Patent Rights – Analysis of Compliance with Article 30 of the TRIPS Agreement.* Springier, Heidelberg.
17. Ravi Srinivas, K. (2015). *Intellectual Property Rights and the Politics of Food*, in: Ronald Herring (ed), "The Oxford Handbook of Food, Politics, and Society", Oxford University Press, Oxford
18. Rimmer, M. (2011). *Intellectual Property and Climate Change – Inventing Clean Technologies.* Edward Elgar, Cheltenham.
19. Sanderson, J. (2017). *Plants, People and Practices – the Nature and History of the UPOV Convention*. Cambridge University Press, Cambridge.
20. Seville, C. (2016). *EU Intellectual Property Law and Policy*. 2nd edition, Edward Elgar, Cheltenham.
21. Stroschon, O. (2012). *The use of plant variety protection to add value for farmers in Brazil* in: "Proceedings of the Symposium on the Benefits of Plant Variety Protection for Farmers and Growers", November 2012, Geneva.
22. Vaver, D. (2006). *Intellectual Property Rights: Critical Concepts in Law*. Routledge, London.
23. Annual report for 2017, Community plant variety office, Retrieved from https://cpvo.europa.eu/sites/default/files/documents/cpvo_annual_report_2017.pdf (October 20, 2018)
24. Planet variety protection statistics for the period 2013-2017 (r), Retrieved from https://www.upov.int/meetings/en/doc_details.jsp?meeting_id=48108&doc_id=419517 (October 26, 2018)
25. Explanatory Notes on Novelty Under the UPOV Convention, Retrieved from http://www.upov.int/edocs/mdocs/upov/en/c/43/upov_exn_nov_draft_3.pdf (November 13, 2018)
26. Proceedings of the Symposium on the Benefits of Plant Variety Protection for Farmers and Growers, Retrieved from http://www.upov.int/edocs/pubdocs/en/upov_pub_357_4.pdf (November 20, 2018)

FORECASTING MAIZE YIELD IN THE REPUBLIC OF SERBIA BY USING BOX-JENKINS METHODOLOGY

Jelena Đoković[1], Mihajlo Munćan[2], Tamara Paunović[3]

**Corresponding author E-mail: jdjokovic@agrif.bg.ac.rs*

ARTICLE INFO

Review Article

Received: *25 February 2019*

Accepted: *12 June 2019*

doi:10.5937/ekoPolj1902525D

UDC 005.521[633.15:631.559(497.11)

Keywords:

maize yield, time series, Box-Jenkins methodology, forecast

***JEL**: Q10, C53, Q19*

ABSTRACT

As food supply is one of the most important issues for national security, forecasting agricultural production represents a necessity for every country. Forecasting yields and production volume is a very complex task that requires both application of formal statistical methods and assessment of experts. Considering not only the significant role of maize in the immediate diet and processing industry in the Republic of Serbia, but also its absolute dominance in the structure of sown areas, the analysis of the time series and projections of future maize yield were carried out. Maize yield projections obtained through Box-Jenkins methodology, for 2017 and 2018, are 4.97 t/ha and 7.01 t/ha. Comparing the projected with realized yield in 2017 (for which there is available data), it was noticed that the model's forecast indicated a smaller reduction than actually realized. According to the results of the conducted study, it is clear that although the time series model cannot anticipate precise yield quantities, it can certainly be useful in terms of predicting future tendencies in maize yield oscillations.

Introduction

The important contribution of agriculture in the economic structure of the Republic of Serbia primarily comes from rich land resources and favorable natural conditions for organizing agricultural production. Almost two thirds of the value of total agricultural output in 2017 comes from crop production. Arable fields and gardens make 75.9% of

1 Jelena Đoković, Ph.D., Associate, University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11080 Zemun, Serbia, e-mail: jdjokovic@agrif.bg.ac.rs, ORCID ID: 0000-0003-4143-7957

2 Mihajlo Munćan, Ph.D., Assistant Professor, University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11080 Zemun, Serbia, e-mail: mmuncan@agrif.bg.ac.rs, ORCID ID: 0000-0003-2359-8642

3 Tamara Paunović, Ph.D., Assistant Professor, University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11080 Zemun, Serbia, e-mail: tamara@agrif.bg.ac.rs, ORCID ID: 0000-0003-4747-0678

the utilized agricultural area in the Republic of Serbia, on which cereals are dominant, with 66.2% of total sown areas.

Within the cereals, the special economic significance of maize is due to production volume that can be achieved, as well as the diversity of its use in human and livestock nutrition and industrial processing, where all the above-ground parts of the plant can find its purpose. According to the total crop-growing area, maize is ranked third in the world, based on the total world production, it is ranked second, and by the yield of grain per unit area, it is in the first place (Munćan, Živković, 2014).

In the immediate diet, maize can be found in the form of grains or as a grinding product in the form of maize flour or meal, while the major part used in human nutrition is consumed through products such as oil, corn flakes, popcorn, sugars etc. However, the most of maize production is used as livestock feed, either as processed grains in form of concentrated fodder mixtures or overhead biomass as a bulky feed. In addition, maize products found their purpose in the textile, paper, alcohol, pharmaceutical and other industries.

In the last decade, the average area under maize in the Republic of Serbia is about 1.15 million hectares with an average production of 5.7 million tons and the average yield around 5.3 t/ha. Since maize production takes place on nearly one fifth of the utilized agricultural area the Republic of Serbia, it represents the most widely spread field crop intended not only for domestic consumption, but also for export.

Bearing in mind the strategic role of maize from the aspect of food security mainly through ensuring the needs of the domestic processing industry, primarily the fodder industry, it is necessary to plan the production volume. In this context, time series analysis is used as one of the leading tools for monitoring yield oscillations and for forecasting future ones.

Materials and methods

In order to anticipate future trends, data concerning production volume and realized yields of maize over the past seven decades, was obtained from the documentary materials of the Statistical Office of the Republic of Serbia and was processed using the program EViews10. It is one of the leading software for complex analysis of statistical data, their graphical representation, simulation of econometric models, analysis of time series and forecasting.

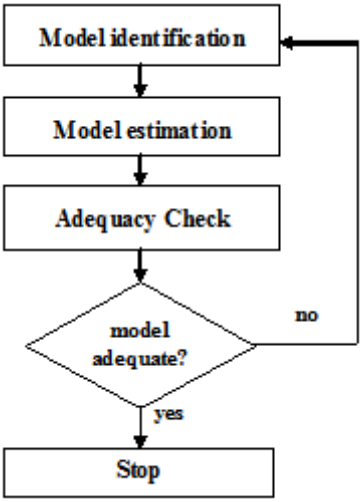
Statistical techniques of time series analysis have been widely disseminated in the literature, and there is a great variety of circumstances and researches in which they can be used, especially in studies involving economic decisions, such as: national and international economies behavior, stock market, price forecast, supply and demand for agricultural products, among others (de Oliveira et al, 2012).

Many of parameters that need to be monitored and forecasted are influenced by factors which occurrence and implications are not easy to predict. Agricultural production, primarily crop production, bears significant risks in terms of achieving production

results. When it comes to yield and production assessments, main limiting components are soil and weather conditions (Tokatlidis, 2013; Vanuytrecht et al. 2014; Bartlova et al., 2015; Döring, Reckling, 2015; Ogar et al., 2017; Biberdžić et al., 2018; Vogel et al., 2019). Therefore, the Box-Jenkins methodology was used for analyzing previous movements in maize yields in order to anticipate future ones.

The Box-Jenkins methodology includes a set of procedures for identifying and estimating time series models within the class of autoregressive integrated moving average models – ARIMA(p,d,q), along with autoregressive models – AR(p), moving average models – MA(q) and autoregressive moving average models – ARMA (p,q), as special cases of the general class. It refers to the iterative application of three stages until stage three produces a model adequate for generating forecasts (Figure 1).

Figure 1. Box-Jenkins methodology for constructing the ARIMA(p,d,q) model



Source: Kovačić, 1995.

The first stage in the Box-Jenkins methodology implies detecting whether the time series is stationary, based on plots of the data, autocorrelation and partial autocorrelation functions, or it needs differencing. When the autocorrelation function dies down slowly, and the partial autocorrelation function is cut off after the first lag, this suggests that the series should be differenced (Kovačić, 1995). Alongside examining graphical representations of the time series, one of the formal statistical procedures should be used to establish if the time series possesses a unit root and needs to be differenced, which in this study was Dickey-Fuller test.

By determining the values of p (autoregressive order), d (differencing) and q (moving average order), the trial model is defined, which can be changed through the iterative process until the final one is formed.

When choosing the optimal number of parameters in the model, three information criteria are usually used: Akaike information criterion (AIC), Schwarz information criterion (SIC) and Hannan-Quinn information criterion (HQ). In this study, choice between models with different number of explanatory variables was made based on the value of the information criteria, whereby a model which minimizes the value of all three information criteria was chosen.

The second stage in the Box-Jenkins methodology implies the evaluation of the parameters of the model identified in previous phase. This means that an assessment of the mean, variance and coefficients in the model is carried out. The most common methods used in this stage are nonlinear least squares method, maximum likelihood estimation and method of moments.

In the third stage, the main objective is to check the adequacy of the previously estimated model. This involves testing the statistical significance of the estimated coefficients and the assumption that the residuals of the estimated model are exhibiting white noise-like behavior. Diagnostic testing is carried out using the Jarque-Bera test (JB) and the Box-Ljung Q-statistic.

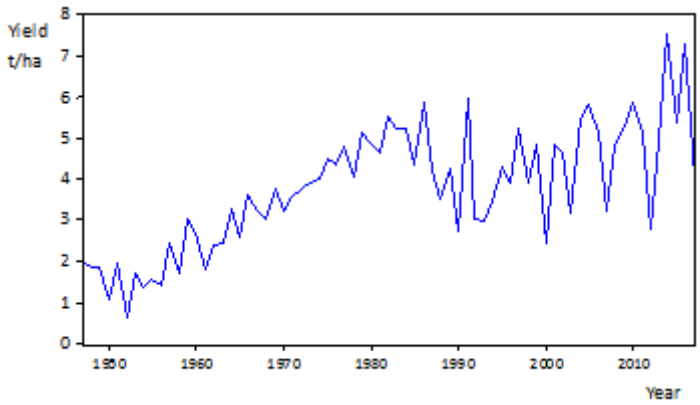
If the residuals of the estimated model are not exhibiting white noise-like behavior, it is necessary to return to the first phase and identify a new trial model. However, if the selected model is adequate, it can be used to generate forecasts.

Results and discussion

Stationarity check with graphical procedure

The first step in the model identification phase involves analyzing a graphical representation of the time series to determine whether it is stationary or non-stationary (Figure 2). Based on the graphic representation, it is possible to make only rough estimation, so in order to be sure whether the time series is stationary or not, formal statistical testing should also be conducted.

Figure 2. Maize yield in t/ha in the period 1947-2017, in the Republic of Serbia



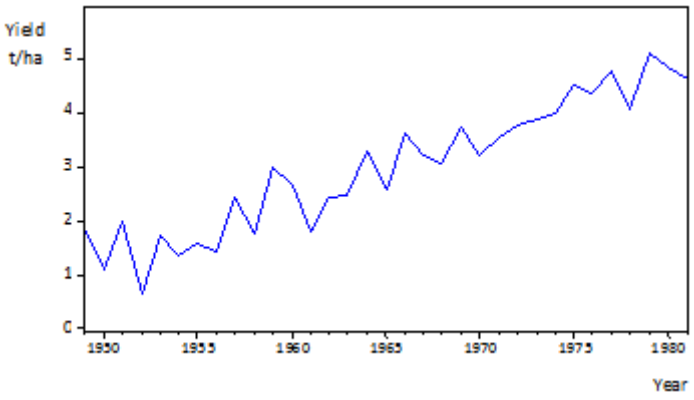
Source: Created by the author based on data analysis in EViews10

Based on the presented trend of maize yield in the period for which the data is available (1947 -2017), it can be noticed that the time series has a structural break, i.e. it shows two patterns of behavior before and after 1981.

Structural break (or shock) represents one or more observations which are not in accordance with the previous data set, as a result of an intervention or exogenous event. These events can affect the time series movement in two ways. On the one hand, influence of the exogenous event, such as the reform of economic or agrarian policy, can produce changes that affect the course of the time series in the following period, and on the other hand, adverse weather conditions such as drought or flood, can cause changes in only one observation.

Identifying the structural break in the time series is particularly important because the formal unit root test, the Dickey-Fuller test, is sensitive to its existence (Mladenović, Nojković, 2015). A structural break which results in permanent movement changes in the trend stationary time series, in DF test application, may suggest a false existence of a unit root. Also, when a structural break has a one-time impact, in the first difference of the time series with a unit root, the application of the DF test may falsely suggest that the series is stationary. Bearing this in mind, it is recommendable to analyze the series before and after the structural break occurrence in 1981. The movement of maize yields in the period before the established shock is presented in the following figure.

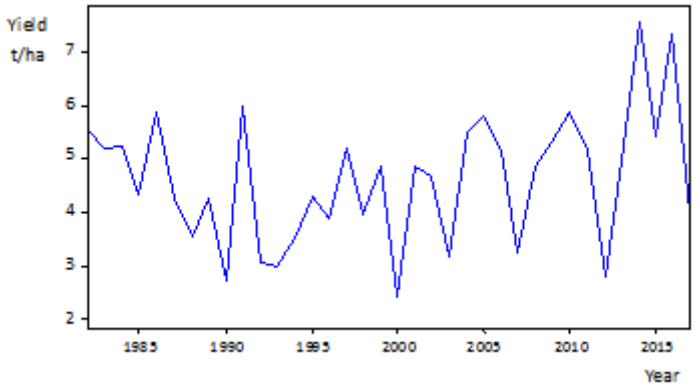
Figure 3. Maize yield in t/ha in the period 1947-1981, in the Republic of Serbia



Source: Created by the author based on data analysis in EViews10

Judging by the graphical representation of the maize yield in the period 1947-1981, the time series seems to be trend stationary with a significant trend increase. This means that in the unit root test application the exogenous regressors consist of a constant and a trend. In the period after 1981, it is noticed that the movement of the maize yield has changed (Figure 4).

Figure 4. Maize yield in t/ha in the period 1982-2017, in the Republic of Serbia



Source: Created by the author based on data analysis in EViews10

By comparing the previous two graphical representations, it can be concluded that there is a difference in the movement of the maize yield in the two observed subperiods. Unlike the trend stationary series present in the period 1947-1981, the time series in the period 1982-2017, exhibits movement without a trend component, but with oscillations around the non-zero mean value (4.62 t / ha). The absence of the trend component means that in this case, the exogenous regressors within the unit root test contain only a constant.

Stationarity check with test procedure

As the graphical representations cannot be solely used for providing reliable conclusions about whether the time series is stationary or not, the unit root test must also be used to increase objectivity.

In order to establish the presence of the unit root, as previously mentioned, in this study, the DF test was applied to both of the observed subperiods. The null hypothesis (H_0) that there is no unit root was set against the alternative (H_a) that the series have one unit root. Results of the DF test were obtained by using the least squares method and compared with test critical values (Table 1). If DF test statistic is lower than test critical value, the null hypothesis should be rejected.

Table 1. DF test statistic and critical values for the period 1947-1981 and 1982-2017

Indicator		t-Statistic	
		Period 1947-1981	Period 1982-2017
		Exogenous: constant and trend	Exogenous: constant
Dickey-Fuller test statistic		-6.491845	-5.491698
Test critical values	1% level	-4.252879	-3.626784
	5% level	-3,542555	-2,944606
	10% level	-3.207094	-2.611531

Source: Created by the author based on data analysis in EViews10

Obtained results show that, in both subperiods, calculated DF test statistic (-6.491845 and -5.491698) is considerably lower than the critical values at all three significance levels, meaning there is sufficient evidence to reject the null hypothesis of the unit root existence. In accordance with the previous finding, it can be claimed that the maize yield series in the period 1947-1981 is stationary with a deterministic trend, and it is stationary with oscillations around non-zero mean value in the period 1982-2017.

Considering the previously established shock in the time series, as well as the different movement of the time series in the two observed subperiods, it was necessary at this stage of the research to decide which period was more adequate for further analysis and projection.

The first observed subperiod is characterized by the improvement of the technological process and finding optimal ways to maximize utilization of yield potential of maize hybrids. The introduction of hybrids in maize production in our country began in the 1950s, and soon after, in 1961, the first domestic hybrids appeared (Tabaković, 2012). Compared to standard varieties, a great number of the maize genotypes with enhanced grain quality were produced at Maize Research Institute "Zemun Polje" (Glamočlija et al., 2016). But, according to Selaković et al. (2006), the work of Maize Research Institute has gone through three evolving periods: the beginning of work and gradual development in the 1950s, the expansionary development in the 1960s and 1970s, and the stagnation and development crisis in the 1980s. So, it can be concluded that progress in the development of technology and agro-technical measures, as well as the development of new maize hybrids with improved properties, had affected the constant increase in maize yield in the period up to 1981.

In the second subperiod, maize yield movements are mainly under the influence of unstable economic and weather conditions. Great oscillations of maize yield, from year to year, are conditioned by small investments in this production, which is most often under conditions of natural water regime, so that frequent droughts significantly influence the yield and grain quality (Jaramaz, 2015).

Since, in a short period of time, revolutionary changes cannot be expected, both in terms of increasing the yield potential of maize hybrids and in controlling objective production conditions, the second subperiod was chosen as more appropriate for further analysis.

Identifying the model order (p, q), estimation and adequacy check

Once it has been established that the time series is stationary, the next stage in the Box-Jenkins approach is to identify autoregressive and moving average order.

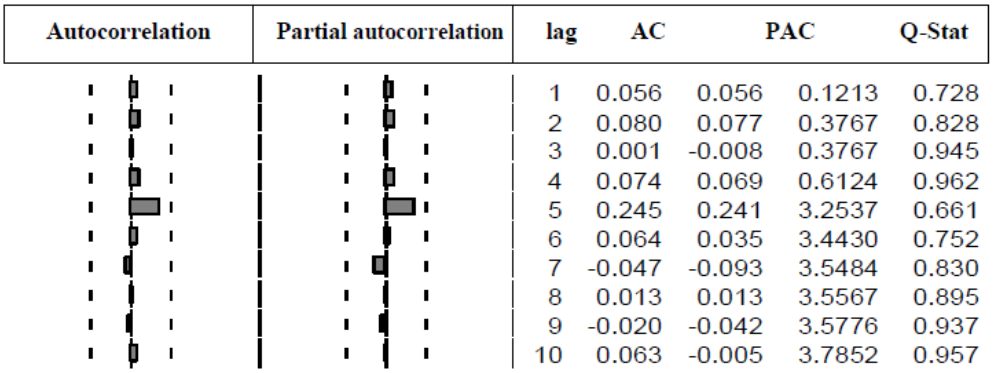
As stationary series is completely specified by its mean, variance, and autocorrelation function, the most subjective task in Box-Jenkins approach is to identify an appropriate model from the sample autocorrelation function.

For an AR(p) model, the sample and partial autocorrelation plots show that the autocorrelation function has an exponential or sinusoidal decay, while the partial autocorrelation function cuts off after lag p. For a MA(q) model, the sample and

partial autocorrelation plots show that the autocorrelation function cuts off after lag *q*, while the partial autocorrelation function has an exponential or sinusoidal decay. In an ARMA(*p*,*q*) model, both autocorrelation plots show the tendency to decay (mixture of exponential decay and damped sine-waves) after the first *q*-*p* lags for the autocorrelation function and after *p*-*q* lags for the partial autocorrelation function (Kovačić, 1995).

In order to identify the order p and q, the sample and partial autocorrelation functions are calculated and graphically presented (Figure5).

Figure 5. Correlogram of the sample and partial autocorrelation functions for the maize yield series in the period 1982- 2017



Autocorrelation	Partial autocorrelation	lag	AC	PAC		Q-Stat
		1	0.056	0.056	0.1213	0.728
		2	0.080	0.077	0.3767	0.828
		3	0.001	-0.008	0.3767	0.945
		4	0.074	0.069	0.6124	0.962
		5	0.245	0.241	3.2537	0.661
		6	0.064	0.035	3.4430	0.752
		7	-0.047	-0.093	3.5484	0.830
		8	0.013	0.013	3.5567	0.895
		9	-0.020	-0.042	3.5776	0.937
		10	0.063	-0.005	3.7852	0.957

Source: Created by the author based on data analysis in EViews10

By studying the two autocorrelation plots, it was found that there is no autocorrelation, although the production of maize to a certain extent depends on the production volume achieved in the previous period. This is the reason why autoregressive parameters at lags 1, 2, 4, 5 and 7 were selected as explanatory variables.

The assessment of the coefficients has been made taking into account the existence of structural breaks in the data. Based on graphical representation of the time series in the analyzed period, two sharp declines in maize yield were recorded in 2000 and 2012, as a result of the extreme drought. In order to control the effects of these two events, two artificial variables have been introduced into the model (V_1 and V_2) which take the value of 1 for 2000 and 2012, and value 0 for all other observed years.

Considering the sample and partial autocorrelation functions, determined structural breaks and the fact that the time series is a stationary, the ARMA model was estimated using the least squares method containing AR (1), AR (2), AR (4), AR (5) and AR (7), as well as artificial variables V_1 and V_2 (Table 2).

Table 2. Model parameters estimated by the least squares method (model 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4,849310	0,402871	12,03688	<0,0001
AR(1)	-0,026329	0,163194	-0,161334	0,8730
AR(2)	0,375126	0,178230	2,104723	0,0444
AR(4)	0,280311	0,194778	1,439131	0,1612
AR(5)	0,405086	0,208631	1,941639	0,0623
AR(7)	-0,490220	0,205558	-2,384833	0,0241
V1	-3,249857	0,831126	-3,910184	0,0005
V2	-2,074519	0,912113	-2,274411	0,0308
Indicator	**Value**	**Indicator and IC**		**Value**
R-squared	0,454248	Mean dependent var		4,627250
Adjusted R-squared	0,317810	S.D. dependent var		1,212486
S.E. of regression	1,001451	Akaike info criterion		3,033906
Sum squared resid	28,08129	Schwarz criterion		3,385799
Log likelihood	-46,61031	Hannan-Quinn criterion		3,156726
F-statistic	3,329335	Durbin-Watson stat		2,061927
Prob(F-statistic)	0,010458			

Source: Created by the author based on data analysis in EViews10

As already stated, in the Box-Jenkins procedure, the defined trial model can be changed through the iterative process until the final one is formed. So, at this point of the study, it was necessary to establish if any alterations can be made leading to enhanced model.

Based on the obtained results, it is determined that the estimated coefficients of the artificial variables introduced to control the effects of the structural breaks in 2000 and 2012, are negative as expected. It is also determined that the coefficients for the variables AR (1) and AR (4) are not statistically significant at the 10% level, and therefore the exclusion of these variables from the model should be considered. So, as exclusion of the variables AR (1) and AR (4) may improve model's explanatory power, the second model is defined (Table 3).

Table 3. Model parameters estimated by the least squares method (model 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4,763340	0,245852	19,37481	<0,0001
AR(2)	0,373841	0,175523	2,129876	0,0415
AR(5)	0,444225	0,196886	2,256258	0,0315
AR(7)	-0,519969	0,202861	-2,563172	0,0156
V1	-3,398351	0,806989	-4,211150	0,0002
V2	-1,720717	0,920706	-1,868910	0,0714
Indicator	**Value**	**Indicator and IC**		**Value**
R-squared	0,414024	Mean dependent var		4,627250
Adjusted R-squared	0,316361	S.D. dependent var		1,212486
S.E. of regression	1,002514	Akaike info criterion		2,993910
Sum squared resid	30,15100	Schwarz criterion		3,257829
Log likelihood	-47,89037	Hannan-Quinn criterion		3,086025
F-statistic	4,239322	Durbin-Watson stat		2,089288
Prob(F-statistic)	0,004925			

Source: Created by the author based on data analysis in EViews10

By excluding the variables AR (1) and AR (4), all remaining variables in the model are statistically significant, 31.6% of variations in maize yield are explained by the model and all three information criteria have decreased (AIC from 3.03 to 2.99, SIC from 3.39 to 3, 26 and HQ from 3.16 to 3.08). According to these results, the second model can be considered as enhanced, and therefore used for the purpose of further analysis.

In order to be accepted as adequate for forecasting, the test results need to show that the model's residuals are normally distributed and uncorrelated. The residuals in the time series model represent what is left over after fitting a model, and for many (but not all) time series models, the residuals are equal to the difference between the observations and the corresponding fitted values (Hyndman, Athanasopoulos, 2018).

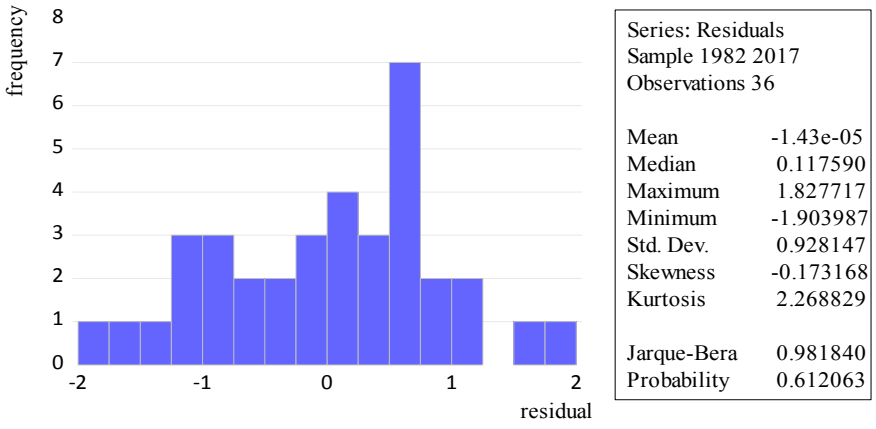
The Jarque-Bera test (JB) is used to examine how much the empirical distribution of the series residual deviates from the normal distribution. As normal distribution has a skewness of zero and a kurtosis of three, the following hypothesis were set:

H_0: $E(r^s)^3=0$ and $E(r^s)^4=3$ vs.

H_1: $E(r^s)^3\neq 0$ ili H_1: $E(r^s)^4\neq 3$

Under the null hypothesis of a normal distribution, the JB statistic is distributed as χ^2 with 2 degrees of freedom. The critical value for χ^2 distribution with 2 degrees of freedom, at the 5% significance level, is 5.99. If the value of the JB test statistic is lower than the critical value, it is considered that the residuals are normally distributed. The results for testing whether the series is normally distributed are shown in the following figure.

Figure 6. Histogram – normality test (model 2)



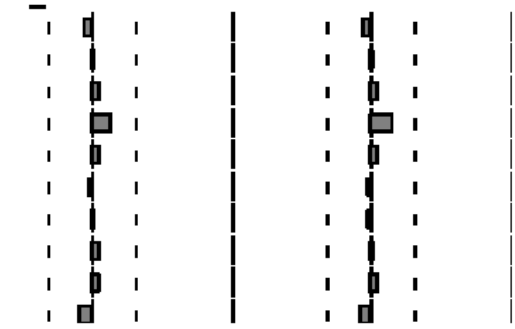
Source: Created by the author based on data analysis in EViews10

The calculated JB statistic (0.98) is considerably lower than the critical value, which indicates that the residuals do not deviate significantly from the normal distribution,

so the null hypothesis of the residual normality cannot be rejected.

When it comes to determining whether the residuals of selected model exhibit white noise-like behavior, it is necessary to analyze the sample and partial autocorrelation plots and conduct autocorrelation test. By observing autocorrelation plots it can be concluded that the residuals are not distinguishable from a white noise series, when all the autocorrelations and partial autocorrelations are small (Figure 7). For formal autocorrelation testing, the Box-Ljung Q-statistic is used to increase the precision in the decision-making process. The Q-statistic tests the joint hypothesis that the first K autocorrelations of the adjusted error terms are jointly zero: H_0: $\rho_1=\rho_2=\ldots=\rho_k=0$ against the alternative that at least one of the first K autocorrelation coefficients of the residual series is different from zero. If the p-value is greater than significance level the null hypothesis of uncorrelated residuals cannot be rejected.

Figure 7. Correlogram of the sample and partial autocorrelation functions for residuals (model2)



Autocorrelation	Partial autocorrelation	lag	AC	PAC	Q-Stat
		1	-0.052	-0.052	0.1065	
		2	0.009	0.007	0.1100	
		3	0.056	0.057	0.2395	
		4	0.154	0.161	1.2572	0.262
		5	0.046	0.065	1.3517	0.509
		6	-0.014	-0.013	1.3603	0.715
		7	-0.001	-0.024	1.3604	0.851
		8	0.041	0.008	1.4437	0.919
		9	0.052	0.041	1.5798	0.954
		10	-0.083	-0.076	1.9384	0.963

Source: Created by the author based on data analysis in EViews10

Since the p-value for the Box-Ljung statistic is greater than 0.05, it can be inferred that there is no autocorrelation of the residual in the estimated model.

As it has been proven that the residuals of the rated model are normally distributed and uncorrelated, the model can be used for maize yield projections in the following period.

The maize yield forecast

The model identified, evaluated and fortified as adequate for forecasting through the Box-Jenkins methodology, was used to achieve the main goal of the conducted study, that is, to project maize yield in 2017 and 2018 (Table 4). The maize yield projection for 2017 was made to enable comparison with the yield actually realized.

Table 4. Projection and realization for maize yield in 2017-2018, in the Republic of Serbia

Year	Maize yield (t/ha)	
	Projection	Realization
2017	4.97	4.01
2018	7.01	-

Source: Created by the author based on data analysis in EViews10

Comparing the projected and realized maize yield in 2017, it can be noticed that the model's forecast indicated a decrease, but somewhat lower than the realized.

Compared to 2016, the obtained results predict that, in 2017, the maize yield will decrease by 31.9% (i.e. from 7.303 t/ha to 4.97 t/ha), while the forecasted yield for 2018 is 7.01 t/ha, which represents an increase of 41%.

Although the Republic of Serbia is characterized by favorable conditions for the cultivation of a wide range of crops, without frequent occurrence of temperature extremes, in some years there are still dry periods or excessive amounts of precipitation. Due to dry period incidence, even drought-resistant hybrids do not fully demonstrate their genetic yield potential. Negative impact of adverse weather conditions is reflected in the reduction of yield and grain quality, which causes great damage to producers through decline of the production cost-effectiveness. However, it is possible to adapt to or mitigate the effect of adverse weather if a forecast of the expected weather can be had in time (Sodha, Saha, 2016).

Depending on the drought intensity, maize yields can be reduced by 50% or even by 80% in extremely drought years. For these reasons, according to Filipovic (2012), high yields and stable production of maize in unsteady weather conditions in our country, is possible only with the application of irrigation. Numerous studies indicate that the proper water regime has a positive effect on maize yield (Bošnjak, Pejić, 2000; Maksimović et al, 2001; Pejić et al., 2007; Kresović et al, 2011; Kresović et al, 2015; Gava et al., 2017; Lopez et al., 2017; Munćan, 2018; Fang, Su, 2019; Zhao et al., 2019). Unfortunately, considering the percentage of irrigated areas, The Republic of Serbia is ranked very poorly in Europe, and that small percentage of irrigated areas is mostly under the fruit and vegetable crops in greenhouses and not so much under the field crops, such as maize.

Weather conditions, specifically high temperatures and lack of precipitation, contributed to a significant reduction in maize yield in 2017, as conducted forecast indicated. This is why, according to Ralević (1985), only the exact methods of forecasting that include a priori expert information, provide a solid basis for decision-making when it comes to agriculture.

Conclusions

The application of Box-Jenkins approach for identifying, estimating and selecting the model suitable for predicting future maize yields, provided relatively satisfying results, since the forecasted decreasing trend of maize yield in 2017 was actually realized.

However, there is a difference of about 20% between the forecasted and realized maize yield, which is quite substantial taking into account the extent of the area covered with maize on an annual basis.

The realized decrease in maize yield is due to long-lasting dry periods, given the fact that the largest part of this production takes place under direct influence of the weather conditions and without irrigation. This kind of developments usually has a severely harmful effect on the supply, prices and exports of essential agricultural products in the following period, which particularly increases the significance of planning both yield and total production volume.

Forecasting by using time series analysis cannot provide the exact quantities of future yields, but it can and should be used as a framework for forecasting future trends in their fluctuations. Therefore, it is important to ensure an adequate input base in the process of planning the development of maize production, in order to gain solid results through the statistical forecasting methods and experts' forecasts.

In addition, as time passes, new values of the time series are generated, which is why it is possible to determine the deviation from their formerly predicted values, as well as the necessary corrections for subsequent periods. In other words, it is possible to perform a revision of the forecast.

Conflict of interests

The authors declare no conflict of interest.

References

1. Bartlova, J., Badalikova, B., Pospíšilová, L., Pokorný, E., & Šarapatka, B. (2015). Water stability of soil aggregates in different systems of tillage. Soil and Water Research, 10(3), 147-154.
2. Biberdžić, M. O., Barać, S. R., Lalević, D. N., Stojiljković, J. V., Knežević, B. P., & Beković, D. K. (2018). Influence of soil type and compaction on maize yield. Arab Universities Journal of Agricultural Sciences, 63(4). [*in Serbian*: Biberdžić, M. O., Barać, S. R., Lalević, D. N., Stojiljković, J. V., Knežević, B. P., & Beković, D. K. (2018), Uticaj tipa i sabijenosti zemljišta na prinos kukuruza].
3. Bošnjak, Đ., & Pejić, B. (2000). Maize yield and its components depending on the depth of irrigation drip in the soil. Proceedings of the Institute of Field and Vegetable Crops, 34, Institute of Field and Vegetable Crops, Novi Sad, 95-101. [*in Serbian*: Bošnjak, Đ., & Pejić, B. (2000), Prinos i komponente prinosa kukuruza u zavisnosti od dubine prokvašavanja zemljišta navodnjavanjem].
4. de Oliveira, S. C., Pereira, L. M. M., Hanashiro, J. T. S., & do Val, P. C. (2012). A study about the performance of time series models for the analysis of agricultural prices. Revista GEPROS, 7(3), 11.

5. Döring, T. F., & Reckling, M. (2018). Detecting global trends of cereal yield stability by adjusting the coefficient of variation. European journal of agronomy, 99, 30-36.
6. Fang, J., & Su, Y. (2019). Effects of Soils and Irrigation Volume on Maize Yield, Irrigation Water Productivity, and Nitrogen Uptake. Scientific reports, 9(1), 7740.
7. Filipović, V. (2012). Water for irrigation in the service of sustainable development. Current advisor, PDS Institute ″Tamiš″ Pančevo, 1, 4-7, Pančevo. [*in Serbian*: Filipović, V. (2012), Voda za navodnjavanje u službi održivog razvoja].
8. Gava, R., Usher Neale, C. M., Frizzone, J. A., Anselmo, J. L., Cotrim, M. F., & Kuhn, I. E. (2017). Performance of maize hybrids subject to different application depths under center pivot. WATER RESOURCES AND IRRIGATION MANAGEMENT-WRIM, 6(3), 161-168.
9. Glamočlija, Đ., Popović, V., Živanović, L., Filipović, V., Glamočlija, N., & Ugrenović, V. (2016). Morphological and productive properties of red grain maize in variable weather conditions. Plant breeding and seed production, 22(1), 1-9. [*in Serbian*: Glamočlija, Đ., Popović, V., Živanović, L., Filipović, V., Glamočlija, N., & Ugrenović, V. (2016), Morfološke i produktivne osobine kukuruza crvenog zrna u promenljivim vremenskim uslovima].
10. Hyndman, R. J., & Athanasopoulos, G. (2018). Forecasting: principles and practice. OTexts, Monash University, Australia.
11. Jaramaz, M. (2015). Effects of plant density on yield and maize grain quality under irrigated and rainfed condition. Doctoral Dissertation, University of Belgrade-Faculty of Agriculture, Belgrade. [*in Serbian*: Jaramaz, M. (2015), Uticaj gustine useva na prinos i kvalitet zrna kukuruza u uslovima navodnjavanja i prirodnog vodnog režima].
12. Kovačić, Z. (1995). The time series analysis. University of Belgrade- Faculty of Economics, Belgrade. [*in Serbian*: Kovačić, Z. (1995), Analiza vremenskih serija].
13. Kresović, B. J., Gajić, B. A., Tapanarova, A. Đ., Pejić, B. S., Tomić, Z. P., Vujović, D. S., & Životić, L. B. (2015). Effects of deficit irrigation on grain yield and ear characteristics of maize. Journal of Agricultural Sciences, 60(4), 419-433. [*in Serbian*: Kresović, B. J., Gajić, B. A., Tapanarova, A. Đ., Pejić, B. S., Tomić, Z. P., Vujović, D. S., & Životić, L. B. (2015), Uticaj deficitarnog navodnjavanja na prinos zrna i karakteristike klipa kukuruza].
14. Kresović, B., Dragičević, V., & Videnović, Ž. (2011). Effects of chernozem water regime and fertilising on maize yields under conditions of direct sowing. Agricultural Engineering, 36(2), 33-42 [*in Serbian*: Kresović, B., Dragičević, V. & Videnović, Ž. (2011), Uticaj vodnog režima černozema i đubrenja na prinos kukuruza u uslovima direktne setve].
15. Lopez, J. R., Winter, J. M., Elliott, J., Ruane, A. C., Porter, C., & Hoogenboom, G. (2017). Integrating growth stage deficit irrigation into a process based crop model. Agricultural and Forest Meteorology, 243, 84-92.

