# SCIENTIFIC HORIZONS

## Smart agriculture for urban regions: Digital transformation strategies in the agro-industrial sector for enhanced compliance and economic growth

**Olegs Cernisevs***
Doctoral Student
Baltic International Academy
LV-1003, 4 Valerijas Seiles Str., Riga, Latvia
https://orcid.org/0000-0003-1859-4102

**Andrey Surmach**
Doctor of Economics, Associate Professor
Baltic International Academy
LV-1003, 4 Valerijas Seiles Str., Riga, Latvia
https://orcid.org/0000-0003-4202-2956

**Stanislavs Buka**
Doctor of Economics, Associate Professor
Baltic International Academy
LV-1003, 4 Valerijas Seiles Str., Riga, Latvia
https://orcid.org/0000-0002-4235-8890

**Abstract.** Research on this topic is becoming relevant due to the growing pressure on agriculture in urbanized regions due to population growth, climate change and the need for sustainable production, which requires the introduction of smart technologies to increase productivity and sustainability. The purpose of this paper is to investigate the impact of growing pressures on agriculture in urbanized regions due to population growth, climate change and sustainable production needs. The methods used include the analytical method, classification method, functional method, statistical method, synthesis method, and others. The study found that modern digital transformation technologies have great potential to improve agricultural productivity and sustainability in urbanized regions, particularly in Latvia and the European Union. The use of data analytics allowed identifying key trends and patterns, which contributed to informed decision-making in the agricultural sector. The study results confirmed the need to implement comprehensive strategies to achieve compliance with sustainable development standards and ensure economic growth. The introduction of modern agricultural technologies, such as aeroponics and hydroponics, has focused on innovative methods to increase productivity and ensure sustainability. The use of the Internet of Things (IoT), data analytics, and modern agricultural technologies has led to

*Corresponding author

an increase in the efficiency of urbanized agriculture. The practical significance of the work lies in the development of specific recommendations aimed at optimizing the functioning of agriculture, which will increase the efficiency of resource use and ensure sustainable economic growth in urbanized regions

**Keywords**: agrotechnology; advanced technologies; agribusiness development; environmental; monitoring

## INTRODUCTION

In today's world, amidst rapid urbanization, agriculture is becoming a key sector that is under increasing pressure and requires innovative strategies to effectively enter a new stage of development. Against the backdrop of population growth, extreme climate change and the growing need for sustainable production, the agricultural sector in urbanized regions is facing increased pressure. Current challenges, such as the EU's agricultural reform, which focuses on green initiatives and technological transformation of production, provide an important context for researching digital transformation strategies (Fama & Corrado, 2023). This research is critical for the development of innovative strategies aimed at optimizing production, rationalizing resource use, and achieving sustainable development in the agricultural sector.

From the perspective of smart agriculture for urban regions, the urban environments that employ interconnected technology to enhance the efficiency, viability, and sustainability of urban agriculture practices – are smart cities. In smart cities, agriculture is not just about producing food but doing so in a way that is deeply integrated with the urban ecosystem (dos Santos, 2016). This means efficiently using limited urban space through vertical farming and hydroponics, deploying sensors AI to precisely manage water and nutrient cycles, and using data to understand and predict urban food demands. The goal of smart agriculture in smart cities is to create a closed-loop system that minimizes waste and maximizes resource use. It's a system where the production of food is tailored to the consumption patterns of the city's inhabitants, where transportation distances are minimized, and where the impact on the environment is considered in every farming decision (Volianska-Savchuk *et al.*, 2023).

The problematic of this study was to analyse not only from a technological point of view, but also taking into account the social, economic and environmental aspects of implementing digital strategies. This required examining the interaction between modern technologies and production processes, as well as their impact on consumers, rural communities, and the environment. It was important to consider the diversity of geographical, climatic, and economic conditions in urbanized areas to develop context-specific strategies. These issues are relevant not only for this study, but also for the governments of the European Union (EU) countries implementing their agricultural policies.

