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DIGITAL TRANSFORMATION OF FOOD PRODUCTION IN EUROPE AND OPPORTUNITIES FOR ITS ADAPTATION IN BULGARIA

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ABSTRACT

Agricultural production in Europe has been focused on increasing its efficiency and improving its ecological imprint. New digital technologies have created opportunities to achieve these goals and thus created a competition among producers for their implementation on a large scale. In the meantime, CAP of EU has presented multiple forms of support for the digital transformation of the sector.

The goal of this study is to analyze the key points of digital transformation of agricultural production in Europe and distinguish the opportunities for technological adaptation of digital solutions in Bulgaria.

In order to achieve this goal the following tasks must be solved: to analyze the means of digital transformation of food production in Europe and its main advantages; to recognize the opportunities for transfer of technologies and solutions adapted for the Bulgarian agricultural sector.

Key words: production technology, competitiveness, agriculture

INTRODUCTION

The agricultural sector faces complex and controversial problems. Food production is threatened by climate change and the lack of sustainability in the use of resources, but the sector is both a key player in the environmental degradation and a major source of anthropogenic greenhouse gas emissions. The increased use of databases and digital technologies in food systems is giving rise to a new model of agriculture, "digital agriculture", supporting more precisely data-driven agriculture as a potential solution to the complex problems of the agri-food system. From the use of climate forecasting databases and massive robotic tractors, the application of satellite pest control and precision farming to unmanned aerial vehicles, digital farming is beginning to spread in the traditional agribusiness and is supported by innovative organizations (start-ups), that receive support from governments and the media.

In addition to technological change, digital agriculture is part of ongoing social, cultural, political and environmental transformations that may be driving a "digital green revolution" similar to previous green revolutions.

METHODOLOGY

The main methods used in solving the research problems and achieving the goal are: literature review of available research in peer reviewed jurnals with significance to the topic, comparative analysis of the proposed policies and presentation of relevant institutional framework for support of the digitalization of agriculture in the European Union.

RESAULTS AND DISCUSION

Today, farmers interact with digital technologies in new and unprecedented ways for the production and application of information that will serve them for management decisions on farms and for the application of robotic equipment in the field. Developers in digital agriculture are focusing on growing industrial crops - especially large industrial, capital-intensive grain producers - because of their production practices and economies of scale. The "digital green revolution" is a new term explaining the changes that are taking place in traditional approaches to production and management in

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the food industry, which are undergoing a fundamental transformation. Undoubtedly, it offers significant opportunities through the availability of highly interconnected and intensive computing technology solutions as part of Industry 4.0. But this transformation poses new problems for manufacturers, as its adaptation depends on many elements subject to individual analysis.

Many researchers expect that the digital revolution in the food industry among all sectors will have the greatest impact on the transformation of the industry. This will not only change the way SMEs do business but will also transform the industry from the bottom up. Digital agriculture combines new opportunities, along with the widespread use of advanced, intensive computer technology-related production models, also called the Industry 4.0 revolution, and its application in agriculture (Ozdogan et al. 2017). With digital farming tools that can be used in all agricultural and livestock systems, high-precision and real-time optimization and customized solutions for the use of information become possible in resource management and this creates opportunities for improved management of agricultural production and optimal realization of all finished products (van ES et al. 2016; Deichman et al. 2016). A report written by GIFS (2015) claims that less than 20% of agricultural land worldwide is managed using digital agricultural technology.

A common topic discussed in scientific paper under review is the inevitability of changes in agriculture: digital technologies are leading to positive transformations in the agricultural sector. The view expressed, both implicitly and explicitly in the texts, is that societies are at risk of failing to provide sustainability and food security if they fail to implement digital agriculture. The various digital agricultural technologies are presented as achieving major transformations in both large and small farms, from the automation of equipment through the use of smartphones and the application of the resulting data sets collected by all farmers. The collision or intersection of small and large farm transformations presupposes concerns expressed in some articles, including concerns about the extent to which the transformations that are expected to be achieved through digital agriculture will include or exclude smallholder farmers (Lajoie- O'Malley, et al. 2020). Large and small farms are often considered separately in the texts. The current and future transformational impacts of precision agriculture and the tools needed for them are taken for granted on large farms.

