CONNECTION OF GLOBAL G.A.P. STANDARDS AND PRECISION AGRICULTURE

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ABSTRACT

The goal of writing the paper is to point out the importance of introducing standards in the process of primary agricultural production, because its benefits are multiple: economic, ecological and social. In this case, it means more effective introduction of Global G.A.P. standards that were observed from two aspects. *The first,* which significantly contributes to the production of health-safe food that is of controlled quality, to better health of the population at the global level and to the preservation of biodiversity. *Second,* by introducing precision agriculture into primary agricultural production, it is easier to adapt to the requirements of Global G.A.P. standards. Data on the number of farms that have these certificates, as well as the area that was in the Global G.A.P. system. standards in Serbia from 2010 to 2021 show very little interest of farms in the implementation of this standard, because only 0.23% of farms and 0.97% of the area were covered by Global G.A.P. certificate in 2020 (in this year, the maximum values of the participation of the observed indicators were recorded). Finally, a schematic representation of the connection that was recognized during the research between GLOBAL G.A.P. standards and precision agriculture. The main data sources for the research are the Statistical Office of the Republic of Serbia (abbr. SORS) and internal data of GLOBAL G.A.P. organizations (obtained on request). Also, data from the literature relevant to the researched areas were used. During the research, methods of descriptive statistics, analysis and synthesis, as well as induction and deduction were used.

Keywords: GLOBAL G.A.P., certification, health-safe food, precision agriculture, environmental protection.

INTRODUCTION

In the scientific and professional literature, more and more attention is paid to the development of agriculture by encouraging the development of rural households and rural communities, while preserving natural resources and protecting the environment. Therefore, one of the ways to strengthen agricultural farms is the implementation of certificates in the production and/or processing process. In this way, agricultural producers create added value to their product, which is widespread in the Common Agricultural Policy (abbr.CAP) supported by the European Union (abbr. EU) in both developed and underdeveloped countries of Europe (Alonso & Northcote, 2013; EU, 2013; Lu, & Dudensing, 2015; FAO, 2018; Piao et al, 2019; EC, 2020; Clark et al., 2021; EU, 2021).

Many authors emphasized the positive aspects of creating added value to agricultural products from the aspect of economic development of agricultural farms, environmental preservation and the realization of goals aimed at environmental protection (Crozet et al., 2012; Alonso & Northcote, 2013; Kleemann et al., 2014; Latouche & Chevassus-Lozza 2015; Tran & Goto, 2019; Riamondi et al., 2020). In this sense, Global G.A.P. the standard is recognized internationally because it ensures good agricultural practice that promotes the production of health-safe food, the safety of workers, the preservation of animal health and the protection of the environment (Flachsbarth et. al., 2020).

Increasing the competitiveness of the agricultural and food industry, along with reaching EU quality standards and creating products with added value, Serbia realizes by adopting numerous strategic documents (SARD, 2014; NRDP, 2022). Implementation and control of activities related to the implementation of Global G.A.P. standards are under the jurisdiction of the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia (abbr. MAFW), group for rural development. This group continuously works on the implementation of quality schemes for agricultural and food products and their standards in order to obtain health-safe food, as well as on compliance with EU regulations (NPAA, 2022).

Serbia constantly aligns its agricultural production with Global G.A.P. standard since 2010 (SARD, 2014; Bešić et al., 2015). In Serbia, this certificate is introduced exclusively in plant production, and in 99% of cases fresh fruit is certified (significantly less vegetables), while the most common holders of group certificates are exporters of fruits and vegetables (Paraušić & Grujić Vučkovski, 2023; Grujić Vučkovski et al., 2023). In addition to the mentioned activities on the economic progress of farmers, production and export companies, it is necessary to constantly work on their education, networking of farms and strengthening of awareness about the changes that occur every day and accompany primary agricultural production (Grujić et al., 2019).