The authors H. Azadi *et al.* (2021) redefined sustainable agriculture from climate-smart to vulnerable. Their work was to study and evaluate the strategies used in the implementation of climate-smart agriculture and their transformation in the context of growing challenges that lead to vulnerable agriculture. However, this work did not consider the impact of the studied strategies on social and economic aspects, such as employment, farm income and access to food.

The study by L. Vistarte *et al.* (2023) shows a significant positive impact of the new common agricultural policy of Latvia on the climate resilience of the sector. The authors found that Latvia's new policy aimed at climate neutrality was successful. However, in order to maximize the positive impact, it is important to continue to improve technologies, involve farmers in the process, and take into account social and economic aspects in solving problems.

In their research, J.A.J. Mendes *et al.* (2022) conducted a study on the development of smart rural regions, their challenges, and opportunities. Their work has expanded the understanding of the dimensions of digital transformation in agriculture, providing important insights for improving strategies aimed at increasing the efficiency and sustainability of this important sector of the economy. However, the paper did not provide a detailed consideration of emerging technologies, such as blockchain, sensors, and their potential in digital transformation. These emerging technologies have notable effect for the smart rural regions like smart cities, as shown by other researchers (Popova & Cernisevs, 2023; Cernisevs & Popova, 2023).

The work of N. Griškjāne (2020) is dedicated to the assessment and development of the smart economy in Latvia. Her research concluded that the smart economy is important and promising for Latvia. With the proper implementation of strategies, the country can achieve sustainable economic growth, improve the quality of life of citizens and increase competitiveness in the global market. However, the author did not pay enough attention to the possibilities of using innovations in the field of social services and human capital development.

The research by D. Vasilevska and B. Rivza (2022) is aimed at studying the priorities and obstacles in the digital transformation of agriculture. Their work identified priorities in digital transformation for agriculture, analysed obstacles and provided guidance on how to overcome them. She also developed recommendations for agriculture and government agencies. However, the authors did not develop a clear plan for scaling up the

initiatives so that their benefits and innovations could be effectively implemented in other areas.

The purpose of this study is to analyse and identify strategies for improving agricultural production processes to achieve higher levels of compliance and economic growth for urbanized regions.

## MATERIALS AND METHODS

This study was carried out using methods that reveal the theoretical and practical content of the object. The analytical method in this study carried out a thorough analysis and processing of the collected data to identify trends in the use of digital technologies in agriculture and determine their impact on the production process, yields and economic indicators. This method allowed for a detailed review, which included a detailed examination and processing of various numerical data to identify the main trends characterizing agriculture in urbanized regions. It revealed the effectiveness of implementing smart strategies and made it possible to identify the benefits and challenges faced by the agricultural sector in the context of digital transformation. The analytical method also provided the basis for objective conclusions and recommendations for the development of smart agriculture in urbanized regions.

The classification method allowed systematizing and grouping the collected data, identifying common characteristics, and establishing links between different aspects of the use of digital technologies in agriculture in urban areas. The method helped to create a structured approach to understanding the diversity and specificities of digital transformation, which is important for formulating objective conclusions and recommendations. The functional method was used to structure and describe the functionality of different elements of the smart agriculture system for urbanized regions. The use of this method allowed for the analysis of the functions and interactions of these elements, but not in the context of direct analysis or evaluation. It identified the main functional tasks that need to be addressed for the effective implementation of digital technologies in agriculture in urbanized regions.

The statistical method in this study was used to systematize, process, and analyse numerical data. This method allowed transforming the collected data into numerical forms using the methods of sorting, grouping, and aggregation. By applying statistical measures such as mean, median and standard deviation, representative characteristics of the data set were obtained. By examining statistical trends, including changes over time, regional characteristics, and other factors that influence agricultural development in urbanized areas, a deeper understanding of the dynamics of this process was gained. Also, using a comparative analysis with statistical methods, various aspects of digitalization and its impact on agriculture were assessed, making clear the differences and similarities between different

aspects of the topic under study. The synthesis method in this study was used to merge and synthesize various data and concepts to form an integrated and holistic understanding of smart agriculture in urbanized regions. This method contributed not only to the synthesis of existing knowledge, but also to the creation of new ideas and concepts that contribute to a deeper understanding and development of the research area. As a result of the synthesis method, a holistic view of the challenges and opportunities facing smart agriculture was developed, providing a deeper and more comprehensive understanding of the research subject.

