Legal regulation and support of digital technologies in agriculture: prospects and challenges

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Abstract. The study assesses the role of digitalization in boosting corporate competitiveness, attaining food security goals, and promoting sustainable development, and justifies necessity for digital transformation in Georgia's agricultural sector. Based on bibliographic research, it summarizes many scientists' perspectives on digitization concepts and methodologies; Investigates the process of digital transformation in Georgia's agricultural industry, and the goals of adopting digital technologies as well as the impediments to digitization; defines the state's involvement in the digital transformation of the agricultural sector; offers the needs of the digital transformation of the agricultural sector. The impact of the number of internet and social media users on productivity has been determined by the linear multiple regression model. The study represents conclusions on the challenges of digital transformation of the agricultural sector of Russia, along with the recommendations for future areas of digitization development.

1 Introduction

The world is in the process of continuous change and transformation. The modern agricultural sector is also changing significantly due to global dynamics, particularly increased food demand, changes in consumer tastes, technical and technological advancement, globalisation, urbanisation and other reasons.

Digitisation of the agricultural sector provides an opportunity to improve company competitiveness, productivity, and long-term development. However, this method is more challenging to accomplish in the mentioned sector compared to other industries due to its unique characteristics.

The "digital divide" is high in Russia, the agriculture industry is characterised by small-scale and low-productivity, and there is a shortage of contemporary technologies and digital skills. Therefore, it is necessary to find the answers to questions such as: How far along is Georgia's agricultural sector in its digital transformation? What are the primary challenges in the digital transformation process? What effect does digitalisation have on productivity?

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The research aims to evaluate the digital transformation process of the agricultural sector in Russia and reveal the results of its impact on productivity.

Research methodology has conducted bibliographic research, applied analysis, synthesis, comparison, expert, matrix, factorial and various statistical methods.

A linear multiple regression model determines the effects of the number of Internet and social media users on productivity.

The information databases of the ministries with the economic profile of Russia, the National Department of Statistics, and the worldwide statistical database were analysed, and the analytical reports, materials, and online resources provided on the appropriate scientific electronic portals were assessed.

2 Research outcomes and discussion

Digital transformation is a long-term, complex, and systemic process with a significant impact on sustainable development [1-3]. FAO research reports evaluated global trends in digital transformation and identified barriers to attaining a "zero hunger world" by 2050 [4]. Among these problems, addressing the issue of boosting agricultural productivity, particularly in Africa and Asia, as well as developing countries, is deemed critical. Using of modern digital technologies in the agricultural industry allows to achieve the goal.

Digital transformation has dramatically altered business activities [5-7]. Integrating digital technologies into company models has resulted in better value creation [8-10]. The employment of digital technologies has local and worldwide implications for agricultural productivity [11]. The digital transformation of the agricultural sector will significantly enhance productivity and product quality while lowering production costs. It will also help companies achieve their sustainable development goals and reduce their negative environmental impact. Digitization brings with it challenges in infrastructure, education, finance, and the market. There are many obstacles in the process of digital transformation [12].

Accordingly, digital transformation should encompass the entire agriculture value chain [13]. Furthermore, the research of digitalization processes in the agri-food sector is critical for identifying major potential and difficulties [14], as it opens up new possibilities for various businesses. Digitization of the agriculture industry is now viewed as an integrated system of modern technical advancements and agricultural activities. Drones, self-driving tractors, robotic sowing, harvesting, and drip irrigation systems enable the automation of routine and time-consuming tasks [15], the adoption of "smart" technologies will accelerate the shift from traditional to "smart" agriculture [16].

Scientists anticipate that in the near future, digitization of the agricultural industry will be the most common and widespread process in the majority of countries, with a large increase in market value. If the market value of "smart" agriculture was USD 15 billion in 2022, it is predicted to reach USD 33 billion by 2027 [17]. The number of agricultural robots will also increase. By 2030, the world will have almost six times more agricultural robots than in 2020. During the same period, the global market value of self-driving tractors is expected to reach USD 11.6 billion by 2030 [18].

Digitization in agriculture is a significant driver in transforming traditional production methods. The transformation will be based on technology advancements that are required to create a sustainable production system in farms [19].

The combination of digital technology and agriculture will speed up the shift from traditional to "smart" agriculture, resulting in the automation of simpler and more routine processes [15]. Farmers will be able to considerably boost the quantity and quality of agro-food products thanks to artificial intelligence.

Accordingly, researchers examine the benefits of agricultural digitization, concentrating on the constraints and requirements for implementing this process [16].

The studies prove, that it is especially crucial to boost the digitalization process of small and medium-sized companies through the relevant policy agenda [20].