Given that agriculture is the main source of food on a global scale (Friha et al., 2021), we are seeing increasing concerns about its safety and environmental protection (Inoue, 2020). For this reason, digital devices are increasingly being used in agriculture, which significantly facilitate coping with numerous challenges. Nowadays, under the term digital agriculture, we mean the use of information technologies, satellite navigation, application of various types of sensors, monitoring of working machines, as well as their analysis (Mogili et al., 2018).

In certain situations, digital agriculture can also be called precision agriculture, which contributes to: optimizing resources (fertilizer, seeds, pesticides, fuel and water) (Višacki et al., 2018), saving working time, higher yields, better quality of the final product, reducing negative impact on the environment (Pajić et al., 2019) as well as better documentation management during the production process.

The application of digitization in agriculture most often implies the replacement of human activities in numerous processes, whereby it gives multiple positive economic, ecological and social results (Rolandi et al., 2021; Vasile, 2012; Vial, 2021).

However, digitization in agriculture has not only been introduced in primary agricultural production, but also in the food industry. The reasons why digitalization in agricultural production is more and more prevalent are found in the fact that major climate changes are occurring, on the one hand, and on the other hand, it contributes to greater data transparency (Androniceanu et al., 2022; Grujić, Subić, 2024). Also, the application of digitalization in agriculture affects the economic and political aspects of community life, and ultimately the global development of all communities (Sinitsa et al., 2021).

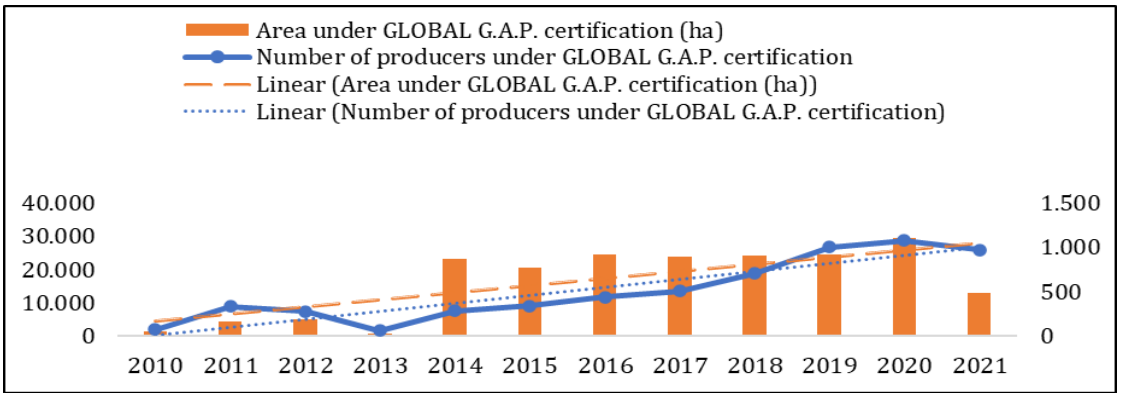
METHODOLOGY

The main sources of data are SORS and the organization GLOBAL G.A.P. Given that the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia (abbr. MAFWM) does not have data on the number of issued GLOBAL G.A.P. certificate in Serbia, we used data from GLOBAL G.A.P. organizations that we received upon request. Also, relevant literature dealing with this topic is cited.

For the purposes of the research, two indicators were analyzed, namely the number of agricultural producers and the area of used agricultural land (abbr. UAA), which is included in GLOBAL G.A.P. certificate in Serbia, while data on the total number of agricultural holdings and used agricultural area (UAA) were taken from the Census of Agriculture 2012 and the Farm structure survey 2018 published by the SORS. The mentioned indicators were analyzed for the period from 2010 to 2021, because from 2010 began with a more serious application of this certificate. During the research, the methods of induction and deduction were used, the results of the research were presented graphically and schematically, and explained by the methods of descriptive statistics. The justification of this research is contained in the fact that the production of health-safe food concerns the population on a global level, and not individual parts of the world.

RESULTS AND DISCUSSION

In the continuation of the work, a shorter statistical analysis of the movement of the number of certified agricultural producers and the area that is in the Global G.A.P. system with the trend line (Graph. 1) from 2010 to 2021 in Serbia.