## RESULTS

Population growth in urbanized regions affects agriculture in a number of ways (Almadani & Mostafa, 2021). Firstly, population growth leads to a significant increase in demand for agricultural products, which poses challenges for the agricultural sector to ensure efficient and sustainable production and supply. The need to develop efficient supply systems to ensure reliable and rapid supply of agricultural products in urbanized areas is becoming increasingly important. Population growth is also creating a competitive environment among agricultural producers, requiring them to innovate to differentiate themselves and compete in the market. In the face of increasing demand and competition, the analysis showed that efficient production requires a shift to sustainable farming, using environmentally friendly methods and green technologies (Bunge *et al.*, 2022).

The use of smart agricultural technologies in the EU is becoming increasingly important, necessitating the introduction of the Internet of Things (IoT) and advanced agricultural technologies. This is essential for increasing productivity and optimizing agriculture, especially in the context of limited land space in large cities. An integrated approach takes into account the challenges and opportunities arising from population growth in urbanized regions of the EU and identifies ways to improve agriculture in urban areas. It recommends the creation of integrated networks of agricultural devices for automation and control over production, including automatic irrigation and plant growth monitoring systems.

Climate change and the need for sustainable production are having a significant impact on agriculture in urbanized areas (Dang *et al.*, 2021). On the one hand, climate change leads to unpredictable weather conditions, which creates challenges for the agricultural sector. In particular, the increase in extreme weather events, such as droughts or floods, requires the development of adaptation strategies and the use of technologies for balanced production in the face of unpredictability. On the other hand, the need for sustainable production in the EU drives the need to adopt environmentally friendly practices and technologies in agriculture. The results emphasize that the use of smart agricultural technologies

and management systems helps to optimize resource use, reduce environmental impact, and ensure sustainable development of the agricultural sector.

The analysis revealed that the needs for sustainable production include two key recommendations. First, it is necessary to ensure sustainable development, which involves the introduction of efficient agricultural technologies and methods aimed at preserving natural resources and ecosystems. This includes the development of new agricultural technologies aimed at maximizing productivity with minimal use of resources and reducing the environmental impact of agriculture. Secondly, it is important to use environmentally friendly technologies to optimize production and reduce the negative impact on nature. These include the introduction of smart agricultural technologies and management systems aimed at increasing productivity and efficiency, while reducing the environmental footprint of agriculture. The development of organic and ecological farming methods is also identified as a key element for ensuring high quality products and maintaining ecological balance in the agricultural sector. Taking these aspects into account in agricultural planning and implementation is strategically important for achieving sustainable development in urbanized regions.

Figure 1 illustrates the impact of growing pressures on agriculture in the EU's urbanized regions due to population, climate change and the need for sustainable production. The figure shows the percentage distribution of pressures between key factors identified as resource efficiency, climate resilience and innovation in sustainable production in the EU.
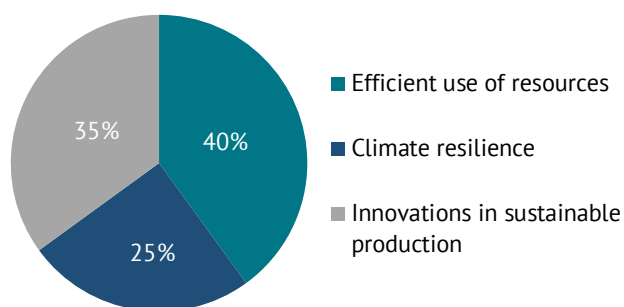