16. Maksimović, L., Dragović, S., Jocković, Đ., & Stojaković, M. (2001). NS-hybrid yield potential under irrigation conditions. Proceedings of the Institute of Field and Vegetable Crops, 35, Institute of Field and Vegetable Crops, Novi Sad, 415-424. [*in Serbian*: Maksimović, L., Dragović, S., Jocković, Đ., & Stojaković, M. (2001), Potencijal rodnosti NS-hibrida kukuruza u uslovima navodnjavanja].
17. Mladenović, Z., & Nojković, A. (2015). Application of Time Series Analysis. Second Edition, University of Belgrade- Faculty of Economics, Belgrade. [*in Serbian*: Mladenović, Z., & Nojković, A. (2015), Primenjena analiza vremenskih serija].
18. Munćan, M. (2018): Economic effects of irrigation of basic field crops on family farms. Economics of Agriculture, 65(2), Institute of Agricultural Economics, Belgrade, 787-800.
19. Munćan, P., & Živković, D. (2014). Management of crop production, University of Belgrade-Faculty of Agriculture, Belgrade. [*in Serbian*: Munćan, P., & Živković, D. (2014), Menadžment ratarske proizvodnje].
20. Ogar, T. F., Olaoye, G., Abiola, A. Y., Olakojo, S., Isah, M., Bankole, F., Ishaq, M., & Yussuf, A. S. (2017). Evaluation of maize grain yield in drought-prone environment. *Journal of Agricultural Sciences*, *62*(1), 15-29
21. Pejić, B., Maksimović, L., & Milić, S. (2007). The effect of irrigation on yield of corn hybrids from different groups of ripening. Acta biologica Iugoslavica - series A: Soil and plant, 56(2), Yugoslav Society for Land Survey, Belgrade, 59-66. [in Serbian: Pejić, B., Maksimović, L., & Milić, S. (2007), Efekat navodnjavanja na prinos hibrida kukuruza iz različitih grupa zrenja]
22. Ralević, N. (1985): Stochastic methods and models of forecasting in agricultural policy. Doctoral Dissertation, University of Belgrade- Faculty of Economics, Belgrade. [*in Serbian*: Ralević, N. (1985), Stohastički metodi i modeli predviđanja u agrarnoj politici].
23. Selaković, D., Mirić, M., Vidaković, M., & Hojka, Z. (2006). Production and trade of seeds of the Maize Research Institute "Zemun Polje". Plant breeding and seed production, 12(3-4), 97-103. [*in Serbian*: Selaković, D., Mirić, M., Vidaković, M., & Hojka, Z. (2006), Proizvodnja i promet semena Instituta za kukuruz "Zemun Polje"].
24. Sodha, D., & Saha, G. (2016). Crop management of agricultural products using time series analysis. In Recent Trends in Electronics, Information & Communication Technology (RTEICT), IEEE International Conference on (pp. 1456-1460), IEEE.
25. Tabaković, M. (2012). Influence of weather conditions, soil and genotype combination on maize hybrid seed features. Doctoral Dissertation, University of Belgrade-Faculty of Agriculture, Belgrade. [*in Serbian*: Tabaković, M. (2012), Uticaj vremenskih uslova, zemljišta i genotipske kombinacije na osobine hibridnog semena kukuruza].

26. Tokatlidis, I. S. (2013). Adapting maize crop to climate change. Agronomy for Sustainable Development, 33(1), 63-79.

27. Vanuytrecht, E., Raes, D., & Willems, P. (2014). Global sensitivity analysis of yield output from the water productivity model. Environmental Modelling & Software, 51, 323-332.

28. Vogel, E., Donat, M. G., Alexander, L. V., Meinshausen, M., Ray, D. K., Karoly, D., Meinshausen, N. & Frieler, K. (2019). The effects of climate extremes on global agricultural yields. Environmental Research Letters, 14(5), 054010.

29. Zhao, J., Xue, Q., Hao, B., Marek, T. H., Jessup, K. E., Xu, W.W., Bean, B.W. & Colaizzi, P. D. (2019). Yield determination of maize hybrids under limited irrigation. Journal of Crop Improvement, 33(3), 410-427.

SOME FEATURES OF DEVELOPMENT IN THE AGRICULTURAL POLICY WESTERN BALKAN CANDIDATES FOR MARKET ACCESS IN THE EU

Zoran Simonović[1], Slavomir Miletić[2], Vesna Popović[3]

**Corresponding author E-mail: zoki@medianis.net*

A R T I C L E I N F O

Review Article

Received: *04 April 2019*

Accepted: *06 May 2019*

doi:10.5937/ekoPolj1902541S

UDC 338.439.01/.02(497.15:4-672EU)

Keywords:

agricultural policy, countries of the Western Balkans, CAP, EU, agriculture, market.

***JEL**: Q13, Q18, F15*

A B S T R A C T

The agricultural policy of Western Balkan countries in the process of accession to the European Union market is characterized by high volatility, which is expressed in terms of the applied instruments and measures as well as the product concerned. In the first phase of liberalization of prices and trade, most countries abolished or significantly reduced the customs import and export barriers to a wide range of products and also reduced or eliminated production subsidies. Only import tariffs are the only basic protection instrument for producers. Input prices have increased considerably for producers, which has led to a decrease in income in agriculture. In reality, this meant that domestic agricultural production was left to the ruthless competition of EU countries that have far better developed agricultural and food production. In the past few years, the implementation of the new agrarian policy, in countries from the first round of accession candidates, the European Union has introduced budget support measures for producers, mainly in the form of payments per hectare or throat. These budget payments were made according to the model of the EU CAP.

Introduction

Due to the process of globalization, the development of international cooperation between countries, as well as between international organizations, has been of

1 Zoran Simonović, PhD, Research associate, Institute of Agricultural Economics, Belgrade, Volgina St. No.15, Phone: + 381 (0) 11 697 2858, e-mail: zoki@medianis.net, ORCID ID (https://orcid.org/0000-0002-2769-6867).

2 Slavomir Miletić, PhD, University of Priština, Faculty of Economics, Kolašinska street 156, Kosovska Mitrovica, Serbia, phone: +38163424987, e-mail: mil.slavko@gmail.com, ORCID ID: https://orcid.org/0000-0003-2433-0867;

3 Vesna Popović, PhD, Principal Research Fellow, Institute of Agricultural Economics, Belgrade, Volgina St. No.15, Phone: +381 11 6972854, e-mail:vesna_p@iep.bg.ac.rs, ORCID ID (https://orcid. org/0000-0003-1018-2461).

increasing importance (Dudić et al., 2018). The agricultural policy of the candidate countries is characterized by high volatility expressed in terms of the instruments and measures applied, as well as the product concerned, to which it applies (EC, 1998a). In the first phase of liberalization of prices and trade, most countries abolished or significantly reduced non-tariff import and export barriers for a wide range of products. Also, most countries have reduced or eliminated production subsidies and left import tariffs as the primary instrument for protecting producers. Input prices have increased considerably for producers, which has led to a decrease in income in agriculture. This trend took place in most of the candidate countries from the Western Balkans sometime between 1990 and 1992. (Volk, 2004).

Later on, due to the negative effects of the transition itself and the real decline in income, ad-hoc price and foreign trade interventions were introduced in many countries in the function of stabilizing agriculture and protecting consumers and producers. Countries from the territory of the Balkan Peninsula had a late transition caused by the political reasons caused by the breakup of the SFR Yugoslavia (Croatia, Bosnia and Herzegovina, Serbia and Montenegro). For this reason, they have led a strictly controlled agrarian policy.

In the past few years, the implementation of the new agrarian policy, in countries from the first round of accession candidates, the European Union has introduced budget support measures for producers, mainly in the form of payments per hectare or throat. First of all, we are referring to Slovenia as the only country in Southeast Europe that has met the standard for this type of support. These budget payments were made according to the model of the Common Agricultural Policy (CAP) of the EU. In the field of rural development policy, the adjustment of measures practically in all these countries was at this stage at the initial stage. (OECD, 2002).

In principle, the strategic goals of these countries are more or less aligned with EU principles and can be summarized in ensuring the stable production of quality food with reasonable prices and the safety of this food; sustainable resource management; increasing the effectiveness and ensuring an adequate standard of living (income) for agricultural producers and the rural population. However, in terms of operational programs and implementation of agrarian policy, as well as adaptation of CAP, there are great differences between countries. (Volk, et al., 2015; Gandolfi et al., 2018; Booth, 2018).

Slovenia and Croatia are already in the European Union. A sufficient element of harmonization with EU legislation and program documents, especially in the field of rural development SAPARD5 (2005-2006) and IPARD6 (2007-2013) programs can be found in Macedonia, where IPARD programs are being prepared and implemented, and in Montenegro, where at the programming level, all documents (strategies, national program, legislation) have been prepared in accordance with EU principles. Rural development program documents that were drafted on the basis of EU rural development regulations were adopted in Albania and Serbia. Bosnia and Herzegovina has a specific situation because there is no single Ministry of Agriculture at the state level. There are two separate strategies for agriculture and rural development at the entity level,

while agricultural policy is partially applied even at lower levels (cantonal). Although program documents and planned activities in these countries are closely related to EU integration, agrarian policy is still largely implemented on the basis of annual budget allocation programs that are not stable in terms of resources, support measures and criteria. (Volk, 2010).

In most of these countries, the main strategic document is complemented by a multi-year program for its implementation. At the same time, the IPARD Instrument for Pre-Accession Assistance (IPARD) programs have also been prepared as key issues concerning pre-accession EU support in the fields of agriculture, institution building and the improvement of the agricultural sector. However, the establishment of the necessary institutions for the implementation of the IPARD program has not yet been met by any Western Balkan countries, except for Northern Macedonia, which has led to delays in the use of EU funds.

Materials and methods

In this paper, the authors used methods that best reflect the character of the analysis given in the title of the topic. In the research of the development of agrarian policy of the countries of the Western Balkans, they were dominated by quantitative methods of economic analysis. In the first place, these are various legal texts, statistical data and literary sources related to the application of agrarian policy. An analysis of the content of secondary data sources was also used during the research. Secondary data, information on the history of CAP and its reforms were taken mainly from official documents of the European Commission and relevant literature. A comparative statistical survey on the application of agrarian policy in the countries of the Western Balkans is particularly emphasized. It should be noted that Internet information was also used which are numerous and significant.

The contribution of this paper is reflected in the review and analysis related to the state of subsidies in agriculture in the countries of the Western Balkans. It is pointed out that it is necessary to align agricultural policy with the CAP, but also to preserve certain peculiarities in individual agricultural production. This can be done by more efficient implementation of measures of agrarian policy, in which the creation of the state must involve larger individual agricultural producers. What the text of this paper we believe confirms.

In this paper, the authors tried to point out that a well-organized agrarian policy can be an advantage in the organization of agricultural production. The result of this research is, as you can see from the text of the paper, an attempt to get to know the full role and full significance of a well organized system of subsidies as a potential model for faster start-up of economic activities.

A special contribution was made in the work of the research work, which was elaborated on the basis of a comparative statistical survey on the progress of agricultural policy development in the countries of the Western Balkans.

In this paper, the authors tried to give an insight into the current situation in the application of agrarian policy in the agriculture of the Western Balkans. They believe that this is necessary today when the agrarian countries of the Western Balkans are preparing for accession to the European Union.

Results and Discussions

CAP as the best model for the countries of the Western Balkans

For this reason, we want to emphasize that negotiations with the countries of the Western Balkans represent the next significant step in the development of the CAP. The countries in this part of Europe are in principle agricultural land with low productivity and low prices of agricultural products that need to be completely restructured. These countries can be reintegrated into CAP only by respecting the rules and with the help of EU member states. In practice, this would mean that the level of productivity and prices of agricultural products will be competitive with the CAP and the EU countries. The Directorate-General for Agriculture and the Commission calculate that the transition period and the period after accession are significant for harmonization with the new CAP system. The total amount of support for these countries would be between 12 and 15 trillion Eco, including all important investments in all types of infrastructure, economy and development. Also, from the Joint Structural Fund, it is planned to allocate 15 trillion EEK per year. (European Commission, 1997). Foreign direct investment is crucial to the development of the world economy (Dudić et al., 2018) which inflow can be affected by exit from EU (ex. Brexit) (Gudgin et al., 2018; Orazulike, 2018).

After 2004, when eight countries of Eastern and Central Europe joined the European Union, increased aid to farmers. There has been an integration of the agrarian policy regimes of these eight countries with the EU Common Agricultural Policy. In this same year, assistance to the agricultural sector of Slovenia has increased. (Anderson, Swinnen, 2008).

Various adaptation strategies may be adopted in connection with the requirements for accession. In the last enlargement, the most successful countries were those that timely supported the construction of these institutions necessary for the implementation of the CAP, and at the same time they prepare manufacturers for procedures and levels of support that are applied after accession. Rational (taking into account opportunities and needs) and the gradual introduction of CAP as elements most closely fills this approach. Elements that no longer exist or are significantly different from those applied in the EU should not be adopted. This is especially important for candidate countries.

In the development of agriculture and agrarian policy, two elements prevail in general. The first is that the European model is successful in all aspects: productivity, quality and quantity of production, in the production of healthy food, in terms of sustainable development, waste utilization, etc. The second element is that this model is based on market principles as one of the best in the world and has a strong impact on agriculture and agrarian policy of countries in transition, primarily European.

The development problems of the countries of the Western Balkans are much more pronounced than in the countries of Central and Eastern Europe that joined the EU in 2004. The development process, with limited domestic funds, with the grant of financial assistance on a bilateral and multilateral plan with per capita foreign direct investment that is significantly lower than that of the countries of eastern and central Europe, has not in most of these countries led to the overcoming of a transitional shock, closer approximation to the level of development of EU countries 15. (Simonović, 2014).

Despite these indicators, we can say that the impact of the European agricultural model on the agriculture of the countries of the Western Balkans is very strong and multiple.

1) - It is reflected primarily in ownership transitions or in the transfer from state (social) to private property on the ground. In other words, state farms become private. By changing ownership to the country, the possibility for entrepreneurship is realized, conditions for greater interest in successful production, better equipment, greater care and greater safety of the producers are created. This principle would primarily apply to Albania, where in the period of communist domination there were almost no privately-owned agricultural lands. In the countries of the former Yugoslavia agricultural land was mostly privately owned. There is another problem here, which is the fragmentation of agricultural possessions.

2) - The European model of agriculture offers better organization of agriculture and farmers because it is a complex system that is both vertically and horizontally connected. This division of labor in the agro-industrial system allows for a high degree of specialization, and therefore a superior productivity of labor. It is understood that such manufacturers are in the trend of scientific and technological solutions, because they are related to science and top practice.

3) - The European model of agriculture is striking in economic terms. It takes into account sustainable development, agrarian resources, and the production of healthy food. In these aspects, the European agricultural model is measured with a successful American model.

4) - The European model is exemplary for the countries of the Western Balkans, and it offers the entire European market. It is a huge market and great market opportunities. On this side, each member state can find its agrarian comparative advantages. This will result in a more successful foreign trade.

5) - Europe's agriculture is highly specialized, standardized, branded, protected and imported. This fact also drives the countries of the Western Balkans towards such developments. And in this case, it is the influence of a more successful model.

6) - In the European agricultural model we have an example of regulated agricultural and rural areas; built and arranged infrastructure: roads, irrigation systems, irrigation systems, landscaped urban settlements. The European model of agriculture has an urban-territorial advantage, which is also exemplary for the countries of the Western Balkans.

7) - The normative legal order of the European agrarian sector is at a high level and is a model for countries in the Western Balkans.

Measures of agrarian policy

Interventions on the domestic and international markets are characterized by agrarian policy in almost all countries, where governments use a large number of often complex measures to support the agricultural sector. These measures include price support, quantitative restrictions on the production or use of inputs, budget payments, trade barriers, regression inputs, etc. All these measures affect the allocation of production resources to production sectors and regions, and therefore to the use of inputs, farm structure, income and rural economy. Generally speaking, agrarian policy has initiated growth in the use of inputs and the use of resources in agricultural production. Lovre, Zekić, (2008).

Looking at the level of liberalization in the agricultural markets of all these countries, it is quite different from countries to countries. Border protection is the subject of agrarian policy in all these countries. In the last few years the level of border protection has been minimized. For the purpose of conducting negotiations with WTO and quotas (except for preferential), they have been abolished (or not introduced into everything). Customs are set at a relatively low level in Albania, Bosnia and Herzegovina, and Northern Macedonia (0% to 15%), while in Serbia[4] and Montenegro customs duties for some products are higher (up to 50%). All countries of this country have signed several free trade agreements (the most important of which is CEFTA7), which significantly reduce the level of effective foreign trade of protection so far. Overall, it can be said that the level of trade protection in these countries is relatively low.

Table 1. Forms and importance of support measures on the market

	Albania	Bosnia and Herzegovina	Northern Macedonia	Montenegro	Serbia
border protection	relative	relative	relative	relative	relative
export support	not	not	not	not	not
intervention in the market	not	not	not	not	not
other support measures	-	yes	-	-	-

Source: Research by the author

Export subsidies (refunds) are just an important measure of market support in Serbia.

In other countries, this measure has not been implemented. Intervention in the market system is formally only in Serbia, but in recent years' interventional redemption is rarely implemented. That we can freely say that there is no longer. From other measures of market support, administered prices are realized in Bosnia and Herzegovina (for wheat and rye).

4 The most sensitive products for Serbian farmers will remain protected by payment of customs duties until Serbia joins the EU: this applies to all types of meat, yogurt, butter, certain types of cheese, honey, some types of vegetables and flour, and customs protection for these products varies from 20 up to 50% in relation to the MFN customs duties that Serbia applies to trade with the rest of the world. (https://europa.rs/srbija-i-evropska-unija/trgovina/).

Measures of direct subsidies to producers are certainly the most important instrument of agrarian policy in all countries. This instrument contains all basic forms, except for separate payments. However, the support structure varies by country.

The most total amount of support funds received was paid based on outputs (prices), which is still very important in all observed countries, but especially in Bosnia and Herzegovina. Direct payments based on area and number of animals are the most widespread form of subsidies implemented in all countries. The importance of these payments is particularly significant in Northern Macedonia. In all these countries, the use of inputs (seeds, fertilizers, etc.) is also subsidized. In Serbia, input subsidies are the most important form of direct support to producers. The process of separating these payments is delayed in all of these countries, even though it was planned.

Table 2. Forms of direct subsidies to producers

	Albania	**Bosnia and Herzegovina**	**Northern Macedonia**	**Montenegro**	**Serbia**
direct payments for production	introduced	relative	relative	relative	relative
direct payments to the animal domain	introduced	relative	relative	relative	not
variable input subsidies	introduced	not	introduced	relative	relative
separate payments	not	yes	not	not	not

Source: Research by the author

Support for public services in agriculture is present in all countries of Southeast Europe. More attention is given to veterinary and phyto sanitary services in candidate countries.

Table 3. Forms of direct subsidies to producers

	Albania	Bosnia and Herzegovina	Northern Macedonia	Montenegro	Serbia
renewed service	Yes	Yes	relative	relative	relative
veterinary and phytosanitary protection	Yes	Yes	relative	relative	Yes
other	Yes	Yes	Yes	Yes	Yes

Source: Research by the author

This part of agrarian policy is modestly commented on in the reports of all these countries. Therefore, a rather vague picture of the real state of things is obtained. If we observe programs by the volume of agricultural budget funds allocated for this purpose, then it could be said that the importance of public services is low in all these countries. Some experts believe that these services are financed from other sources (donors, other ministries), but without long-term financing, it is difficult to expect the development of public institutions needed for faster advancement of agriculture.

In addition to showing the total amount allocated for support, the structure of this support, which is an indicator of agrarian policy, is also important. In this regard, Albania regularly applies a very limited number of direct support schemes (for cow's milk, sheep and goats, hives and olives), while several schemes have been applied sporadically (schemes applied for only one or two years). Support rates are comparable with other Western Balkan countries, but the relative levels of direct support that are actually paid to producers are still low (less than 6 EUR / ha CAP in 2015), although the total budget for direct support measures has increased significantly since 2010. years.

In 2015, almost 80% of total direct support went to the livestock sector, mainly for sheep and goats (64% of the total). The admissibility criterion for direct payments to the livestock sector is determined in a relatively narrow range (100 to 300 sheep and goats, 100 to 300 hives, and 1500 to 15000 liters of milk per month), and therefore, only a limited number of animals or quantities are supported through direct payments production. In Bosnia and Herzegovina, and after 2003, also in Montenegro, with the increase of total support, its composition is also changing. Indeed, the share of resources related to rural development measures is increasing at the expense of reducing the direct support of the producers. (Volk et all, 2017).

This means that Bosnia and Herzegovina is characterized by a very large number of different payment schemes that are specific to certain products, both for the flora and fauna, which have not changed to a large extent since the period 2011-2012, when the bulk of payments based on the total production replaced with surface payments. However, in all the years analyzed, the milk product sub-sector received about half of the total direct support (57% in 2015), while the rest was divided among other products, each of which received a small share (generally less than 5%. (Volk et all, 2017).

In Montenegro, direct support is mainly directed towards the dairy product sub-sector, which amounts to 56% of the total planned funds for these measures in 2015. Together with support for the production of cattle and sheep and goats (12%), direct payments for livestock production represent a large majority total direct support (80% in 2015). Only about 16% of the total resources are reserved for direct support for production of crops on arable land and tobacco, while the rest (4%) is comprised of subsidies for crop production and livestock insurance (all products). (Volk et all, 2017).

This is not the case in Northern Macedonia, where the structure in recent years is quite rigid and the share of direct producer support has remained very high. Generally speaking, only funds in the field of dairy farming and production were paid in Northern Macedonia in 2015, which resulted in a sharp decrease in the level of total direct support in comparison with 2014 and previous years. In all years except 2015, the relative level of direct support actually paid to producers (EUR / ha KPZ) was the highest among the countries of the Western Balkans. (Volk et all, 2017).

Serbia is a special case. In addition to the significant decline in total support since 2005, a dramatic change in the direct support structure of the manufacturer can be seen over the past few years - switching from direct payments to input subsidies. The case of Serbia (and Northern Macedonia until 2004) clearly indicates the problem of the stability of agrarian policy.

Significant changes in direct support were recorded in Serbia, where the number of payment schemes, the amount of support and the specific admissibility criteria have frequently changed since 2010. In 2010 and 2011, the highest amount of direct support was paid in the form of subsidies for inputs for crop production (seed, fuel and fertilizer). The livestock sector had support only through dairy premiums and some payment for throats for high quality breeding animals.

In 2012, individual payments per surface were introduced, and the number of subsidies for inputs and their amount declined in the coming years (for fuel about 40% and for fertilizer about 60% from 2010 to 2015). In 2012 and 2013, new payment schemes for the livestock sector (payment for slaughterhouses, livestock and hives) were introduced, which resulted in a significant increase in total direct support to cattle breeding in the years that followed. (Volk et all, 2017).

In 2015, the criteria for direct payments for crop crops have been changed, so the maximum eligible area per user is set at 20ha (from 100ha in 2013-2014). As a consequence, total support for plant production is more than halved compared to the average for the period 2010-2014. In 2015, direct support to plant production accounted for 41% of total direct support, down from 64% in 2014 and 92% in 2010. In livestock production, cattle breeding and milk production received most of the direct support (each 22%), followed by the pig production subsector (8%).

Table 4. Share of subsidies in agriculture in millions of euros in total budget expenditures of the countries of the Western Balkans

Country	2013.	2015.	2017.
Albania	20,1	32,4	30,6
Montenegro	17,6	20,0	24,0
Bosnia and Herzegovina	71,0	68,0	80,9
North Macedonia	109,3	132,9	136,3
Serbia	268,3	212,0	229,1

Source: Statistical Yearbook for each of the countries in the table, sites of the Ministries of Agriculture for each of the given countries, publications of the World Bank, national agricultural development strategy.

Planned budget support to agriculture in the period 2005-2017. was the highest in 2014 and amounted to about 45.4 billion dinars, which accounted for 4.9% of the planned budget of the total budget. In the next two years, planned budget funds for agriculture have been reduced, while such a trend has been discontinued in 2017, when it increased by about 3.3 billion, or 8.2% compared to 2016, amounting to around 43.8 billions of dinars, or 354 million euros (Law on Budget of the Republic of Serbia, 2017). (Božić, Papić, 2017).

Concerning budget support, in Table 4, we presented a million euro's view of how each state allocates from its budget for agriculture.

Market-price policy

The agrarian market in the countries of the Western Balkans is still under construction, i.e. it was not built to a sufficient degree. Only the regulation of the agrarian market involves more complex actions. Some of these actions are: selection of production, technical-technological equipment, financial loan support. Each of these questions is, we have to admit, complex. Thus, the choice of production means finding comparative agricultural products with which they would be competitive. For example, the quality of Serbian raspberry is a true brand although it is not formally branded. Therefore, the regulated agrarian market also means branding or standardization of quality. All this represents a complex job for the countries of the Western Balkans that are trying to place their agrarian products on the EU market.

Market pricing policy does not only mean financial support and support for production and price support in order to achieve competitiveness. It is precisely the market-price policy that consists of the following measures:

• Measures of market support,

• Measures of direct budget support for products and

• Other direct payments.

In the European area, different problems related to the regulation of the market are encountered in different countries. A well-regulated market for agricultural products would mean differentiated and specialized agrarian production across Europe. The process of price liberalization had different effects in the countries of the Western Balkans in relation to the countries of Central and Eastern Europe where it was more intense.

Some of the CEE countries, such as Hungary and the Czech Republic, supported the export of agricultural products by granting export credits. At the beginning of the nineties, Croatia and Albania had liberalized the prices of their agricultural products.

With the abolition of the market price control in transition countries, domestic product prices began to jump and approach the world market prices.

Price liberalization in the countries of the Western Balkans has led to a rise in the price level and a fall in domestic aggregate demand with not so easy access to foreign markets. Due to the constant presence of economic sanctions directed towards the Russian Federation, they have led to difficult opportunities for placement of agricultural products, and on the other hand, the European Union market has been largely closed for most agricultural products of countries in transition. The measures taken by the states in the first half of the nineties were ad hoc and related to import tariffs, export subsidies, minimum guaranteed prices, the determination of maximum measures and restrictions on imports. In the period that follows in the second half of the nineties and later, there is more complete liberalization of prices and trade flows of agricultural products, as well as the formulation of a more comprehensive agricultural policy.

In that sense, if the first pillar of agrarian policy is observed, most of the funds that the countries of the Western Balkans allocate for agriculture are directed towards measures of direct support to producers. In the period during which the analysis was conducted, some market support measures (market interventions) existed only in Bosnia and Herzegovina and Montenegro (listed in the program documents). A detailed analysis is, therefore, focused only on the part of the first pillar in terms of direct support measures for producers.

Most countries in the region show a trend of increase in funds intended for direct support to producers. After 2010, the largest and most consistent increase in funding for direct support to producers was recorded in Serbia by 2013. In 2015, direct support to producers in Serbia has dropped significantly, mainly as a result of altered eligibility criteria for some measures of direct support to producers. In Bosnia and Herzegovina and Montenegro, the direct support budget for producers is stable, while significantly varies in Northern Macedonia from year to year (Table 5). Annual deviations in direct support to producers in Northern Macedonia were mainly due to delays in payment of measures implemented in previous years. In 2015, only a small amount of direct payments for this year is paid to users.

Table 5. Direct support to agricultural producers in the Western Balkans countries in millions of euros

Country	2013.	2015.	2017.
Albania	6,3	11,6	6,4
Montenegro	10,1	12,4	18,7
Bosnia and Herzegovina	61,3	62,2	75,8
North Macedonia	90,4	110,0	106,4
Serbia	239,1	287,0	207,3

Source: Statistical Yearbook for each of the countries in the table, sites of the Ministries of Agriculture for each of the given countries, publications of the World Bank, national agricultural development strategy.

Relatively speaking, direct support per hectare of the CAP in 2015 totaled more than 11 million euros in Albania, 12 million euros in Montenegro, about 50 million euros in Bosnia and Herzegovina and Serbia (reduction of 81 million euros in Serbia), 60 million in Northern Macedonia (EUR 18 near 2015) The level of direct support to producers is still significantly lower than in the EU, where the average value of direct support to producers in 2015 was EUR 236 million per hectare. (Volk, et all, 2017).

Problems of integral agrarian development

The problems of the integral agrarian development of the European Union as well as its consequences on the agricultural policy of the countries in transition must be seen through the segment of the development of the CAP. The common agrarian policy, as we have already pointed out, is based on three basic principles. These are the common market, financial solidarity and orientation towards the formation of a community.

The period of the last few decades of the last century marked the search for alternative solutions to economic development, as an antipode to the classic model of industrialization and urbanization. These search attempts for new solutions led to the theoretical and practical evaluation of ecology, natural resources and sustainable development. This has resulted in the policy of integral agrarian development, which studies specific concepts, measures and procedures for solving the problems of development, both developed countries of the European Union, as well as countries in transition, i.e. countries of new member states of the European Union and candidate countries.

Integrated agrarian development is comprehensive and comprehensive. It includes:

• Development of private property,

• Development of agriculture in accordance with natural conditions

• Development of irrigation and irrigation systems

• Development of agrarian organizations (individual agricultural holdings, cooperatives, agricultural enterprises, etc.)

• Development of vertical and horizontal connection and development of agro system

• Development of multifunctional agriculture

• Development of rural systems in the agrarian environment

• Development of sustainable development

• Development and conservation of natural resources

• Land legal regulation

• Construction of market institutions

1. agrarian brand

2. agrarian standards

3. Agricultural stock exchanges and fairs

4. various agrarian services

• System of branding, development and construction, arrangement of export study for ISO, etc.

All these points are present in the initial form. They need to further develop them and raise their level. This process requires a comprehensive work and comprehensive preparation if some results were to be achieved.

Although at various stages of development, the countries of the Western Balkans are facing similar challenges in terms of diversifying and modernizing their rural economies. the ultimate purpose of these changes relates to the strengthening of the

competitiveness of the rural economy. natural and working resources, favorable climate and proximity to the EU market give every reason to suggest that the countries of the Western Balkans have adequate preconditions for the successful implementation of the concept of integrated rural development. However, there are numerous limitations for the development of these areas in the process of EU integration. (Vujicic, at all, 2012).

When adjusting the agrarian policy of the Western Balkan countries to integral agrarian development, attention of national governments should be directed, along with the primary orientation towards the ending of price and market liberalization, land reform, privatization, institutional reform, and above all the part of the agricultural infrastructure that is related to public goods, public services. Also, regulations related to land issues, anti-monopoly regulations, insurance regulations should be established. The customization program itself should include:

• Balance of macroeconomic and sectorial measures, i.e. compliance of the exchange rate and trade policy.

• Completion of the process of market liberalization and prices, land reform, privatization and institutional reforms.

• Public investment policy in social and economic infrastructure.

• Prevention of large agricultural holdings and the agro-industrial sector in gaining a privileged position

• The introduction of measures aimed at the development of the agrarian sector, which should be dominated by technologically developed farms that rely on their workforce. (Lovre, Trkulja, 2003).

We want to emphasize that in line with the goals of the Europe 2020 strategy, the EU has set three main goals of the new, reformed CAP - sustainable food production, sustainable management of natural resources and mitigation of climate change and balanced territorial development. Newspapers will be reflected in the 4 new umbrella regulations - the Direct Payments Regulations, the Regulation on the Common Organization of the Market in Agro-Food Products, the Rural Development Regulation and the Horizontal Regulation governing the financing, management and monitoring of the implementation of the CAP and the financing of measures in the new program for the period 2014-2020, will continue to be based on the use of funds from two EU agricultural funds - EAGF and EAFRD. (Jurišić, 2014).

Conclusions

We assume that the aim of adjusting the agrarian policies of the countries of the Western Balkans is in line with the interests of the EU, which is an increase in the welfare of the population of all its members. In order for a country to become a full member of the EU, it must make a number of changes that primarily relate to the creation of a stable legal, economic and social system, as well as a radical change in the role of the state in these

countries. Creating conditions for developing an effective ownership and economic structure, as well as an institutional framework, are prerequisites for creating a solid market economy. Exactly stable institutions create a basis for removing deformations, crime and corruption that are burdened by the countries of the Western Balkans.

We consider that more developed countries should give the underdeveloped countries a picture of a better future. It is natural to learn from the better, to endure the impact of a more successful one. But, in the case of the European agrarian model, it is not a thoughtful model like the Colossian model, for example, but it is a real model, about the experience of more developed countries that the countries of the Western Balkans want to become.

On the other hand, countries of the European Union themselves wanted to facilitate access to new countries. In this sense, the CAP changes that were adopted before the accession of the countries of Eastern Europe to the Union indicate that the central policy is weakening towards agriculture and a kind of rationalization of agricultural policies. The best example for this claim is foreign exchange differences. These premiums were paid by the national states, and since the introduction of the euro, the exchange rate differences disappeared, the 2000 premiums were redefined in the form of national envelopes. They should serve to determine the special premiums for beef and milk.

At the end, we want to point out that the reform of legal, strategic and program documents for which the agrarian policy of the countries of the Western Balkans and the institutional structure for EU accession has been in charge for several years is the main goal of their state organs. However, the progress towards adoption and implementation of the necessary changes in the agricultural policy, especially regarding the harmonization with the CAP, must be more visible in practice. The uncertainty about the dynamics of EU accession and the latest development trends in the global and regional markets require greater concentration on the real situation and problems in the agricultural sector. Therefore, a clear political decision on the priority policy objectives (selection between competitiveness, equity and public goods) as well as the establishment of explicit targets is essential for the effective distribution of support to agriculture.

Acknowledgements

The paper is prepared within the project III 46006 Sustainable agriculture and rural development in the function of accomplishing strategic objectives of the Republic of Serbia in the Danube region, financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia in the period 2011-2018.

Conflict of interests

The authors declare no conflict of interest.

References

1. Anderson K., Swinnen J.F.M., (2008): *Distortions to Agricultural Incentives in Europe's Transition Economies*, The World Bank, Washington, D.C., 54.
2. Božić, D., & Papić, R. (2017). Reform of the CAP 2014-2020 and comparison with instruments of agricultural policy in Serbia. *Anali Ekonomskog fakulteta u Subotici*, (38), 37-49. https://doi:10.5937/etp1604055B
3. Booth, A. (2018). ASEAN and its changing economic relations with Asia and the World. *Journal of Self-Governance and Management Economics*, 6(1), 33-63.
4. Branović, M. (2016). Agriculture of the Western Balkan countries within the context of EU integrations. *Ekonomija: teorija i praksa*, *9*(4), 35-51.
5. Dower, M. (2014). Empowering rural stakeholders in the Western Balkans. *European Commission, Brussels*.
6. Dudić, B., Dudić, Z., Smoleň, J., & Mirković, V. (2018), Support for foreign direct investment inflows in Serbia, *Economic Annals-XXI* 169(1-2), 4-11, DOI: https://doi.org/10.21003/ea.V169-01
7. Dudić., B., Drahošová., M., Dudić., Z., Smoleň., J. (2018), The Economic and Trade Relations of Serbia with the European Union, Proceedings of the 31st International Business Information Management Association Conference, IBIMA 2018: Innovation Management and Education Excellence through Vision 2020.
8. Gandolfi, G., Regalli, M., Soana, M. G., & Arcuri, M. C. (2018). Underpricing and long-term performance of IPOS: evidence from European intermediary-oriented markets. *Economics, Management & Financial Markets*, 13(3), 11-36.
9. Gudgin, G., Coutts, K., Gibson, N., & Buchanan, J. (2018). The macro-economic impact of Brexit: using the CBR macro-economic model of the UK economy (UKMOD*). Journal of Self-Governance and Management Economics*, 6(2), 7-49.
10. Jurišić, Ž. (2014). Croatian agriculture in the Common Agricultural Policy of the EU – today and tomorrow [*In Croatian*: Jurišić, Ž. (2014). Hrvatska poljoprivreda u zajedničkoj poljoprivrednoj politici Europske unije: sadašnjost i sutrašnjica. *Civitas Crisiensis] Zavod za znanstvenoistraživački i umjetnički rad Koprivničko-križevačke županije u Križevcima*, *1*(1), 207-221.
11. Lovre, K. M., & Trkulja, Đ. (2003). Integrated agricultural and rural development policy of the European Union and implications for the agricultural policy of the countries in transition [*In Serbian:* Lovre, K. M., & Trkulja, Đ. (2003) Integralna politika agrarnog i ruralnog razvoja Evropske unije i implikacije na agrarnu politiku zemalja u tranziciji.] *Anali Ekonomskog fakulteta u Subotici*, (9), 12-14.
12. Lovre, K., & Zekić, S. (2008). The contradictions and complementarity of agrarian and rural development policies. [*In Serbian:* Lovre, K., & Zekić, S. (2008). Protivrečnosti i komplementarnost agrarne i politike ruralnog razvoja.] *Anali Ekonomskog fakulteta u Subotici*, (20), 93.