Based on a study of digital transformation trends, the challenges to digitalization in Georgia's agriculture sector were highlighted, including limited access to contemporary technologies, a lack of digital skills, high costs, and others [21]. The opinion is supported that the policy of transportation of food and beverages should be considered from this perspective [22]. Furthermore, the main obstacles of sustainable development, chances for stimulation, and future orientations of growth should be addressed through the lens of digital transformation [23]. In general, the pandemic has become the basis for the development of digital and online business [24].

"Smart" agriculture is growing more popular in developing countries. Today, several organisations are adopting digital technology assistance programmes to help small farmers [25]. Digitization of the agricultural sector is examined by country, farming type, software provision, services, solutions, and applications. According to study, the countries of North America currently dominate the market in terms of digitization, and it is projected that there will be considerable growth in the Asia-Pacific countries between 2022 and 2029 [26].

The primary possibilities and difficulties in the agriculture sector, as well as the effects of digitization, have been assessed for their potential to boost productivity development and competitiveness. Digitization makes resources more efficient and sustainable, optimises manufacturing processes, improves risk management, forecasts market trends, and strengthens strategic decision-making capabilities. Digitization can fundamentally alter the interactions between technology and product suppliers, farmers, processing units, retailers and wholesalers, and consumers.

Labor productivity indicators are notably poor in developing nations, which is one of the most significant barriers to achieving food security [27-28]. Georgia's agricultural industry is similarly characterized by low labor productivity; in instance, the agricultural sector produces 7.0% of the country's GDP, while the rural population accounts for 39.6% of the total population [29].

Based on the foregoing, the primary goal of the research was to address the following question: What influence does digitization have on productivity? Was used a linear multiple regression model to estimate the impact of factor variables (the number of Internet and social media users) on productivity.

In the agricultural sector, in 2017-2022, the level of productivity (y) was calculated based on the data on the volume of production and the number of employees (Table 1).

Table 1. The volume of labor productivity in 2017-2022 in Russia.

Year	*Production volume (GEL)*	*Number of employees (person)*	*Productivity* - y *(gel/person)*
2017	3724500000	289500	12865,28
2018	4884700000	253900	19238,68
2019	5176700000	247400	20924,41
2020	5759600000	246300	23384,49
2021	5969800000	230300	25921,84
2022	6180000000	229200	26963,35

Note: the values of column 2 and 3 are retrieved from: Agriculture of Russia 2020 [28], Agriculture of Russia 2021 [29]; The value of column 4 is calculated by the authors [30].

A linear multiple regression model was used to study the relationship between the number of Internet and social media users and the labor productivity index (Table 2).

Table 2. Labor productivity, number of Internet and social media users in Russia in 2017-2022.

Year	*Productivity* - y *(gel/person)*	Number of internet users (person) x_1	Number of social media users (person) x_2
2017	12865,28	2250000	2200000
2018	19238,68	2370000	2600000
2019	20924,41	2600000	2700000
2020	23384,49	2730000	2700000
2021	25921,84	2880000	3100000
2022	26963,35	2870000	3350000

Note: data in columns 3 and 4 taken from Datareportal [32].

The linear multiple regression model ($\hat{y}=b_0+b_1x_1+\ldots+b_nx_n$, where y is the result variable; $x_1, x_2, \ldots x_n$ – factor variables; $b_0, b_1, b_2, \ldots b_n$ – regression coefficients) was used to evaluate the effect of a one-unit change in the factor variable on the outcome variable.

Based on the data shown in Table 2, the multiple regression model is:

$$\hat{y}=-14736,34800+0.009917x_1+0,0039266x_2 \quad (1)$$

The coefficient b1 represents the increase in average labor productivity (result variable) caused by a one-unit change in the number of Internet users (x1), all other factors remaining constant. That is, an increase in the number of Internet users by one person leads to an increase in labor productivity by 0.009917 (GEL/person);

The coefficient b2 represents the increase in average labor productivity (result variable) caused by a one-unit increase in the number of social media users (x2), all other factors remaining constant. That is, an increase in the number of social media users by one person leads to an increase in labor productivity by 0.0039266 (million GEL/person).

In the model, we additionally incorporated 2023 data, for which we generated the labor productivity index using left-hand imputation of production volume and the number of employees (Table 3).

Table 3. Labor productivity in Russia 2017-2023.

Year	*Production volume (Gel)*	*Number of employees (person)*	*Labor productivity (Gel/person)*
1	2	3	4
2017	3724500000	289500	12865,28
2018	4884700000	253900	19238,68
2019	5176700000	247400	20924,41
2020	5759600000	246300	23384,49
2021	5969800000	230300	25921,84
2022	6180000000	229200	26963,35
2023*	6390000000	228100	28014,91

The dependence of the Internet and social media users number on the productivity index in 2017-2023 is presented in Table 4.

Table 4. Labor productivity, number of Internet and social media users in Georgia in 2017-2023.