**Figure 1.** *Pressure factors on agriculture in the urbanized regions of the EU*
**Source**: *M. Agovino et al. (2019)*

The results of the study revealed a number of key challenges in agriculture for urbanized regions. Firstly, the identified challenges relate to production efficiency, where it is important to increase productivity and optimize the use of resources. These include improving agricultural practices, adopting new technologies and developing effective management systems. The second aspect of the challenges relates to resource management, where it is important to use land, water, and other materials efficiently. Ensuring the sustainable use of these resources includes water conservation strategies, the use of highly efficient land cultivation methods and the development of recycling technologies. The third aspect of the issue relates to the resilience of the industry to change, including changes in climate conditions and market trends. Ensuring the industry's flexibility and adaptability is key to overcoming the challenges posed by environmental change. This includes introducing innovative technologies, adapting to new climate conditions, and developing market adaptation strategies. These could include the development of specialized hydroponic farms and vertical farms that would allow for growing food in limited land space, reducing transportation and storage costs; setting standards for organic farming, providing subsidies for farmers using environmentally friendly practices; creating online markets where farmers can present their products and city residents can easily order fresh and sustainable food; organizing seminars, trainings, and access to modern agrotechnologies to improve the skills of farmers and stimulate their interest in innovation.

Digital transformation also includes the use of modern agricultural technologies as an important aspect of strategies (Quy *et al.*, 2022). The introduction of advanced agricultural equipment, including automated irrigation systems, drones for vegetation monitoring, and artificial intelligence systems for soil analysis, can increase productivity and efficiency. Drones are being used for area-based monitoring of farmland in Latvia, which allows problems such as disease or insufficient watering to be quickly identified and the necessary measures taken. In the EU, farmers use drones and satellite imagery to collect data on the condition of their fields. This allows them to obtain detailed information about plants, their diversity, and condition, which in turn helps them to more accurately determine fertilizer needs and regulate irrigation. The use of such technologies helps to reduce costs and maximize yields.

Modern agricultural technologies take into account the use of advanced agricultural equipment, such as automated irrigation and production control systems, which helps to optimize production processes and reduce resource consumption (Sinha & Dhanalakshmi, 2022). Aeroponics and hydroponics, as innovative methods of plant cultivation, make it possible to grow crops without using soil, ensuring efficient and environmentally friendly production. These agricultural technologies help to adapt EU agriculture to the conditions of urbanization, where limited land space and high demand for products put increased pressure on production processes. The introduction of such innovations helps to increase productivity and ensure the sustainable development of agriculture.

Data analysis is a key strategy for digital transformation in the agricultural sector. The use of analytical tools allows for the efficient processing of a large

amount of information obtained from sensors and other sources used in smart agriculture (Totin *et al.*, 2018). At the EU level, data analysis is aimed at studying global trends in agriculture and market conditions, which helps to adapt policies and strategies to changes in agriculture and the market environment. In Latvia, the analysis of crop and product quality data helps farmers to make decisions on the optimal time of harvesting, inventory management and consumer research. The overall goal of data analysis is to improve the efficiency, resilience, and sustainability of production through the rational use of resources and the introduction of advanced technologies.

The concepts of making agriculture more compliant with sustainability and product safety standards include a number of strategies and initiatives. The strategy of improving production processes and introducing environmentally friendly methods of land cultivation and plant growing contribute to the compliance of agriculture with environmental standards. The use of advanced agricultural technologies, such as precision farming and automated irrigation systems, helps to reduce resource use and minimize the negative impact on the environment. Adopting high standards of product safety and quality, including traceability and quality control systems, ensures that agricultural products meet the highest standards and are safe for consumers. The introduction of certification systems, such as organic production or quality management systems, helps to confirm that products meet established standards and ensures consumer confidence. Educational initiatives among farmers on the importance of responsible and sustainable production help to promote awareness and adoption of modern farming practices. These strategies are aimed at achieving a high level of compliance of agriculture with modern requirements, which is an important aspect for ensuring sustainable development and competitiveness of the industry in urbanized regions. A look at economic growth in the EU and Latvia reveals several aspects that point to opportunities to improve the efficiency and competitiveness of agriculture in urbanized areas.