In analyzing visions for the future of digital agriculture formulated by FAO, the OECD and the World Bank, we assume that technologies are viewed and shaped in a complex social context, including the ways in which people present them. Because of the context FAO, OECD and the World Bank play an important role in shaping the prospects for the future of agriculture worldwide, and a further in-depth analysis of the policies developed by these institutions is needed. Some of these institutional documents describe the future of digital agriculture as similar to the present, just "tweaked" (IPES, 2016), and not substantially reformed.

The transition to digital agricultural technology due to increased efficiency of agricultural production will require a significant reduction in utilized agricultural area and the need for labor in the agricultural sector and a significant increase in investment in agriculture (Korotchenya, 2019).

A good example of the operation of a digital system in agriculture is presented by Cambra Baseca, Sendra, Lloret and Tomas (2019). The rule-based preparation process can be divided into several sequential steps, presented in **Figure 1**, in which several sequential steps are created: data preparation, training of association rules, selection of rules, testing of a classification model, editing of a set of rules and implementation of rules.

The data is collected by an intelligent decision-making system (soil sensors, leaf sensor, etc.), meteorological and environmental conditions, as well as the condition of machines (irrigation machines, controllers, pumps, etc.) by a number of devices and the information is then transmitted through the network coordinator to the middleware. This data, once pre-processed and formatted, is sent to the rule-based processing mechanism to obtain relevant results. Some rules may require information from a historical information database.

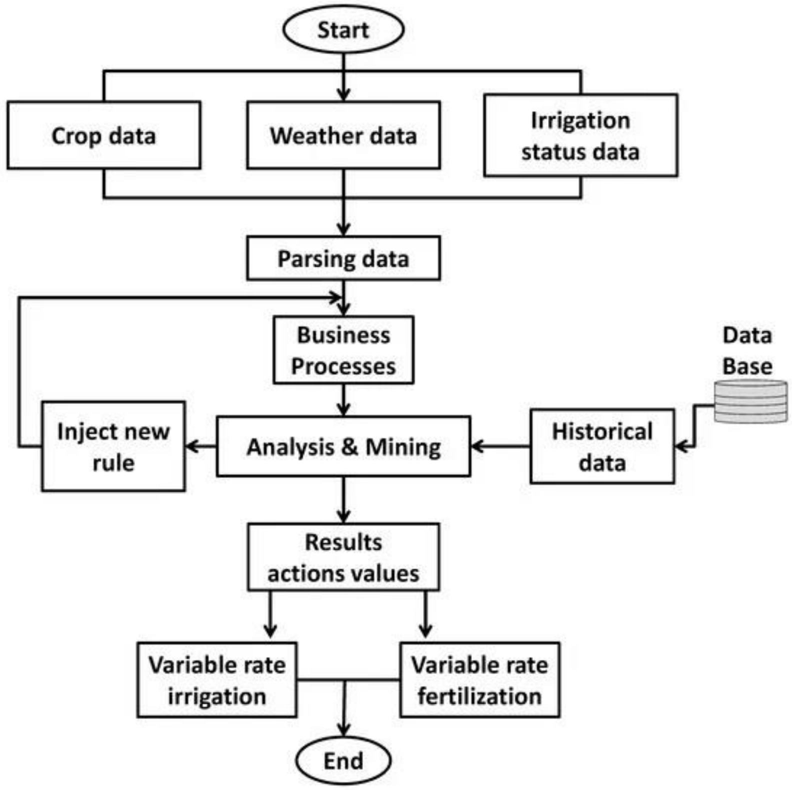

Figure 1. Farming smart decision systems (SDS) flow diagram
Source: Cambra Baseca, C., Sendra, S., Lloret, J., & Tomas, J. (2019).