Graph. 1. Number of certified agricultural producers and UAA with the Global G.A.P. certification and with the trend line in Serbia, 2010-2021

Source: GlobalG.A.P. Organization, data obtained on request and authors' calculations.

In the graph above, we can see that the average number of producers covered by the IFA certificate in Serbia in the period 2010-2021 was 508. We also see a significant decrease in the number of IFA certificate holders from 2010 to 2013, after which their continuous increase followed. until 2020 The share of certified producers in the total number of producers in Serbia in the observed period did not exceed 0.23%, and that was during 2020. The trend line for this variable shows us that Serbia is recording an increase in the number of producers who realize their primary plant production under the auspices of Global G.A.P. certificate.

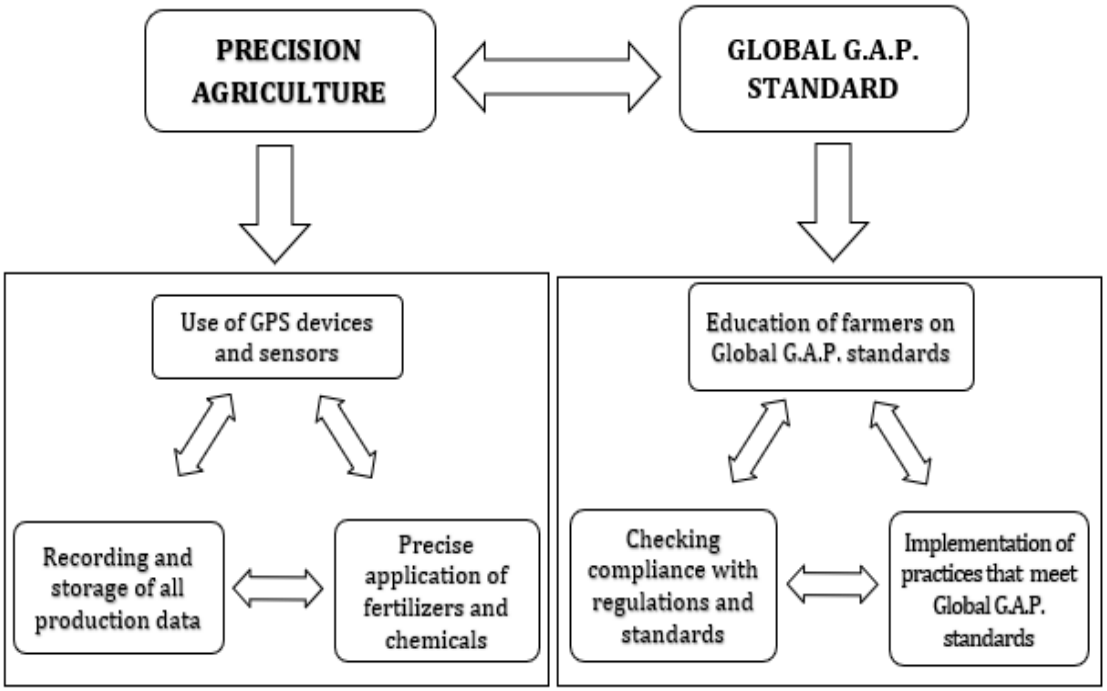
If we look at the graphic representation of the movement of the area covered by the Global G.A.P. with the certificate (Graph. 1.), we observe oscillations until 2013, when its minimum value was recorded. Since 2014 there is a sudden jump in the areas covered by this standard, but the oscillations are still present until the end of the observed period. The share of certified areas in the total used agricultural land of Serbia (abbr. UAA) for the period 2010-2021 does not exceed 1%, with the largest share in 2020 (0.97%). The trend line shows us that this indicator recorded a continuous growth of the areas covered by this certification despite the oscillations that were present.