The introduction of modern technologies, such as IoT, agrotechnology and digital management systems, has contributed to increased productivity and reduced production costs. The effective use of technology has allowed agriculture to become a more efficient and profitable industry (Pilvere *et al.*, 2022). In the EU, IoT technology is used to monitor the condition of animals, determine important parameters of animal husbandry, and automatically detect diseases. Large farms use sensors to monitor temperature, humidity, movement, and other parameters in animal quarters, ensuring optimal conditions for their health and growth. This approach not only increases the efficiency of the farm, but also helps to reduce losses through early detection of problems and quick response to them. In Latvia, the use of

monitoring systems includes control over milk production, the quality of its suitability for consumption and the health of livestock. Farms use modern sensors and data analysis systems to check the quality of milk, determine its composition and identify any possible anomalies that may indicate animal health problems or incorrect housing conditions. This allows farmers to respond quickly to potential problems, ensuring high product quality and animal health. When anomalies are detected, monitoring systems can automatically notify owners or veterinarians to take the necessary measures to improve animal conditions and treatment. This approach helps to increase the efficiency of agricultural production and ensure high quality agricultural products. The study identified opportunities to reduce losses in production processes, ranging from efficient use of resources to supply chain optimization and minimization of losses, which contributed to increased gross production and resource savings. The introduction of technological innovations and efficient resource management contribute to economic growth in the agricultural sector in urbanized regions.

In the EU, manufacturers are introducing hydroponic systems for growing plants without soil (Ravis & Notkin, 2020). Hydroponics is the cultivation of plants in aqueous solutions with the necessary nutrients, rather than in traditional soil. This allows for optimal use of water and fertilizers, providing plants with all the necessary elements for growth. Hydroponic systems typically reduce water consumption compared to traditional agriculture and allow for precise control of the environment for optimal plant growth. In Latvia, farmers are developing and implementing vertical farms, which allow plants to be grown in vertical layers. This approach makes the most of limited space and increases production per unit area. Vertical farms typically use light-emitting diode systems to provide plants with the necessary light for photosynthesis. This method of cultivation is effective in urban environments and allows for the production of high-quality agricultural products without a large land area. Both approaches demonstrate innovation and respond to the challenges of modern agriculture, such as efficient use of resources, increased productivity, and adaptation to the limited space available in large cities.

Urbanized areas and agriculture interact in population growth and urban expansion. The link between urbanization and agriculture lies in the impact of urban structures on rural areas and the interaction between urban and rural aspects. First, urbanization leads to a reduction in available rural land space due to the growth of urban areas, which necessitates the use of limited rural land resources in a more efficient and sustainable manner. Second, urbanized areas create demand for rural products within the city. There is a growing need to grow food closer to consumers, which promotes the development of modern farming methods, such as

vertical farming or other innovative techniques. Third, urbanization also affects agriculture through pollution, emissions, and other aspects of urban infrastructure. Waste management and green urbanization are becoming key elements for sustainable agriculture. Thus, urbanized areas determine the specifics of agriculture through interaction with urban structures, requiring agriculture to adapt to the urban environment, increase efficiency and ensure sustainable production.

To achieve sustainable development and optimization of agriculture in urbanized areas, it is recommended to implement a set of strategies and measures. It is important to develop and implement improved production processes aimed at balancing economic growth with environmental sustainability, including the use of advanced technologies to optimize production processes and reduce losses. The use of digital technologies, such as monitoring, data analytics and automation systems, will help reduce costs, improve the supply chain, and increase overall production efficiency. This also includes the adoption of best practices to optimize resource utilization and increase economic competitiveness. Developing and implementing strategies to improve the safety of agricultural products is an important aspect. This can be achieved through standardization and systematization of production processes. Establishing a system for systematic monitoring and adaptation to changes in the environment, climate, and market conditions will allow for effective monitoring and timely response to various challenges.

