

# REPUBLIC OF AZERBAIJAN

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## ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

### ASSESSMENT OF THE IMPACT OF DIGITALIZATION ON THE ECONOMIC DEVELOPMENT OF THE AGRICULTURAL SECTOR IN THE REPUBLIC OF AZERBAIJAN

Specialty: 5312.01 – “Sectoral economics”

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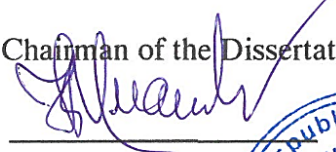
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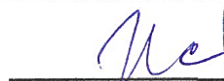
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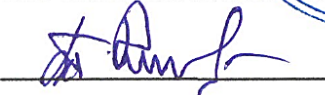
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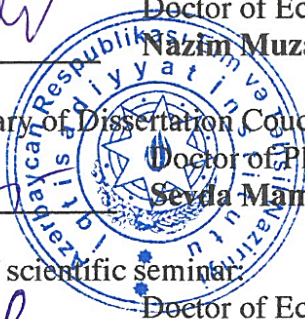


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# **OUTLINE OF DISSERTATION**

## **INTRODUCTION**

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- 1.1. The content, essence and main features of digital economy
- 1.2. Theoretical aspects of the digitalization of the agricultural sector
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### **Chapter II. CURRENT STATUS OF DIGITALIZATION IN AZERBAIJAN AND ASSESSMENT OF IMPACT ON THE AGRICULTURAL SECTOR**

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## **GENERAL CHARACTERISTICS OF THE RESEARCH WORK**

**Relevance and degree of completion of the topic.** In conditions of global economic modifications and technological transformations the digitilization turns into the essential factor in terms of agricultural sector. Considering that production of agriculture serves as a prime term for food security and basic element of national economy, it faces necessity toward the adaptation to contemporary challenges, including climate change, limited resources, sustainability and effectiveness, growing circumstances. Nowadays, digitalization is becoming a strategic tool for creating a competitive, sustainable, and innovative economy, which further increases the importance of accelerating the digital transformation of both the agricultural sector and other sectors.

First of all, accelerating the development of the digital economy and its optimal organization, creates the need to assess the impact of digitalization on socio-economic development indicators in separate fields. In this regard, assessing the impact of digitalization in the agricultural sector on the economic development of the industry is of particular relevance. The results obtained by investigating the impact of digitalization on the economic development of the agricultural sector can significantly contribute to the development of effective state support strategies, digitalization programs, and investment plans that foster modernization of the sector. This is also important in terms of forming a theoretical and methodological basis for the effective organization of the digital agricultural sector in the liberated territories of Azerbaijan.

Nowadays, the expansion of agricultural production, reduction of import dependence for strategic commodities, efficient utilization of agricultural land, and the digital transformation of the agricultural sector through the integration of advanced technologies have become central components of national economic development strategies of states aimed at ensuring food security. Its realization has underscored the necessity for rigorous academic research in this domain. Our research conducted in several agricultural enterprises within the country demonstrates that enterprises, which apply digital

technologies in both management and production processes can achieve higher economic indicators, minimize resource and product losses, and improve labor conditions for employees. This further reinforces the significance of a digitalized agricultural sector as a catalyst for advancing both economic growth and social development.

On the other hand, despite the specific characteristics of the agricultural sector, assessing its digitalization potential requires an analysis of the current state of the information and communication technologies (ICT) sector in the country.

An analysis of Azerbaijan's regulatory and legal framework for digitalization reveals that extensive state initiatives are being implemented to promote the digital transformation of the national economy.

One of the newest and most important documents adopted in this direction is the "Digital Development Concept in the Republic of Azerbaijan", approved by the Decree of the President of the Republic of Azerbaijan dated January 16, 2025. This concept aims to accelerate digital transformation, increase the accessibility of services, ensure e-participation and data security, reduce the administrative burden for businesses, strengthen competition, and develop public-private partnerships<sup>1</sup>. It should be noted that in the documents adopted before the approval of this concept, special importance was given to the creation of "Electronic Government" and "Government Cloud" within the framework of Azerbaijan's socio-economic development policy, the operation of the "Electronic Government Information System" (EGIS) in this context, the application of electronic signatures and the implementation of public services based on the "single window" principle<sup>2</sup>. The Strategic

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<sup>1</sup>Azərbaycan Respublikasında Rəqəmsal İnkişaf Konsepsiyası: [Elektron resurs] / Azərbaycan Respublikası Prezidentinin rəsmi internet səhifəsi. – Bakı, 16 yanvar 2025. – 25 s. URL: [https://static.president.az/upload/Files/2025/01/16/7b72d9ce4de45ac4fee0c4b1c8ffb392\\_5253488.pdf](https://static.president.az/upload/Files/2025/01/16/7b72d9ce4de45ac4fee0c4b1c8ffb392_5253488.pdf)