13. Mikuš, O., Ramani, D., & Franić, R. (2011). Directions of the European Union Common Agrivultural Policy After 2013 [*In Croatian*: Mikuš, O., Ramani, D., & Franić, R. (2011). Smjernice Zajedničke poljoprivredne politike Europske unije nakon 2013. godine.*] Agronomski glasnik: Glasilo Hrvatskog agronomskog društva*, *72*(6), 345-358.
14. OECD. (2002): *Agricultural policies in transition Economies, trends in policies and support*, OECD, Paris, 27.
15. Orazulike, U. (2018). Post-Brexit Threats to Work Safety and Health Standards and Good Working Conditions in the UK. *Psychosociological Issues in Human Resource Management,* 6(1), 63-95.
16. Prokopijević M. (2009): *European Union*. [*In Serbian:* Prokopijević M. (2009) *Evropska Unija,* Službeni glasnik, Beograd.] 223.
17. Simonović, Z. (2014). *Management of agriculture in Serbia in transition.* [*In Serbian: Upravljanje agrarom Srbije u tranziciji.*] Institut za ekonomiku poljoprivrede, Beograd, *177.*
18. Simonovic, Z. (2016). Development policy advisory public service in agriculture in the Republic of Serbia. *Ekonomika*, *62*(1), 59-68. https://doi:10.5937/ekonomika1601059S
19. Stevanović, S., & Đorović, M. (2007). Countries in transition on the path to EU integration in the monograph "International experiences in the transition of the agrarian sector and rural areas". [*In Serbian:* Stevanović, S., & Đorović, M. (2007). *Zemlje u tranziciji na putu integracije u EU-poglavlje u monografiji „Međunarodna iskustva u tranziciji agrarnog sektora i ruralnih područja"*.] Društvo agrarnih ekonomista Srbije, Poljoprivredni fakultet-Institut za agroekonomiju, Beograd, 9-16.
20. Statistical Yearbook of the Republic of Serbia for 2018.
21. Statistical Yearbook of the Republic of Albania for 2017.
22. Statistical Yearbook of the Republic of Macedonia for 2017.
23. Statistical Yearbook of the Republic of Montenegro for 2016.
24. Statistical Yearbook of the Republic of Bosnia and Herzegovina for 2017.
25. Volk T. (2004): The impact of agrarian policy on the development of agriculture in Slovenia in the period of transition and accession to the European Union. [*In Serbian:* Volk T. (2004): Uticaj agrarne politike na razvoj poljoprivrede Slovenije u periodu tranzicije i priključenja Evropsku uniju, DAES, Beograd, 2004, 20-21.
26. Volk T. (2010): *Agriculture in the Western Balkan Countries*, IAMO, Leibniz, 25-26.
27. Volk, T., Rednak, M., & Erjavec, E. (2012). Western Balkans agriculture and European integration: unused potential and policy failures? *Post-Communist Economies*, *24*(1), 111-123. https://doi.org/10.1080/14631377.2012.647631

28. Volk T. At all, (2017). *Monitoring the development trends of agricultural policies in the countries of the Western Balkans, the European Union*. [*In Serbian:* Volk T. At all, (2017). *Praćenje razvojnih trendova poljoprivrednih politika u zemljama zapadnog Balkana*, Kancelarija za publikacije Evropske unije Evropska Unija, Luksemburg.

29. Vujicic, M., Ristic, L., & Vujicic, M. (2012). European integration and rural development policy of the Republic of Serbia and West Balkan countries. *Bulgarian journal of agricultural science*, *4*, 519-530.

30. Union européenne. Commission européenne, & EUROSTAT. (2018). *Agriculture, forestry and fishery statistics*. Publications office of the European Union.

31. APP- Agricultural Policy, Plus South Eastern Europe, Retrieved from https://publications.europa.eu/en/publication-detail/-/publication/d6429250-c06f-11e8-9893-01aa75ed71a1 (March 26, 2019).

32. 2018 economic reform programs of Albania, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Turkey, Bosnia and Herzegovina and Kosovo, The Commission's overview and country assessments. ISSN 2443-8014, Retrieved from https://publications.europa.eu/en/publication-detail/-/publication/d6429250-c06f-11e8-9893-01aa75ed71a1 (March 25,2019).

APPLICATION OF THE MODEL FOR SUPPORT DECISION IN THE CREDITING OF AGROINDUSTRY COMPLEX

Aleksandar Živković[1], Snežana Krstić[2], Nataša Simić[3]

**Corresponding author E-mail: profdrsnezanakrstic@gmail.com*

ARTICLE INFO

Review Article

Received: *31 March 2019*

Accepted: *15 June 2019*

doi:10.5937/ekoPolj1902559Z

UDC 338.43:336.77/.78

Keywords:

crediting, financing, agroindustrial complex

JEL*:O13, Q14*

ABSTRACT

The optimal function of the financing function is achieved through the planning process. By planning development, as one of the basic functions of management, goals, tasks and the way of their realization are determined. The realization of financing plans is realized through the function of financing with own funds, and borrowed both from the domestic and foreign markets. The importance of financing consists in the fact that the level of reproductive capacity of the agro-industry complex depends to a considerable extent on the normative organization, organization and quality of financing. The goal of financing is precisely, timely, quality and under the most favorable conditions, the acquisition of financial resources on the market in order to meet the needs for continuous business of the subjects of the agro-industrial complex.

Introduction

The function of financing is realized through several subprocesses: planning; market research and price monitoring; contracting; tracking billing maturity. To this end, the application of scientific methods in the study and market research is necessary, the formation and engagement of expert teams for execution of certain financial arrangements, the implementation of complex economic analyzes, essentially looking at all relevant factors that would ensure the execution of the purchase of financial resources under the most favorable conditions.

In addition to the elements of economy, for every purchase of financial resources, justification from the point of view of real needs is important. Well elaborated financial provision plans represent a decision on what, how much and at what affordable price

1 Aleksandar Živković, Ph.D., Full Professor, Faculty of Economics, Belgrade University, Kamenička No.6, 11000 Belgrade, Serbia, Phone: +381113021047, aca@ekof.bg.ac.rs

2 Snežana Krstić, Ph.D., Full Professor, Military academy, Belgrade, Pavla Jurišića Šturma No.33,11000 Belgrade, Serbia, Phone: +381642756677, profdrsnezanakrstic@gmail.com

3 Natasa V. Simic PhD, Associate Professor, Faculty of Economics and Finance, "University Union - Nikola Tesla" Cara Dusana No. 62-64, 11000 Belgrade, Serbia; Phone: +381641678286, nsimic68@gmail.com, https://orcid.org/0000-0002-1196-891X

they are to procure. Economic analysis in the decision-making on credit funds (Popović S, Janković I, Stojanović Ž., 2018) is an analysis of the future of events and events aimed at finding the most rational solutions based on the collected data in order to make an optimal decision. (Mihajlović et al., 2012)

The cost of financing is one of the most important elements in the process of obtaining financial resources. If the framework for the freedom to form a bidder's price is higher, that is, if the market of imperfect competition is more complex, the process of securing the financial resources being implemented. When forming the price of money on the market, it should be taken into consideration that the most common selling is done directly, which differentiates it from consumer goods. Given that loans (Marjanović, Prelić, Belokapić-Čavkunović, 2017) as a financial product are sold directly to buyers, the degree of control over the price is higher than the sales made by consumables. (Rađenović, 2015)

The agro-industrial complex significantly reflects the lending of providing capital equipment. In financing such funds, selecting the credit structure (Bai, at. All., 2019) of financial assets is dominant as a fact that determines a potential agro-producer (Mariyono, 2019), which is also the subject of research in this paper.

The idea of how people make decisions is as old as the civilization itself, and it is presented through a variety of theories. These theories are not characterized as strict scientific approaches that are encountered in literature. It is therefore not surprising that literature in decision-making is in constant progress. What is common to all decision makers is that the decision is the most important task of each manager and that the decision-making process occupies the bulk of their working time. Bearing in mind the fact that the decision implies the choice of one of the considered alternatives, they can be made immediately or after the analysis of the problem being considered. (Petrović et al., 2012)

Materials and methods

There are a number of methods and techniques that have been developed over time and used to solve decision-making problems in real-life situations, and can all be divided into two large groups: methods of single-criterion decision making and multi-criteria decision making. The first group of methods is often referred to as the methods of operational research and include: linear programming, transport methods, nonlinear, dynamic programming, network planning, game theory, (Pamucar et al., 2012)

The second large group, the methods of multi-criteria decision-making, refer to decision-making situations when there are a number of, most often, conflicting criteria. It is precisely this fact that represents a significant step towards the reality of the problems that can be solved by multi-criteria decision-making methods. All classic optimization methods use only one decision-making criterion, which drastically reduces the reality of problems that can be solved. Problems that are solved using the multi-criteria decision-making methods have the following common characteristics: (Čupić, Suknović,

2010) a number of criteria, that is, the attributes that must be created by the decision maker; the conflict among the criteria, as the most common case for real problems; unreparable units of measure, because as a rule, each criterion, that is, the attribute has different units of measure; design or selection. Solutions to this kind of problem are either designing the best action (alternative) or selecting the best action from a set of previously defined final actions. The problem of determining the significance of the criteria in the realization of the provision of financial resources (Tadić, 2018) through loans for the agro-industrial sector (Milić, Soleša, 2017), includes several stakes.

The term criterion takes an important place in the decision-making process on the most favorable bid. According to the direction of agreement, they differ (Pavličić, 2010): income criteria; expense criteria and non-monotonic criteria. There are numerous methods for solving the multi-criteria decision-making model, which can be divided on the basis of several criteria, and as the best in today's time, they are distinguished: ELECTRE method; method PROMETHEE; AHP methods (analytical hierarchical processes); TOPSIS method; method SAW et al.

For research purposes, we will use the AHP method, which represents the method of multi-criteria decision making, designed to assist decision-makers in solving complex decision-making issues involving a larger number of decision-makers, a greater number of criteria in multiple periods (Ahmad, at. all. 2018). Methodologically, AHP is a multi-criteria technique that is based on explaining a complex problem in a hierarchy. The method of analytical-hierarchical processes holds all the parts of the hierarchy in connection, so it is easy to see how the change of one factor influences other factors

The decision-making process is often very complex because of the presence of conflicting targets among the available criteria or alternatives. The problem is to choose an alternative that will best meet the set goals (Milojević, 2018). The field of application of this method is multi-criteria decision-making where, based on a defined set of criteria and attribute values for each alternative, the choice is most acceptable. For easier application of this method, a software tool from the Expert Choice decision support system was developed.

The process of implementing the AHP method involves four basic phases: (Čupić, Suknović, 2010) Structuring a problem that consists of decomposing any complex problem of decision making in a series of hierarchies, where each level represents a smaller number of manageable attributes. They then decompose into another set of elements corresponding to the next level. This hierarchical structuring of any decision problem in this way is an effective way of dealing with the complexity of real problems and identifying significant attributes (Cvijanović, at. all., 2013) in order to achieve the overall goal of the problem. Data collection is the beginning of the second phase of the method of analytical-hierarchical processes. The decision maker assigns relative estimates in attribute pairs, one hierarchical level, for all levels of the entire hierarchy. The most familiar scale used to assign weight is Saaty's nine-point scale.

Estimating relative weights implies that the matrix of comparison, by pairs, translates into problems of determining its own values, in order to obtain normalized and unique own vectors, with the weights for all attributes to each level of the hierarchy.

Determining the solution to the problem is the last phase which involves finding the so-called. composite normalized vector. After the vector of the order of the values of the criteria in the model is determined, in the next round it is necessary to determine within each observed criterion, the order of importance of the alternative in the model with respect to the same procedure. The mitigating circumstance when using any method of multi-criteria decision-making is the fact that all software is supported. (available at: www.odlucivanje.fon.rs)

Results and Discussion

Using the procedure of the AHP method, we analyzed the data that we came up with by researching 60 purchases of financial assets from loans (Hai, Shi, Peng, 2013) made in the entities of the agro-industrial complex in the Republic of Serbia. Procurement was related to loans, and for the needs of the research they were grouped into three categories. The first category consisted of 20 credit arrangements where the lowest loan price (interest rate) was observed as a criterion. The second category consisted of 20 credit arrangements where the criterion was observed in addition to the price-interest rate and the terms of lending. In the third category, 20 credit arrangements were placed, in which, besides the price and terms of lending, the following criteria were used: the creditors' financial rating, the administrative obligations regarding the granting of loans and the financial capacity of the lender.

Bearing in mind that there are different elements of the criteria (Xing, 2014), the model takes the ones that are most important for providing continuous financing of the entities of the agro-industrial complex, starting from the conditions of performing this economic activity. Criteria on the basis of which the alternatives are evaluated in this case are:

Table 1: Criteria for the selection of an optimal bidder (calculation of the author)

No.	Criteria label	Description of criteria
1	K_1	The speed of securing money.
2	K_2	Quality of credit line resources.
3	K_3	The degree of execution expressed in percentage terms and calculated after the expiry of the lending period.
4	K_4	Security, which refers to the time of realization - compliance with the needs for money.

Using the Delphi method, the values of the criteria and their relative weight are estimated:

K1 - loan securing rate (0.30),

K2 - quality of the credit line (0.20),

K3 - the degree of execution (0.20) and

K4 - loan security (0.30).

The decision matrix in this case is shown in Table 2:

Table 2: Decision Matrix

Alternatives	Eligibility criteria			
	Loan Security Speed	Credit line quality	Level of execution	Security of credit
Category 1	5	Satisfies	4	50
Category 2	4	Satisfies	5	40
Category 3	5	Completely satisfies	3	60

By quantifying this matrix, using Saaty's scale (Saaty, 1980) with nine points for assigning weight, the resulting matrix is shown in Table 3:

Table 3: Quantified input data

Alternatives	Eligibility criteria			
	Loan Security Speed	Credit line quality	Level of execution	Security of credit
Category 1	5	7	4	50
Category 2	4	7	5	40
Category 3	5	9	3	60

At the beginning of the problem processing it is necessary to start from determining the relative weight of the criterion, that is, the significance of the criteria (Florindo, at. all., 2018). To assess relative weights, Saaty's scale is used:

Table 4: Saaty's Valuation Scale

Importance	Definition	Explanation
1	Same importance	Two elements are identical in meaning to the goal
3	Poor dominance	Experience or reasoning slightly favors one element in relation to the other
5	Strong domninance	Experience or judgment greatly favors one element in relation to the other
7	Demonstrated dominance	The dominance of one element is confirmed in practice
9	Absolute dominance	Dominance of the highest degree
2,4,6,8	Between values	Compromise needed or further division

Table 5: Estimating Relative Weights of Criteria (Author's Calculation)

Eligibility criteria	Loan Security Speed	Credit line quality	Level of execution	Security of credit
Loan Security Speed	1	5	5	3
Credit line quality	(5)	1	3	(5)
Level of execution	(5)	(3)	1	(5)
Security of credit	(3)	5	5	1
Σ	1,733	11,333	14	4,4

Table 6: Calculating own vectors of the corresponding own values

Eligibility criteria	Loan Security Speed	Credit line quality	Level of execution	Security of credit
Loan Security Speed	0,577	0,441	0,357	0,681
Credit line quality	0,115	0,088	0,214	0,045
Level of execution	0,115	0,029	0,071	0,045
Security of credit	0,192	0,441	0,357	0,227
Σ	2,056	0,462	0,260	1,217
W(Σ/4)	0,514	0,115	0,065	0,304

By comparing the value of the weight of the criteria obtained by using the Saaty scale and the value obtained by applying the Delphi method, it can be concluded that the criterion of the rate of rationalization in relation to its importance given to it in practice is overestimated. Unlike him, the criterion of the degree of execution should be given greater importance, which confirms the result obtained. The quality and safety criteria are well assessed by the data obtained.

Based on the data obtained by estimating the relative weight of the criteria, one should consider the same procedure of the alternatives that are available, that is, the three categories set. A comparison of the alternatives will be done by Saaty's rock.

Table 7: Calculation of own vectors of the corresponding own values (Loan Security speed)

Alternatives	Category 1	Category 2	Category 3	Σ	W(Σ/3)
Category 1	1	(5)	(3)	0,358	0,119
Category 2	5	1	(3)	0,993	0,331
Category 3	3	3	1	1,647	0,549

Table 8: Calculation of own vectors of the corresponding own values (Credite line quality)

Alternatives	Category 1	Category 2	Category 3	Σ	W(Σ/3)
Category 1	1	2	(4)	0,632	0,210
Category 2	(2)	1	(4)	0,398	0,132
Category 3	4	4	1	1,164	0,654

Table 9: Calculation of own vectors of the corresponding own values (Level of execution)

Alternatives	Category 1	Category 2	Category 3	Σ	W(Σ/3)
Category 1	1	(3)	3	0,780	0,260
Category 2	3	1	5	1,899	0,633
Category 3	(3)	(5)	1	0,317	0,654

Table 10: Calculation of own vectors of the corresponding own values (Security of credit)

Alternatives	Category 1	Category 2	Category 3	Σ	W(Σ/3)
Category 1	1	(5)	(3)	0,317	0,105
Category 2	5	1	3	1,899	0,633
Category 3	3	(3)	1	0,780	0,260

After the formation of the comparison table, the weights in pairs for each alternative were separately calculated by the own vector. In this way, we have gained the weight of any alternatives essential for determining the solution to the problem.

After assessing the relative weight of alternatives in relation to each criterion, it is approaching determining the category of securing credit funds, which has the highest value in relation to the criteria observed. The choice of a category is based on the obtained own vector alternatives and previously obtained own vectors of the criteria. The overall priorities of the alternatives are obtained by multiplying each weight for each alternative within the observed criterion, and in the end, the results obtained are summed up.

Table 11: Selection of the most favorable creditor

Alternative	Eligibility criteria			
	Loan Security Speed	Credit line quality	Level of execution	Security of credit
Category 1	0,119	0,210	0,260	0,105
Category 2	0,331	0,132	0,633	0,633
Category 3	0,549	0,654	0,105	0,260

From Table 11 it can be concluded that after the implementation of the AHP method, in the research, the order of alternatives would be the following: “Category 1” (14%), “Category 2” (42%), “Category 3” (44%), which shows that in relation to the given criteria “Category 3”, ie credit arrangements where the criterion, besides the price and terms of lending, were used: the financial rating of the lender, the administrative obligations regarding the granting of loans and the financial capacities of the lenders have the greatest value.

Conclusions

The agroindustrial complex is characterized by the integrity of the production process, which also depends on the integrity of financing. The use of quantitative models can provide a good basis for the decision-maker, although in these models the decision maker’s subjectivity is present, when evaluating the relative weight of criteria and

alternatives, it can be diminished by combining several different methods of multi-criteria optimization and comparison of the solution.

The application of this model in the survey found that creditors with the highest credit rating, administrative obligations in terms of granting loans and the financial capacity of lenders for institutions that implemented the operation to provide assistance to civilian authorities after floods. These credit arrangements also had the highest value in terms of the speed of implementation, which affected the adequate provision of financial resources from the producers of the agro-industrial complex. The survey found that credit arrangements where multiple criteria were used to evaluate bids were implemented more quickly.

This research has proven that creditors who have respected the deadline for securing financial resources and who had better financial capacities in line with the required level were reliable and safe, which also affected the integrity of the financing of the producers of the previous industrial complex. Also, in the research, the decision support system showed that the reliability of the lenders is correlated with its indicators of financial capacity.

Ackonowledgements

The paper is a result of the researching project VA-DH17/19

Conflict of interests

The authors declare no conflict of interest.

References

1. Mihajlović. M., Dašić, M., & Pamučar, D. (2012), Primena AHP metode prilikom nabavke opreme za objekte ishrane u sistemu odbrane, 34. Simpozijum o operacionim istraživanjima, SYM-OP-IS 2012,. 409-412 [*in English*: Mihajlović. M., Dašić, M., & Pamučar, D. (2012), Application of the AHP method for procurement of equipment for food facilities in the defense system, 34th Symposium on Operational Research, SYM-OP-IS 2012, 409-412.
2. Rađenović, Ž. (2015). The influence of the competition policy on state aid and public sector within the European union single market. *FACTA UNIVERSITATIS-Economics and Organization*, 12(1), 83-95.
3. Petrović, D., i dr.: Menadžment i organizacija, Fakultet organizacionih nauka, Beograd, 2012. [*in English:* Petrović, D., et al . (2012), *Management and Organization*, Faculty of Organizational Sciences, Belgrade]
4. Pamučar, D., Đorović, B., Božanić, D., & Ćirović, G.: Modification of the Dynamic Scale of Marks in Analytic Hierarchy Process (AHP) and Analytic Network Approach (ANP) through Application of Fuzzy Approach, Scientific Research and Essays, Vol. 7(1), 2012, pp. 24-37.

5. Čupić, M., & Suknović, M. (2010), *Odlučivanje,* Fakultet organizacionih nauka, Beograd, 2010. [*in English:* Decision making, Faculty of Organizational Sciences, Belgrade]
6. Pavličić, D. (2010), *Teorija odlučivanja,* Ekonomski fakultet Beograd, Beograd, 2010. [*in English:* Decision making theory, Faculty of Economics, Belgrade.]
7. Faculty of Organizational Sciences: www.odlucivanje.fon.rs
8. Saaty, T.: The Analytic Hierarchy Process", McGraw-Hill, New York. 1980.
9. Marjanović, N., Prelić, J., & Belokapić-Čavkunović, J. (2017). The role of the National Bank of Serbia in regulation of monetary policy. *Oditor-časopis za Menadžment, finansije i pravo*, 3(3), 73-88.
10. Tadić, A. (2018). Liquidity risk. *Oditor-časopis za Menadžment, finansije i pravo*, 4(1), 139-152.
11. Popović S, Janković I, & Stojanović Ž., (2018) The importance of bank credits for agricultural financing in Serbia, *Ekonomika poljoprivrede*, vol. 65, br. 1, str. 65-80
12. Milić, D., & Soleša, D. (2017). The analysis of macroeconomic determinants of the banking sector liquidity with role in financing agricultural sector. *Economics of Agriculture*, 64(2), 533-550.
13. Mariyono, J., (2019) Micro-credit as catalyst for improving rural livelihoods through agribusiness sector in Indonesia, *Journal of Enterepreneurship in Emerging Econoies*, 11(1), pp. 98-121
14. 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.
15. Bai, C., at. all., (2019) Banking credit worthness: Evaluating the complex relationship, *Omega*, United Kingdom, 83, pp. 26-38
16. Florindo. T. J., at. all., (2018) Application of the multiple criteria decision-making (MCDM) approach in the identification of Carbon Footprint reduction actions in the Brazilian beef production chain, *Journal of Cleaner Production*, 196, pp. 1379-1389
17. Milojević, I. (2018) The application of Boolean algebra in solving the legal status of retired university teachers. *Oditor - časopis za Menadžment, finansije i pravo*, 4(3), 62-70.
18. Ahmad, D., Chani, M. I., & Afazl, M., (2018) Impact of formal credit on agricultural output: Empirical evidence from Pakistan, *Sarhad Journal of Agriculture*, 34(3), pp. 640-648
19. Xing, S., (2014) Agricultural credit institution efficiency evaluation research based on data envelopment analysis, *Open Cybernetics and Systemic Journal*, 8, pp. 535-539
20. Hai, L., Shi, B., & Peng, G., (2013) A credit risk evaluation index system establishment of petty loans for farmers based on correlation analysis and significant discriminant, *Journal of Software*, Vol. 8, No. 9, pp. 2344-2351.

RESEARCH OF FACTORS OF NON PERFORMING AGRICULTURAL LOANS BY PRIMARY DATA PANELS

Almir Muhović[1], Nikola Radivojević[2] , Nikola Ćurčić[3]

**Corresponding author E-mail: radivojevic034@gmail.com*

A R T I C L E I N F O

Review Article

Received: *18 May 2019*

Accepted: *03 June 2019*

doi:10.5937/ekoPolj1902569M

UDC 336.77/.78:338.43

Keywords:

Agricultural Loans, non-Performing Loans, profitability, capital adequacy ratio, , return on own funds, returned on total assets.

***JEL**: G24, C22, C52, C53*

A B S T R A C T

The paper examines factors that influence the occurrence and movement of nonperforming agricultural loans in Serbia, Montenegro and Bosnia and Herzegovina.

The aim of the paper is to determine the direction and significance of the relationship between the key micro and macroeconomic factors and the impractical agricultural loans in these countries, but also to point out the importance of applying dynamic data panel evaluators when it comes to the study of this problem.

Introduction

The paper examines the factors of the occurrence of nonperforming agricultural loans, on the example of the data panel of the three countries: Serbia, Montenegro and Bosnia and Herzegovina. Research related to this problem in the mentioned markets is very rare and, according to the author's knowledge, is mainly related to the study of different determinants of the appearance of total nonperforming loans, without separation into individual categories. For example, research conducted by Stakic (2014) refers to the study of six micro and macro variables that affect the occurrence of nonperforming loans in the banking system of Serbia. He studied the impact of four

1 Almir Muhović, Ph.D, Assistant Professor, University Business Academy, Faculty of Applied Management, Economics and Finance, Jevrejska No. 24, 11000, Belgrade, Serbia,Phone: +381631070932, e-mail:amuhovic@gmail.com, ORCID ID https://orcid.org/0000-0003-1479-2654

2 Nikola Radivojević, Ph.D, Professor, Technical College of Applied Studies, Str. Kosovska, No. 8, 34000, Kragujevac, Serbia, Phone:+381600555173, e-mail: radivojevic034@gmail.com, ORCID ID 0000-0002-6137-4431

3 Nikola Ćurčić, PhD, Assistant Professor, University Union Nikola Tesla, Faculty of Management, Sremski Karlovci, Njegoseva 1, Sremski Karlovci, Serbia, Phone: +381 64 2777771, e-mail: nikolavcurcic@yahoo.com, ORCID ID https://orcid.org/0000-0003-3375-2690

micro variables such as profitability, capital adequacy ratio, provision for covering over potential losses, ownership structure of banks and the impact of two brand variables such as concentration of banks and growth of gross domestic product. Characteristic of this research is that the method used for the simplest least squares is used to evaluate the data panel. The application of this method requires the fulfillment of very strict conditions and assumptions of the model, which when dealing with panel data can always be called into question. Radivojević and Jovović (2017) studied the influence of three macro and three micro factors on the occurrence and movement of nonperforming loans using the data panel. The panel consisted of 15 developing countries, including Serbia, Montenegro and Bosnia and Herzegovina. The significance of this research is that they have used a number of different static and dynamic techniques for evaluating the data panel, ranging from the simplest least-squares method to the mid-stage differentiated general method of moments. A contraction of high-quality demand for loans and the expansion of nonperforming loans, which started to burden bank balance sheets and their results, led to a significant tightening in banks' standards and conditions for new lending (Durkalić & Ćurčić, 2019) and most countries compete that with investments from abroad (Huxley & Sidaoui, 2018). Todorović et al. (2018) declared that available information on performance indicators and nonperforming loans needs to be reliable, comparable, and clear. Muhović et.al (2018), conducted the only known research on the study of factors of the occurrence of impractical agricultural loans on the example of the data panels of Serbia, Montenegro and Bosnia and Herzegovina. His study was concentrated on the impact of three key macro factors of non-performing agricultural loans, unemployment rates, growth rates of gross domestic product and inflation rates, and three key micro variables such as return on own funds and total assets and an indicator of the capital adequacy of the bank. The results of their research indicate that there is a negative and statistically significant link between unemployment and non-performing loans, that there is no statistically significant relationship between the growth rate of gross domestic product and these loans, and that there is a positive and significant relationship between the inflation rate and the occurrence of these non-performing loans. Also, the authors conclude that there is either negative or positive statistically significant relationship between the return on the active, i.e. the indicators of capital adequacy and the occurrence of non-performing loans. However, the conclusions of this research are based on the application of static data panel estimates, which cannot detect the effects of legendary variables. The estimates of model parameters were obtained using the smallest squares method and the fixed effect method. Bearing in mind the limitations of the application of the smallest squares to the panel data, as well as the limitations of the fixed effects method (for more details see this in Radivojević et.al 2019), the results of this study should be taken with caution. Hence, the aim of this paper is to use the dynamic data model of the dataset using the dynamic model of the certificate or deny the findings of the aforementioned research, that is, to indicate the importance of applying the techniques for evaluating the dynamic data model of the data panel.

Materials and methods

The survey was conducted on a sample of data panels of Serbia, Montenegro and Bosnia and Herzegovina for the period from 2000 to 2015. The data was collected from the official World Bank website and the Bank for International Settlements. The dynamic data panel model is shown as follows:

$$NPLi,t = \beta_1 + \beta_2 npls_{i,t-1} + \beta_3 gdp_{i,t} + \beta_4 unr_{i,t} + \beta_5 inf_{i,t} + \beta_6 roa_{i,t} + \beta_7 roe_{i,t} + \beta_8 car + +\varepsilon_{i,t} \quad (2.2.1)$$

Where there are:

$NLP_{i,t}$	- NPL rate for i - country in (t) time period
$NLP_{i,t-1}$	- NPL rate for i- country in (t-1) time period
$gdp_{i,t}$	-The rate of gross domestic product for i- country in (t) time period
$unr_{i,t}$	- Unemployment rate for i- country in (t) time period
$inf_{i,t}$	- Inflation rate for i- country in (t) time period
$roe_{i,t}$	- rate the return on equity for i- country in (t) time period
$roa_{i,t}$	- rate of return on assets for i-country in (t) time period
$cap_{i,t}$	- Capital adequacy ratio between equity and assets for i- country in (t) time period

The model thus described allows for the influence of NPL from the previous period on a dependent variable, with the NPL variable being dependent on the current period. Independent variables are the unemployment rate, gross domestic product growth rate, inflation rate and rate of return on own funds and assets and capital adequacy ratio. To evaluate the models the following methods are used.

The dynamic model was estimated using the one-step differentiated generalized momentum method (GMM), developed by Arellano and Bond (1991). The selection of this evaluator is in line with the empirical research of Louziset et.al (2010) and De Bocka and Demianets (2012). Their assessment began with the transformation of all variables by differentiation, and then using the difference of GMM. GMM estimation is based on the transformation of the first order of the equation (2.2.1) in the following way:

$$\Delta NPLi,t = \beta_1 + \beta_2 \Delta npls_{i,t-1} + \beta_3 \Delta gdp_{i,t} + \beta_4 \Delta unr_{i,t} + \beta_5 \Delta inf_{i,t} + \beta_6 \Delta ennr_{i,t} + \beta_7 \Delta hip_{i,t} + \beta_8 \Delta roa_{i,t} + \beta_9 \Delta roe_{i,t} + \beta_{10} \Delta car + \beta_{11} \Delta llp_{i,t} + \beta_{12} \Delta nimr_{i,t} + \beta_{13} \Delta nimr_{i,t-1} + \beta_{14} \Delta nimr_{i,t-2} + \varepsilon_{i,t} \quad (2.2.2)$$

where Δ is the operator of the first differentiation.

Since it is expected in equation (2.2.2) that the dependent variable with the position (dependent variable from the previous period) $\Delta npls_{i,t-1}$ be correlated with $\Delta\varepsilon_{i,t}$, implies bias in evaluation. Moreover, this model can cause bias because of the endogenous explanatory variables, which leads to autocorrelation problems. Arellano and Bond (1991) state that the problem of autocorrelation between the dependent

variable of the previous period and the faults (residuals) of the model can be solved by adding additional instruments to the model of dynamic panel data. The point is that in the models (2.2.2), instruments that are not correlated with the model error shall be found. Valid instrument is $npls_{i,t-2}$, because it is largely correlated with $npls_{i,t-1} - npls_{i,t-2}$, and is not correlated with $\varepsilon_{i,t} - \varepsilon_{i,t-1}$. The basic idea behind the GMM assessment is that we have valid instruments that can be tested with the Sargan test.

In addition to the GMM method, the two-level method of the smallest squares is also used to estimate the model, which is also used to solve the endogenous problem of one or more explanatory variables. More precisely, this method was used under the assumption that the dependent variable from the previous period was instrumentalized with all the regressors from the previous period in the model. In addition to these two assessors, the model was also evaluated using the dynamic model of a fixed effect, since it is assumed that the selected countries have their specificities that are time-invariant.

Results

The first step in working with panel data involves descriptive analysis of collected data and stationary analysis. Table 1 shows the results of descriptive analysis.

Table 1. Descriptive statistics panel of data **(%)**

Variables	Volume	Middle	St.dev.	Minimum	Maximum
NPL	48	12,751	6,783	2,900	24,100
GDP	48	4,745	4,195	-3,120	17,290
UNR	48	20,467	4,760	7,250	31,100
INF	48	10,407	19,944	-0,910	95,010
ROA	48	0,285	1,397	-4,790	4,000
ROE	48	1,902	8,708	-25,670	19,170
CAP	48	21,336	7,133	6,000	42,000

Source: Authors

As you can see the level of NPL ranges from 2.9% to 24.10%. The average NPL value is approximately 12.75%, which highlights the need to pay more attention to credit policy in these countries in the future. GDP shows both negative and positive values, indicating high fluctuation and stagnation in economic growth in these countries, with the notion that the average growth rate in the observed period is positive, indicating that these countries achieved economic growth. The analysis of the unemployment rate indicates that these countries face all the major unemployment problems, as well as a high average inflation rate. The high values of the standard deviation of macroeconomic variables can be interpreted as a consequence of large oscillations in economy and economic activities in these countries. The values of microeconomic variables are relatively similar among countries and indicate that despite the fact that the minimum value of profitability

indicators was about 4.8%, banks profitably operate in these countries. The relatively high value of capital adequacy indicators implies the resilience of the banking sector to extreme shocks and macroeconomic instability. On the other hand, the relatively high value of the standard deviation of this parameter can be an indication of changes in prudential requirements during the observed period (Muhović et.al (2018). An analysis of the stationary data panel was performed using the Levin-Lin-Chu unit root test. The results given in Table 2 reveal that the variables NPL, GDP and CAP are non-stationary. While other variables are stationary, (Muhović et.al (2018). The unstableness of the GDP is justified by the great economic instability in these countries, while the lack of stability in the indicators of capital adequacy explains the frequent changes in prudential requirements, as a consequence of frequent reforms in the financial sector. After the first-order differentiation, non-stationary series became stationary.

Table 2. Results of the LLC test

Variable		test value	*p*-value
NPL	Level	6,37925	0,3821
	1· difference	25,8609	0,0002
UNR	Level	20,4845	[0,0023]
	1· difference		
GDP	Level	11,1123	0,0850
	1· difference	42,0469	0,0000
INF	Level	50,4943	0,0000
	1· difference		
ROE	Level	14,2472	0,0270
	1· difference		
ROA	Level	22,6279	0,0009
	1· difference		
CAP	Level	11,0279	0,0875
	1· difference	21,595	0,0014

Note: the test is performed for a confidence level of 5% of the test value
Source: Authors

The second step in working with panel data was to examine the correlation between the selected variables. High correlation between independent variables may also be implicated by the presence of multicolority, which generates certain problems in econometric analysis. A correlation of over 0.8 is considered high and may generate certain problems in the research. Correlations between variables are shown in Table 3. As one can expect high correlations, there are two variables concerning the profitability of banks, i.e. between ROA and ROE (0.959). In order to avoid potential problems of the ROE variant, the ROE variant has been excluded from further research.

Table 3. Correlation matrix

NPL	GDP	UNR	INF	ROE	ROA	CAP	
1,000	-0,101	-0,188	0,247	-0,402	-0,393	0,271	**NPL**
	1,000	-0,331	0,086	-0,369	-0,332	-0,027	**GPD**
		1,000	-0,497	0,209	0,186	-0,473	**UNR**
			1,000	-0,115	-0,154	0,732	**INF**
				1,000	0,959	0,038	**ROE**
					1,000	-0,020	**ROA**
						1,000	**CAP**

Source: Authors

In Table 4, the results of the dynamic model estimation are presented using the three previously described assessors.

Table 4. Results of the assessment of the dynamic model parameters for all three countries for the period from 2000 to 2015 (dNPL - dependent variable)

	Evaluator Dynamic fixed effect			**2SLS regression**			**One-degree GMM ratings**		
Variable	**Coefficient**	**p verbal**		**Coefficient**	**p verbal**		**Coefficient**	**p verbal**	
Constant	18,116	0,000	***	5,462	0,008	***	7,615	0,340	
NLPt-1	−0,296	0,161		−0,396	0,000	***	−0,523	0,000	***
dGPD	−0,156	0,220		−0,182	0,000	***	−0,417	0,003	***
UNP	−0,819	0,000	***	−0,179	0,008	***	−0,171	0,440	
INF	0,126	0,483		−0,134	0,008	***	−0,605	0,011	**
ROA	−2,013	0,000	***	−1,661	0,205		−0,289	0,683	
dCAR	0,534	0,024	**	−0,002	0,994		−0,788	0,003	***
R2	0,258			0,185			AR(1)	-1,711 (0,087)	
							AR(2)	1,576 (0,115)	
							Sargan test	35,049 (0,371)	

Source: Authors

Note: Assessments using 2SLS evaluators have robust (HAC) errors. The brackets are given p - values. The H-matrix was used to evaluate the variance-covariance matrix.