Further development of technologies includes continuous innovation activities aimed at improving agriculture (Majore & Majors, 2022). It includes the introduction of advanced agricultural technologies, the development of the latest tillage methods and modern automation tools that will help increase productivity and optimize production processes. Expanding the network of partners involves active cooperation of agricultural enterprises with representatives of other industries and partners. This includes the creation of integrated solutions that bring together the agricultural sector with technological, scientific and trade partners to jointly implement projects and solve common problems. Joint innovation and experience in digital transformation helps to develop a sustainable and efficient agricultural sector in different countries. Increased competitiveness reflects the expected increase in production efficiency and quality, which, in turn, will help strengthen the market position of urbanized agricultural regions.

## DISCUSSION

This research article addressed the key topic of smart agriculture for urbanized regions in the EU and Latvia, focusing on digital transformation strategies in the agricultural sector, which is a relevant and promising topic of current challenges and opportunities. The discussion of this topic covered various aspects that affect the efficiency and sustainability of urbanized agriculture. The high level of urbanization requires the agricultural sector to improve and adapt to new realities. Modern technologies, such as IoT, sensors, data analytics, and artificial intelligence, are opening up new opportunities to increase productivity, manage resources, and create environmentally sustainable agricultural processes. The use of digital technologies has made it possible not only to monitor production in real time, but also to improve product quality and safety control (Samoilenko *et al.*, 2022). Automation and monitoring ensured compliance with standards and market requirements, increasing competitiveness. Digital technologies have been used to rationalize the use of resources such as water, fertilizer, and energy, which is important for sustainable production. Automated systems respond to changes in climate conditions by optimizing irrigation and fertilization processes. The implementation of digital strategies has become a catalyst for economic growth in agriculture. The creation of new business opportunities, the development of innovative products and services, and the expansion of sales markets have all been made possible by digital transformation (Kryvovyazyuk, 2023).

Study by A. Renner *et al.* (2020) examined the expected biophysical consequences of this process and their impact on the environment. The findings allowed developing specific strategies and recommendations for achieving sustainable agricultural development, balanced between economic benefits, social responsibility, and nature conservation. The introduction of internal use has helped to create conditions for biodiversity by reducing the use of pesticides and other chemicals that have a harmful impact on the ecosystem. The introduction of environmentally friendly technologies and practices had a positive impact on the health of the local population and contributed to the development of green jobs in rural communities (Lada *et al.*, 2023). Both studies are aimed at improving production processes and achieving efficiency in the agricultural sector. Smart agriculture, using digital technologies such as IoT and data analytics, aims to optimize agriculture and ensure sustainable development in an urban environment (Rexhepi *et al.*, 2023). On the other hand, research on environmental pressure considers internal use as a tool to reduce the negative impact of the agricultural system on the environment. Internal use helps to reduce the negative impact on groundwater and ensures optimal use of natural resources. Regarding the positive impact of environmentally friendly technologies, it is important to recognize that this opens up prospects for improving the quality of life of the local population. Reducing the use of chemicals in agriculture reduces environmental pollution and contributes to a safer and healthier environment for communities to live in and develop (Wrzecińska *et al.*, 2023).

The study by G. Gagliardi *et al.* (2021) aimed to examine the impact of IoT technologies on smart agriculture

and identify the key benefits and challenges associated with the implementation of IoT in agriculture. As a result, using IoT, farmers can monitor various production parameters, such as soil moisture, temperature, nitrogen levels, and others. This allows them to optimize irrigation, apply fertilizers only where they are needed, and ensure the best conditions for plant growth. Both studies consider various aspects of the impact of digital technologies on the agricultural sector, but from different perspectives. This paper is distinguished by its overall strategic perspective, which provides an in-depth analysis of digital transformation strategies aimed at increasing compliance and ensuring economic growth in the agricultural sector. The study by the researchers specializes in the application of IoT technologies in agriculture, providing specific insights and success stories. The focus on the application of IoT technologies makes it more specific and detailed, analysing specific uses of these technologies in agricultural production.