After receiving the results, the coordinator module communicates with the relevant services (eg. pumps, irrigation controllers, etc.), sends their recommendations via virtual routing and forwarding (VRF) and virtual rate irregation (VRI) and reports either to the farmer via its profile or directly to systems installed on the automated deployment farm, if the system device is configured to do so. The type of setting and the basic information for a set of settings - ie. on, watering time, off - are configured by the farmer with appropriate permits for automatic system adjustment.

In order to prevent the need for a high level of public spending, digital agriculture must be stimulated through a set of measures for the transition to new technologies (eg. digital agriculture within the framework of the sustainable development paradigm, and it is necessary to increase the amount of state support for agriculture in the EU aimed at building capital, as digital agriculture requires large investments).

The European Innovation Partnership on Agriculture (EIP-AGRI) was implementet by EU to promote competitive and sustainable agriculture and forestry that "achieves more and better than less". It contributes to ensuring a stable supply of food, feed and biomaterials by developing its work in harmony with the main natural resources on which agriculture depends (Van Oost, 2017).

The European Innovation Partnership on Agricultural Productivity and Sustainability (EIP-AGRI) was launched in 2012 to contribute to the European Union's Europe 2020 strategy for smart, sustainable and inclusive growth. This strategy places the strengthening of research and innovation as one of its five main objectives and supports a new interactive approach to innovation: the European Innovation Partnerships.

EIP-AGRI aims to bring together innovation actors (farmers, advisers, researchers, businesses, NGOs, etc.) in agriculture and forestry at EU level. Together, they form an EU-wide EIP network. EIP in this network, task forces, multi-stakeholder projects and thematic networks are key building blocks. While the Task Forces are funded by rural development programs, multi-stakeholder projects and thematic networks are supported by the H2020 program. EIP-AGRI Task Forces are project-based and tackle a specific (practical) problem or opportunity that may lead to innovation. The task force approach makes the best use of different types of knowledge (practical, scientific, technical, organizational, etc.) in an interactive way. The Task Force consists of those key actors who are best placed to achieve the objectives of the project, to share experience in implementation and to disseminate the results widely. Task forces are currently being set up in several EU countries and regions (Van Oost, 2017).

A study by Lioutas and Charatsari (2020) concluded that the compatibility between digital agricultural technologies and short food supply chains can be divided into two types. Indeed, compatibility refers to the suitability between intelligent technologies and the characteristics of agriculture. According to the analysis, farmers believe that digital technologies cannot solve the real problems they face in their daily farming practices, while the diversity and low level of technological progress of farms makes the transition to intelligent production systems difficult, if not impossible. Interestingly, for consumers, the authors also found that the adoption of intelligent technologies by farmers who sell their products through short supply chains is practically impossible.

CONCLUSION

Food production practices aimed at increasing yields often create externalities that increase the costs of regulating and maintaining ecosystems, such as regulating soil quality and other natural resources. This necessitates critical thinking about how digital agriculture can be applied, which can favor maximizing food production only through a technological solution within an industrial production model. This presentation of the relationship between the problem and the solution can mask the ways in which people choose not only which technologies to develop, but also how to implement them. Digital agricultural innovation deserves a careful assessment of the contribution they can make to tackling the great challenges of the 21st century. It is extremely important to think carefully about social and technological changes in agriculture. Can we imagine using emerging digital technologies that don't just replicate existing systems? In what specific context do we see digital tools applied and significantly, according to which principles (eg. productivity versus biodiversity)? Here, researchers of ecosystem services can offer a lot, taking into account the consequences of different models of digitalization of agriculture in the future, analyzing the impact and trade-off of digital agriculture and its relationship with different types of future food systems. These analyzes can shape the processes of responsible innovation. The implementation of digital agriculture models in Bulgaria must be part of a larger framework allowing for consideration of all externalities in order to avoid mistakes made by more experiancesd countries presented in this paper.

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