Discussions

The results shown in Table 4 indicate that the applied assessors can reliably be used to examine the impact of determinants of nonperforming agro-credits in countries that are the subject of research in this paper. However, the determination coefficient values

(R2) are quite low. In the case of a dynamic fixed effect assessor, it is 0.28, while in the case of a two-stage method of the smallest squared it is 0.185. They indicate that only 28% and 18.5% of the variability in the dependent variable can be explained by the selected variables in the model. In the case of a third grader, the Sargan test shows that all instruments included in the model are valid. Also, the results of autocorrelation tests show the presence of autocorrelation of the first, or the absence of the second order, which is in accordance with the conditions for applying this assessor. The analysis of the obtained data reveals that there is a clear link between the levels of nonperforming loans from the previous period and the current rate of non-performing agricultural loans. This can be interpreted as having the credit conditions unchanged, as well as habits, i.e. credit rating of the debtor. An interesting result in relation to research carried out using static data panel evaluators (Muhović et.al, (2018) is that there are statistically significant and negative correlations between gross domestic product growth rates and the rate of non-performing agricultural loans. This finding is consistent with the expectations and findings of numerous authors, such as Makri et.al (2014) and Jovović (2014). Namely, it is expected that impaired loans are closely linked to the economic and business cycle, i.e. behind every financial crisis there are macroeconomic factors, such as a decline in aggregate economic activity. Financial crisis pinpointed on weaknesses that were more than obvious on derivatives market. (Dudić et al., 2018). When growth slows down or becomes negative, borrowers reduce cash inflows, which make it difficult for them to pay interest and principal on bank loans. In such circumstances, borrowers will face a lack of liquidity and delays in meeting their financial obligations towards banks will likely increase (Radivojević and Jovović, 2017). Since these countries have a large share of agriculture in the total gross domestic product, this is expected to be a high value of this coefficient. In this analysis, it is about 0.42, which implies that with each decrease in the economic activity of these countries from 0.42% leads to the growth of nonperforming loans of 1%. The results of the first two evaluators indicate that there is a significant but negative correlation between the unemployment rate and the non-performing agricultural loans, while the third assessor does not have a statistically significant link. This finding is in contrast to numerous findings, Nkusu (2011), Louzis et.al (2012), Makri et.al (2014) and the view that unemployment reduces available household income and weakens the borrower's ability to pay its loan installments on time. This finding can be justified by the fact that people who are left unemployed do not take loans or that the bank does not approve such loans to such people. The reason is also found in the fact that in these countries there are mechanisms for securing loans in the event of a debtor without a job. The reasoning behind is, however, the fact that the unemployment rate of this sector in the overall unemployment rate in these countries is relatively small, and that the fluctuations in the overall rate do not affect the creditworthiness of agricultural producers, but also the fact that a large number of the labor force engaged seasonal jobs in this sector are not recorded in labor markets. The results of the research using the static model are contradictory. By using a pooled OLS method, a positive relationship was established; while a negative relationship was established using the FE model.

Inflation is an important factor that affects the creditworthiness of the borrower. In the study of Muhović et.al (2018), using the pooled OLS method that is inexistent, i.e. using FE model to have a positive relationship, while the results of the application of dynamic assessors indicate a negative relationship, which explains that inflation increases the prices of agricultural products and the earnings of agricultural producers grow faster than the inflation rate, which is in contrast to Mileris (2012) and Nkusus (2011). While this finding should be taken with caution, bearing in mind that negative inflation rates have been recorded in Montenegro and Bosnia and Herzegovina, so that these data can influence the panel analysis result. Regarding the relationship between ROA and NPL, a statistically significant link was not revealed, which can be explained that the quality of bank management has no impact on the occurrence of non-performing agricultural loans. Also, it is interesting merger and acquisition (Agarwal et al., 2018). The results of the static model application indicate that there is a positive link between the capital adequacy indicators and the NPL, while the results of the research in this paper obtained using the dynamic FE model confirm the findings of the previous study. However, the application of the GMM model indicates the existence of a negative link, which is justified by the fact that banks with higher rates are entering risky activities ((Rime, 2001, Luise et al. (2012), Garsiy and Fernandez (2007)).

Conclusions

In this paper, literature on the most significant micro and macro factors that influence the occurrence of nonperforming loans was considered. More precisely, the work focuses on the impact of the movement of gross domestic product, inflation and unemployment rates, on the one hand, and indicators of profitability and performance of banks, as well as the level of adequacy of bank capital coverage, on the other hand, on the occurrence and movement of nonperforming agricultural loans, with the note that in this work under agricultural loans are meant long-term investment loans approved for the purchase of agricultural machinery, construction or adaptation of facilities for intentions of agricultural production and infrastructure works, establishment or extension of livestock farms etc. The research was carried out using the data panel of Serbia, Montenegro and Bosnia and Herzegovina. Data were collected for the period from 2000 to 2015.

In addition to examining the significance of the aforementioned micro and macroeconomic factors on the occurrence and movement of these impractical loans in these countries, the aim of the work is to point out the importance of using dynamic data panel evaluators, and to point out the differences in the findings obtained by applying these evaluators data panel in relation to the use of static data panel evaluators, which were used in a similar study.

The results that have come to light in this paper can be summarized as follows: 1) that there is a statistically positive link between the levels of nonperforming loans from the previous and the current period, which explains that the conditions for granting loans and the target group between these two periods have not changed, as well as

the habits of the borrowers; 2) that there is a statistically significant and negative correlation between gross domestic product growth rate and dependent variable, which is contrary to the findings of Muhović et.al (2018), who did not reveal the existence of a statistically significant link between these variables; 3) that based on GMM assessors, it can be concluded that there is no statistically significant link between unemployment and non-farming agricultural loans, while the other two point to the existence of a negative link. The results of the abstracted studies are also contradictory, and no clear conclusion can be drawn from them on the nature of the relationship between these two variables; 4) that inflation has a negative impact on the occurrence and movement of non-performing loans. Based on the results presented by Muhović et.al (2018), a clear view on this relationship cannot be drawn because the obtained conjunction findings are obtained using two different assessors of the static model of the data panel; 5) that there is no statistically significant link between ROA and NPL; 6) that there is a rate of capital adequacy of the bank in a negative relationship with the dependent variable.

Bearing in mind the results of the research, but also the findings of the study, which is referred to in this paper with which the results are comparable, one can conclude on the necessity of 1) the application of dynamic data panel models, since they provide a deeper insight into the presence of the effects of residual NPLs at the current NPL and 2) the need to use different assessors, and the comparison of their results.

Conflict of interests

The authors declare no conflict of interest

References

1. Agarwal, N., Kwan, P., & Paul, D. (2018). Merger and acquisition pricing using agent based modelling. *Economics, Management & Financial Markets*, 13(1), 84-99.
2. Boudriga, A., Taktak, N., Jellouli, S. (2009), Bank Specific, Business and Institutional Environment Determinants of Nonperforming Loans: Evidence from MENA Countries. *Paper presented at Economic Research Forum 16th Annual Conference Cairo.*
3. Dudić., B., Drahošová., M., Lukić., J., Dudić., Z., Smoleň., J., Mirković., V. (2018), Counterparty Credit Risk Closure: Challenges in Big Data Era, Proceedings of the 31st International Business Information Management Association Conference, IBIMA 2018: Innovation Management and Education Excellence through Vision 2020.
4. Durkalić, D., Ćurčić, M., (2019), Mutual influence of the international investment position and the net government position with the banking sector of the Republic of Serbia, *Ekonomika,* Niš, 65 (1), 78-91.
5. Godlewski, J. C. (2005), Bank capital and credit risk taking in emerging market economies. *Journal of Banking Regulation*, 6(2), 128-145.
6. Garsiya, M. T., and Fernandez, R.M.D. (2007), Risk-taking behavior and ownership in the banking industry: The Spanish evidence. *Journal of Economics and Business*, 60 (4), 332 – 354.

7. Huxley, S. J., & Sidaoui, M. (2018). Gaining market share in emerging markets portfolios by moderating extreme returns: The case of Peru. *Economics, Management & Financial Markets*, 13(3), 37–55.
8. Jovovic, J. (2014), Determinants of Non-Performing Loans: Econometric Evidence Based on 25 Countries. *Master thesis, City University London*.
9. Louzis, P. D., Vouldis, A. T., Metaxas, V. L. (2012), Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios. *Journal of Banking and Finance*, 36 (1), 1012-1027.
10. Makri, V., Tsagkanos, A., Bellas, A. (2014), Determinants of Non-Performing Loans: The Case of Eurozone. *Panoeconomicus*, 2, 193-206.
11. Makri, V., Papadatos, K. (2012), How accounting information and macroeconomic environment determine credit risk, Evidence from Greece. *International Journal of Economic Sciences and Applied Research*, Vol. 7 (1), 129-143.
12. Mileris, R. (2012), Macroeconomic Determinants of Loan Portfolio Credit Risk in Banks. *Izerine Ekonomika-Engineering Economics*, 23(5), 496-504.
13. Muhović, A. Radivojevic, N, Curcic, N. (2018), Empirical research determinant of NPL in emerging markets by using the fixed effects method: Study of the case of Serbia, Montenegro and Bosnia and Herzegovina, *Vojno delo*, No. 7.,335 – 344.
14. Nkusu, M.(2011), Nonperforming Loans and Macrofinancial ulnerabilities in Advanced Economies. *IMF Working Paper 161.*
15. Radivojevic, N., Cvijanovic, D., Sekulic D., Pavlovic, D., Maksimovic, G., Jovic, G. (2019), Econometric model of non-performing loans determinants, *Physica A: Statistical Mechanics and its Applications,* Vol. 520, 481-488.
16. Radivojevic, N., Jovovic, J., (2017), Examining of determinants of non-performing loans, *Prague economic paper*, 26 (3), 300-316.
17. Stakić, N., (2014), Determinants of trends in the level of non-performing loans in the banking sector in Serbia. *Bankarstvo,* No. 4.,122 -146.
18. Tabak, B. Guerra, M. S., Solange, M, Lima, E.JA., Chang, E.J. (2005), The Stability-Concentration Relationship in the Brazilian Banking System. *The Banco Central do Brazil Working Papers*, 145.
19. Todorović, V., Furtula, S., Durkalić, D., (2018), Measuring performance of the Serbian Banking sector using CAMELS model, *TEME*, Niš, 42(3), 961-977, DOI: 10.22190/TEME1803961T.
20. Vučinić, M. (2014), Financial Stability – Comparative Analysis: Montenegro, Serbia and the Netherlands, *Journal of Central Banking Theory and Practice*, No. 1, 63-93.
21. Wooldridge, J., M. (2009), Introductory econometrics: a modern approach. 4th ed. Mason, Ohio: *South-Western Cengage Learning.*

INTEGRAL ACCOUNT AND AGROECONOMIC APPLICATION OF AN INTRODUCTORY INTEGRAL

Ivan Milojević[1], Svetlana Ignjatijević[2], Mihailo Ćurčić[3]

**Corresponding author E-mail: curcicmihailo@gmail.com*

ARTICLE INFO

Review Article

Received: *23 March 2019*

Accepted: *09 June 2019*

doi:10.5937/ekoPolj1902579M

UDC 517.4:657.372

Keywords:

Agroeconomic phenomena, integral analysis

***JEL**: C69, D49*

ABSTRACT

Agroeconomic events follow the formation of relationships in the society regarding transactions that occur in market systems. Integration as a mathematical operation has wide application in solving certain agroeconomic changes.

The dependence of application of integration in certain agroeconomic functions takes the dominant position in solving real problems. In this connection, we will show the application of an unspecified integral in some agroeconomic events. What will we try to contribute to the application of this kind of quantitative analysis on agroeconomic factors.

Introduction

Agroeconomic policy is an important segment of the overall macroeconomic policy of every society. The investigation of the phenomenon from this segment requires the application of the equimetric and quantitative models. Due to the evident domination of the marginalist economic direction, such research is gaining in importance.

The subject of this paper is to demonstrate the possibility of applying an integral account in the research of agroeconomic phenomena and processes.

Integration is an inverse operation from differentiation. Integration sign $\int$ is an elongated letter S. This symbol is not arbitrarily selected as, for instance, a symbol $\sqrt[n]{}$ for the root. An elongated letter S shows that this is a surgery that has a similarity

1 Ivan Milojević, PhD, Professor, University of Defense, Military Academy, Pavla Jurišića Šturma street No. 33, Belgrade, Serbia, +381690702697, drimilojevic@gmail.com, https://orcid.org/0000-0003-3653-3477?lang=en

2 Svetlana Ignjatijević, PhD, Associate Professor, Faculty of Agroeconomics and Engineering Management, Cvećarska street No. 2, Novi Sad, Serbia, +38121400484, ceca@fimek.edu.rs, https://orcid.org/0000-0002-9578-3823

3 Mihailo Ćurčić, MA, Teaching Assistant, University of Defense, Military Academy, Pavla Jurišića Šturma street No. 33, Belgrade, Serbia, +381654009049, curcicmihailo@gmail.com, https://orcid.org/0000-0001-7674-0310

to summation, such as differentiation analogous to subtraction. In fact, it has been shown beforehand that it is a differential dy approximately equal to the difference $\Delta y = y_2 - y_1$.

If two inverse operations are executed successively over a certain size, for example, over a variable, then their operation is canceled and the size remains unchanged, i.e. $\int dx = x + C$, C - integration constant.

The reason that along with the appearance of one more arbitrary constant, it is easy to understand. Actually, $dx = d\left(x + C\right)$ then $\int dx = \int d\left(x + C\right) = x + C$. Otherwise, this constant is indeterminate and according to it, the integral is called an indefinite integral. This inverse operation from differentiation can also be understood in the following way.

Under the sign $\int$ is the difference, i.e. product derivative of function and differential of independent variables. In our previous assumption, the copy is equal 1. Therefore, the integration here meant determining a function whose output is equal to the unit. And what function does it have as a copy of 1? This, obviously, is not just a function $y = x$ but also all linear functions of the form $y = x + C$. Integration is, therefore, reduced to the search for a function whose derivative is known. In other words, integration is the search for a primitive function, primitive in terms of the original.

Integration, however, is not that simple at all. In order to solve the integrals of more complex functions, it is not enough to know just the rules of differentiation.

By systematizing knowledge in the field of the integral account, significant starting points for each research can be obtained.

Literature review

The application of integral analysis in agroeconomic processes establishes a systematically marginalistic approach to the quantitative study of the process of this scientific whole (Daze, 2008).

By studying the possibility of integral modeling of the optimal development of large systems. (Markova et al., 2019) as the subject of the integral application takes the age structure of equipment according to certain types. In the case of such an integral application, it is possible to investigate and set the boundaries of integration in the agro-industry complex in order to find a replacement solution for the numerical way by optimizing the cost of replacement.

Finding Convertible Relations as the Basis of Production of the Agro-Industrial Complex makes the application of the integration conditional on the case of investment construction (Cevi et al., 2010) in the process of evaluating the investment of a continuous tubular model with a plastic blanket for pig breeding, and it came to the

conclusion that the technical The dimension has a major impact on the results and economic development.

A competitive environment imposes a need for a constant analysis of inflows and outflows of money. Due to the need to retain existing investors, a new attraction is imposed by the need for the application of analytical methods (Knežević et al., 2016). The agroindustrial complex fulfills all the necessary conditions to be the subject of analysis, contrary to the turbulent modern business. Investors monitor the inflows and outflows of money due to which they make their business decisions.

The agro industry encompasses all activities starting from harvests, transformation, storing and preparation of agricultural raw materials for production or final consumption (Wohlmuth, Kormawa, 2012). The main focus is on production and food processing, but it should not be wrongly identified with the food industry, which is processing agricultural raw materials into food and beverages (FAO et al., 2008).

In order for the development of the agro industry to be efficient, there are some necessary structural changes in agriculture and the food industry which are required. Although they are time consuming and financially demanding, the practice shows that they are manageable, but with an inadequate support of agrarian and industrial policies. (Savić et al., 2016)

Taking into consideration that this paper is concerned with proving connection and interaction between integral account and introductory integral, it can be stated that the main subject of a correlation analysis is to examine the mutual strength of the relationship and the dependence between the variables. According to Durkalić and Ćurčič (2019), the examination of the direction and strength of the interaction is carried out on the basis of a correlation analysis.

Materials and methods

From the rule for the sum of differentials $d\left[u(x)+v(x)\right]=d\,u(x)+d\,v(x)$ i the fact that the differentiation and integration of mutually inverse operations is followed

$$\int\left[du(x)+dv(x)\right]=\int d\left[u(x)+v(x)\right]=u(x)+v(x)=\int d\,u(x)+\int d\,v(x),$$

ie. the integral of the sum equals the sum of the integral of the collection (Babić et al., 1996). In the same way, the rule according to which the integral of the difference is equal to the difference of the integral is performed.

If we read the following rule: $d\left[k\ f(x)\right]=k\cdot df(x)$, apply to this equation operator $\int$, we get that $\int k\ f(x)=\int d\left[k\cdot f(x)\right]=k\int df(x)$, ie. the integral of a product of a constant and some function is equal to the product of the constant and the integral of this function. (Drenovak, 1999)

Now, any whole rational function can be integrated. (Ivović, 1999). For instance

$$\int (3x^4 + 5x^3 - x^2 + 1)dx = 3\int x^4 dx + 5\int x^3 dx - \int x^2 dx + \int dx =$$

$$= \frac{3}{5}x^5 + \frac{5}{4}x^4 - \frac{1}{3}x^3 + x + C$$

If the operator is applied $\int$ on both sides of the formula:

$$d\left[u(x)\cdot v(x)\right] = v(x)du(x) + u(x)dv(x),$$

is obtained, (and by applying the rule for integral sums)

$$= \int v(x)du(x) + \int u(x)dv(x).$$

That's it

$$\int u(x)dv(x) = u(x)\cdot v(x) - \int v(x)du(x),$$

or shorter

$$\int u\,dv(x) = u\cdot v - \int v\,du.$$

This is the formula for partial integration.

When to determine $\int x^2 e^x dx$ with partial integration, (Martić, 1976) then applying the rule is obtained

$$\int x^2 e^x dx = x^2 e^x - \int e^x 2x dx,$$

where $u = x^2$ and $dv = e^2 dx$, and integral from the right side is

$$\int 2xe^x dx = 2\int xe^x dx = 2(xe^x - \int e^x dx) = 2(xe^x - e^x) + C,$$

and finally

$$\int x^2 e^x dx = x^2 e^x - 2(xe^x - e^x) + C.$$

From the first order it can be seen that integrating a function $x^2 e^x$ performed only partially. The integral remained $\int 2xe^x dx$, which is certainly simpler than the starting integral (Atash et al., 2017). In the next order, the determination of this integral is reduced to the determination of an even simpler integral $\int e^x dx$. So we complete the

integration of the function x^2e^x come a series of partial integration. The result is being monitored:

$$\left[x^2e^x - 2(xe^x - e^x + C)\right]' = 2xe^x + x^2e^x - 2(e^x + xe^x - e^x) =$$

$$= 2xe^x + x^2e^x - 2xe^x = x^2e^x,$$

ie. the integral derivative is equal to the subintegral function (Kožul, 2017).

If necessary to determine $\int \ln x\,dx$ using partial integration, then applying the integration rule is obtained $\int \ln x\,dx = x\ln x - \int x\cdot\frac{1}{x}dx = x\ln x - x + C$, where $u = \ln x$ and $dv = dx$.

The result obtained is checked through $\left(x\ln x - x + C\right)' = \ln x + x\cdot\frac{1}{x} - 1 = \ln x$.

From the rule for differentiating the complex function $y = f\left(u(x)\right)$, then from

$$d\,f\left(u(x)\right) = f_u \cdot u_x dx, \text{ (where } u_x dx = du\text{)},$$

it follows

$$\int f_u \cdot u_x dx = \int f'(u)du = f\left[u(x)\right] + C,$$

which is a form for the substitution method (Damnjanović et al., 2018.).

By the method of substitution we can determine

$\int \sin 2x dx$ applying the integration rule

$\int \sin 2x dx =$ (where $2x = u$ and $2dx = du$) it follows

$$= \frac{1}{2}\int \sin u\,du = -\frac{1}{2}\cos u + C = -\frac{1}{2}\cos 2x + C.$$

If it is necessary to determine $\int \operatorname{ctg} x dx$ substitution method by applying the rule of trace (Leković et al., 2018)

$\int \operatorname{ctg} x dx =$ (where ü $x = u$ and $\cos dx = du$) it follows:

$$= \int \frac{du}{u} = \ln u + C = \ln \sin x + C$$

.

This result can be generalized. Instead of $\frac{\cos x}{\sin x}$ it should be taken generalized $\frac{f'(x)}{f(x)}$, ie. a fraction that has a function in the directory, and in the brochure a copy of that function. It was then

$$\int \frac{f'(x)}{f(x)} dx = \ln f(x) + C$$

.

By supstitution method (Jovanović et al., 2017) it can be defined $\int \sin^5 x \cos x \, dx$ where the application of the rule is obtained

$$\int \sin^5 x \cos x \, dx =$$

(where $\sin x = u$ and $\cos dx = du$) it follows

$$= \int u^5 du = \frac{u^6}{6} + C = \frac{\sin^6 x}{6} + C$$

.

It's generally valid: $\int f^n(x) \cdot f'(x) dx = \frac{f^{n+1}(x)}{n+1} + C$.

Results and Discussion

Let's take some surface of the land or machines R_1, R_2, R_3,…, R_n dinars rent at the end of this year, or at the end of each of the following $n-1$ year. The present value *A* of such an annuity is the same

$$A = R_1 r^{-1} + R_2 r^{-2} + ... + R_n r^{-n} = \sum_{k=1}^{n} R_k r^{-k} ,$$

provided that the compound interest is calculated decisively and that the interest rate in that period is constant. If it is $R_k = const.$, $(k = 1, 2, ..., n)$, then it is

$$A = R \sum_{k=1}^{n} r^{-k} = R \frac{1}{r^n} \frac{r^n - 1}{r - 1} = R \, IV_p^n .$$

Suppose an annuity does not arrive at a discontinuous, leapfrog at the end of each year, but runs continuously throughout the year. Let her get the way every year after

R dinars. Then it comes approx $R\frac{1}{365}$ dinars per day, $R\frac{1}{365\cdot 24}$ dinars per hour etc., then $R\cdot\Delta t$ dinars per small time interval Δt.

If rent $R\cdot\Delta t$ comes after t years, starting today (when $t=0$), ie. in the interval $t,\ t+\Delta t$, then its present value, with continuous interest, is approximately equal

$$R\cdot\Delta t\, e^{-\frac{pt}{100}}.$$

What is the current annuity value over the entire interval of $t=0$ do $t=x$ years. Obviously, it is roughly equal to the sum: $\sum_{\Delta t\in[0,x]} Re^{-\frac{pt}{100}}\cdot\Delta t$.

Symbol $\Delta t\in[0,x]$ shows that it is supposed to be summed over time intervals Δt from $t=0$ to $t=x$.

If $\Delta t\to 0$, sum converges the integral $\int_0^x Re^{-\frac{pt}{100}}dt$, which represents the exact value (Đuričin et al., 2018) considered rent in time $t=0$. In a special case, when the annual interest rate p fixed, we have

$$\int_0^x Re^{-\frac{pt}{100}}dt = R\int_0^x e^{-\frac{pt}{100}}dt = R\left[-\frac{100}{p}e^{-\frac{pt}{100}}\right]_0^x = R\left(-\frac{100}{p}e^{-\frac{pt}{100}}+\frac{100}{p}\right).$$

Consequently, the current value of annuity dinars for the year, which runs on a continuous basis with continuous accumulation and $p=const.$, it is equal to

$$A=R\cdot\frac{100}{p}\left(1-e^{-\frac{px}{100}}\right).$$

Obviously, A is a simple time function x and interest rate p. It's easy to see that A depends on the x. It's evident that it is A the bigger it is x higher, i.e., that the present value of an annuity increases when a wider time interval (Duran et al., 2018). What's more, from the above relationship it follows that

$$\lim_{x\to\infty} A = R\frac{100}{p}.$$

This result is interesting because it shows that the present value of annuity in the continuous and discontinuous case is the same. Therefore, the current or present value (Mitrović et al., 2015) The eternal annuity does not depend on how this rent is made, nor how interest is calculated (continuously or discontinuously).

It's easy to show that A decreases when p increases (and x is fixed), or symbolically:

$\lim_{p\to\infty} A = 0$, since it is

$$\lim_{p\to\infty} A = \lim_{p\to\infty} R\frac{100}{p} \cdot \lim_{p\to\infty}(1 - e^{-\frac{px}{100}}) = 0(1-0) = 0$$

It follows that, in a continuous, as well as in a discounted case, the present value of annuities decreases when the interest rate rises.

Conclusions

In addition to these methods, there are a number of procedures for integrating certain types of integrals. It is, of course, more difficult to integrate than to differentiate. So, after all, with many other inverse operations. It is harder, for example, to reduce or log in than to scale. As the second root of the negative real number is not a real number, so the integral of some simple functions does not have a solution in the domain of elementary functions.

The primary aim of the agroeconomic implementation of an introductory integral lays in solving certain agroeconomic changes such as: increasing the productivity and economic strength of households, the quality of life for the agricultural and rural population and sustainable rural development. Implementing these measures requires a significant increase of budget funding and a greater exploitation of competent both European and worldwide agricultural and rural development help funds. If the methodological basis of the quantitative analysis is properly applied in the process of making and implementing the decisions, it must be followed by strengthening of institutions, infrastructural development, increasing the size of households, mechanization and equipment modernization and training of agricultural workers.

The agrarian policy should be harmonized with the industrial policy, thus impacting a more efficient development of the food industry and exporting. The application of integration in certain agroeconomic functions could find its implementation in modernization and better capacity exploitation, strengthening the ties between raw materials manufacturers and processors, and production diversification significantly increase the comparative advantages of agriculture, food self-reliability and the overall supply of services and goods.

The scientific contribution of this paper lies in a essential explanation of the integral account and an introductory integral implementation in agriculture and food industry development, as well as to mark the potentials and perspectives of its application toward more individual areas, in order to put in use the comparative advantages of agriculture.

It has practical application and can be used in the decision-making process, respecting agrarian and industrial policies. If the method of applying an integral account is correctly set, it allows the management to make timely and optimal business decisions in order to fulfill its objectives, in a longer time span.

Conflict of interests

The authors declare no conflict of interest.

References

1. Atash, A. A., Bellehaj, S. H. (2017). General integral formulas involving Hubert hypergeometric functions of two variables. *Mathematica Moravica*, 21(2), 75-84.
2. Babić, Z., Aljinović, Z. (1996). *Ekonomska matematika*. Ekonomski fakultet, Split [*In English*: Babić, Z., Aljinović, Z. (1996). *Economic Mathetmatics*. Faculty of Economics, Split].
3. Cervi, G. R., Esperancini, M. S. T., Bueno, O. de C. Pinotti, B. E., (2010). Analysis of economic break-even point of the biogas utilization for electrical power conversion: case study in a swine terminated unit. 7 CBPE: *Brazilian congress of energetic planning*, Sao Paulo, Itajuba, MG Brazil
4. Durkalić, D., Ćurčić, M. (2019). Mutual influence of the international investment position and the net government position with the banking sector of the Republic of Serbia. *Ekonomika*, 65(1), 95-106.
5. Damnjanović, R., Đurković, V., Miljković, M. (2018). Određeni integral u ekonomskim funkcijama. *Oditor - časopis za Menadžment, finansije i pravo*, 4(3), pp. 71-81 [*In English*: Damnjanović, R., Đurković, V., Miljković, M. (2018). A Certain Integral In Economic Functions. *Oditor - Journal of Management, Finance and Law*, 4(3), 71-81].
6. Deže, J. (2008). *Agroekonomika - priručnik*, Poljoprivredni fakultet Sveučilišta J.J. Strossmayera, Osijek [*In English*: Deže, J. (2008). *Agroeconomics - manual*, Agricultural Faculty of the University J.J. Strossmayera, Osijek].
7. Drenovak M. (1999). *Privredna i finansijska matematika*. Modeli i algoritmi, Komino trade, Kragujevac [*In English*: Drenovak M. (1999). *Economic and Financial Mathematics*. Models and Algorithms, Komino trade, Kragujevac].
8. Duran, U., Acikgoz, M. (2018). Apostol type (p, q): Frobenius-Euler polynomials and numbers. Journal of Mathematics, 42(4), 555-567.
9. Đuričin, S., Beraha I., Bodroža, D. (2018). Alternatives for exiting the loss zone for medium-sized agricultural enterprises in the Republic of Serbia. Economic of agriculture, 65(1), 391-411.
10. FAO, UNIDO, IFAD (2008). Report of the Global Agro-Industries Forum, Improving Competitiveness and Development Impact. FAO, Rome, pp. 6.
11. Ivović M. (1999). *Finansijska matematika u neinflacionim i inflacionim uslovima*. Ekonomski fakultet, Beograd [*In English*: Ivović M. (1999). *Financial Mathematics in Non-Inflationary and Inflationary Conditionos*. Faculty of Economics, Beograd].
12. Jovanović, D., Milenković, N., Damnjanović, R. (2017). Ocenjivanje i predviđanje potreba potrošača. *Oditor - časopis za Menadžment, finansije i pravo*, 3(1), 70-79 [*In English*: Jovanović, D., Milenković, N., Damnjanović, R. (2017). Evaluating and forecasting consumer needs. *Oditor - Journal of Management, Finance and Law*, 3(1), 70-79].

13. Knežević S., Mitrović S., Ilić A. (2016). Different perspectives on the cash flow statement. *Hotel and Tourism Management*, 4(2), 48-54.
14. Kožul, N. (2017). Tržišna cena rizika. Bankarstvo, 46(1), 58-67 [*In English*: Kožul, N. (2017). Market Risk Price. Banking, 46(1), 58-67].
15. Leković M., Cvijanović D., Jakšić M. (2018). Farmland real estate investment trusts. *Economic of agriculture*, 65(2), 745-755.
16. Markova, E. V., Sidler, I. V. (2019). Numerical solution of the age structure optimization problem for basic types of power plants.Yugoslav Journal of Operations Research, 29(1), 81-92.
17. Martić, Lj. (1976). *Primjena matematičkih metoda u ekonomskoj analizi - Zbirka zadataka*, Informator, Zagreb [*In English*: Martić, Lj. (1976). *Application of Mathematical Methods in Economic Analysis - Collection of Tasks.* Informator, Zagreb].
18. Mitrović A., Knežević S., Veličković M. (2015). Ratio analysis specifics of the family dairies' financial statements. Economic of agriculture, 62(4), 1061-1078.
19. Savić, Lj., Bošković, G., Mićić, V. (2016). Agroindustrija Srbije – potencijali i perspective, Ekonomika poljoprivrede, 63(1), 107-122 [*In English*: Savić, Lj., Bošković, G., Mićić, V. (2016). Agro Industry Of Serbia - Potentials And Perspectives, *Economics Of Agriculture*, 63(1), 107-122].
20. Wohlmuth, K., Kormawa, P.M. (2012). Context of Agro-industry in Africa. Agribusiness for Africa's Prosperity – Country Case Studies, UNIDO, Vienna, pp. 7.

BROWNFIELD INVESTMENTS AS POSSIBILITY OF REVITALIZATION AND SUSTAINABILITY OF LOCATIONS

Zorica Sredojević[1], Nataša Kljajić[2], Boško Gajić[3]

**Corresponding author E-mail: zokas@agrif.bg.ac.rs*

ARTICLE INFO

Review Article

Received: *04 June 2019*

Accepted: *19 June 2019*

doi:10.5937/ekoPolj1902589S

UDC 339.727.22:711.5

Keywords:

revitalization of locations, Brownfield investments, sustainability

***JEL**: Q13, Q26, Q51*

ABSTRACT

Investments for revitalization of locations through Brownfield investments provide an opportunity to establish and test new sustainable development practices. The economic advantage of analyzed Brownfield investments is that there are already certain capacities and infrastructure in a specific location. The research found that the funds invested in the cleaning of the terrain, waste treatment with the so-called. "Wild" landfills, in adaptation of buildings, arrangement of green areas, improvement of infrastructure and the like, have economic and financial justification. In addition, a number of other qualitative effects of general interest have been highlighted. The effects of this investment are considered from socio-economic, environmental and other aspects, as well as to the development of local economy and environmental protection. In addition to the ecological and economic aspects of investing in Brownfield investment, special attention should be paid to risk management and social aspects of local sustainable development.

Introduction

Brownfield locations pose a particular challenge for investors in order to revamp and unused and neglected buildings and land and make it usable and useful again. Brownfield locations directly affect to water, soil, and even air, but they also have subtle effects on the environment (infrastructure hindering the efficiency of urban form), and even the social and economic impact, which is much more difficult to measure

1 Zorica Sredojević Ph.D., Full Professor, University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11080, Zemun, Serbia, Phone: +381 11 441 32 97, E-mail: zokas@agrif.bg.ac.rs, https://orcid.org/0000-0001-7224-1573

2 Nataša Kljajić Ph.D., Scientific Associate, Institute of Agricultural Economics, Volgina 15, 11060 Belgrade, Serbia, Phone:+381 11 69728 48, E-mail: natasa_k@iep.bg.ac.rs, http://orcid.org/0000-0003-2245-8285

3 Boško Gajić Ph.D., Full Professor, University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11080, Zemun, Serbia, Phone: +381 11 441 31 38, E-mail: bonna@agrif.bg.ac.rs, https://orcid.org/0000-0001-8270-0198

because it is a part of the benefits of Brownfield regeneration (Ferber & Nathanail, 2006). Brownfield locations are affected by: environmental, sociological, economic, technical and architectural-urban factors. Revitalization, or re-animation of Brownfield location, has positive effects at many levels. Unlike Greenfield locations, abandoned and undeveloped locations come with the risk of contaminated land and the cost of demolishing and cleaning (Gorman, 2003). Disposal of waste in inappropriate places leads to degradation of soil and pollution of water and air, as often significant quantities of waste are disposed of in unapproved places such as rivers, rural landfills, land near roads, in addition to embankments, boreholes, bays or pits, abandoned buildings, etc.

The main challenges of waste management in Serbia, especially in rural areas, still relate to ensuring good coverage of capacity to provide basic services such as collection, transportation and sanitary waste disposal. It is estimated that in Serbia there are over 4,000 illegal, "Wild" landfills. According to official estimates, the total annual damage caused by improper waste management in Serbia is between 0.40-1.10 percent of GDP (Filipović et al., 2016). Almost all European countries have recognized the effectiveness of land use and recording ecological pollution of sites as issues of national interest. These sites pose a particular challenge for national and regional policies that should facilitate the reintegration of rehabilitated sites into the real estate market and to ensure their re-economic benefits (Lorber, 2011). The development of world locations is based on the principle of taking free (Greenfield) areas, which results in a discontinuity in the urban structure, visual disruption and aggression affecting the identity of the environment and human health. On this basis, there is a need for orientation towards existing, underutilized areas, to improve the environment (Perović & Kurtović-Folić, 2012).

Brownfield locations are created under the influence of social and economic restructuring of the whole community. Weathered soil, low standards, the disintegration of society and the steady increase in the number of unemployed people has a detrimental economic impact on the physical environment (Ferber & Nathanail, 2006). The main objective of urban regeneration is a response to the complex dynamics of contemporary life and to issues of revitalization of economical, environmental, social and cultural functions (Perović & Kurtović-Folić, 2012).

The EU Environmental Liability Directive (2004/35/CE) provides a good basis for the prevention and elimination of environmental damage based on the "polluter pays" principle. Costs that address the issue of environmental liability, in some cases, exceed the value of the assets in many cases, so that their precise calculation requires determination of the ecological, physical, geological and hydro-geological characteristics of the site, as well as the type and quantity of harmful substances. Brownfield locations are a challenge for investors, due to certain advantages, as well as a range of risks. Revitalization benefits of Brownfield locations are: quality of locations, less risk of low attendance (especially for mixed use), a steady increase of property value, lower investment costs due to the available infrastructure, the financial support of the local community and a longer life cycle of historically significant objects (Stojkov, 2007). Urban economic

development is a complex series of processes of growth and change, whose effects are impossible to predict even in the near future, and the process of regeneration of Brownfield locations is often complex and unpredictable (Bacon et al., 2008). The level of subsidies necessary to use private money can be large or small, depending on the size of the investment (Paull, 2008). Some of the issues and circumstances to consider when allocating costs and risks between owners, investors, and local or government authorities are: Is it suggested to sell or lease revitalized property if it is a local self-government? Are there other ways to benefit from increasing the value of assets in order to make up for public sector funds invested in the revitalization / preparation of the site? Is it necessary to form a public-private partnership for Brownfield Investment Management? In this paper, an attempt was made to find out the answer to some of the above questions. The main objective is to take the case out of practice, to analyze and analyze the calculating and qualitative effects of the revitalized locations.

Materials and methods

For each investment, it is important to ensure financial sustainability, that is, there is consistency between the expected cash inflows and outflows, in each individual observed year of the analyzed period. For research in this paper, data collected by survey and interviews on the rehabilitated and revitalized site of 1.40 ha were used and is located in the southeastern part of the Republic of Serbia. At the location there was abandoned water well around which the waste was illegally dumped, so-called "Wild" landfill. Not far from the waterfall there is an ethnically owned restaurant. At the same location there is an entrance to the natural cave. With a private-public partnership, the landfill was cleaned, the buildings renovated, the museum and the ethno restaurant were opened and the location is decorated and today is the place of numerous visitors. On one side, the money from the local self-government budget was invested, and the other from the funds of the owner of the facility. Regardless of ownership and public-private partnership relationship, this paper focuses on the potential effects of investing in Brownfield location. The economic effects are calculated by the calculative procedure. Other effects are expressed by qualitative indicators.