The aim of the study by I. Pilvere *et al.* (2022) was to conduct a comprehensive assessment of the impact of the European Green Deal policy on Latvian agriculture, taking into account support payments. The analysis shows that the European Green Deal policy has already had a significant impact on the structure of agriculture in Latvia. Increased requirements for environmental sustainability and fair use of resources have led to restructuring of production processes. At the same time, support payments have become more focused on environmentally sustainable production, which encourages farmers to adapt new methods. Both studies address relevant aspects of agriculture, but have different approaches. The work of the researchers is more focused on the impact of the new EU policy on agriculture in a particular country (Latvia). Support payments aimed at environmentally sustainable production can encourage farmers to adopt new methods. This will help ensure a smooth transition to more sustainable and environmentally friendly agriculture. This study highlights the use of digital technologies in agriculture in urbanized regions, particularly for increasing compliance and economic growth. Both studies are important for understanding the current challenges and opportunities in agriculture.

The study by A. Rehman *et al.* (2022) was aimed at reviewing IoT technologies used for monitoring and control in smart agriculture. As a result, IoT technologies have great potential to improve the efficiency and sustainability of the industry. The integration of data, collection, and analytics has enabled farmers to make informed decisions, which is an important step towards sustainable and efficient agriculture. The central goal of both studies is to increase agricultural productivity through the introduction of innovative technologies and strategies. Both studies emphasize the use of modern technologies to optimize agriculture. They recognize the importance of implementing IoT, data analytics and digital strategies to achieve productivity gains. They

also consider the importance of data collection and analysis for making informed decisions. However, their differences lie in the specific topics and target groups they address. Taking both approaches into account, comprehensive strategies can be developed to improve agriculture in both traditional and urbanized areas.

Paper by J. Yang *et al.* (2021) reviewed the basics and benefits of using IoT in the context of smart agriculture. The introduction of IoT in agriculture has made it possible to create automation systems for machinery. Tractors, seeders and other machines can work autonomously, taking into account the needs of a particular field. IoT is also used to monitor the condition of animals. Both studies have a similar focus on the use of modern technology to improve agriculture. However, this paper looked in detail at the application of IoT in specific aspects of production. IoT for animal monitoring is really useful in agriculture. It helps farmers in tracking animal health and welfare, which in turn has a positive impact on productivity and product quality. However, it is also important to consider the possible challenges related to data privacy and security of IoT in agriculture to ensure that its potential and limitations are fully understood.

The article examined how digital transformation is affecting the development of agriculture in urbanized regions of the EU and Latvia. One of the key ideas was the use of modern technologies, in particular, the IoT, to optimize production processes, which included the introduction of sensors and data collection and allowed for effective monitoring and management of various aspects of agricultural activities. The study also highlighted the importance of digital transformation to improve the industry's compliance with modern standards and requirements. The use of analytical tools and technologies has allowed businesses to adapt to changes in legislation, ensuring high quality and safety of products. Digital transformation strategies, as shown in the study, contributed to economic growth. This was achieved by optimizing production processes, reducing losses, and increasing productivity. In addition, the study highlights the importance of using innovative agricultural technologies to ensure sustainability and competitiveness.

Overall, the study not only addresses the urgent issue of smart agriculture for urbanized regions, but also provides a valuable contribution to the field of digital transformation strategies in the agricultural sector. It offers specific strategies, taking into account various influencing factors. Its results serve as a basis for further developments and implementations in the field of modern technologies in the agricultural sector.