Year	*Labor productivity (Gel/person)* y	Number of internet users (person) x_1	Number of social media users (person) x_2
2017	12865,28	2250000	2200000
2018	19238,68	2370000	2600000
2019	20924,41	2600000	2700000
2020	23384,49	2730000	2700000
2021	25921,84	2880000	3100000
2022	26963,35	2870000	3350000
2023	28014,91*	2860000	3050000

Based on the data shown in Table 4, the linear multiple regression model is:

$$\hat{y}=-19132,55062+0.012421x_1+0,003238x_2 \quad (2)$$

The model allows us to derive the following conclusion:

– An increase in the number of Internet users by a person, other things being equal, leads to an increase in labor productivity by 0.012421 (Gel/person);

– An increase in the number of social media users by a person, other things being equal, leads to an increase in labor productivity by (mil gel/person).

The above-mentioned relationship is graphically presented in Fig. 1.

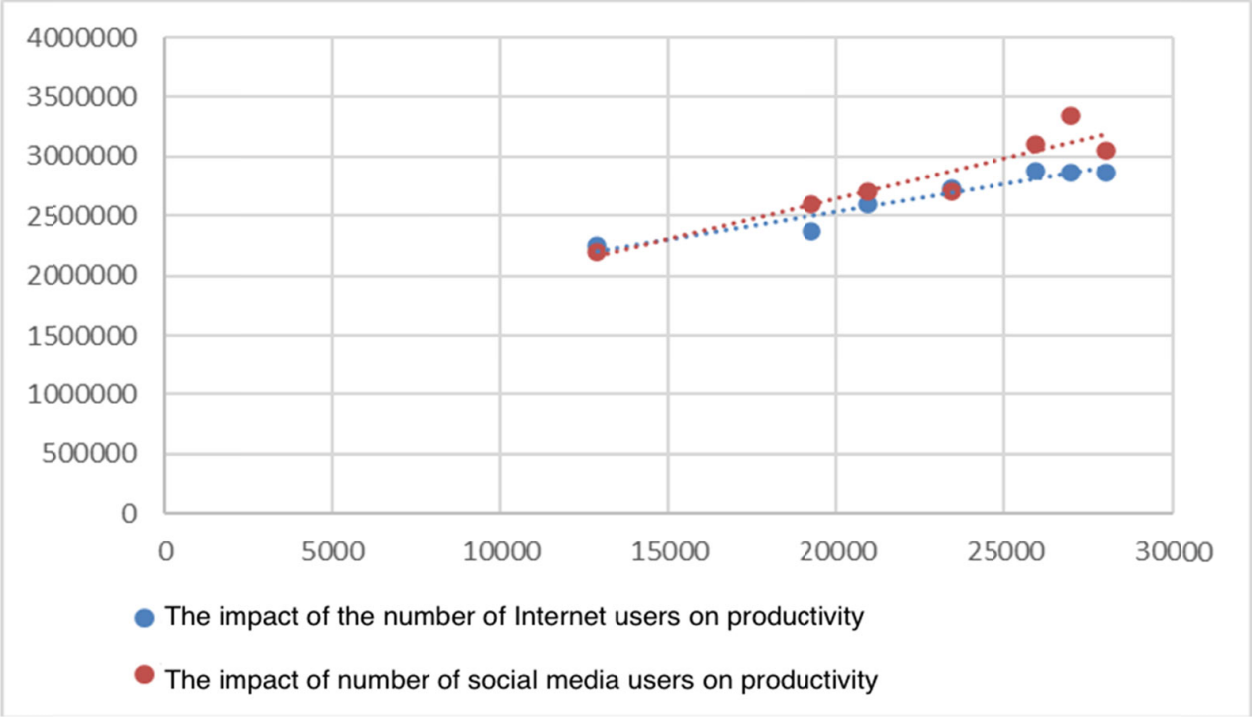

Fig. 1. The impact of the number of Internet and Social Media Users on Productivity (Agricultural Sector).

Thus, the quantity of Internet and social media users has a favorable influence on productivity, with social media users increasing productivity faster than Internet users.

3 Conclusion

In Georgia's agricultural industry, users have limited internet access, Internet connection is slow, employees are unaware of current digital technologies and portals in their sphere of operation, the sector is small-scale, and productivity is low. It is necessary to make digital transformation a priority and invest in this area. It is advisable to develop mechanisms for implementing and transferring investments in digital technology.

A linear multiple regression model allowed to discover that an increase in the number of Internet and social media users will lead to an increase in productivity, with social media users increasing productivity faster than Internet users. Young farmers can effectively employ digital technologies; consequently, it is recommended that financial support packages be developed for young farmers to conduct digital transformation processes. To accelerate the processes of digital transformation in the agricultural sector, it is needed banks to offer financial products tailored to the digital needs of young farmers, as well as credit lines with flexible conditions (for example, low interest rates) that are tailored to business cycles.

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