Results and Discussions

In order for revitalization to be considered profitable, the value of the revitalized land, after deducting the cost of preparation and the cost of restoration (revitalization), should be greater than zero. The first examples of the revitalization of abandoned buildings are known in the United States, then in Western Europe, and later they began to pay attention to them in the countries of Central Europe and countries in transition. Brownfield sites were created as a result of earlier use and abandoned location. They can have negative ecological, economic and social impacts on the community. Such locations often have more owners and most of them do not want to invest anything in the real estate, while changes in the market and innovations in the repair technology do not bring satisfactory profit in sales. Multi-year non-use of objects creates an ecological,

social and aesthetic problem. Their revitalization has been delayed and hampered by legal, financial and environmental issues. This weakens the competitive investment position of the cities and regions of South East Europe as a European region (Lorber, 2011). A good investment climate, as one of the factors of the country's development strategy and recognizing the benefits that Brownfield investments bring, would enable economic growth and integration flows of the economy with the goal of joining the global business system (Simić, 2008). Revitalization of Brownfield sites leads to an increase in the value of real estate at neighboring locations by 5-15%. In some cases, Brownfield investments can become a backbone to create a positive ambiance for new investments. Investing in a Brownfield location can open access to the local community and for non-commercial projects, such as parks, public areas, roads and residential buildings, which due to proximity to the city center could not be used as production facilities. The experience of some countries shows that the development of free zones often did not give the expected effects due to insufficient and restrictive legislation, but also the ineffectiveness of the management structures (Savanović, 2008).

Brownfield locations require various forms of public intervention. The complexity of location problems, uncertainties, and costs associated with their revitalization and reuse, and especially increased risks, seem to be unconstrained for private direct financial investments. In order to overcome these problems, it is necessary to establish a public-private partnership between private investors and the state. In the territory of the Republic of Serbia, there are a large number of abandoned buildings, facilities, warehouses and similar former combinations / enterprises, cooperatives, public and social institutions such as hospitals, schools, homes of culture and the like (Kaufman & Cloutier, 2006). The most common reasons why investors do not opt for investing their assets in our country are unresolved property-legal problems. The protection of property rights includes, first and foremost, the absence of danger of expropriation, the independence and irreversibility of the judiciary, and the ability of individuals and companies to enforce contracts (Estrin & Meyer, 2011).

Brownfield investments in the revitalization of locations can be classified as investments that, in addition to ecological effects, generate net revenues. By realizing such investments, positive effects on the effectiveness and efficiency of sustainable use of natural resources, improvement of the quality of the environment and general, socio-economic and economic development of the society (Brzaković et al., 2016). For the successful realization of such investment projects in practice, it is necessary to provide measurement of important parameters: cleaning of locations; investments in the reconstruction of buildings; greening and surface editing, and the effects of significance for location and local development, etc. The basics in making decisions for the realization of such investments in practice are indicators of their economic viability. The determination of economic indicators of investments is based on determining the differences and the relationship between the amounts of investment investments made and realized cash receipts during the investment period (Sredojević et al., 2017). In the case of public-private partnerships, with key indicators of economic justification

and financial acceptability of the site, the analysis should show the financial effects that can be shared between the public and private sectors within the partnership. With the increase of demand for private sources and financing of building new public infrastructure and investments in goods in general use, as well as for providing quality services of general interest in conditions of insufficient budget funds, public-private partnership becomes a novelty in Serbian business practice (Stanković & Vignjević-Dordević, 2013). The location that is the subject of research in this paper has certain specifics. As a key place for waste disposal was the coast of the mountain river where the abandoned water well and wooden bridge are located. In the immediate vicinity there is a privately owned building, and at the same location there is an entrance to the natural cave. With the cooperation of the private owner and the local self-government, the landfill was cleaned, the terrain was rehabilitated, the river and the surrounding part were renovated waterfalls were renovated and converted into a museum a private facility was renovated and opened a restaurant and the entrance and inside of the cave were arranged. The final location is regulated, perennial plants are planted, individual grass surfaces are planted, benches and other elements for visitors are planted. Today, the site represents a place of various visitors - tourists, mountaineers, scouts and other lovers of nature and cultural values. The structure of the main activities and the amount of costs per activity for the analyzed site are given in Table 1.

Table 1. Investments for landfill removal and revitalization of the location, 1.40 ha

	Activities at the location	Amount (€)
1.	Loading and dumping garbage from an illegal landfill	1,100.00
2.	Cleaning the riverbed and arranging the flow of water	850.00
3.	Removing the remains of a wooden bridge and installing a new one	490.00
4.	Renovation and arrangement of wooden waterworks as a museum	1,250,00
5.	Repair and renovation of ethno restaurants with a garden	1,920.00
6.	Rehabilitation of the terrain and recreation paths	970,00
7.	Procurement of seedlings and planting of perennial plants	1,750.00
8.	Preparation and sowing of the surface under the grass	740.00
9.	Positioning the bench and waste bin	1,220.00
10.	Arrangement of the entrance to the cave and security elements	940.00
11.	Upgrading of accompanying canopies for ethno souvenirs	1,360.00
12.	Placing a board and other markings for the museum, the park and the cave	380,00
13.	Other costs (project and other fees, licenses, etc.)	330.00
		Total: 13,300.00

Source: Calculation by the authors

The economic benefits and costs of realizing such investments should be identified on a case-by-case basis, depending on the project goals, locations, businesses, and environment, all in accordance with the spatial plan, legislation, etc. The analysis should include socio-economic costs and benefits in relation to: users of such investment, the impact of environmental investments, economic activities at the site,

and others. Special attention is paid to the use of specific zones, for example, nature parks, protected zones, natural shelters, etc. By analyzing modes and shortcomings at a certain level, the potentials of such investments, the risks during their realization, as well as the possibilities of their sustainability can be estimated (Gajić et al., 2013). After the revitalization of the location, through the collection of services, tickets and other fees for visitors to the museum, Nature Park, cave visitors, as well as various services in the ethno restaurant, significant financial effects are achieved. Cash inflows, mostly, arrive during the tourist season, scout scouts, mountaineers, etc. in the period from March to November. Average cash inflows using the analyzed revitalized site amount to 5,700.00 euro per year. On the other hand, cash outflows for the use and maintenance of the location are generated throughout the year in this case they amount to 2,300.00 euro per year (Table 2).

Table 2. Economic and financial indicators of the revitalization of the location, 1.40 ha

Parameters of investing in the revitalization of locations	
Investments for recovery and revitalization of the site (€)	13,300.00
Average annual cash outflows for maintenance and use of the site (€)	2,300.00
Average annual cash flow from activity on site (€)	5,700.00
Non-rated benefits*	x
Economic and financial indicators of investment investments	
Average annual financial benefit from using the location (€)	3,400.00
Cost ratio: Benefit from a revitalized location	1.00:1.68
Coefficient of economy	2.48
Accumulation rate (%)	26.00

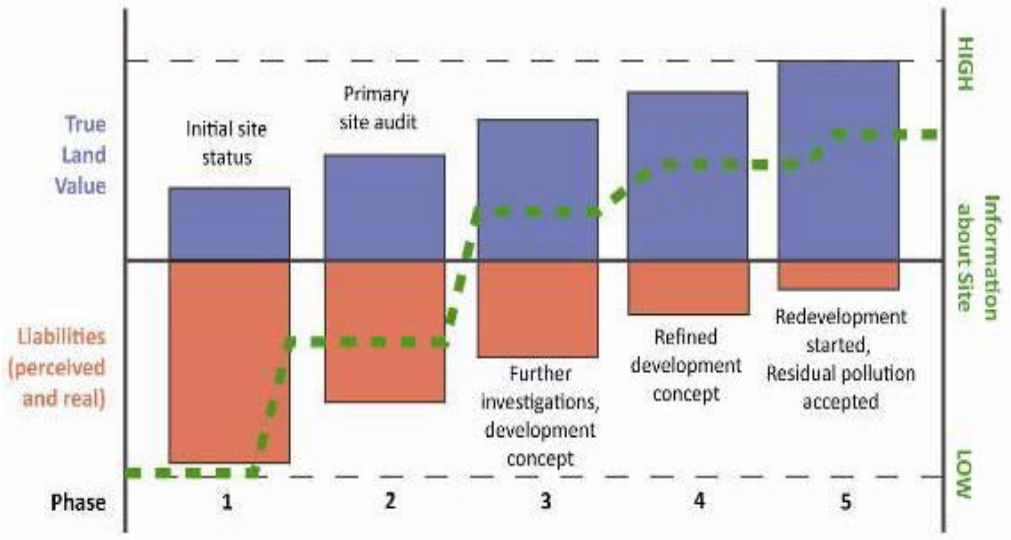
* Undefined benefits-the degree of preservation of biodiversity, soil, water and air, etc.

Source: Calculation by the authors

Using the revitalized location, significant effects are achieved by the financial effects of an average of 3,400.00 euro per year. Throughout the year, at a cost of 1.00 euro a gain of 1.68 euro is achieved. Apart from the coverage of regular annual issues, from a series of annual cash inflows, for every 100 euro of invested capital, 26 euro is allocated for accumulation. Also, this is a fairly economical investment, with the ratio of annual inflows and cash outflows to 2.48. Therefore, from the perspective of investors, investing in such an investment is economically justified. Revitalized location is an investment that will increasingly produce positive effects of general interest with years. Financial assets invested in Brownfield Investments have a beneficial effect on the environment, contribute to land conservation, reduce emissions, improve water quality, and the like. Economic analysis compares and evaluates all the advantages and disadvantages of the venture (Subić, 2010). Financial assets invested in Brownfield Investments have a beneficial effect on the environment, contribute to land conservation, reduce emissions, improve water quality, and the like. Economic analysis compares and evaluates all the advantages and disadvantages of the venture. For both public and private entities, parties should reach an agreement on the allocation of risks and benefits. The risk sharing

is most often determined by the interests of the parties in the arrangement and their ability to assess, control and manage the risks (Howland, 2007). By agreement on the allocation of risks, it is possible to establish a fair and sustainable way of dividing the benefits from revitalization. The way in which funds from local sources are stimulated to stimulate the private sector and reduce the risk to investors is a matter of legislation. Experience in the world shows the different possibilities for using incentive measures and public sector subsidies in the realization of Brownfield projects (De Sousa, 2006). Local governments can use financial, fiscal or planning instruments to reduce the cost of financing to the investor. For the revitalization and reuse of abandoned locations, examples of successful practice are studied and analyzed. Local self-government has organized and financed removal, illegal dumps and sanitation of terrain. It was not directly involved in the reconstruction and construction of facilities, but it helped the investor to issue building permits. The local self-government has come to help the investor to accelerate the process of planning and fostering sustainable development. The accuracy of remediation costs can be greatly improved by creating a good database and critical to risk planning and risk management (Figure 1).

Figure 1. Graphical display of the increase in the value of the revitalized location



Source: Customized view by authors made according to CABERNET, 2006

These measures are most often found in the environmental regulations of the building permit and are the obligation of the contractor to implement them during the preparation of the construction. During this phase, the costs are calculated accurately in order to make a negative investment balance against the excess of the value that is generated from the investment and future revenues of revitalization. The initial plans for rehabilitation and revitalization are further elaborated through an environmental impact assessment. The assessment takes into account the ecological value of the

site and analyzes the impact of revitalization on the environment, or the surrounding areas. A further step of research in this field is to determine the qualitative effects that are far more significant for the wider environment and the community. Investment in Brownfield locations contributes to the increase in economic development, the disposal of abandoned buildings, economic activities and through the increase in the number of jobs and investments. Increased investments through Brownfield projects contribute to the improvement of fiscal benefits, which can also be reported through: restitution of abandoned land for reuse, direct contribution to increasing local and state tax revenues. Important environmental, energy, economic, social and fiscal indicators of Brownfield effect and their effects are quantitatively listed in Table 3.

Table 3. Types of indicators and qualitative effects of Brownfield location

Types of indicators	Qualitative effects
Ecological and energy	Renovated field and reduced health risk; Better air quality and no spread of toxic substances; Better quality of water and the possibility of using sources; Preservation of agricultural land; Provision and conservation of natural habitats; Greater diversity of flora and fauna;
Economic, social and social	Revitalization of the environment and development of the economy; Visits to tourists and more activities; Better valuation of assets in the environment; Motivation of investors and incentives for employment; Development of awareness and education on the conservation of nature resources; Sustainability of the aesthetic and cultural value of the site;
Fiscal	Direct revenues through local taxes, taxes, etc .; Refund of external costs for transport infrastructure; Income tax after rehabilitation and re-use of property; Saving and improving the investment climate; Subsidies, premiums, loans, etc .; Ecological insurance, taxes, fees and other;

Source: View by authors

Investing in Brownfield locations leads to an increase in the value of assets, which through indirect taxation indirectly increase tax revenues of local governments. By encouraging investors to enter existing facilities and locations, where there is already existing infrastructure, it would become a great opportunity for the Republic of Serbia, a significant part of the stabilization, reconstruction and sustainable development of the country (Gligorijević, 2015). The revival of Brownfield sites has a fiscal impact, which involves generating new sources of local government revenues derived from investing in non-productive land and reducing the necessary investment in infrastructure. By encouraging investors to invest in Brownfield locations, where technical and traffic infrastructure already exists, it would become a great opportunity for the Republic of Serbia for economic growth.

Conclusions

At the local level, attraction of Brownfield investments can be stimulated through planning and various fiscal measures and land related policies. Approach pertains to the activities and cooperation with partners on the local community development. The revival of Brownfield sites has a fiscal impact, which involves generating new sources of local government revenues derived from investing in non-productive land and reducing necessary investment in infrastructure. By encouraging investors to invest in Brownfield locations, where technical and traffic infrastructure already exists, it would be a great opportunity for the Republic of Serbia for economic growth. The success in resolving Brownfield locations in all economies is based on cooperation and partnership between the public and the private sector.

The location that is the subject of this research is an example of good practice for public-private partnership in the realization of Brownfield investment in Serbian business practice. Local self-government participates in the division of risks, such as: providing necessary infrastructure, rehabilitation of the terrain, issuing necessary permits for parks, housing, recreation, cultural, tourist and other facilities. The advantages are that local self-government can, on the one hand, generate economic activity and improve social and environmental conditions, and on the other hand to minimize pressure on public finances. Obstacles to address Brownfield locations at national, regional and local levels, which many experts point out are: the lack and insufficient education of actors to foster resolution of this problem; insufficient information exchange; inexperience in the mentioned issue; insufficient understanding of the essence of the problem and the like. Addressing Brownfield's problems should also be found in programs, strategies, legal framework and support for investment priorities, with the exchange of experiences with countries that have addressed such problems, pilot projects and ongoing education.

Acknowledgements

This paper work is result of the projects: 179028-Rural labor markets and rural economies Serbia-diversification of income and poverty reduction; 46009-Improvement and development of hygienic and technological procedures in the production of foodstuffs of animal origin in order to obtain high-quality and safe products competitive on the world market; III 46006 - Sustainable agriculture and rural development in function of the Republic of Serbia strategic goals achievement within the Danube region, financed by Ministry of Education, Science and Technological Development of the Republic of Serbia, 2011-2019

Conflict of interests

The authors declare no conflict of interest.

References

1. Bacon, K. L., Dagenhart, R., Leigh, N. G., Skach, J. (2008). The Economic Development-Urban Design Link in Brownfield Redevelopment. *Economic Development Journal-Spring* 2008, International Economic Development Council, pp. 20-39, Washington DC, 2008
2. Brzaković, T., Brzaković, A. & Petrović, J. (2016). Application of Scenario Analysis in the Investment Project Evaluation. *Economics of Agriculture*, Vol. 63, No 2, pp. 501-513
3. CABERNET (2006). Sustainable Brownfield Regeneration-*CABERNET Network Report.* The University of Nottingham
4. De Sousa, C. (2006). Unearthing the Benefits of Brownfield to Green space. Projects: An Examination of Project Use and Quality of Life Impacts, *Local Environment* 11(5), pp. 577-600
5. Estrin, S. & Meyer, E. K. (2011). Brownfield Acquisitions: A Reconcept-ualization and Extension, Berlin:*Managment International Review*, Volume 51, Issue 4, pp. 483-509
6. Ferber, U. & Nathanail, P. (2013). Brownfields Handbook. Faculty of Civil Engineering, *VSB-Technical University of Ostrava*, Ostrava, 2006 www.fast.vsb.cz/lepob (Accessed May 28, 2019)
7. Filipović, D., Pešević, D. & Ružić, M. (2016). Koncept upravljanja otpadom kroz sistem prostorno planske dokumentacije u Srbiji. *Časopis ECOLOGICA* vol. 23, br. 84. BG:Naučno-stručno društvo za zaštitu životne sredine Srbije, 849-853 [in English: Filipović, D., Pešević, D. & Ružić, M. (2016). The concept of waste management through the spatial planning documentation system in Serbia. *Journal ECOLOGICA* Vol. 23, No. 84. Belgrade: Scientific-Professional Society for Environmental Protection of Serbia, pp. 849-853]
8. Gajić, B., Tomić, Z. & Sredojević, Z. (2013). A simple method estimates and economic indicators of photovoltaic system for drip irrigation. *Journal Economic of Agriculture*. Year 60, No. 2 (217-436), pp. 223-237
9. Gligorijević, J. (2015). Reaktiviranje Brownfield u Srbiji. *Aktuelnosti* br. 29, Banja Luka College Journal, B. Luka, str. 46-60 [in English: Gligorijević, J. (2015). Reactivating Brownfield in Serbia. *Aktuelnosti* No.29, Banja Luka College Journal, Banja Luka, pp.46-60]
10. Gorman, H. S. (2003). Brownfield's in Historical Context. *Environmental Practice* V, No. 01, Cambridge University Press, pp. 21-24, Cambridge, 2003.
11. Howland, M. (2007). Employment Effects of Brownfield Redevelopment: What Do We Know from the Literature? *National Center for Environmental Economics,* http://yosemite.epa.gov/ee/epa/eed.nsf/WPNumberNew/2007-01? OpenDocument
12. Kaufman, D. & Cloutier, N. (2006). The Impact of Small Brownfield's and Green spaces on Residential Property Values. *Journal of Real Estate Finance and Economics* 33, pp. 19-30

13. Lorber, L. (2011). Interdisciplinary methodological approach to the process of Brownfield revitalization of traditional industrial areas. Journal for Geography, Ljubljana, 6-1, pp. 7-22

14. Paull, E. (2008). The environmentally and economic impact of Brownfield redevelopment, *Journal of Northeast-Midwest Institute*, Washington.

15. Perović, S. & Kurtović-Folić, N. (2012). Braunfild regeneracija - imperativ za održivi urbani razvoj, Građevinar LXIV br. 5, Hrvatski savez građevinskih inženjera, Zagreb, pp. 373-383 [in English: Perović, S. & Kurtović-Folić, N. (2012). Braunfild regeneration - an imperative for sustainable urban development, Construction LXIV no. 5, *Croatian Association of Civil Engineers*, Zagreb, pp. 373-383]

16. Savanović, S. (2009). Braunfild i grinfild projekti, Banja Luka, Finansiranje lokalnog razvoja, Agencija za razvoj preduzeća, Eda [in English: Savanović, S. (2009). *Brownfield and Greenfield Projects*, Banja Luka, Local Development Financing, Agency for Enterprise Development, Eda]

17. Simić, J. (2008). Investicije u savremenoj svetskoj privredi, Novi Sad: Visoka poslovna skola strukovnih studija, *Škola biznisa*, naučno-stručni časopis, No 3, str. 18-23) [in English: Simić, J. (2008). Investments in the Contemporary World Economy, Novi Sad: High Business School of Vocational Studies, *Business School*, Scientific-Professional Journal, No. 3, pp. 18-23]

18. Sredojević, Z., Oljača, S. & Kresović, B. (2017). Organska poljoprivredna proizvodnja-osnove planiranaja i analiza poslovanja. *Monografija,* Poljoprivredni fakulet, Beograd-Zemun, str. 262 [in English: Sredojević, Z., Oljača, S. & Kresović, B. (2017). Organic agricultural production- basics of planned and business analysis. *Monograph,* Faculty of Agriculture, Belgrade-Zemun, p. 262]

19. Subić, J. (2010). Specifičnost procesa investiranja u poljoprivredi, Institut za ekonomiku poljoprivrede, Beograd, str. 192 [in English: Subić, J. (2010). *Specificity of the investment process in agriculture*, Institute of Agricultural Economics, Belgrade, p. 192]

20. Stanković, B. & Vignjević-Dordević, N. (2013). Javno-privatno partnerstvo i koncesije, kao posebni oblici stranih ulaganja u Srbiji, Banja Luka: *Časopis za ekonomiju i tžišne komunikacije,* God./Vol. 3 br./No. 2, pp. 285-298 [in English: Stanković, B. & Vignjević-Dordević, N. (2013). Public-Private Partnership and Concessions, as Special Forms of Foreign Investments in Serbia, Banja Luka: *Journal of Economics and Communications*, God./Vol. 3 No./No. 2, pp. 285-298]

21. Stojkov, B. (2007). Ka recikliranju građevinskog zemljišta u Srbiji, *Glasnik Srpskog geografskog društva*, Vol. 87, br. 2, Univerzitet u Beogradu, Geografski fakultet, pp. 175-185 [in English: Stojkov, B. (2007). Towards recycling of construction land in Serbia, *Gazette Serbian Geographical Society*, Vol. 87, No.2, University of Belgrade, Faculty of Geography, pp. 175-185]

SUSTAINABLE OPERATIONS AS A STRATEGY OF MANAGEMENT OF COMPANIES, WITH A REVIEW IN THE FIELD OF AGRICULTURE

Ljiljana Rajnović[1], Snežana Cico[2], Jelica Eremić – Đorđić[3]

**Corresponding author E-mail: rajnoviclj@gmail.com*

A R T I C L E I N F O

Review Article

Received: *29 March 2019*

Accepted: *12 June 2019*

doi:10.5937/ekoPolj1902601R

UDC 631:[502.131.1:347.725

Keywords:

sustainable business, corporate governance, company goals, business crises, agriculture

***JEL**: Q14*

A B S T R A C T

The operation of companies on the domestic or international market implies, a well - organized company whose function is based on efficient business and, on the fiduciary duty of the owner and management, which is at the same time a challenge, but also a great responsibility in view of the interests of all constituents. The disadvantage or loss of these features in organizing the companies, leads to significant lagging of the company in relation to its competitors and the continuous weakening of economic power can lead to the collapse, which is the hardest blow to the investors but also the recognition of the manager that he was not successful. The agriculture is one of the most important sector of activity in Serbia, in the last hundred years, in terms of the volume of production and the number of engaged population, which is why sustainable business in this area is necessary.

Introduction

Many research studies applied in corporate governance practice (Vasiljević, 2013) state that a company is only at first glance an idyllic legal entity with one interest, the interest of the owner of the capital, regardless of whether the owner is one or a numerous of economic entities, legal entities, individuals or the state. On the contrary, a company is, in fact, a lot of conflicts and interests, both within the society itself and in relation to the outside world that surrounds it. Various business entities are interested in the permanent business and the survival of the company: shareholders, creditors, employees, management, the companies themselves, and the state in a sociological sense. They

1 Ljiljana Rajnović Ph.D., Institute of Agricultural Economics, Belgrade, Volgina 15, Phone: + 381 63 273 237, E – mail: rajnoviclj@gmail.com, ORCID ID (https://orcid.org/0000-0002-8209-9088)

2 Snežana Cico Ph.D., Severtrans ad Sombor, Filipa Kljajića bb, Phone: + 381 64 44 02 057, E – mail: snezanacico@gmail.com, ORCID ID (https://orcid.org/0000-0003-3356-6767)

3 Jelica Eremić - Đorđić Ph.D., Assistant Professor, Educons University, Faculty of Business Economics /EPS Elektrodistribucija doo Beograd, Bulevar umetnosti 12, Phone: + 381 064 83 72 738, E-mail: jelicaerdjo01@gmail.com, ORCID ID (https://orcid.org/0000-0003-2462-1672)

all have their own interests in relation to a company, but also risks, depending on their relationship with society. Much of this is added to the interest of consumers, which is justified, although it is not based on a contractual arrangement with the company.

On the part of economics, several approaches to the economy were crystallized. According to the usual approach, the company is viewed as an economic entity in a market that transforms resources into economic goods (goods and services) that are sold on the market. The company's behavior is based on the choice of volume and structure of resources and produced productions, with the goal of establishing such prices and production volumes that would bring maximum profit.

And other theories (behavioral, evolutionary) emphasize the complexity of the company, i.e. the existence of various interest groups in it. One of the developed models, the agent problem (principal – agent), is based on the complexity of distinguishing the objective positions that the managers occupy within the company. From the aspect of this paper, this theory, which originates from A. Smith (Smith, 1776) and Berle & Means (Berle & Means, 1932), is of particular importance, and it is promoted in the work of Jensen and McKinley (Jensen & Meckling, 1976).

The obligation of a sustainable business of companies

The time in which we exist is called the age of a creative economy. There are no routine answers for problems faced by businesses. Academic knowledge of individuals and institutions is no longer sufficient. In order to find the best answers, it is necessary to deepen the inner knowledge that lays sleeping in each individual and organization. Imperative success becomes the creative use of all knowledge. Just as nature creates, it is expected from every business entity and especially the management, to use good principles in their business life and work and turn every problem into a creative challenge.

The question is often raised to what extent the company is capable of mobilizing energy potentials of all available resources, including employees, and directing them to achieve common goals. It is indisputable that the quality and intensity of the company's energy essentially affect the overall results it achieves in its business.

The search conducted in practice on a sample of over hundred companies showed that with high productive energy companies, compared to those with low one:

- overall performances were higher by 15%,
- productivity of employees by 17%,
- customer loyalty by 12% and
- commitment is higher by 10%.

At the deepest level, every company is a vibrant energy field whose vibrations affect the thinking, feelings and creativity of management and employees. The quality and intensity of the organizational field also affects the partners, business partners of the company and all those who come into business contacts directly or indirectly with the company.

Energy, intelligence and creation clearly show the source of vitality and humanity and organization. All companies are initiate by vital energy and intelligence guides them. Cultivating vital energies represents a major step forward in the modern understanding of organization and management. The most important interest of all persons interested in the business of companies (constituents), but also the duty of the owner of the capital and managers, is to ensure successful and continuous performance of the company's activity, for an indefinite period of time and with constant growth, in order to ensure a secure survival in a constant turbulent environment. Nowadays companies are increasingly taking care of who they are doing business with, in order to maintain their reputation in the conditions of maximum transparency. Therefore, ninety-five percent of the two hundred and fifty world's largest companies regularly provide public reports on their sustainable development. In Serbia, pioneers in these practices of Delta, NIS, Holcim and Titan have taken on board their responsibilities towards the communities in which they work.

At the same time, standards are being developed in the field of reporting, and today more than eighty percent of the reports have been developed according to the Global Reporting Initiative (GRI) standards. Standards help to make reports comparable and meet common indicators in order to compete with competitors. Sustainable business reporting is becoming more and more subject of legislator attention, especially at the EU level, and the legal reporting obligation is already in place in France, Denmark and Sweden. Sustainability, which is nowadays called sustainable value creation, is the business imperative of the century. In the largest multinational corporations, all teams are assigned an obligation to tackle this issue. Economic sustainability is often the first type of sustainability that a company aspires to. How can companies' revenues cover the costs with sufficient residual income needed for business growth and satisfaction of the owner of the capital? The challenge is not to determine the priorities of a kind of sustainability in relation to the other, but to make fully conscious decisions, knowing the long-term and short-term consequences.

In addition to creating a sustainable business model that guarantees business survival, sustainability reports help companies to identify those processes that can make the business more efficient. They complement the image of the company and help potential investors or business partners to properly evaluate all business risks and value of cooperation. At the same time, this is one of the ways to improve the quality of relationships with different stakeholders, from employees across the local community to the government of the country's nationality of the company and beyond, and they have undoubted importance in the process of developing corporate strategies, but also developing new services and offering new products.

In this sense, the value of a company on regulated markets of developed world countries, above all Western Europe, is justified on the basis of the following, in business world of recognizable characteristics: successful and long-lasting business, originating from stable markets, properly carrying out its obligations. These are attributes that give one company a reputation and they find it recognizable in the market and a desirable partner in business cooperation.

It is precisely, the main goal of each company is to ensure permanent, continuous business operations for an indefinite period of time, which in theory and practice appears as a written but also unwritten rule, that is, as an obligation of persons who, with their own decisions prevail influence on the organization and management of the company. The individual goals of the person interested in the company's business may or may not be different, and are largely defined by the ownership of the company. When we talk about a corporation that Jensen and Meckling (Jensen & Meckling, 1976) define as "one form of legal fiction" that serves as a chain of contractual relationships, distinguished by dividing residual rights to assets and cash flows that can be sold without seeking permission from other contracting parties, we can to conclude that, in the opinion of these authors, the corporation is nothing more than a "chain of contractual relations" whose main purpose is to maximize value for shareholders, and not to satisfy the interests of other constituents and the wider community. All companies, in the basis of their existence, have a need for permanent and safe business and for an unlimited duration, although the goals that affect the core of their business are different.

In the countries of the continental system of law, to which our country belongs, the capital company is defined as a collection of several legal, and / or physical persons, associated with the aim, in addition to carrying out some commercial activity under a personal or real firm, on the basis of the association of certain capital, expressed in shares or shares, will achieve a certain profit, which will be distributed among themselves according to the criteria established by the founding agreement and the law. Under this system, the company has a lucrative goal and the legal presumption of commerciality, that is, the goal of forming capital companies is business to acquire and dispose of profits among the members of the company, with the prior payment of obligations towards all creditors and other persons interested in the business of the company. In economic literature it is undisputed that the company is the basic economic cell of society. Hence, all economists point to the foreground the two cornerstones of each company: the organizational aspect and the target aspect - profit.

The company, as a legal entity and the bearer of subjectivity, through which it acquires rights and obligations on the market, has several properties:

- the Enterprise represents the technique of contractual organization of members, for the purpose of joint performance of the agreed economic activity,
- the enterprise is a technique of organization as a societal form, which allows the separation of dedicated assets for the enterprise and easy transmission of the company through the transmission of membership rights (stakes and / or actions).

The enterprise is a technique for the organization of dedicated property, which is a part of the dogma of unity and indivisibility of the property (Cozian & Viandier, 1998).

In support of the obligation of the company to maintain the continuity of business, the principle of fixedness and preservation of the integrity of capital of capital companies is also discussed. Although companies are established to earn profits, assets do not need

to, or will not always increase, but can be reduced due to internal and external reasons due to loss in business. Since the capital companies do not have the responsibility of members for the obligations of the company (other than the initial and possibly later role of members in the company), this is extremely important for the creditors of the company, what is the adequacy of its capital, because the company must have a favorable relationship between its capital and borrowed capital, so-called, impaired capitalization is a bad signal for its liquidity. Therefore, the company's capital is entered into public registers that keep records of business subjects and this information must be publicly available to every interested person. In some countries, for example, Germany, the amount of capital is an integral part of the company's memorandum, and the nomination of non-nominal capital, as well as the other basis of capital increase, and in particular the basis and procedure of capital reduction, are in the constant focus of strict legal rules of registration and publication all over the world.

The goals of the modern corporation and its managers

All business activities undertaken by one company determine the overall impact of that company on society, including individuals, companies, the state and the environment. The positive and proactive performance of the business sector in all these areas has become an established practice in the developed world, primarily because it has been shown that such a practice benefits all persons interested in the business of the company, including the state. Increased accountability in business is shown not only as a necessity, but also a prerequisite for survival and development of the company.

Today, profitability is just one of the demands that the company's management has before itself. Profit is a necessary condition for the survival of all economic entities and serves multiple people. Sustainability or sustainable development represents an idea of development that meets current needs, but takes into account the needs of future generations. Economic sustainability for itself is not a sufficient condition for the long-term viability of a society. In this sense, responsible business represents one of the key solutions for achieving sustainable development and survival of the company, because it creates a balance between economic interests, as the main driver of development and the interests of the whole society.

According to the well-known principles of corporate governance, adopted in most countries of the world, the achievement of the company's target function - maximizing profits, that is, the company's value is the imperative of every company. It is widely known that in today's world the main goals of the modern corporation and its managers are: a) a stable and growing return on investment, a sustained cash flow and increased earnings; b) high income of the management with the possibility of worthy annual bonuses; c) growth and expansion of the corporation in order to expand business and market; d) good competitive position. These goals are in a causal and consequential relationship, and thus we come to the imperative activity of the corporation and its administration towards a constant increase in profit, as it maintains a safe life of the corporation. Profit is a means for the periodic and annual corporate dividends to be

distributed to shareholders through a dividend, a reward for the results achieved by the Board, and a substantial part of accumulating for investment in new projects, or preserved in the case of aleatory or occasional cyclical economic events worldwide.

Everywhere in the world companies perform a very important function for each state and society as a whole, have a great impact on the community, so they have an obligation to act in the general social interest (Corbett, 2008), respecting the good rules of socially responsible business. The company's motto is based on following bases (Rajnović, 2013):

- successful,
- long and profitable business,
- be ethical and
- socially responsible.

The concept of corporate social responsibility was created primarily on the basis of voluntarism, and later turned into a field of legal obligation, somewhat. In addition, there exists the concept that, being socially responsible does not mean just fulfilling the legal orders, but also to go "beyond" that companies are obliged. Given the inefficiency of regulation and self-regulation, the question is can a corporation go beyond the law? It seems that this issue is not necessary with regard to the minimum regulation to ensure the efficiency of the business. Corporations should volunteer to do so, go beyond the law, and that is the essence of their social responsibility. It is believed that these corporations can do it anyway when such an investment (Vives, 2008), for example, greater investment in human rights protection than the legally prescribed minimum protection, greater protection of consumers from the legal minimum protection, higher investments in environmental protection, greater protection of other stakeholders besides the owner: employees, creditors, administration, local community, state (Elkington, 1998; Nica, 2018).

This approach has its direct starting point in increasing the productivity, profit and competitiveness of the company. In this way, the demands of the states regarding the company's commitment to social responsibility, from the idea that it was originally conceived, to apply only to the largest multinational corporations, were extended to small and medium-sized enterprises. In the event of a conflict of interest between maximizing profits and corporate social responsibility, the theory of social responsibility provides arguments that support the company's social responsibility, such as: 1) legal arguments - the company's social responsibility leads to the inability to interfere in its affairs and greater autonomy, 2) economic arguments - in the long run strengthens the company's identity and reputation in front of stakeholders, which is reflected in its economic position, 3) personnel arguments - Corporate Social Responsibility is capable of attracting more qualified staff and 4) ethical, companies have a general responsibility towards the society in which they function.

If the aforementioned company responsibilities were presented in the form of a pyramid, the broadest basis and power would have:

1. economic responsibility, then
2. legal responsibility of the company, while after that it will come,
3. moral accountability at on the top, as the least in power and commitment of the company, would come,
4. charitable or philanthropic responsibilities, which reflect the smallest part of the company's social responsibility. Of course, the rule is that ethical and charity responsibilities are undertaken only if it increases the profit of the company. For example, "If a company donates to a director's wife, it is a conflict of interest and no economic effects, and as such is not permitted" (Nehme et al., 2008).

In support of the concept of social responsibility, the reasons for ethics and the reasons for marketing point out, but because both have their own economic expression in increasing profits. Nevertheless, "there is no basis for the claim that there is a proven view that the socially responsible behavior of companies inevitably leads to an increase in their profits" (Savkovic, 2009). It is considered to be a kind of investment, so-called. socially responsible investment, not the cost so that it has the impression that, as such, they are not enough (Besmer, 2006).

Namely, it is about the real condition without which there is no sustainable development of the company in the long term, nor the development and stability of the companies and each individual state. If sustainable development is to be achieved, then social responsibility must be accepted by companies. In the long run, companies can benefit from social responsibility because it plays a direct role in ensuring sustainable development (Herrmann, 2004). The concept of sustainable development is broader than the concept of corporate social responsibility (Vives, 2008).

In the market, everything is subordinate to the strengthening of the economic power of the company, because it is an essential component of the survival of not only individual companies, but also in the wider context and the status of a country with economically strong economic entities. Therefore, the most powerful companies with their economic power and the most powerful countries, often supported by the strength of their companies, use international politics and international institutions to demolish the barriers that stand in the way of their economic expansion all over the world.

In developed markets, the payment of dividends, the protection of minority shareholders, a clear and stable dividend policy are some of the basic premise of modern successful business. In Serbia, the number of companies that pay dividends, part of the gains to shareholders, owners of shares is still limited, while one part of the big companies did not go out on the stock market or think to leave. In Serbia, as well as in every country, the payment of profit is of great importance for the stability of the budget. As a dividend, any form of distribution of value that the capital company conducts to its

shareholders or members is considered. Although dividends are primarily paid out in cash, they are not necessarily limited to that type of asset, but can also be paid in other assets, such as shares in other companies or the distribution of some other values.

The condition for the payment of a dividend is, above all, the profit of the company, which is why this data clearly indicates the profitability of one company and a positive attitude towards the shareholders. In addition, a clear dividend policy and the regular payments of profits, part profits to the owners of capital, are at the same time a sign of respect for the owners of capital, especially those of the minority, as well as a significant psychological message about the stability of an enterprise. At the same time, it is a call to investors to continue investing in the company's shares, as this will definitely make them profitable for a long time.

In this way, the dividend policy of the company becomes much more than the distribution of value and turns into a way in which responsible companies communicate with their shareholders and with the market. Therefore, the value of the company on the market is visible and connected with the dividend policy. The sudden change in this policy, especially in terms of restriction, almost as a rule brings down the value of the company's shares and creates certain distrust of investors and the environment. Therefore, responsible economic entities try to form a predictable dividend policy, and auditing it only when it is necessary or when they are convinced that they will be able to pay dividends to the shareholders over a longer period of time.