The relationship between Global GAP production and PA can be multiple. The characteristics that connect these two complex systems are given below. By applying the Precision agriculture (abbr. PA) system, products of better quality are obtained (Kovačić, 2019) and with higher yields per unit area. The ways in which PA affects the quality of the obtained product are primarily related to the optimization of production conditions for each crop separately. This involves precisely managing irrigation systems exactly according to the needs of each plant (King et al., 2004; Pierce, 2010). Also PA includes systems for monitoring the quality of water used for irrigation (Syu et al., 2020; Brahmanand & Singh2022), which is of great importance given that the Global G.A.P. the standard requires the healthiness of the water used in agricultural production. Also, PA includes systems that enable soil analysis (Sedlar et al., 2019) and the formation of maps with different soil properties, which enables the application of fertilizers exactly according to soil needs, while avoiding excessive use of fertilizers. The PA crop protection system enables the targeted application of pesticides and herbicides (Vasić et al., 2022), which contributes to the reduced use of chemical agents, which also affects the reduction of the presence of pesticide residues on agricultural products. By integrating Global G.A.P. standards into already existing PA systems meet international standards and market requirements. Also, Global G.A.P. the standard ensures that said resources are used in a way that ensures the security of a food supply that is health-safe (Inoue, 2020).

Tracking and records. These activities represent the key aspects that enable the alignment of Global G.A.P. standard with current production. By monitoring agricultural activities, PA further facilitates this process. Modern technical systems upgraded with various devices (GPS, sensors) enable the creation of records on the basis of which all agricultural activities (sowing, irrigation, application of fertilizers, chemical protection, harvesting) can be monitored. Also, detailed monitoring of input utilization during all agricultural activities is enabled (Oljača et al., 2005), which is indicated on the product declaration. Tracking systems enable the recording of machinery maintenance, as a digital record records the dates, types of maintenance and thus ensures that the machinery is used in a correct condition (Luo et al., 2022). Precise monitoring of yield based on sensors (Chung et al., 2016) and GPS technology enables obtaining a digital image with an accurate distribution of the obtained yield on the entire plots. This documented information can be key to obtaining Global GAP certification.

Risk reduction. Crossing PA and Global G.A.P. standards, risks that are closely correlated with climate change, crop diseases and food safety issues are reduced. We are witnessing constant climate changes that predominantly affect crops whose main part of the growing season is related to the summer months. In that case, precision irrigation systems can reduce the risk of drought (Jagermeyr et al., 2017; Kang et al., 2017; Wang et al., 2021; Wu et al., 2023). Also, monitoring and control of used chemicals and fertilizers can reduce the risk of environmental pollution (Oparnica et al., 2019) and pesticide residues in food.

On Picture 1. gives a schematic representation of the stages through which the process of applying the PA and Global G.A.P standards goes.



Picture 1. Schematic representation of the stages of introduction of PA and Global G.A.P. standards
Source: Author's view.

This schematic representation allows primary agricultural producers and exporters of plant products to understand more easily how to connect these two compatible production systems. Also, the application of PA can speed up the process of obtaining GLOBAL G.A.P. certificate, and the products obtained in this way certainly meet international standards for food quality and safety and contribute to better competitiveness of domestic products on the global market.

CONCLUSION

Changes in the number of certified agricultural producers and areas covered by this standard in the observed period had large fluctuations, especially from 2010 to 2013.

With the further development of precision agriculture, it is possible to respond in a timely manner to all the changes that occur in the field, all with the aim of obtaining healthy products.

Taking into account both aspects of the research, we came to certain conclusions:

- a small number of agricultural producers who support the implementation of GLOBAL G.A.P. certificates in their production;
- insignificant share of areas included in GLOBAL G.A.P. standard in the total UAA;

- primary agricultural producers have not yet recognized the advantages of the precision agriculture system in order to obtain GLOBAL G.A.P. certificate;
- implementation of GLOBAL G.A.P. certificates in primary agricultural production, contribution to the preservation of biodiversity and landscapes, etc.

We are witnessing that PA is increasingly represented on agricultural farms in all its forms. Therefore, we believe that the implementation of GLOBAL G.A.P. standards in combination with modern agricultural systems was significant and useful in many ways.

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