## CONCLUSIONS

The study found that in Latvia and in the EU, modern digital transformation technologies have great potential to improve the productivity and sustainability of agriculture. The use of the IoT has proven to be an

important and promising area for optimizing production and increasing the efficiency of the industry. The introduction of animal welfare monitoring systems, soil and plant analysis, and automation of production processes using IoT has enabled accurate and efficient management of various aspects of agriculture. The use of data analytics stands out in its ability to identify key trends and patterns, which has contributed to informed decision-making. Modern agricultural technologies, such as aeroponics and hydroponics, have become a strategically important step towards achieving sustainable and efficient production in urbanized regions.

The results of the study highlighted the need to implement comprehensive strategies to achieve compliance with sustainable development standards and ensure economic growth in Latvia and in the context of the EU. The analysis of the needs for sustainable production and recommendations for the use of modern technologies indicate opportunities to improve the efficiency and competitiveness of agriculture in the context of urbanization. In summary, the study highlighted that digital transformation in agriculture for urbanized regions has great potential to address current challenges. The findings suggest that the use of digital technologies is a promising and effective approach. Another important aspect of the findings is the need to comply with sustainable development standards and the emphasis on economic growth strategies. The recommendations for continuous monitoring, adaptation and implementation of the latest technologies have become key points for the further successful development of digital agriculture in urbanized areas.

The study serves as a practical guide for agricultural enterprises, organizations, and authorities in Latvia and the EU seeking to implement digital innovations in their operations. The recommendations on the effective use of technology, sustainability standards and economic enhancement strategies can serve as a basis for the development of specific smart agriculture programmes and projects.

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## CONFLICT OF INTEREST

None.

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# Розумне сільське господарство для урбанізованих регіонів: стратегії цифрової трансформації в агропромисловому секторі для посилення відповідності та економічного зростання

**Олегс Кернісевс**

Докторант

Балтійська міжнародна академія

LV-1003, вул. Валерія Сейле, 4, м. Рига, Латвія

https://orcid.org/0000-0003-1859-4102

**Андрій Сурмач**

Доктор економічних наук, доцент

Балтійська міжнародна академія

LV-1003, вул. Валерія Сейле, 4, м. Рига, Латвія

https://orcid.org/0000-0003-4202-2956

**Станіславс Бука**

Доктор економічних наук, доцент

Балтійська міжнародна академія

LV-1003, вул. Валерія Сейле, 4, м. Рига, Латвія

https://orcid.org/0000-0002-4235-8890

**Анотація.** Дослідження на цю тему стає актуальним через зростаючий тиск на сільське господарство в урбанізованих регіонах через зростання населення, зміну клімату та необхідність сталого виробництва, що вимагає впровадження смарт-технологій для підвищення продуктивності та стійкості. Метою цієї статті є дослідження впливу зростаючого тиску на сільське господарство в урбанізованих регіонах через зростання населення, зміну клімату та потреби сталого виробництва. Використані методи включають аналітичний метод, метод класифікації, функціональний метод, статистичний метод, метод синтезу та інші. Дослідження показало, що сучасні технології цифрової трансформації мають великий потенціал для підвищення продуктивності та сталості сільського господарства в урбанізованих регіонах, зокрема в Латвії та Європейському Союзі. Використання аналітики даних дозволило виявити ключові тенденції та закономірності, що сприяло прийняттю обґрунтованих рішень в аграрному секторі. Результати дослідження підтвердили необхідність впровадження комплексних стратегій для досягнення відповідності стандартам сталого розвитку та забезпечення економічного зростання. Впровадження сучасних сільськогосподарських технологій, таких як аеропоніка та гідропоніка, зосередило увагу на інноваційних методах підвищення продуктивності та забезпечення сталості. Використання Інтернету речей, аналітики даних та сучасних агротехнологій призвело до підвищення ефективності урбанізованого сільського господарства. Практична значущість роботи полягає в розробці конкретних рекомендацій, спрямованих на оптимізацію функціонування сільського господарства, що дозволить підвищити ефективність використання ресурсів та забезпечити стале економічне зростання в урбанізованих регіонах

**Ключові слова:** агротехнологія; прогресивні технології; розвиток агробізнесу; навколишнє середовище; моніторинг