Warning signals that jeopardize business continuity

If the company is currently doing business successfully, that does not mean that it will be the same in the future, therefore, the performance cannot be guaranteed in the future, and the previous good business, no matter how long it lasts, is not a guarantor of future good results. By investing in an enterprise, the owner/investor is exposed to a certain risk, and depending on how much he is ready to take risks, he can opt for the type of activity that best suits him, who he is familiar with or who he or his manager has in his knowledge. It is known that companies with more risky investments potentially have higher returns, while those with a relatively conservative investment policy, which relate, for example, to preserve value, they have less returns, but investing in them invests even less risk.

Risks are the likelihood, or the possibility of adverse effects on the business and financial position of the entity. Risks can be systematic and non-systematic.

Systematic risk is one that the company has no influence, or very small, because this risk cannot be avoided by diversifying investments. Non-systematic risk is one that can be limited by diversification and the appropriate choice of investment or some other business policy measures.

All economic entities are in constant changes and turbulences that are caused by various factors, human, scientific, technological, political and the demands of nature.

Restructuring, various types of reorganization, and other major changes are very common in trying to make companies grow to enormous rammers or survive.

Due to the inevitable changes caused by various reasons, business entities in their life cycle go through different stages, ups and downs, which necessarily require changes and adaptation to changes in newly emerging situations. For example. in the phase of growth of the company from small to medium, it is inevitable to move from an entrepreneur to a management organization. This change is very sensitive and is often realized with delay, especially in underdeveloped countries of the world that do not have sufficient knowledge.

Because of the above, it is obvious that the organization's transformation in contemporary conditions is a condition of the company's growth and development strategy, as well as the condition of its recovery and survival as well as success. In theory and practice of transformation, the change of organization is still most often used in crisis situations.

Organizational changes represent new challenges and requirements that are posed to all actors, including company management, employees and other constituents interested in the business of the company. If the change, especially in the conditions of the external crisis, is not managed in an adequate way, there are additional problems within the company itself, which certainly reflects on the business of the company (Rajnović, 2012). Employees in the companies certainly strive for job security, and hence their own stability and stability, and since changes often bring uncertainty, employees often face resistance to the unknown, according to the changes. In such situations, both capital owners and the management themselves need to introduce employees with the reasons for the changes, the essence of the change and the goal that is to be achieved, in order to provide the necessary readiness for changes without any or at all major disruptions of the work and business processes in the company.

It is expected from management, to predict timely crisis, external or internal, the possible operation of the crisis and other factors that may adversely affect the company's business and to has enough time, opportunities and knowledge to adapt it carefully by choosing methods and models of enterprise restructuring.

Regardless of external or internal causes of the occurrence and development of business disturbances, the problems in the company do not occur suddenly but cumulatively and more often, in individual areas and not in all parallel areas. This provides the opportunity for professionals to anticipate the crisis and timely precaution. The signs of the crisis, even those who are weak, must not be ignored. If the problem is fixed earlier it is resolved faster. If the crisis has progressed, and in the meantime, the necessary measures have not been taken, the responsibility is solely on the management of the company, since the owner of the company / investor is not in a position to adequately monitor the work of managers, because there is an asymmetry of information: namely, the manager knows more about the relevant matters from the owner, because he is a professional and because he is far closer to the business of the company than the remote owner. The owner, therefore, hires the managers because this other person has the necessary knowledge of the management of the company.

Internal signals of the crisis in the company's business

In practice, very often until the crisis in the company comes not only due to disorders created in the external environment. Many companies have collapsed due to their internal problems. In previous practice, it has been shown that many of the more important causes of illiquidity and companies of internal character are. Unlike external conditions, the company can more easily and effectively influence the internal causes of business disruption, in order to halt the weakening of the company's performance, poor business results and ultimately prevent the collapse and failure of the company, if it sees a timely problem and has a sufficient management capability to take adequate measures restructuring.

The crisis is the result of poor financial results and management decisions, persons who can make timely decisions on the data from the financial statements, financial analysis done through different models. In the early 1970s, models such as the Altman model were developed, based on the analysis of traditional financial transactions. Over time, with the development of information technology, models such as "data mining", intelligent model and neural network techniques have been developed. Of the financial indicators, the most commonly used is the ratio of liquidity, indebtedness, loss, negative cash flow from business activities, and so on.

Signs or symptoms that indicate that a crisis has occurred, or the financial crisis has already come are numerous. A detailed analysis within the company itself, in particular the analysis of financial statements, is the basic tool used to identify these signals. Often it happens that non-financial signals give earlier information on the existence of a crisis, when it is noticed and all financial signals often happen that it is already in the advanced stage of the problem. Signals are those that enable us to realize the existential danger, their monitoring and analysis in a timely manner, in order to respond to the crisis, the causes have already led to such a situation, and they are identified in the next phase, the root of the problem is sought and resolved. The most important techniques for anticipating business failure and for early detection of potential crisis signals are: company's solvency, balance indicators, off - balance indicators, compliance of goals and results, gap analysis and others.

As internal causes of insolvency in enterprises most often occur: high costs of production and therefore the prices of products; inadequate management of the company lack of financial control; low level of productivity; lack of working capital; high rate of uncollectible receivables; permanent insolvency of the company; poor quality marketing and sales; high indebtedness of the company, etc. The cause of crisis situations often are the owners themselves, because of their unrealistic ambitious ambitions, wrong decisions regarding expansion, uneconomical diversification of activities by entering into unfamiliar business activities in different sectors of the economy, the desire for rapid development and fast pay, buying other enterprises with poor performance, overconfidence in existing management, ignorance, etc.

In many countries of a developed market, primarily in the United States, it is common practice before the adoption of a decision on the application of the appropriate crisis resolution model is most commonly introduced. crisis management that does not only

presuppose the change of the existing management or the bringing of a new one, but the establishment of such an environment in a company that requires fast and focused action at all levels of the company. Existing management often changes because of the role it played in the timely identification of the onset and growth of the crisis, of its own mistakes that made it from neglect or ignorance. It is difficult to expect the same management to be able to propose and implement an adequate solution to the company's emergence from the crisis.

Operational risk is the likelihood of adverse effects on the business and financial position of the enterprise, and in the work of employees, inadequate internal procedures and processes, inadequate management of the information system and other systems, as well as due to unpredictable external events. With well-established procedures and internal controls, this risk can be avoided successfully.

State of sustainable business in agriculture

The backbone of the economy in the Republic of Serbia in the last hundred years, and still is, in terms of production volume and the coverage of the engaged population, makes agriculture, and therefore has a special role within the concept of sustainable rural development. Sustainable agriculture requires a systematic approach, that is, to look at agriculture as one of the most important areas of territorial development. It essentially represents the optimal balance of various production systems that, in accordance with the specific ecological conditions and economic interests of the stakeholders, fulfill more ecological, economic and social functions at the regional level. (Popović et. al., 2013).

Research has shown that high levels of rural poverty and unemployment are largely closely linked to the great reliance on rural areas in agriculture. For the restructuring and improvement of the economic base of rural areas, initiatives and efforts of all key subjects of sustainable rural development are necessary, since the insufficient influence of certain social groups can lead to the emergence of poverty, social exclusion and the threat to the cultural identity of business entities. Bearing in mind the experience of developed countries, it is clear that, in addition to supporting the development of agriculture, the policy of sustainable rural development must also focus on supporting the development of a non-agricultural economy due to inseparable business ties. Farmers' households in the United States, e.g. generate significant revenues from operations outside the farm. From agriculture, income from securities, interest on savings deposits, revenues from public programs, etc. It is known that the owner of a small enterprise or entrepreneur has a higher motivation for working and achieving positive financial results than managers of large companies, the best and most efficient use of resources, they have a better opportunity to produce small commodities and thus meet the demand for specific products, which is why they are interesting associates large companies.

Although rural areas of the Republic of Serbia have certain resources for successful

implementation of the concept of sustainable development, there are numerous limiting factors of development, so major structural changes and significant material investments are needed in this very important area. According to UN Agenda 21 (Ch.14, 1992) of the Rio Conference on Sustainable Development of 1992, a new development approach was defined in the Sustainable Agriculture and Rural Development - SARD study. In accordance with the above act, the sustainability of agriculture and rural development ensures sustainable management of biological systems in agriculture (land, water, integral systems of plant nutrition and protection against pests and diseases, renewable energy sources and genetic resources), diversification of economic activities in small family farms in the rest of the local economy, which contributes to the increase of employment and quality of life in local communities, as well as the construction of infrastructure facilities, or the development of multifunctional agriculture, which can provide an environmentally friendly, economically efficient and socially responsible agricultural production, thus contributing to a sustainable territorial development. Of course, a prerequisite for the realization of the mentioned development concept is an integral policy of supporting multifunctional agriculture and sustainable development. In addition, good coordination with environmental policy, social policies and spatial and regional development policies is necessary, as well as strengthening bottom-up approach, especially in the management of natural resources.

In this process, the important role of science is most important, from which it is expected to provide a decisive contribution to the economic and social sustainability of agriculture, and thus to rural development, as well as the contribution to the whole country in the sociological sense in the future, because the necessary profitability of the agricultural sector can be provided only by innovations that can to bring about high yields in agriculture.

The process of transition of the agrarian sector in the Republic of Serbia started more than twenty years ago and significantly changed its structure. However, compared to other developed European countries, agriculture in the Republic of Serbia is still at the bottom of the scale. Although many strategic documents of the Republic of Serbia point to the great importance of rural areas in terms of dominant territorial representation, the number of inhabitants engaged in this activity, the availability of natural and anthropogenic resources, the participation of agriculture in employment, GDP and exports is still unsatisfactory and the state is still has not created a sufficient incentive environment for the development of this area.

The former dominance of large agricultural farms and cooperatives, in particular, replaced the new ownership structure of Serbian agriculture, in which new owners of agricultural land, private companies, have huge land holdings, are incomparably larger than they had before the Second World War on the territory of the former Yugoslavia. The final results of privatization for Serbian agriculture are not favorable. Out of a total of 253 privatized companies in the period from 2001 to 2012, a significant number ceased to exist due to illiquid business, bankruptcy, in over 50 companies a contract for the sale of social capital was terminated, which was concluded in the privatization process of privatization entities whose activity was related for agriculture, and a significant number of employees in these companies was left unemployed (Bukvić, 2018).

Conclusion

If the persons with the greatest responsibility in managing the company, the managers and the majority owners of the capital, act as their law requires, while respecting the fiduciary duty towards the company, it is possible to ensure the stability of the company's business in the long term and, of course, if the management of the company is regulated in accordance with generally known principles of good corporate governance, which are applied in developed countries of the world. Profitability is the main basis for realizing the success and growth of the company. It represents the goal not only of the company, but of all other persons interested in the business of the company, including the state and the environment.

Therefore, it proved that is inevitable to introduce to every company of good corporate governance rules in order to regulate and respect the accountability system. Conscientious and responsible behavior, together with conscientious risk management and internal controls within a company, can identify potential problems before a serious crisis of business takes place, to take adequate measures, which creates favorable conditions for maintaining a lasting business of the company.

Legal systems of the world of the world, within which national legislation has different approaches, practices and a normative framework for solving these problems, are similar. Some insist on protecting small equity holders while limiting the role of large, and others strengthening management control by major shareholders. The practice of the oldest capital markets in the world, the United Kingdom and the United States, has shown that the regulation of these conflicting interests are possible in companies where there are a large dispersion of shareholders, and the imposing economic positions of many American corporations nevertheless show that a balance of different goals, primarily the owners of capital and managers, but also other stakeholders, found.

Possible solutions to the agent problem can be based on a number of basics: (Rajnović & Bukvić, 2017), a reliance on the desire of managers to gain and preserve their own business reputation, in order to increase the price of their knowledge on the market, 2) contracting various incentive schemes to reward managers for the company's good results 3) clear definition of the fiduciary duty of the manager to the company followed by lawsuits in the event of a breach of duty, 4) a good system of control over the work of managers, 5) consolidation of shareholding or partial concentration of ownership and control in the hands of several major investors, 6) protection of the rights of minority shareholders, 7) which is considered a disciplining factor for management, 8) hostile takeover of the company, 9) the struggle for the shareholders' votes at the assembly, especially in the event of large dispersion of shareholding.

In this regard, regulations and well-known good practices, which regulate the provision of this area, should be conceived in accordance with the best international practices in the regulation of these institutions and in a uniform, recognizable way throughout the world. Then, the inclusion, integration and fitting of the theoretical and practically

established regularities in the certain system of information of all economic entities, existing or newly formed, is followed. At the same time, the formation of behavioral habits - the stereotype based on the established good regularity in the event, the formation of faith in the correctness of the usual behavior, beliefs, in a word, form a good, generally known and applicable practice. At the same time, it is necessary to anticipate a set of control mechanisms that increase the safety of business operations, including the protection of investment funds from fraud and abuse in the business of the company.

Acknowledgements

Paper is a part of research within the project No. III 46006 – Sustainable agriculture and rural development in the function of accomplishing strategic objectives of the Republic of Serbia in the Danube region, financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

Conflict of interests

The authors declare no conflict of interest.

References

1. Berle, A. A. & Means, G. C. (1932). Modern Corporation and Private Property, *Transaction Publishers,* New York.
2. Besmer, V. (2006). The Legal Character of Private Codes of Conduct: More than Just a Pseudo-Formal Gloss on Corporate Social Responsibility. Hasting Business Law Journal 2(1), 279-306.
3. Bukvić, R. (2018). One hundred years of agriculture in Serbia 1918 - 2018 (on Serbian), Society for Economic History, Belgrade.
4. Corbett, A. (2008). Corporate Social Responsibility – Do We Have Good Cause to be Sceptical About it? Griffith Law Review, 17(1), 413-432.
5. Cozian, M., & Viandier, A. (1988), Droit des societes, Litec, Paris.
6. Elkington, J. (1998). Cannibals with Forks: The Triple Bottom Line of 21st Century Business, North Macanto, Capstone Publishing.
7. Jensen, C. M., & Meckling, H.W. (1976). Theory of the firm: Managerial Behavour, Agency cost and Ownership Structure. Journal of Financial Economics, 3(4), 305-360.
8. Nica, E. (2018). Gig-based working arrangements: Business patterns, labor-management practices, and regulations. *Economics, Management, and Financial Markets,* 13(1), 100-105.
9. Popović, V., Sarić, R. & Jovanović, M. (2013), The state and possibilities for the development of sustainable agriculture and rural development in the Danube Region (7-37), Sustainable agriculture and rural development - conceptual starting

points, Belgrade, Institute of Agriculture Economics.

10. Rajnović, Lj. (2012). Principles of Corporate Governance (in Serbian), Law and Economy, ISSN 0354 – 3501, UDK 347.7, 240 - 249.
11. Rajnović, Lj. (2013). Socially responsible business in the function of improving the economic environment in the Republic of Serbia (on Serbian). Association of economists of Belgrade, Belgrade.
12. Rajnović, Lj. & Bukvić, R. (2017). Corporate governance as part of the company's business strategy of companies (on Serbian). Belgrade: Institute of Agricultural Economics.
13. Savković, V. (2009), Corporate social responsibility - from moral to legal obligation. Legal Life, 532(12), 425-436.
14. Smith, A. (1776). An Inquiry into the Nature and Causes of the Wealth of Nations. London: W. Strahan and T. Cadell.
15. Vasiljević, M. (2013). Corporate governance, Belgrade, University of Belgrade, Faculty of Law.
16. Vives A. (2008). Corporate social responsibility: The role of law and markets and the case of developing countries. Chicago – Kent Law Review, 83, 199-229.
17. Nehme, M., & Koon C. G. W. (2008). Tracing the Historical Development of Corporate Social Responsibility and Corporate Social Reporting. James Cook University Law Review, 15 (1), 129-168.

IMPACT OF AGRICULTURAL ADVISORY SERVICE ON DEVELOPMENT OF AGRICULTURAL PRODUCTION

Mlađan Dimitrijević[1], Vladislava Stojić[2]

**Corresponding author E-mail: kgdimasc@gmail.com*

ARTICLE INFO

Review Article

Received: *16 April 2019*

Accepted: *13 June 2019*

doi:10.5937/ekoPolj1902617D

UDC 631.1:005.942]:338.432

Keywords:

agriculture, agricultural advisory, development factors

***JEL**: Q012*

ABSTRACT

Agricultural advisory includes coordination between people, modern technology and natural conditions. Since in the conditions of domination of small family farms, the agricultural advisory service along with agricultural cooperatives represents one of the two hubs of the agricultural development of Serbia, the aim of this paper is to determine, on the basis of analysis of the current development and present performance of the agricultural advisory service, the need to provide new forms of advisory services. The successful organization and practical functioning of the agricultural advisory service, especially in unstable economic conditions, is essential for achieving the development goals of Serbia's agriculture. There are already many activities of the advisory service, but the aim of this paper is to analyze the extent to which the agricultural advisory service in Kragujevac influenced the development of agricultural production in the surrounding villages. The obtained results indicate that the agricultural advisory service in Kragujevac has very little influence on the development of agricultural production in the surrounding villages.

Introduction

The agricultural advisory service is a necessary institution in the development of agriculture and villages, especially in the conditions of the post-socialist transition of the dual concept of development of our agriculture. Small family farms, dominant in production capacities, could not make a significant contribution to the overall development of our agriculture, especially in the realization of commodity agricultural production. Among the significant institutional factors whose insufficient presence has negatively affected the overall development of our agriculture, and especially

1 Mlađan Dimitrijević, Student Center Kragujevac, Radoja Domanovića 12, Kragujevac, Serbia, Phone: +38134336065, E-mail: office@studentskicentar-kg.rs

2 Vladislava Stojić, Assistant, Department of Medical Statistics and Informatics, Faculty of Medical Sciences, University of Kragujevac, Serbia, Phone: +38134306800, E-mail: vladislavastojic@medf.kg.ac.rs, ORCID:http://orcid.org/0000-0002-9532-810X

agricultural production in family farms, analysts of our agrarian practice necessarily include the engagement and assortment of agricultural advisory services.

The subject of the work is a comprehensive review and analysis of the agricultural advisory service, which has a special importance and role in the process of training agricultural workers for European integration, in particular for the implementation of the standards of agrarian policy, technology and technology of agricultural production and the concepts of rural development that are applied in the European Union. The European Union's trade strategy since 2006 has been justified on the assumption that deep and comprehensive bilateral trade agreements are at worst complementary to and at best promote multilateral negotiations, sustainability and democracy (Garcia et al., 2018; Smith and Stirling, 2018; Meilă, 2018).

Since in the conditions of domination of small family farms, the agricultural advisory service represents, with the agricultural cooperatives, one of the two hubs of the agricultural development of Serbia, the aim of the work is to draw on the analysis of the current development and present performance of the agricultural advisory service (tasks, organization, financing, material resources and staffing potential), points to the need to provide new forms of counseling services in rural areas.

The successful organization and practical functioning of the agricultural advisory service, especially in unstable economic conditions, is essential for achieving the development goals of Serbia's agriculture. There are already numerous advisory services, but the aim of the work is to point out the directions for adjusting agricultural advising to modern requirements of competitiveness of agriculture.

Based on the objectives and subject matter, the starting hypotheses are as follows:

1. The importance of agricultural production in the economy of the Republic of Serbia requires that the agricultural advisory service is well organized and efficient.
2. Education and professional development of farmers is necessary in modern business conditions, so that they can be informed and trained for modern production methods within their activities and be able to solve problems in organizing agricultural production.
3. Informal forms of education of farmers in Serbia are not sufficiently theoretically, neither methodologically defined nor standardized.

The first part of the paper includes the consideration of the importance of agricultural advisory in market-oriented agriculture. The need for entrepreneurship is that the choice in the field of technology is carried out with the help of agricultural advisory services. Within this part of the paper, the basic concepts of agricultural advising, the emergence and development of agricultural advisory services, the basic objectives of the functioning of the advisory service, with the basic concepts of advisory work as well as systems of knowledge and information in agriculture are explained. The second part is a survey aimed at determining the extent to which the agricultural advisory

service in Kragujevac influences the development of agricultural production in the surrounding villages. The survey was conducted on a statistically representative sample, by random selection of household members in five villages around Kragujevac. Final considerations, in addition to the final analysis of theoretical considerations, include the evaluation of the results obtained by the research.

Literature Review

Agriculture is one of the promising and important industries for Serbia. The development of agriculture and the implementation of the process depend on many social and economic factors, from the achieved level of development of production forces and production relations and their influence on the state and attitude in the agrarian sector (Sekulić-Maksimović et al., 2018). For the agrarian development, creative power of knowledge and intellectual potential is vital - education as a process of acquiring knowledge, building skills, adopting a system of values, new technologies, business and organizational culture (Cukanović-Karavidić et al., 2018).

The term advisory is generally known and accepted by most people, but at the same time it does face rejection for various reasons: insufficient understanding of the meaning of the term itself, negative experience with advisors and advisory services, inadequate content of counseling, which in turn does not lead to sufficiently positive effects for organizers and donors etc.

In global terms, advisory is closely linked to the distribution of information to the population and the provision of assistance in assessing the large amount of information available to them for the purpose of finding a solution. Accordingly, advisory has the task of developing human resources. It places the person - the man at the center of its activities. Advisory is a process in which an advisor tries to motivate and encourage his client for a certain behavior through the provision of spiritual help so that he can solve his own problems in the right way. Clients then gain a better insight into the interconnectedness of the problem and identify possible alternative solutions. This way they become stimulated and focused on the behavior that leads to the overcoming of the problem. Thus, human resources are "liberated" and more fully exploited. It is important that the relationship between the advisor and the client is based on equality and that the advisor is committed to working for the benefit of the client. In addition, it is very important to preserve the decision-making autonomy and personal responsibility of the client, since he is obliged to bear responsibility for the consequences of his actions (Ogrizović and Teofanov, 2007). Finally, advisory can be viewed as a process through which an advisor tries to encourage and enable the client to overcome his acute problems.

The definition itself points to the fact that advisory is a very broad area and that advisors must have many skills and knowledge: in addition to a high level of knowledge regarding technical (professional) aspects in terms of what the client's interest is, they must also be familiar and skilled in the methodology of advisory work. However, the final decision on the extent of usefulnesss of the advisory content belongs to clients themselves. It is

essential that the advisor has a positive attitude towards the client, which implies mutual respect, respect for the client as an equal partner and, of course, sincerity.

Advisory in agriculture should analyze the circumstances and needs of clients in advance, before precisely determining the objective of the advisory process. In almost all countries there is a history of joint activities in the local community and close family ties and connections among members of the local community. This justifies an advisory approach that is based on participatory advisory concepts and methods; the principles of self-help and the use of local available resources. Tumbas and Krmpotic (2001) highlight the following characteristics of the advisory approach:

1. The objectives must be clear, transparent and in line with the definition of the advisory service. The advisor may not have double roles. Advisory and monitoring are two independent processes that insist on different approaches.

2. The client is in the focus of an advisory approach. This implies that they are involved in the planning, monitoring and evaluation of advisory activities.

3. The adoption of the approach which emphasizes the process is a main task, with many smaller individual steps in the process which are accompanied by appropriate monitoring of data (certain indicators). Basically this means that an advisory organization has to work with the target group by focusing closely on their problems and finding alternative solutions to these problems together with them. Alternatives can be included in the advisory content.

4. The selection of adequate methods and instruments should be in harmony with the nature of the organization, the capabilities of the staff and the availability of local resources.

5. The homogeneity of the target group regarding their problems and situations, provides the potential for group advisory work.

6. During the work, policy and legal frameworks should be emphasized.

7. Without the technology to be offered, there is little chance that the advisory programs can have an impact on production.

The basic concept of this definition is "participation". Participation in advisory work involves joint decision-making and action by clients and advisors from agricultural advisory services (Čikić et al., 2008).

The Agricultural Advisory Service, which is one of the organizational and developmental instruments of agrarian policy, represents an important factor in the functioning and development of the economy, and it realizes its authority on development by achieving the set goals while respecting the specificities of the development policy. The main goal of the agricultural advisory is the harmonization of macro goals - the goals of the state with micro targets - the goals of the manufacturer. Harmonization of micro and macro goals at the level of agriculture is achieved through education and professional

development of farmers. This stimulates the education and specialization of farmers for a given type of production, or for re-training, with the aim of finding possible opportunities for income (Mitrović et al., 2009). In today's business conditions, education and professional development of farmers are necessary for them to be informed and trained for modern production methods within their activities. This is of particular importance to our conditions, especially when it comes to the fact that the professional level of farmers is at a low level. Observed from this position, advisory should be a means by which additional knowledge and ideas are distributed in rural areas, and therefore lead to changes and improvements to the lives of farmers and their families. Proper organization and work of the agricultural advisory service are necessary in order to successfully accomplish this task (Hill, 2012).

Establishing an appropriate organization of the agricultural advisory service insists on providing adequate elements (personnel, financial, organizational, etc.) that ensure its proper work. It is particularly important that this organization is in line with the real needs of farmers as well as the changes taking place in their environment. In other words, counseling is a dynamic phenomenon that transforms and is forced to continually adapt to the resulting changes (Veselinović et al., 2002). Certainly, this is a continuous and very complex task, and therefore, it is very difficult to achieve. The modern advisory service in these areas is still not sufficiently developed. Of course, in the future, the existence of such a service will be necessary for successful implementation of the process of agricultural modernization.

Bearing in mind that there are many different advisory organization models, the problem of qualitative classification of these models is posed. In fact, the organization of these models ranges from a statewide organization of agricultural advisory, through semi-state models, to fully privatized consultancy. The type of model to be accepted depends on the level of agricultural development, the needs of the farmer for advisory services, and the developmental ability of the appropriate organization of agricultural advisory services. When it comes to Serbia, it is necessary, when selecting a counseling model, to provide all the necessary resources for its work, but also all the necessary information on how the functioning of already existing models works, as well as the possible problems and difficulties that these existing models face (Čikić et al., 2008).

Having a ready-made model of advice from a developed country does not necessarily mean that this model would be successful in our country. Accordingly, the appropriate model is one that is in line with the corresponding social and economic circumstances of the country in which it is applied.

The work of the advisory service falls under the jurisdiction of the state, regardless of whether it is in state, mixed or private ownership. Accordingly, the advisory service, as a state institution, should carry out its tasks through appropriate organizations such as the ministries of agriculture, regional agricultural stations, agricultural faculties and institutes, local agricultural services and various state or private development agencies. It is necessary that among these organizations there is an adequate distribution of jobs

harmonized with the role and the importance that each organization carries in the process of distribution of knowledge, technology and innovation. In this case, the role of local economic development office and agricultural professional services created at local government level in Serbia is very important (Aničić et al., 2019).

The process of adopting farmers' decisions can be considered from different positions. Adoption of decisions represents a subjective and complex process, but it does not matter where the decision is made and who makes them. This claim applies to agriculture or farmers as decision makers (Janković, 2007). Certainly, auxiliary means are available, which are helpful to the farmer in raising the quality level of the decisions he makes. In order for the farmer to use them, it is necessary to develop appropriate skills for their implementation. The process of thinking starts from certain familiar information about an experiment or idea. Creating an idea, in general, is a deductive activity. Upon the creation of the idea, data is collected for its verification. That verification is empirical, in the form of testing certain claims. In doing so, using a rational flow of thinking raises the level of systematicity. Such a systematic course of reflection, which is used as a scientific method in practice, has also been shown on the farm in solving certain problems as the most effective means (Tumbas and Krmpotić, 2008).

The basic principles of doing business are an important tool in directing the deductive flow of thinking. They focus on the types of information that need to be collected and analyzed, and also provide an appropriate framework of information that can be used in the analysis of alternative decisions. In other words, they provide guidance for the decision-making process for farmers.

The process of selecting alternative decisions is a complex process that complicates the limitations of certain resources. For this purpose, the term alternative cost was introduced, which represents a loss of profit that could be realized using the same resources by choosing the next best alternative in decision making (Castle et al., 2002). This way, the economic principles directly emphasized the necessity of thinking about alternative decisions during the decision-making process. Implementation of the economic principles in decision making of farmers limits the lack of adequate information. It is not a rare case that the application of economic principles is criticized because it requires a larger amount of information than that available to the farmer. However, it is not possible to dispute the fact that economic principles provide a methodological basis for decision making.

The economic principles of the decision-making process are generally well-known, thus this paper will only outline them. Each production is based on an adequate relationship between the value of the input and the value of the output. As this relationship represents a rule, at the same time it represents a functional relationship or production formula (Tumbas and Krmpotić, 2008). This formula defines a change in yield depending on the transformation of the investment level of a particular production element that has an impact on the yield. The features of this formula are defined by the movement of total, average and marginal yields. The mutual relations of total yield, average yield

and marginal yield in production represent the interdependence in which farmers make decisions about the amount and combination of investments of the available production elements. By appropriate analysis of these interdependencies, farmers can narrow down the range of possible alternatives to a rational measure. In addition, the limits of the rational height of the investment of the production factors are the maximum average yield and the maximum total yield.

Making a decision about the production of a certain product and the structure and level of production is determined by the costs. Costs are classified in several ways. It is important to determine their classification to fixed and variable costs, as the variable costs are crucial when deciding (Tomić and Živković, 2004). By inversing the relations of variables in the production formula, we get a cost formula – a new formula in the theory of production. Through the cost formula, it is observed how much the variable costs will be changed according to the quantity of products obtained.

The typology of advisory work enables the systematic, complete and precise registration, monitoring and analysis of the basic characteristics of the advisory work of each individual advisor. The type of advisory work identifies two main groups of characteristics:

1. General information about the user of the advisory services: name and surname of the user, place, farm code (if registered), date of obtaining advisory services

2. Information on advisory work: a group of advice to which the specific provided advice belongs (for each individual expert area of advisory work), the method of advisory work (individual or team), the method of giving advice (method of advisory work), the time required for giving advice, a brief description of a specific problem (Čikić et al., 2008).

Advisory work can be seen as a process of educating farmers with the aim to provide knowledge and information, as well as means for mastering certain skills, with the task of effectively solving problems that the farmer faces which can present a barrier to improving production and / or overall quality of life of the household or the local rural community of which the farm is an integral part. Like every educational process, advisory work implies certain aspects. Then you can talk about:

• the psychological aspect (it concerns the level of motivation of farmers for active participation in the advisory process, as well as their personal characteristics and preferences, but also the motivation of the advisor to actively contribute to the transfer of knowledge, innovations and technologies)

• pedagogical (didactic) aspect (it implies the available methods and tools for advisory work, as well as the ability of the advisor to apply them adequately to make the advisory process more efficient) and

• the sociological aspect (it includes a system of needs, values, norms and interests that determine the need and readiness of farmers to participate in this type of education, general

social conditions in which counseling work takes place, as well as the characteristics of advisory organization and its basic goals) (Novković and Šomođi, 2009).

The effectiveness of the advisory work depends on the relationship between these three aspects. The theory of advising speaks of three basic methods of advisory work: individual, group method and advisory work using mass communication tools. These methods differ based on the method of implementation, the nature of the contact between the counselor and the farmer and the scope of the target group (Čikić et al., 2008). Regardless of the differences in the mentioned methods and their individual forms, their common goal is to ensure: establishing a trust relationship between an advisor and a farmer (target group members), distributing and acquiring knowledge and skills, increasing interest in advising farmers, and attracting and directing their attention to independently gaining the advantage of the practical application of new knowledge and skills.

The term individual metods of advisory work comprises advice given on the farm, at the station or by telephone. Group methods include lectures and other forms of group advisory work (demonstrations, field days, group discussions and workshops, excursions, trips, fairs, exhibitions, etc.). Advisory work through the use of mass media comprises advice provided through information technologies (e-mail, Internet), as well as the preparation and publication of printed material and education of farmers through means of mass communication (radio, television).

Methodology of the Research

The aim of the research is to analyze the extent to which agricultural advisory services in Kragujevac affect the development of agricultural production in the villages around Kragujevac. The agricultural station Kragujevac, as an expert service, covers the agricultural area of the Sumadija region with its work. This area has about 180,000 ha of arable land, with 120,000 ha of oranges, about 30,000 ha under fruits and vineyards, 30,000 ha of meadows, pastures, etc. Agricultural production is involved in more than 30,000 households in the area of 172 villages. In addition to expert staff, the Agricultural Station has the necessary laboratories and equipment: agrochemical laboratory, phytopathology and laboratory for quality control of seed of agricultural plants. There are three basic components of the content of the work: cooperation with scientists for practical application, education of the profession in all aspects of primary agricultural production and entrusted tasks by the Ministry of Agriculture (systematic control of fertility of the soil, control of production of seeds and planting material of agricultural plants, selection measures in livestock breeding, forecasting service).

The basic task of the agricultural advisory and expert service is the improvement of agricultural production, plant and animal husbandry on the farms of agricultural producers, the introduction of new varieties of hybrids of agricultural plants and domestic animal breeds, as well as the introduction of modern technology in the field of agriculture, in production. The financing of the service is done partially from the

agrarian budget through the Ministry of Agriculture, Forestry and Water Management of the RS and partly from the market revenues by providing professional services to organizations in this area. Advisory services for agricultural producers are free of charge. Supervision of the work of the agricultural service is carried out by the Ministry of Agriculture and Forestry of the RS.

The survey was conducted on a statistically representative sample, by random selection of household members in five villages around Kragujevac (Lužnice, Cerovac, Desimirovac, Pajazitovo and Grbice). The units of observation are members of the households with agricultural production. The sample is stratified to cover parts of the pilot areas belonging to rural areas, according to international standards. The research is focused on members of agricultural households, regardless of the socio-economic structure (farm size, source of income, etc.). The survey was conducted in January 2019 by the author of the paper. A questionnaire for rural household members included a set of questions from the following areas:

- Selection questions
- Data on household members
- Household data
- Perception of potentials, attitudes, estimates, desires, plans
- Partnership and assessment of national / local support to rural areas
- The role of the agricultural advisory service.

The obtained results of the survey research were tabulated and graphically interpreted in such a way that for each answer the average level at all five villages was shown. The results of the survey are grouped according to the statistical definition of household types, the subjective assessment of the source of income, the importance of agricultural income and the perception of the future of the household.

Results and Discussion

The survey was conducted on a statistically representative sample (54), formed by random selection of household members in 5 villages around Kragujevac (Lužnice, Cerovac, Desimirovac, Pajazitovo and Grbice). The unit of observation was a household with agricultural production. The research is focused on agricultural households, regardless of the socio-economic structure (farm size, household members, source of income, etc.).

Selection questions

The answers to the selection questions included data on household members (number, age, and gender), demographic characteristics of the household owner - decision maker (sex, education), country processing and employment of household members.

Almost all surveyed households in selected villages (98%) have more than one member, and most of them have at least one member between 20 and 40 years of age (84%).

There are almost no households in which more than one member is employed outside agriculture (only 4%) and almost all household and decision holders are elderly men (89%), over 50 years of age (average age is 51.1). Households in which women are decision-makers are almost nonexistent. One of the reasons for the unsatisfactory age and gender structure of decision-makers in households is, most likely, the sociological nature and consequence of patriarchal family relationships.

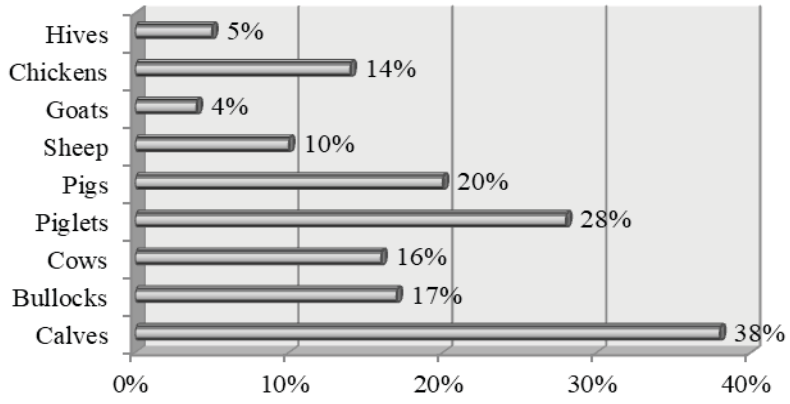
Data on household members

The educational structure of household members showed an extremely low participation of the highly educated population in the total number of household members. Only 5% of household members have graduated from University, 2% have college diploma (three years of higher education), 39% have graduated from a four-year high school, 21% have graduated from a three-year high school, 27% only have elementary school and 6% are with an incomplete elementary school education. The reasons should be sought in the fact that the majority of households surveyed (45%) are of mixed type, according to the subjective assessment of members, while 31% define their farm as agricultural. Mixed households have a better educational structure than the agricultural one, which is also established for the rural population of the whole Serbia. More than half of household members (63%) do not have an extra job besides agriculture, and those who do, do not do it on a daily basis, but occasionally when they get a chance.

Household data

Most households surveyed have a registered farm (71%) and use the land for agricultural purposes. The results show that 28% of the respondents do not have a registered farm, and the main reasons are the lack of confidence (74%) and insufficient information (11%). The average size of the agricultural parcel, which is used for various types of agricultural production, is: fields and gardens - 2.2 ha, orchards - 0.74 ha, vineyards - 0.18 ha, meadows and pastures - 1.62 ha, indicating a significant problem of property fragmentation.

Figure 1. Households possessing certain types of livestock

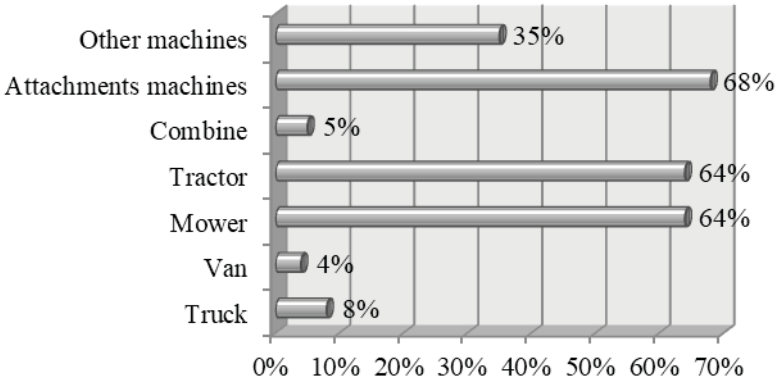


Source: Author's calculation

The largest number of households surveyed produces corn and wheat, and a significant percentage (67%) produces fruit production. The production of other cereals, vegetables, wood and other forest products are also significant factors in the structure of household income. In contrast to production, households mostly sell fruits and vegetables, and in a somewhat smaller percentage wood and other forest products. Households sell all agricultural products to local buyers and shopowners, at a rural green market and neighbors, while co-operatives have almost no redemption activities. Most respondents plan to maintain the same intensity and structure of agricultural production, and 27% even plan to increase production volumes.

However, it is indicative that 24% of the respondents did not give an answer to this question, which may indicate that they do not use long-term planning and assessment in their business, but they approach the decision-making promptly depending on the moment. Almost all surveyed households have a livestock fund (94%), and the percentage of households that own certain cattle and sell livestock products is shown in Figure 1.

Figure 2. Percentage of surveyed households with mechanization



Source: Author's calculation

Households sell livestock products to marketers, in market towns and neighbors. Most respondents plan to keep livestock production at the same intensity, but a significant percentage (25%) is planning to improve production.

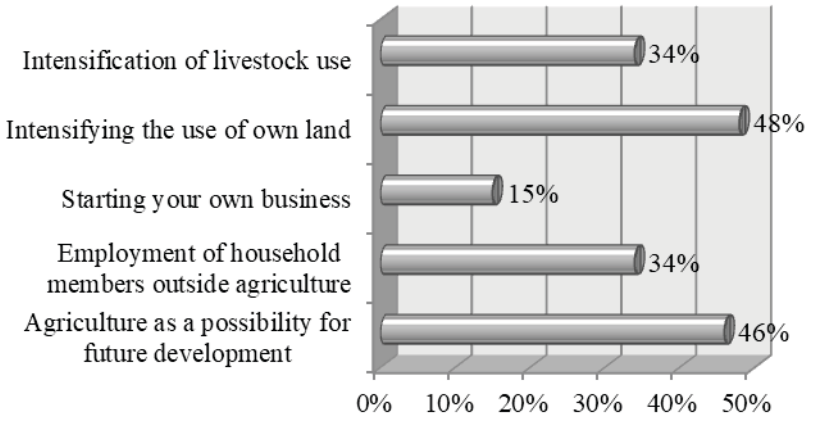
However, there was again a relatively large percentage (20%) of those who did not want to answer this question. Households, in general, own agricultural machinery. The largest number of households surveyed has a basic income from their own household (89%).

Perception of potentials, attitudes, estimates, desires, plans

Almost half of surveyed households (46%) view agriculture as an opportunity for future development. The employment of non-agricultural household members represents the possibility of progress for 34% of households surveyed. Starting your own business (15%) was seen as an additional opportunity for households to develop in the villages

of the region. In this respect, 48% of respondents define the intensification of the use of their own land, and 34% of the stock fund as their plan for the future.

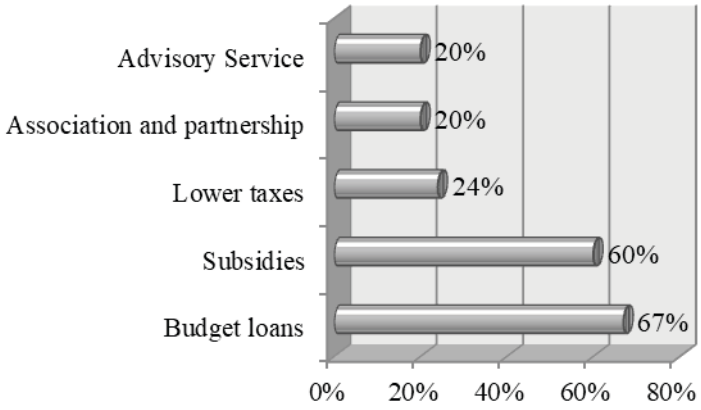
Figure 3. Possibility of household development



Source: Author's calculation

However, a significant number of respondents (as much as 50%), in addition to expanding their agricultural capacities, intend to find work outside agriculture for themselves or members of the household. Only 16% of respondents see the chance for their household's future progress in starting their own business. 68% of households interviewed did not undertake any activity in order to start a new job in the last five years. Only 17% of households started a new job and succeeded (craft, harvesting of forest fruits, trade), while 9% of the respondents tried, but failed to start a new job.

Figure 4. The most urgent support in the field of rural development

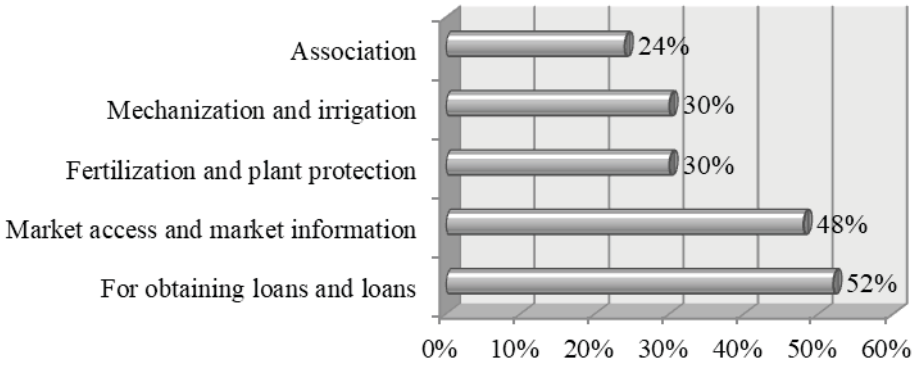


Source: Author's calculation

The lack of financial resources (31%), inaccessibility of the market (16%), lack of knowledge and experience (14%), inability to find partners (11%) were the main

problems and constraints that householders faced in the attempt to start a new job, along with complicated paperwork (10%) and high taxes and fees (10%).

Figure 5. The most common reasons for professional help



Source: Author's calculation

Favorable loans (67%), subsidies (60%), lower taxes (24%), association and partnership (20%) and counseling (20%) represent the most favorable support in the field of rural development by the surveyed households. The most necessary professional assistance is about conditions and procedures for obtaining loans (52%), access to market and market information (48%), fertilization and plant protection (30%), mechanization and irrigation (30%) and association (24%).

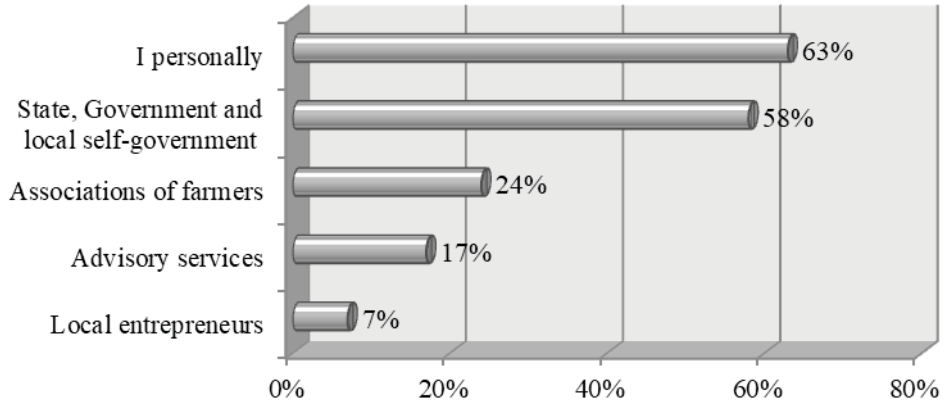
Partnership and assessment of national / local support to rural areas

Farmers have recognized themselves as the subjects that currently make the most of the quality of life for rural households (63% of responses). In second place is the state-government and local self-government (58%), followed by farmers' associations (24%). Some households recognize counseling services (17%), local entrepreneurs (7%) as relevant factors with their own position.

Most households believe that the producers in their village are not united (81%) in any way. On the other hand, most respondents occasionally (45%) or regularly (39%) work with neighbors or family members through an exchange of work, while only 6% never do it.

In the case of agricultural machinery and equipment, the largest percentage of respondents settles their needs with exchanges with neighbors and relatives (49%), while 20% own their own machinery. Some hosts (7%) are willing to pay for the use of machinery through renting a machine or engaging a machine with a worker who will do the work on their farm (9%).

Figure 6. Entities that contribute most to improving the quality of life of the household

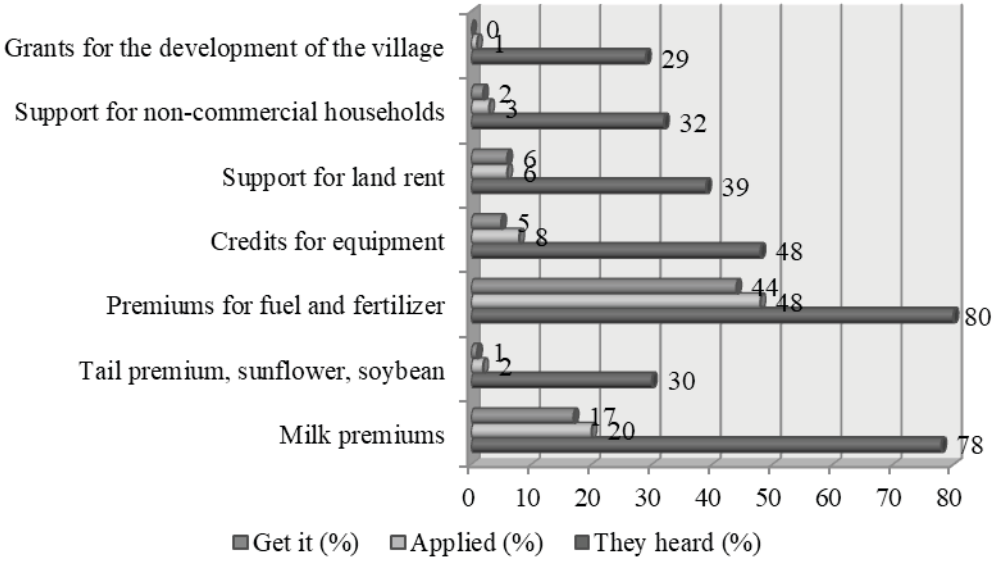


Source: Author's calculation

The role of the agricultural advisory service

A significant percentage of respondents (30%) communicate with the advisory service only when their representatives visit them, but at the same time, a significant percentage (about 40%) is ready to pay advisor services.

Figure 7. Use of state support funds



Source: Author's calculation

At the national level, half of the interviewed households receive information in an informal manner (through talking to neighbors and relatives) or do not try to get

information at all, while respondents show some more advanced habits - 73% are informed via radio and television, 56% reported only over neighbors, 28% are consulted in a local agricultural pharmacy, and 15% read specialized magazines and consult a local agronomist or veterinarian and advisory service. Only 5% reads the Bulletin of the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia. There are no households that do not even try to get information.

The surveyed agricultural households believe that they are familiar with the state support programs (42%), but 15% of the respondents estimate that they do not know absolutely anything about them and that they are not interested in finding out. The largest percentage of respondents is informed about these programs via TV and radio, then through magazines, but also informally through conversation with neighbors and friends. A small percentage of surveyed households applied for some state support programs, and even fewer were supported.

The highest percentage of households applied for fuel and fertilizer refineries and milk premiums, and the regres are the most frequently obtained category.

Discussion

The obtained results of the survey on the extent to which the agricultural advisory service in Kragujevac influences the development of agricultural production in the villages around Kragujevac show that most of the surveyed households with a registered farm (71%) use the land for agricultural purposes and process it, while 28% of respondents do not have a registered farm, and as main reasons they mention the lack of trust (74%) and insufficient information (11%). The results show that almost half of the surveyed households (46%) view agriculture as a potential for future development.

A significant percentage of respondents (30%) communicate with the advisory service only when their representatives visit them, but at the same time, a significant percentage (about 40%) is ready to pay for advisory services. At the national level, half of the interviewed households receive information in an informal manner (through talking to neighbors and relatives) or do not try to get information at all, while respondents show some more advanced habits - 73% are informed via radio and television, 56% reported only over neighbors, 28% are consulted in a local agricultural pharmacy, and 15% read specialized magazines and consult a local agronomist or veterinarian and advisory service.

The surveyed agricultural households believe that they are familiar with the state support programs (42%), but 15% of the respondents estimate that they do not know absolutely anything about them and that they are not interested in finding out. The largest percentage of respondents is informed about these programs via TV and radio, then through magazines, but also informally through conversation with neighbors and friends. A small percentage of surveyed households applied for some state support programs, and even fewer were supported. Based on the obtained research results, we can conclude that the agricultural advisory service in Kragujevac has very little influence on the development of agricultural production in the villages around Kragujevac.

Conclusion

The advisory system develops communication links and realizes the exchange of information both within the system, between the elements of the structure and outside the system at the country level (banks, insurance companies, agricultural suppliers, processors of agricultural products, trade, carriers) and the international level. For the needs of the formation and equipping, development and efficient work of the advisory service and the system as a whole, stable sources of funding are needed. This primarily refers to the resources of the agricultural budget, which should form the basis for financing this system. The development of an advisory system conditioned by the diversity of individual agricultural areas must be selective, absolutely appropriate to the needs of areas that currently have development potential, and only partly to the needs of those areas that represent development potential in the near or distant future. Other areas of low development potential are not included in the development of advisory services, but are assisted by other forms of agricultural development.

The advisory system must be gradually built and must go a long way from the system in which all the activities of the organizations are financed by the budget funds and all services are free, through the system of partial participation of the users of services by charging certain services while other services are free, to the system in which all costs are covered by the service charge to the user and the system is able to finance itself. International experiences are first and foremost confirmed by the fact that the advisory system cannot be organized on the basis of templates, simply by utilizing one of the existing models. Each country has to build its own model of organizing advisory services that will respect the specifics of the country, and the experiences of others can be used as certain guidelines.

It is quite clear through the analysis of international experiences that while defining the development strategy of our country's advisory service, the alternative is the organization of an advisory network by the farmers' association. This is the best choice, the best solution that would not require further modifications later. However, the answer to the question of whether such a strategy can be implemented in our country is no. There are numerous reasons for such an answer, and the most crucial is that in our country there are no strong associations of farmers that represent their interests and that can fund an independent advisory organization from the collected funds for membership fees. However, some compromise must be found, even though it might not the best choice. The optimum alternatives that would be realized in the future should not be abandoned, but it is necessary to approach the organization of the state advisory system on new and changed concepts of development and to support the development of advisory services organized by production and trade organizations and individuals in parallel.

Conflict of interests

The authors declare no conflict of interest.

References

1. Aničić, D., Nestorović, O., Simić, N., & Miletić, S. (2019). The perspectives of sustainable development of Serbia's agriculture in globalized environment. *Economics of Agriculture*, vol. 66, no 1, pp. 221-235.
2. Castle, E., Becker, M. and Nelson, G. (2002). *Farm Business Management*. Macmillan Publishing Company, London.
3. Cukanović-Karavidić, M., Karavidić, S., Pejanović, R. (2018). Agro-economic development based on the economy of knowledge, business and social skills. *Economics of Agriculture*, vol. 65, no 3, pp. 1241-1257.
4. Čikić, J., Janković, D. i Petrović, Ž. (2008). Typology of advisory work. in: Ž. Petrović (ed.), *Information system in the agricultural advisory service of Vojvodina*. Faculty of Agriculture, Novi Sad, 38-56. [In Serbian: Tipologija savetodavnog rada. u: *Sistem informacija u poljoprivrednom savetodavstvu Vojvodine*]
5. Čikić, J., Petrović, Ž. i Janković, D. (2008). The role of the agricultural advisory service in encouraging the production of health-safe food. Thematic proceedings from the International Scientific Meeting: "*Multifunctional Agriculture and Rural Development III – rural development and (un)limited resources*", Faculty of Agriculture in Zemun, book II, 102-108. [In Serbian: Uloga poljoprivredne savetodavne službe u podsticanju proizvodnje zdravstveno bezbedne hrane]
6. Garcia-Duran, P., & Eliasson, L. J. (2018). Squaring the circle: assessing whether the European union's pursuit of bilateral trade agreements is compatible with promoting multilateralism. *Journal of Self-Governance & Management Economics*, 6(1), 7-32.
7. Hill, B. (2012). *Farm Incomes, Wealth and Agricultural Policy: Filling the CAP's Core Information Gap*. Wallingford, Oxfordshire, UK, Cambridge, MA.
8. Janković, D. (2007). Defining agricultural advisory. in: Cvijanović, D., V. Hamović, J. Subić (eds.) *Multifunctional agriculture and rural development - preservation of rural values.* The thematic collection from an international scientific meeting. Institute of Agricultural Economics, Belgrade, Faculty of Agriculture, Novi Sad, Faculty of Economics, Subotica, 938-945. [In Serbian: Definisanje poljoprivrednog savetodavstva. u: *Multifunkcionalna poljoprivreda i ruralni razvoj – očuvanje ruralnih vrednosti*]
9. Meilă, A. D. (2018). The Social Structure of Cities: The Multidimensional Nature of Urban Inequality. *Psychosociological Issues in Human Resource Management*, 6(1), 115-120.
10. Sekulić-Maksimović, N., Živadinović, J.& Dimitrijević, L. (2018). Concerns about hamonization process of Serbian agricultural policy with EU standards. *Economics of Agriculture*, vol. 65, no. 4, pp. 1627-1639.
11. Smith, A., & Stirling, A. (2018). Innovation, sustainability and democracy: an analysis of grassroots contributions. *Journal of Self-Governance and Management Economics*, 6(1), 64-97.
12. Novković, N. i Šomođi, Š. (1999). *Agromenagement*, Information Center, Padinska Skela, Belgrade. [In Serbian: Agromenadžent]

13. Ogrizović, B. i Teofanov, S. (2007). The role and importance of the agricultural advisory service of AP Vojvodina. *Modern agricultural technology*, 33(3-4), 213-219. [In Serbian: Uloga i značaj poljoprivredne savetodavne službe AP Vojvodine]
14. Tomić, R., i Živković, D. (2004), Changes in the Agricultural Advisory Service of Serbia. *Biotechnology*, Vol. 20, 5-6, 293-300. [In Serbian: Promene u poljoprivrednom savetodavstvu Srbije]
15. Tumbas, P. i Krmpotić, T. (2001). Information in the decision-making process of farmers. *Journal of Scientific Society of Power Machines, Tractors and Maintenance*, 6 (2), 7-12. [In Serbian: Informacije u procesu odlučivanja poljoprivrednika]
16. Tumbas, P. i Krmpotić, T. (2008). Agricultural advisory-strategies and organizational models. *Journal of Scientific Society of Power Machines, Tractors and Maintenance*, 3 (5), 51-56. [In Serbian: Poljoprivredno savetodavstvo-strategije i modeli organizovanja]
17. Veselinović, B., Ševarlić, M. i Vasiljević, Z. (2002), Agricultural advisory service and education of manufacturers - the factor of integration into the European Union. *Economist*, (3), 189-200. [In Serbian: Poljoprivredna savetodavna služba i edukacija proizvođača – činilac integracije u Evropsku Uniju]

EUROPEAN UNION COUNTRIES AGRI-FOOD TRADE STRUCTURES AND MAIN COMPETITORS ON THE INTERNAL AND GLOBAL AGRI-FOOD MARKETS

Štefan Bojnec[1], Imre Fertő[2]

**Corresponding author E-mail: stefan.bojnec@fm-kp.si; stefan.bojnec@siol.net*

ARTICLE INFO

Review Article

Received: *9 May 2019*

Accepted: *14 June 2019*

doi:10.5937/ekoPolj1902635B

UDC 339.13.024:338.439.01(497.13:4-672EU)

Keywords:

agri-food trade patterns, assessment of competitiveness, revealed comparative advantage, European Union

***JEL**: F14, Q17; Q18*

ABSTRACT

The paper investigates the key insights of European Union (EU) member states agri-food export and import structures and main competitors in the internal and global agri-food markets in terms of geographical distributions and product coverage. The focus is on four agri-food product groups in global trade: fruit and vegetable products, grain products, meat products, and dairy products. The identification of the major competitors in internal EU markets and major EU competitors in global agri-food trade by calculating revealed comparative advantage indices show considerable differences by products and product groups, but in general the major competitors of the EU member states in the analysed global agri-food markets were particularly overseas countries such as the United States of America, Canada, Argentina, New Zealand, and Australia.

Introduction

This paper focuses on three research objectives: First, the identification of major export and import structures and patterns of European Union (EU) countries in terms of geographical distributions and product coverage. To arrive at this aim, we calculated both export and import shares in the global agri-food trade and export and import shares regarding the main agri-food product groups in global trade. Therefore, the main product focus was on the analysis of the main agri-food product groups, i.e. those which were the most important in value of agri-food exports and those which were typical across

1 Dr. Štefan Bojnec, Professor of Economics and Head of Department of Economics, University of Primorska, Faculty of Management, Cankarjeva 5, SI-6101 Koper, Slovenia, phone number: +386 5 610 2046, e-mail: stefan.bojnec@fm-kp.si; stefan.bojnec@siol.net, ORCID ID: (https://orcid.org/0000-0002-1270-6372)

2 DDr. Imre Fertő, Director, Institute of Economics, Centre for Regional and Economic Studies, Hungarian Academy of Sciences, Tóth K. u. 4, H-1097 Budapest, Hungary, e-mail: ferto.imre@krtk.mta.hu, and Professor of Agricultural Economics, Kaposvár University, Guba Sándor u. 4, H-74000 Kaposvár, Hungary, phone number: +36 82 505800, e-mail: ferto.imre@ke.hu, ORCID ID (http://orcid.org/0000-0002-3742-5964)

the EU-27 member states. This is prior of accession of Croatia, which is analysed by Buturac et al. (2017). The analysis was limited to the four agri-food product groups: fruit and vegetable products, grain products, meat products, and dairy products. On the basis of this disaggregated commodity groups, trade analysis was conducted for the EU-27 member states. The second objective concentrated on the identification of the major competitors in internal EU markets. Finally, the third objective was to identify major EU competitors in global agri-food trade by constructing/ calculating revealed comparative advantage (RCA) indices from the available trade data.

The remainder of the paper is organised as follows: the next section presents materials and methods. The following section describes EU-27 agri-food trade structures by main products chains and discusses main findings on major competitors in the EU internal market, presents and describes RCA indices for main EU competitors in global agri-food exports. The final section derives main conclusions.

Materials and methods

The paper employs export and import shares and calculates Balassa's (1965) revealed comparative advantage (RCA) index to investigate main EU competitors in global agri-food exports (Bojnec and Fertő, 2009, 2015a, 2017b). The RCA index empirically identifies a country's weak and strong export sectors. The RCA index has been defined by Balassa (1965) as:

$$RCA = (Xij / Xit) / (Xnj / Xnt),$$

where X represents exports, i is a country, j is a commodity, t is a set of commodities, and n is a set of countries that is used as the benchmark of comparison for export markets. RCA is based on observed export patterns.

The results of the RCA index presented here are calculated at the World Customs Organisation's Harmonised System (HS) at the six-digit level. The RCA measures a country's exports of a commodity relative to its total exports and to the corresponding export performance of a set of countries, e.g. the world's agri-food exports. If RCA > 1, then a country's agri-food comparative advantage in the world market is revealed. Despite some critiques of the RCA index as an export specialisation index, such as the asymmetric value problem, the problem with logarithmic transformation (De Benedictis and Tamberi, 2004) and the importance of the simultaneous consideration of the import side (Vollrath, 1991), it can provide useful evidence regarding the competitiveness of the EU-27 agri-food exports in global markets.

The UN Comtrade database - International Trade Statistics at the six-digit harmonised commodity description and coding systems (HS6-1996) is used for agri-food exports of the EU-27 countries to world markets. Agri-food trade as defined by the World Customs Organisation contains 789 product groups. The UN Comtrade database is used with the World Integrated Trade Solution (WITS) software developed by the World Bank, in close collaboration and consultation with various international organisations,

including the United Nations Conference on Trade and Development (UNCTAD), the International Trade Center (ITC), the United Nations Statistical Division (UNSD) and the WTO (2018). The UNSD (2018) Comtrade database with WITS (World Trade Integration Solution) software was used in calculations.

Results and Discussion

EU agri-food trade structures by main products chains

In a spite of the increasing importance of the BRIC-4 (Brazil, Russia, India and China) countries (Bojnec, Fertő and Fogarasi, 2015), the EU-27 remained one of the key players in the global agri-food markets, both export and import.

After the EU enlargements in 2004 and 2007, the EU-27 member states' agri-food trade deficit first decreased, and then turned to be positive in 2010 and 2011 (Bojnec and Fertő, 2015c). The EU-27 member states that substantially contributed to the diverse surpluses were/are: the Netherlands, France, Spain, Denmark, Ireland, and Belgium among the old EU-15 member states, and Hungary, Poland, Bulgaria, and Lithuania among the new EU-12 member states.

The share of EU-27 in the global agri-food exports declined from 47.2% in 2000 to 41.3% in 2011 (Table 1). However, this decrease cannot be ascribed to all member states alike but was caused by the old EU-15 member states, since their shares dropped by 8.2percentage points (henceforth pp) during in the analysed period. In comparison, the new EU member countries were even able to increase their aggregated shares by 2.3pp. The highest export shares in 2011 were achieved by the following the EU-27 member states: the Netherlands (7.4%), Germany (6.5%), France (5.9%), Belgium (3.4%), Italy (3.2%), and Spain (3.1%).

Table 1. Agri-food export shares in the world market for selected EU country groups and countries (in %)

	2000	2003	2005	2008	2011	Change (2000-2011) in percentage points
EU-27	47.2	49.1	48.1	45.1	41.3	-5.9
EU-15	45.0	46.4	44.6	40.7	36.8	-8.2
EU-12	2.2	2.6	3.5	4.4	4.5	2.3
France	8.5	8.3	7.5	6.7	5.9	-2.6
UK	3.8	3.5	3.0	2.4	2.3	-1.6
Poland	0.6	0.8	1.3	1.5	1.5	0.9
Romania	0.1	0.1	0.1	0.3	0.4	0.3

Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

The EU-27 member states share in the global agri-food imports declined from 45.5% in 2000 to 40.7% in 2011 (Table 2). Moreover, the import share is slightly lower than the export share. While the old EU member states managed to decrease their share in global agri-food imports by 6.4pp – the total value of agri-food imports still increased –, the

new members' import accounted for a larger portion of global food imports (+1.6pp). The highest import shares took the following EU-27 member states: Germany, the Netherlands, the United Kingdom (UK), France, Italy, and Belgium. The results so far imply some correlation between import and export shares, which in turn suggest that those EU countries that export also import a lot of agri-foods and thus participate more in the global food supply chains (Bojnec and 2017a).

Table 2. Agri-food import shares in the world market for selected EU country groups and countries (in %)

	2000	2003	2005	2008	2011	Change (2000-2011) in percentage points
EU-27	45.5	47.7	47.1	44.9	40.7	-4.8
EU-15	42.7	44.7	43.4	40.2	36.4	-6.4
EU-12	2.7	3.0	3.7	4.7	4.4	1.6
UK	6.4	6.6	6.6	5.4	4.7	-1.7
Italy	5.3	5.2	4.9	4.2	3.9	-1.4
Poland	0.8	0.7	1.0	1.3	1.3	0.5
Netherlands	4.3	4.6	4.3	4.7	4.8	0.5

Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

With respect to export structures, there exist some regional differences and similarities between the EU-27 member states and over time for the Broad Economic Classification (BEC) system of agri-food product groups in the global markets. Indeed, by conducting the analysis with BEC product groups, it was possible to single out some specific regional structures in the EU-27 member states agri-food imports.

The EU-27's share in grain exports in the global markets declined from 27.3% in 2000 to 23% in 2011 (Table 3). After the EU enlargements, the grain export shares most significantly decreased for the following old EU-15 member states: France (with more than one-third of the EU-27 member states' total grain export value, -2.6pp, Germany (-1.8pp), the UK (-1.6pp), Italy (-0.6pp), Belgium (-0.5pp), the Netherlands (-0.3pp), and Spain (-0.2pp). Most new member states increased their shares, e.g. Romania (+0.9pp) and Poland (+0.5pp).

Table 3. Grain products export shares in the world market for selected EU country groups and countries (in %)

	2000	2003	2005	2008	2011	Change (2000-2011) in percentage points
EU-27	27.3	27.2	26.0	24.0	23.0	-4.3
EU-15	25.9	25.4	22.8	19.6	18.1	-7.8
EU-12	1.4	1.8	3.2	4.4	4.9	3.5
France	10.5	10.3	9.3	7.9	7.9	-2.6
Germany	4.8	4.0	4.0	3.6	3.0	-1.8
Romania	0.1	0.0	0.2	0.7	1.0	0.9
Poland	0.0	0.2	0.5	0.3	0.5	0.5

Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

Turning to fruit and vegetables, the export shares developed as follows: the total share of the EU-27 member states declined from around 46% at the beginning of the analysed period to around 40% at the end (Table 4). However, it has mainly been the old EU member states that experienced a sharp decline in their export shares, more precisely in total by -7.5pp, of which e.g. Italy and France accounted for -1.7pp and -1.6pp, respectively. In contrast, as the new EU members could report increasing values, e.g. Poland (+0.5pp) and Lithuania (+0.4pp), they could improve their position and played a slightly greater/ more important role in the global grain export market (in total +0.9pp).

Table 4. Fruit and vegetable products export shares in the world market for selected EU country groups and countries (in %)

	2000	2003	2005	2008	2011	Change (2000-2011) in percentage points
EU-27	45.6	49.3	45.7	46.2	39.6	-6.6
EU-15	43.2	46.8	42.7	42.2	36.3	-7.5
EU-12	2.4	2.5	3.0	4.0	3.3	0.9
Italy	6.3	6.4	5.5	5.8	4.8	-1.7
France	5.2	5.4	4.7	4.2	3.6	-1.6
Poland	1.0	1.3	1.4	1.8	1.5	0.5
Lithuania	0.1	0.1	0.1	0.5	0.5	0.4

Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

In 2011, the EU-27 was the main supplier of dairy products to the world. Almost two thirds of the value of dairy products was provided by this group (Table 5). However, its share fell by 7.9pp from 2000 to 2011; a drop that was caused primarily by some of the old member states, e.g. France (-3.4pp) and Germany (-1.7pp). Altogether, the EU wide decline could be reduced/ weakened by slight increases in the dairy products exports shares of some new members, in particular Poland (+1.4pp) and the Czech Republic (+0.5pp).

Table 5. Dairy products export shares on the world market for selected EU country groups and countries (in %)

	2000	2003	2005	2008	2011	Change (2000-2011) in percentage points
EU-27	73.3	74.6	71.1	67.4	65.4	-7.9
EU-15	70.0	71.1	65.3	60.9	59.2	-10.8
EU-12	3.3	3.5	5.8	6.5	6.2	2.9
France	13.9	13.4	12.1	11.3	10.5	-3.4
Germany	15.3	15.5	15.3	14.2	13.6	-1.7
Poland	1.0	1.2	2.6	2.6	2.4	1.4
Czech Republic	0.6	0.6	1.0	1.2	1.1	0.5

Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

In 2011, the EU-27accounted for nearly 50% of global meat trade (Table 6). But, there existed substantial differences both in the size of shares and development patterns. In

2011, the EU-27 member states with the highest meat export shares were Germany (9.2%), the Netherlands, France (4.5%), Denmark (4.1%), Spain (3.9%), Belgium (3.7%), and Poland (2.9%). However, similarly with the other products the shares of the old EU-15 member states drastically decreased, while, on average, the new EU-12 member states were able to gain export shares in global markets.

Table 6. Meat products export shares on the world market for selected EU country groups and countries (in %)

	2000	2003	2005	2008	2011	Change (2000-2011) in pp
EU-27	49.1	50.0	49.4	49.8	48.4	-0.7
EU-15	46.6	46.9	45.5	45.0	42.8	-3.8
EU-12	2.5	3.1	3.9	4.8	5.6	3.1
France	7.4	6.7	5.6	5.0	4.5	-2.9
Denmark	6.9	6.5	5.8	4.9	4.1	-2.8
Germany	5.3	6.9	8.2	9.3	9.2	3.9
Poland	0.7	1.2	1.8	2.6	2.9	2.2

Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

Major competitors in the EU-27 internal market

Among the EU-27 member states, the Netherlands and Germany represented the two top agri-food importers in external-EU trade, i.e. without considering trade between EU members.

Among the agri-food exporters to the EU-27 member states, Brazil, the United States of America (USA) and Argentina occupied the top three positions (Table 7). The top ten agri-food exporters permanently included China, Switzerland, Turkey, New Zealand (except for 2011), Indonesia (except for the 2001-2005 period), Cote d'Ivoire (except for the 2005-2008 period), and Australia (except for the 2009-2011 period), whereas the following countries only temporarily held this position: South Africa (except for 2000, 2009, and 2011), Ukraine in 2008 and 2011, Chile in 2009, and India in 2011.

Table 7. Top 10 of external EU-27 agri-food importers, 2000-2011 (billion US$)

2000	country	2003	country	2005	country	2008	country	2011	country
1.38	Switzerland	1.96	Switzerland	2.14	Indonesia	3.44	South Africa	3.69	Cote d'Ivoire
1.42	Indonesia	2.10	Australia	2.40	Australia	3.64	Ukraine	3.80	Ukraine
1.57	Cote d'Ivoire	2.14	South Africa	2.54	South Africa	3.73	New Zealand	3.92	India
1.80	New Zealand	2.52	China	2.55	Switzerland	4.38	Switzerland	4.95	Turkey
1.89	Australia	2.57	Turkey	3.12	New Zealand	4.58	Indonesia	5.33	Indonesia
1.90	Turkey	2.64	Cote d'Ivoire	3.47	China	4.64	Turkey	5.91	Switzerland
2.08	China	2.70	New Zealand	3.91	Turkey	5.88	China	6.76	China
3.49	Argentina	4.97	Argentina	5.90	Argentina	12.09	United States	9.37	Argentina
6.88	Brazil	8.79	United States	8.64	United States	12.63	Argentina	12.35	United States
8.51	United States	9.87	Brazil	12.14	Brazil	21.40	Brazil	20.99	Brazil

Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

Comparative advantage index for main EU competitors in global agri-food exports

Few studies have analysed countries global competitiveness in agri-food products (Sarker and Ratnasena, 2014; Jambor and Babu, 2016; Bojnec and Fertő, 2018a) and during the most recent economic crisis (Bojnec and Fertő, 2018b).

Most of the analysed BRICS-5 countries (BRIC-4 and South Africa), the North American Free Trade Agreement (NAFTA-3) countries (Canada, the USA, and Mexico), MIST-4 (Mexico, Indonesia, South Korea, and Turkey), and Tiger Cup-4 countries (Indonesia, Malaysia, the Philippines, and Thailand) were found to be competitive in agri-food exports and revealed comparative advantages (RCA>1) in global markets (Table 8). Furthermore, existing export specialisation of countries could be proved for a smaller number of agri-food products with the RCA index. A larger number of agri-food products with RCA>1 existed for some overseas countries, such as the USA and Canada among the analysed four larger trading groups. In addition, other strong competitors in global agri-food markets were Argentina, New Zealand and Australia.

Table 8. Changes in RCA indices between 2000 and 2011 for main EU competitors in global agri-food markets

	Mean		Median		Share RCA>1 (in %)	
	2000	**2011**	**2000**	**2011**	**2000**	**2011**
Brazil	2.289	1.823	0.128	0.082	22.8	22.1
China	1.522	0.668	0.173	0.113	26.0	19.9
India	4.089	1.899	0.165	0.097	35.0	24.9
Russia	0.287	0.219	0.016	0.009	5.1	5.7
South Africa	1.764	1.297	0.198	0.153	23.5	21.8
Mexico	0.884	0.938	0.105	0.099	18.9	19.8
Argentina	4.976	4.718	0.391	0.503	39.2	39.9
Australia	3.048	1.733	0.381	0.158	35.8	22.7
Canada	0.976	1.240	0.186	0.218	24.4	25.8
Indonesia	2.223	2.360	0.066	0.060	21.4	21.3
Japan	0.094	0.122	0.012	0.010	2.4	1.7
New Zealand	10.913	9.621	0.213	0.199	32.5	33.7
South Korea	0.268	0.194	0.023	0.009	5.2	4.6
Switzerland	0.460	0.355	0.025	0.019	12.1	6.4
Turkey	4.450	2.455	0.173	0.156	29.4	26.0
United States	1.053	1.144	0.628	0.606	36.8	36.6
Malaysia	1.133	1.244	0.066	0.110	14.0	17.2
Philippines	1.979	16.261	0.059	0.100	14.4	22.6
Thailand	2.033	1.474	0.112	0.077	21.9	21.2
BRICS	1.990	1.181	0.136	0.091	22.5	18.9
NAFTA	0.971	1.107	0.306	0.308	26.7	27.4
MIST	1.956	1.487	0.092	0.081	18.7	18.0
Tiger Cup	1.842	5.335	0.076	0.087	17.9	20.6

Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

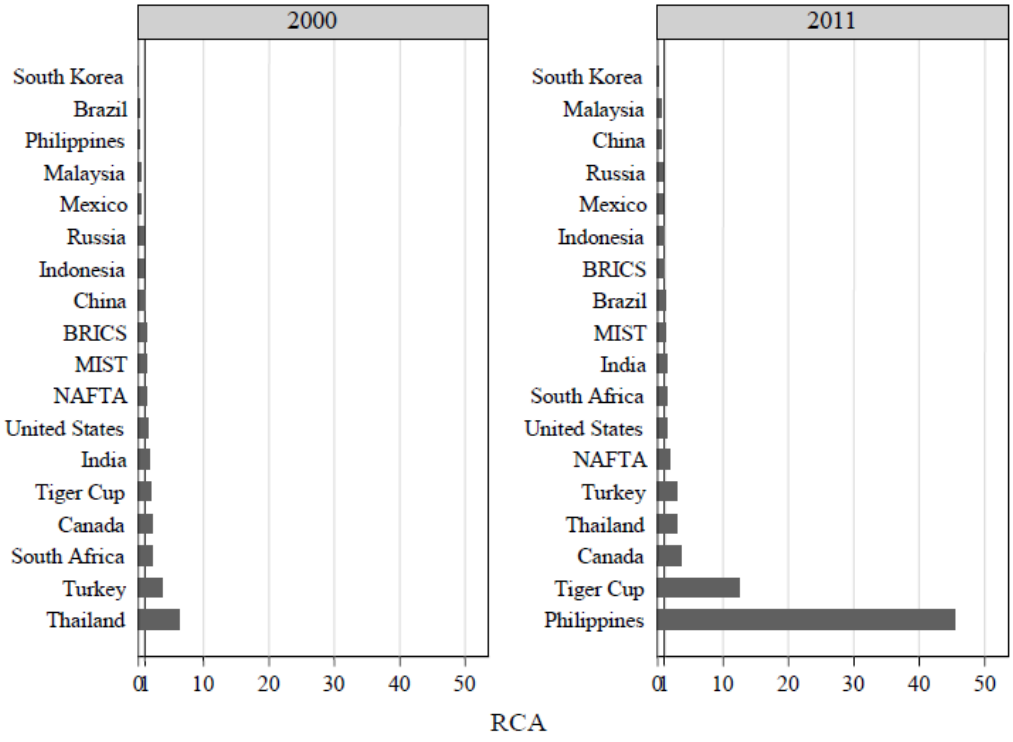
Grain supply chain

In the global grain products markets, the EU-27 member states' export shares deteriorated slightly (Bojnec and Fertő, 2016a). The main competitors among the analysed countries were the USA, Canada, Thailand, India, Russia, and Brazil.

With respect to revealed comparative advantage in the global markets for grain products, Canada, the Philippines and, to a lesser extent, Brazil increased/strengthened their position (RCA>1), while the RCA>1 indices for the USA remained more stable (Figure 1). The relatively high RCA indices of Turkey and Thailand deteriorated, as well as the indices of India and South Africa.

Overall, the BRICS lost their revealed comparative advantage, while the NAFTA and especially the Tiger Cup countries gained revealed comparative advantages for grain products in this global market.

Figure 1. Mean values of RCA indices for grain products exports in global markets for main EU competitors, 2000 and 2011



Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

The analysis of grain products in the global market in a more disaggregated context with single BEC product groups renders a more detailed picture. The analysis considered the following product groups: BEC 21 with primary grain products, BEC 111 with primary grain

products mainly for industry, BEC 121 with processed grain products mainly for industry, and finally BEC 122 with processed grain products mainly for household consumption.

For BEC 21, Canada, the USA, South Africa and Brazil increased their revealed comparative advantages (RCA>1 indices).

For BEC 111, Canada, the USA, India, and Thailand (with some annual variations) strengthened their revealed comparative advantages (RCA>1 indices), while China and Turkey lost ground and achieved revealed comparative disadvantages (RCA<1 indices).

Turning to BEC 121, Canada, the Philippines, Mexico, and with annual variations particularly Indonesia and Turkey strengthened their revealed comparative advantage (RCA>1 indices), while Thailand scored/ yielded relatively high RCA>1 indices, and India and South Africa suffered deteriorations of their RCA>1 indices. Finally, the USA and particularly Russia lost their revealed comparative advantage (RCA>1 indices) to develop reveal comparative disadvantage (RCA<1 indices).

Finally, in the global markets for BEC 122, Turkey and Canada gained revealed comparative advantages (RCA>1 indices). The relatively high RCA>1 indices of Thailand deteriorated, and some of India's RCA>1 indices also declined, while the USA lost their revealed comparative advantage in 2011.

Fruit and vegetable products supply chain

The global fruit and vegetables products markets developed as follows: The EU-27 member states' export shares slightly declined (Bojnec and Fertő, 2016b). The USA, though with a slight deterioration over time and China with increasing significance, were the most important competitors in these markets. Turkey, Thailand, India and South Africa also could increase their importance, whereas Brazil and Canada lost importance.

Among the countries with revealed comparative advantages (RCA>1 indices) in these markets, Mexico, the Philippines, and the USA strengthened their revealed comparative advantages during the most recent years, while some deterioration of relatively high RCA indices were observed for Turkey, India, Thailand, and, to a lesser extent, for South Africa. Overall, the BRICS lost their revealed comparative advantage, and the MIST experienced declines in their revealed comparative advantages. Nevertheless, the NAFTA and the Tiger Cup countries increased their revealed comparative advantages (Figure 2).

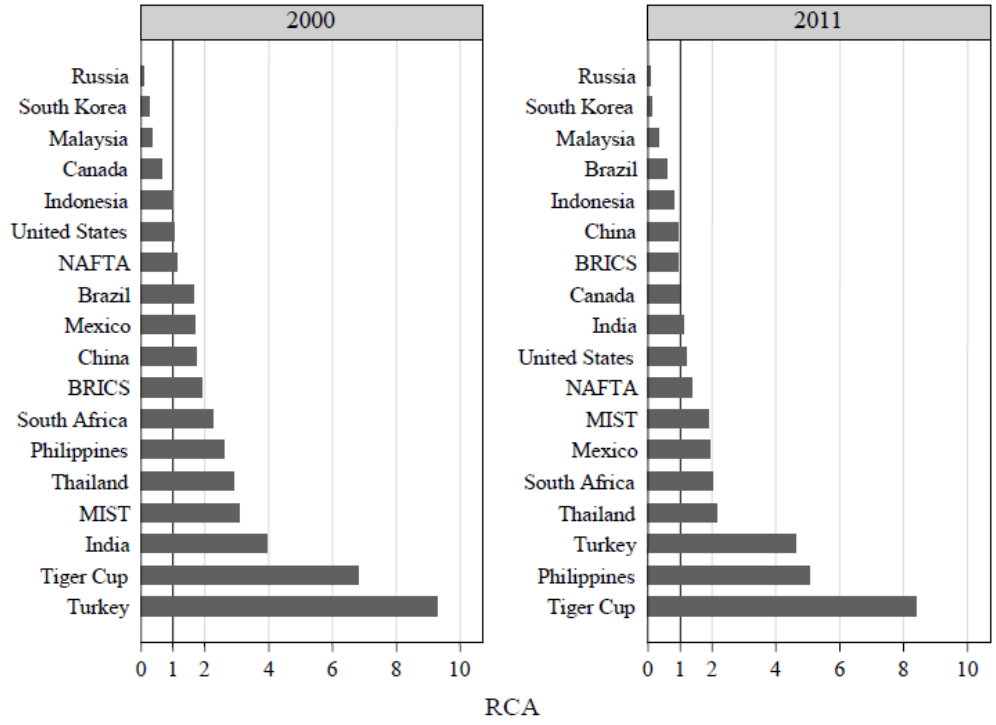
The analysis of disaggregated product groups within the fruit and vegetable products supply chain was conducted with MTN groups, namely: MTN 1201 with fruit and vegetables fresh or dried, MTN 1202 with fruit and vegetables semi-processed and MTN 1203 – fruit and vegetables prepared or preserved.

South Africa, Mexico, the Philippines, the USA and, to a lesser extent, Canada increased their revealed comparative advantage (RCA>1 indices) in the global market for MTN 1201, while Turkey and Thailand had to face a slight deterioration of their relatively higher values of the RCA indices.

For MTN 1202, Mexico gained revealed comparative advantages (RCA>1 indices). The very high RCA indices of India and Turkey declined, and China also saw a slight decline in the revealed comparative advantage (RCA>1).

Finally, in the global market for MTN 1203, the Philippines strengthened its revealed comparative advantage (RCA>1 indices). Turkey and Thailand lost as their very high RCA indices declined, while China, India, and South Africa only observed slight declines in the revealed comparative advantage (RCA>1).

Figure 2. Mean values RCA indices for fruit and vegetables products exports in global markets for main EU competitors, 2000 and 2011



Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

Dairy products supply chain

The EU-27 member states remained the major player for dairy products exports (Bojnec and Fertő, 2014a). However, the USA increased its export shares for dairy products in these global markets.

The Philippines strengthened its revealed comparative advantages (RCA>1 indices), while India lost its revealed comparative advantages (Figure 3).

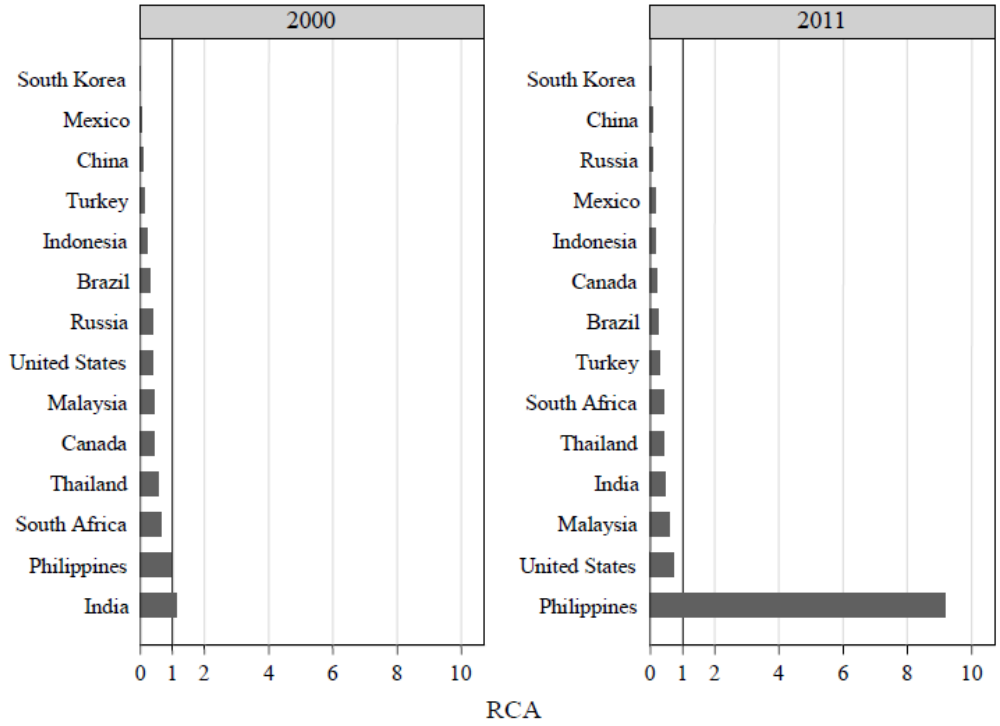
Again, the more detailed analysis of the global markets is conducted with BEC product groups, namely BEC 22 with industrial dairy supplies not elsewhere specified, BEC 112 –

primary dairy products mainly for household consumption, BEC 121with processed dairy mainly for industry and BEC 122 – processed dairy mainly for household consumption.

Within BEC 22, none of the analysed countries achieved a revealed comparative advantage (RCA>1 indices). India and Russia were the only ones that lost their revealed comparative advantage within this product group.

The same holds true for BEC 112. Here as well, none of the analysed countries had a revealed comparative advantage (RCA>1 indices).

Figure 3. Mean values of RCA indices for dairy products exports in global markets for main EU competitors, 2000 and 2011



Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

In the category BEC 121, the USA strengthened its revealed comparative advantage (RCA>1 indices), while the RCA>1 indices of India deteriorated. Brazil and Canada lost their revealed comparative advantages.

For BEC 122 products, the Philippines and, to a lesser extent, Malaysia strengthened their revealed comparative advantage (RCA>1 indices).

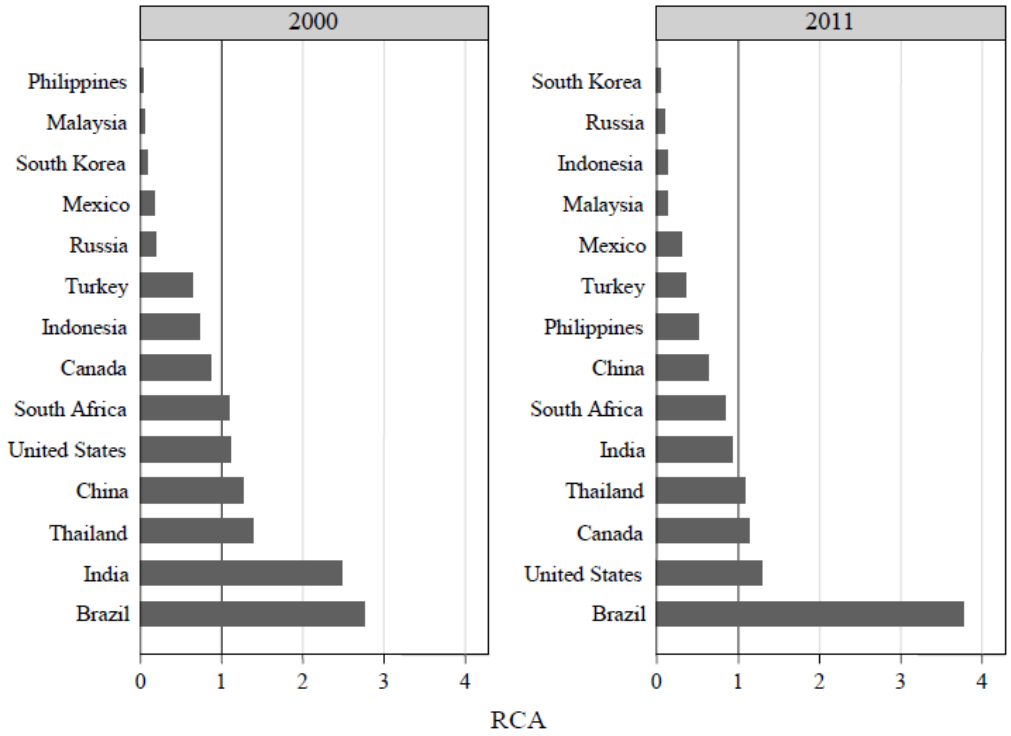
Meat products supply chain

The EU-27 member states' export shares in the world's meat products markets deteriorated slightly (Bojnec and Fertő, 2014b). Among the analysed countries, the

main competitors developed differently: the USA faced declining export shares, while Brazil increased its export shares. The same went for other less important competitors. E.g. Canada and China dealt with declining export shares, whereas India and Thailand emerged with increasing export shares.

With respect to revealed comparative advantages, Brazil, Canada and, to a smaller degree, the USA achieved growing RCA>1 indices in the global markets for meat products, while Thailand saw/ experienced some deteriorations in the RCA>1 indices (Figure 4). India, China, South Africa and Indonesia lost their revealed comparative advantage (RCA>1 indices), and in 2011 even experienced revealed comparative disadvantages (RCA<1 index).

Figure 4. Mean values of RCA indices for meat products exports in global markets for main EU competitors, 2000 and 2011



Source: Authors' calculations based on the UNSD Comtrade database with WITS (World Trade Integration Solution) software.

As with most of the other product groups, the global markets for disaggregated meat products was analysed using the BEC classification: BEC 21 – primary meat products, BEC 22 – industrial meat supplies not elsewhere specified; processed, BEC 121 – processed meat mainly for industry, and BEC 122 – processed meat mainly for household consumption.

In markets for BEC 21, Canada, the USA, Brazil, South Africa, the Philippines, and Thailand increased their revealed comparative advantage (RCA>1 indices). A deterioration pattern in development in the relatively high RCA>1 indices was observed for China and India, while Turkey lost its revealed comparative advantage.

In the group BEC 22, the USA improved its revealed comparative advantage (RCA>1 indices), while South Africa lost its revealed comparative advantage.

For the global BEC 121 markets, the same developments were true, although with different countries: here, Canada increased its revealed comparative advantage (RCA>1 indices), while Brazil and Mexico lost their revealed comparative advantage.

Finally, as regard BEC 122, Brazil strengthened, and on a smaller scale Canada and the USA, its revealed comparative advantage (RCA>1 indices). Thailand experienced deteriorations in its RCA>1 indices, while India and Indonesia lost their revealed comparative advantage.

Conclusions

This paper intended to identify significant products and major competitors in the international and internal EU markets. The empirical results show that the EU-27 member states remain one of the larger players in the global agri-food markets on both the export and import side. After the EU enlargements in 2004 and 2007, the EU-27 member states agri-food trade deficit was first reduced, and then switched to be positive in 2010 and 2010. The EU-27 member states, which significantly contributed to the agri-food trade surpluses, were: among the old EU-15 member states the Netherlands, France, Spain, Denmark, Ireland, and Belgium, and among the new EU-12 member states Hungary, Poland, Bulgaria, and Lithuania.

With respect to major agri-food export patterns, expressed as share of the EU-27 member states in the global agri-food exports, the whole EU-27 faced a decline, from 47.2% in 2000 to 43.3% in 2011. The highest export shares went with the following EU-27 member states: the Netherlands, Germany, France, Belgium, Spain and Italy.

On the other hand, as regards major import patterns, which are measured by the EU-27 member states share in the global agri-food imports, the corresponding share decreased from 46.5% in 2000 to 40.7% in 2011. The EU-27 member states import share was slightly lower than the export share. The highest import shares were received by the following EU-27 member states: Germany, the Netherlands, the UK, France, Italy, and Belgium. Moreover, the results imply some correlation between import and export shares.

The EU-27 member states share in the grain exports in the global markets declined from 27.3% in 2000 to 23.0% in 2011. After the EU enlargements, the grain export shares were reduced, this was particularly true for the most important old EU-15 member states grain exporters: France (which accounted for more than one-third of export share of the EU-27 member states grain exports), Germany, the UK, Italy, Belgium, the Netherlands, and Spain. Most new EU-12 member states increased their export shares in the global grain markets.

The EU-27 member states' fruit and vegetable export shares declined from around 46% at the beginning of the analysed period to around 40% at the end of the analysed period. This overall decline was also reflected in the decline of the main EU-27 exporters within this market, namely Spain, the Netherlands, Italy, Belgium, France, Greece, and the UK.

The EU-27 member states achieved a close to 50% export share in global meat products trade, however with substantial differences among the EU member states regarding both export shares and development patterns. The meat export shares were highest for the following of the EU-27 member states: Germany, the Netherlands, France, Denmark, Spain, Belgium, and Poland.

The EU-27 member states achieved the highest export shares in the global dairy markets, though at a decreasing level over time. So, the shares fell by 7.9 percentage points/pp from 73.3% in 2000 to 65.4% in 2011. The greatest export shares among the EU-27 member states were achieved by the following old EU-15 member states: Germany, France, the Netherlands, and Belgium.

These results state that the EU-27 member states realised the highest, but lately deteriorating, global export shares for dairy products, relatively/ more or less stable export shares for meat products, and declining export shares for fruit and vegetables and grains. Among these four groups of agri-food products the lowest export shares went with grain products.

Regarding the second objective to identify major competitors in internal EU markets, Brazil, the USA and Argentina led the group of the top three external agri-food competitors in the EU-27 member states' markets. This group was followed by China, Switzerland, Turkey, New Zealand, Indonesia, Cote d'Ivoire, Australia, and South Africa. In addition, Ukraine, Chile, and India emerged as important external competitors in the EU-27 member states' agri-food markets during the most recent years of the investigated period.

Finally, regarding the third objective to identify major EU competitors in global agri-food trade, constructing revealed comparative advantage indices from appropriate trade data were calculated. The empirical analysis of the revealed comparative advantage indices using the global trade as the benchmark of comparisons identified some overseas countries from different destinations/parts of the world as major competitors of the EU-27 member states in global agri-food markets: among others the USA, Canada, Argentina, New Zealand, and Australia. The focus of the analysis was placed upon on BRICS-5 (Brazil, Russia, India, China and South Africa), NAFTA-3 (Canada, Mexico, and the USA), MIST-4 (Mexico, Indonesia, South Korea, and Turkey), and Tiger Cup-4 (Indonesia, Malaysia, the Philippines, and Thailand) countries.

The analysis of the major EU competitors in global agri-food chains concentrated on the previously identified four main groups of products: grains, fruit and vegetables, dairy and meat products.

In the global grain products markets important competitors of the EU-27 member states were the USA, Canada, Thailand, India, Russia, Brazil, Turkey and South Africa. Canada, the Philippines and, to a lesser extent, Brazil could improve their revealed comparative advantage indices.

The USA and China turned out to be the major competitors in the global fruit and vegetables produce markets. Turkey, Thailand, India and South Africa also increased their importance and export competitiveness. Among the countries with revealed comparative advantages in these markets also appeared Mexico, the Philippines, Thailand and on a smaller scale, South Africa.

With respect to global dairy products, important competitors were the USA as well as the Philippines, particularly in the BEC 122 – processed dairy mainly for household consumption.

In the global meat products markets, the list of main competitors included – among others- the USA, Brazil, Canada, China, India, Thailand, and, in the BEC 21 (primary meat products) also South Africa and the Philippines.

Among study limitation, this is the coverage of data sample. Therefore, among issues for research in future is to update data sample with the most recent years, capturing the global economic and financial crises, and economic recovery with possible effects on agri-food trade and competitiveness.

Acknowledgements

This paper was generated as part of the COMPETE Project, Grant Agreement No. 312029 (http://www.compete-project.eu/), with financial support from the European Community under the 7th Framework Programme.

Conflict of interests

The authors declare no conflict of interest.

References

1. Balassa, B. (1965). Trade liberalization and revealed comparative advantage. *The Manchester School of Economic and Social Studies, 33*(2), 99-123.
2. Bojnec, Š., & Fertő, I. (2009). Agro-food trade competitiveness of Central European and Balkan countries. *Food Policy, 34*(5), 417-425.
3. Bojnec, Š., & Fertő, I. (2014a). Export competitiveness of dairy products on global markets: The case of the European Union countries. *Journal of Dairy Science, 97*(10), 6151-6163.
4. Bojnec, Š., & Fertő, I. (2014b). Meat export competitiveness of European Union countries on global markets. *Agricultural and Food Science, 23*(3), 194-206.
5. Bojnec, Š., & Fertő, I. (2015a). Agri-food export competitiveness in European Union countries. *Journal of Common Market Studies, 53*(3), 476-492.

6. Bojnec, Š., & Fertő, I. (2015b). Fruit and vegetable trade competitiveness of European Union countries. *Mitteilungen Klosterneuburg Rebe und Wein, Obstbau und Früchteverwertung, 65*(1), 56-71.
7. Bojnec, Š., & Fertő, I. (2015b). Does enlargement has caused intra and extra European Union agri-food trade? *Bulgarian Journal of Agricultural Science, 21*(1), 1-15.
8. Bojnec, Š., & Fertő, I. (2016a). Drivers of the duration of grain competitiveness in European Union countries. *Journal of Agricultural Science and Technology, 18*(5), 1173-1185.
9. Bojnec, Š., & Fertő, I. (2016b). Export competitiveness of the European Union in fruit and vegetable products in the global markets. *Agricultural Economics – Czech (Zemědělská ekonomika), 62*(7), 299-310.
10. Bojnec, Š., & Fertő, I. (2017a). Quality upgrades of EU agri-food exports. *Journal of Agricultural Economics, 68*(1), 269-279.
11. Bojnec, Š., & Fertő, I. (2017b). The duration of global agri-food export competitiveness. *British Food Journal, 119*(6), 1378-1393.
12. Bojnec, Š., & Fertő, I. (2018a). Drivers of the duration of comparative advantage in the European Union's agri-food exports. *Agricultural Economics – Czech (Zemědělská ekonomika), 64*(2), 51-60.
13. Bojnec, Š., & Fertő, I. (2018b). Economic crisis and the fragility of comparative advantage in European agriculture. *German Journal of Agricultural Economics*, 67(3), 147-159.
14. Bojnec, Š., Fertő, I., & Fogarasi, J. (2015). Quality of institutions and the BRIC countries agro-food exports. *China Agricultural Economic Review, 6*(3), 379-394.
15. Buturac, G., Lovrinčević, Ž., & Mikulić, D. (2017). International competitiveness and restructuring of the Croatian food industry. *Acta Oeconomica, 67*(3), 435-462.
16. De Benedictis, L., & Tamberi, M. (2004). Overall specialization empirics: techniques and applications. *Open Economies Review, 15*(4), 323-346.
17. Jambor, A., & Babu S. (2016). *Competitiveness of Global Agriculture.* Springer, Cham.
18. Sarker, R., & Ratnasena, S. (2014). Revealed comparative advantage and half-a-century competitiveness of Canadian agriculture: A case study of wheat, beef, and pork sectors. *Canadian Journal of Agricultural Economics, 62*(4), 519-544.
19. United Nations Statistical Division (UNSD). Commodity Trade Database (COMTRADE), Available through World Bank's World Integrated Trade Solution (WITS), Retrieved from http://www.wits.worldbank.org (March 20, 2018).
20. Vollrath, T.L. (1991). A theoretical evaluation of alternative trade intensity measures of revealed comparative advantage. *Weltwirtschaftliches Archiv, 130*(2), 263-279.
21. World Trade Organisation (WTO). International Trade Statistics. Geneva: World Trade Organisation, Retrieved from http://www.wto.org/english/res_e/statis_e/its_e.htm (March 20, 2018).

PAPER TITLE – USE CAPITAL LETTERS, CENTER, BOLD, TIMES NEW ROMAN, SIZE 12

First Author Name (10pt italic, center align)[1], *First Co-Author Name (10pt italic, center align)*[2], *Second Co-Author Name (10pt italic, center align)*[3]

**Corresponding author E-mail: (10pt italic, center align)*

A R T I C L E I N F O

Original/Review Article

Received: *xx May 2018*

Accepted: *xx September 2018*

doi:xxx

UDC xxx

Keywords:

should include 4-6 key words that summarize the contents of the paper /Times New Roman, Italic, 10/

JEL:(www.aeaweb.org/jel/jel_class_system.php) */Times New Roman, Italic, 10/*

A B S T R A C T

The abstract should contain a maximum of 150 words. The abstracts should avoid any abbreviations and mathematical formulas.
The abstract is a summarization of the full report, written in one paragraph, and should include next elements:

1. Purpose
2. Methodology
3. Results
4. Conclusions
5. Recommendations
6. Additional data

/Times New Roman, 10/

Introduction

Page setup: Paper size: width 170 mm x height 240 mm; Margins: top/bottom 20 mm, left/right 18 mm; Layout: header 1,25cm, footer 1,25cm; Orientation: Portrait.

Articles should be written only in English. It is advisable to write the article in the third-person singular or plural with the use of active form. Before paper submission, please check grammatical and spelling mistakes by the spellchecker for the English language.

Paper volume up to 30.000 characters (without spaces) or 15 full pages including the text, figures, tables, references list and appendices. Articles should not be shorter than 10 pages. Depending on papers' quality, Editorial Board could also accept longer articles. Article has to be prepared electronically (on computer), in program MS Word 2003 or some later version of this program.

1 Name, academic position,institution, address, phone number, e-mail, ORCID ID (https://orcid.org/)

2 Name, academic position,institution, address, phone number, e-mail, ORCID ID (https://orcid.org/)

3 Name, academic position,institution, address, phone number, e-mail, ORCID ID (https://orcid.org/)

Introduction is the first section of an IMRAD paper. It purposes 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/

Please define abbreviations and acronyms during their first occurrence within the text, even in case that they were previously defined in article summary. Do not use abbreviations in article title, unless they can not be avoided.

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

Materials and methods are the second section of an IMRAD paper. Its purpose is to describe the experiment in such retail that a competent colleague could repeat the experiment and obtain the some or equivalent results. Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described.

For equations and formulas use the Microsoft Equation Editor or addition for equations writing MathType (www.mathtype.com). Use of built-in equation editor within the program Word 2007 is not recommended. Please check if all symbols within the equations/formulas are defined (forthwith after equation/formula). The equations are written using Microsoft Word (MathType); they are consecutively numbered and centered.

Results

Results are the third section of an IMRAD paper. Its purpose is to present the new information gained in the study being reported. It should be clear and concise. The Results are core of the paper. You shouldn`t start the Results section by describing methods that you inadvertently omitted from the Materials and Methods section. The Results must be writing in past tense.

Discussions

The final section of an IMRAD paper. Its purpose is to fit the results from the current study into the preexisting fabric of knowledge. The important points will be expressed as conclusions. This should explore the significance of the results of the work, not repeat them. A combined *Results and Discussion* section is often appropriate. Avoid extensive citations and discussion of published literature.

Many papers are rejected by journal editors because of a fault Discussion.

Conclusions

The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a *Discussion* or *Results and Discussion* section. Conclusions should provide a summary of important findings and their implicants to the area of research that is the forms of the article.

Acknowledgements

Collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.). They should be brief.

Conflict of interests

The authors declare no conflict of interest.

References

All manuscripts should be formatted using the American Psychological Association (**APA**) citation style. For additional examples, consult the most recent edition of the Publication Manual of the American Psychological Association.

Reference (author(s) of quotes) has to be entered directly in the text of article in next form (Petrović, 2012; or Petrović, Marković, 2012; or Mirković et al., 2012). Please do not write them as indexes in square brackets [3] or in footnote. Try to use a footnote only in the case of closer explanation of certain terms, or clarification of real and hypothetic situations. ***Do not numerate the pages.***

Reference list should only include works that have been published or accepted for publication. Unpublished works should be only mentioned in the text. Reference list should be with the bibliographic details of the cited books, book chapters, or journal articles.

References in not-English languages should be translated in English, and the English language has to be mentioned in brackets, for example: Максимовић, Г., Секулић, Д., Петровић, А., & Драгичевић, Д. (2017), Савремени трендови и нове стратегије конкурентности у хотелијерству, *Менаџмент у хотелијерству и туризму,* 5(2), 27-35. [in English: Maksimović, G., Sekulić, D., Petrović, A., & Dragičević, D. (2017). Contemporary trends and new competitiveness strategies in hotel industry. Hotel and Tourism Management, 5(2), 27-35.].

Literature units have to be written in font TNR, font size 11, alignment Justified, with mutual interspace of 3 pt - before/after. In all literature units only surnames are written as a whole, while all authors' names has to be shorten on to initial (initials have to

be set after surnames). Please, write surnames of all authors (do not use the style Petrović et al.). Do not combine literature units (under each ordinal number can be only one literature unit) and always write complete titles of used literature units. If used/cited literature was taken over from the internet publication, after adequate writing of literature unit, in brackets has to be note complete link from which material was taken over (available at: www.fao.org).

Citation of Books

Author's surname Initial(s) of the given name(s). (Year of Publication) *Title of Book*, Volume number (if relevant), edition (if relevant). Publisher, Place of Publication

Citation of Articles

Author's surname Initial(s) of the given name(s). (Year of publication) Title of article. *Journal Volume number* (and issue number if issues within a volume number are not consecutively paginated): Number of first and last page of article, DOI

If the cited paper is given a DOI number, it should also be included.

Citation of Websites

Author's surname Initial(s) of the given name(s). (if known) title, type of document (if relevant), date of issue (if available), web address and date of access, if the document or the website may be subject to change.

Citing a journal article found online

Author, A. (Publication Year). Article title. Periodical Title, Volume(Issue), pp.-pp. DOI:XX.XXXXX or Retrieved from journal URL

Example:

1. 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.
2. Hjalager, A. M., & Richards, G. (Eds.). (2003). *Tourism and gastronomy*. Routledge, London.
3. Mićović, A. (2017). Tourism Development and Evolution of Tourism Related Rules, *2nd 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
4. 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.

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
6. The Food and Agriculture Organization of the United Nations (FAO), Retrieved from http://www.fao.org (July 31, 2018)

TABLES AND FIGURES

All tables are to be numbered using Arabic numerals.

Tables have to be created within the text of article, not taken in the form of images from other documents. Tables should be numerated according to order of their appearance. Titles of the tables have to be given immediately above the table to which they relate. Please use following style during their formatting. Title of the table should be set with the interspace 6 pt - before and 3pt - after, in font TNR, font **size 10**, alignment **Centered**. Text within the table should be written in the font TNR, font size 9. Bold the text in the heading. Start with next paragraph at the interspace of 6 pt from the table source or note (after). During the article writing please mark in the main text all calls to a certain table (*Table 5*.). Try to fit all tables in article within the specified format of the page (Table properties – preferred width – max 97% - alignment: center). Complete text within the table cells has to be entered in next form (paragraph - spacing: before/ after 0 pt, line spacing: single). In case when table breaks on next page, broken part of the table on next page has to be accompanied by a table header.

Identify any previously published material by giving the original source in the form of a reference at the end of the table caption.

Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body.

For the best quality final product, it is highly recommended that you submit all of your artwork – photographs, line drawings, etc. – in an electronic format.

Example:

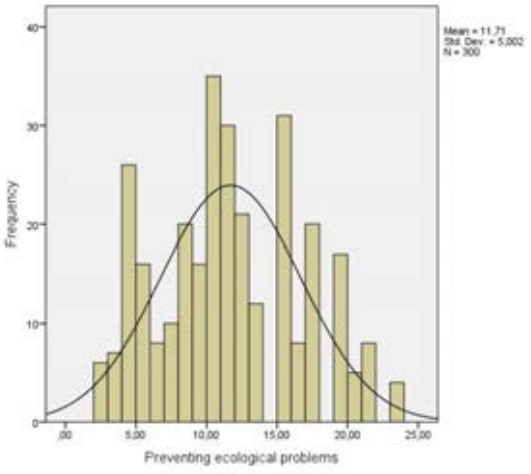
Table 1. The distribution cost of packaged goods from Subotica to retail-store objects

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

All illustrations whether diagrams, photographs or charts are referred to as Figures. The name and number of figures should be centered on the line above a figure.

Figure 1. Agriculture, value added (% of GDP)



Source: Authors' calculations

Technical preparation, prepress and printing:
DIS PUBLIC D.O.O., Braće Jerković 111-25, Belgrade, phone/fax: 011/39-79-789

Number of copies:
300 copies

The Balkan Scientific Association of Agrarian Economists, Belgrade, Serbia, Institute of Agricultural Economics, Belgrade, Serbia and Academy of Economic Studies, Bucharest, Romania is pleased to announce that journal **ECONOMICS OF AGRICULTURE** has been accepted for indexing in the ***Emerging Sources Citation Index (ESCI),*** a new edition of Web of Science.

Content in ESCI is under consideration by Clarivate Analytics, the owner of Web of Science, for additional indexing on the platform, including for the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index.

The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of **ECONOMICS OF AGRICULTURE** in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential **economics of agriculture** content to our community.

You may find necessary information on the following link:
http://mjl.clarivate.com/cgi-bin/jrnlst/jlresults.cgi?PC=MASTER&ISSN=0352-3462

Published quarterly
Journal is registered in major scientific databases:
- Web of Science (Clarivate Analytics) – Emerging Sources Citation Index (ESCI)
- EBSCO
- DOAJ
- ERIH PLUS
- AgEcon Search
- Social Science Research Network (SSRN)
- ProQuest
- Library of Congress E-Resources Online Catalog
- Ingenta Connect
- Ulrich's Periodicals Directory
- CABI
- J-Gate
- The World Wide Web Virtual Library for European Integration
- SCIndeks
- The digital repository of the National Library of Serbia
- doiSerbia
- EconLit
- WorldCat
- Mendeley

EconLit Journal is indexed in major scientific databases:
- Index Copernicus Journals Master List (ICV2013: 5,22).

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

33:63(497.11)

ЕКОНОМИКА пољопривреде = Economics of Agriculture / editor-in-chief Drago Cvijanović. - Год. 26, бр. 5 (1979)- . - Београд : Научно друштво аграрних економиста Балкана : Институт за економику пољопривреде ; Букурешт : Академија економских наука, 1979- (Belgrade : Dis Public). - 24 cm

Тромесечно. - Је наставак: Економика производње хране = ISSN 0352-3454. - Друго издање на другом медијуму: Економика пољопривреде (Online) = ISSN 2334-8453
ISSN 0352-3462 = Економика пољопривреде (1979)
COBISS.SR-ID 27671

The Ministry of Education, Science and Technological Development of the Republic of Serbia provides financial support for publishing of the quarterly journal ECONOMICS OF AGRICULTURE