<sup>2</sup>Azərbaycan Respublikasında Rəqəmsal İnkişaf Konsepsiyası: [Elektron resurs] / Azərbaycan Respublikası Prezidentinin rəsmi internet səhifəsi. – Bakı, 16 yanvar 2025. – 25 s. URL:

Roadmap for the production and processing of agricultural products in the Republic of Azerbaijan, adopted in 2016, envisages the implementation of a land cadastral registration system, the preparation of digital maps, and the automation of land data within the framework of the "Establishing electronic agriculture" priority<sup>3</sup>. The application of these management methods is aimed at identifying existing problems related to the agricultural sector and implementing measures in a timely manner to organize the relevant and efficient use of agricultural land.

An analysis of the realization status of the set goals shows that in order to achieve these aims, there is still a great need to ensure the availability of ICT infrastructure and increase the efficiency of its adoption, which is precisely the general requirements inherent in digitalization. Despite the adoption of the "State Program on the Expansion of Digital Payments in the Republic of Azerbaijan in 2018–2020", approved by the Decree of the President of the Republic of Azerbaijan dated September 26, 2018<sup>4</sup>, final report of the Central Bank on State Program indicated that the measures envisaged in the areas of security in e-commerce, digital entrepreneurship, protection of creditor rights, logistics in accordance with new requirements, and the creation of appropriate infrastructure to ensure the implementation of business and financial services in remote areas, and financial inclusion have not been implemented.<sup>5</sup> As a result, despite all the potential opportunities, the degree of digitalization in the agricultural sector in Azerbaijan is still low. Limited use of ICT

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<sup>3</sup> Aliyev, İ. Aqrar sahənin modernləşməsi və rəqabət qabiliyyətliliyinin təmin olunması problemləri / İ. Aliyev, İ. Soltanlı – Bakı: Avropa, – 2017. – 428 s.

<sup>4</sup> "2018–2020-ci illərdə Azərbaycan Respublikasında rəqəmsal ödənişlərin genişləndirilməsi üzrə Dövlət Proqramı": [Elektron resurs] / Azərbaycan Respublikasının Mərkəzi Bankı. – Bakı, 26 sentyabr 2018-ci il. – 83 s. URL: <https://uploads.cbar.az/assets/c2dca9e0e958e8e02ea4593bf.pdf>

<sup>5</sup> "2018–2020-ci illərdə Azərbaycan Respublikasında rəqəmsal ödənişlərin genişləndirilməsi üzrə Dövlət Proqramı"nın 3 ilin yekunları əsasında monitoring və qiymətləndirilməsi üzrə yekun hesabat: [Elektron resurs] / Azərbaycan Respublikasının Mərkəzi Bankı. – Bakı, 2020. – 66 s. URL: <https://uploads.cbar.az/assets/790d4172ae98248a4eeafc42d.pdf>

among agricultural producers, as well as financial constraints in accessing digital technologies and low levels of digital literacy among the rural population pose serious challenges to the process of digitalization of the sector.

It should be noted that despite the growing interest in the topic of digitalization and the digital economy in the academic literature in general, limited attention has been devoted to the impact of digital technologies on the agricultural sector. Nevertheless, there are significant number of scientific studies conducted by local scholars and researchers on the conceptual issues of the digital economy, the general impacts of digitalization, and the examination of its benefits and limitations.

We can list Azerbaijani economists A.F. Musayev, T.N.Aliyev, A.J.Muradov, V.A.Gasimli, L.A.Allahverdiyeva, I.M.Abbasov, S.A.Aliyev, A.K.Aliyev, A.D.Huseynova and others among the authors of works dedicated to the digital economy and digitalization. The significant scientific research works of our country's well-known scientists I.H.Aliyev, E.A.Guliyev, I.H. Ibrahimov, M.M. Huseynov, R.A.Balayev, F.V.Rustamov and others on the economic problems of the agrarian sector and the identification of prospective directions for its development have formed an important scientific basis for studying the issues of digitalization of the agrarian sector in Azerbaijan.

Foreign scientists S.Oliner, R.Bukht and R.Hicks, Bo Karlsson, E.Brynjolfsson, T.Miroljubova, M.Zhukova and others have devoted a significant number of scientific works to the study of various issues related to the digital economy. The assessment of the impact of digitalization on the agricultural sector was mainly carried out by Chinese researchers Ying Tang, Mangen Chen, Dandan Yang, Zhu Gubo and others.

Based on the reviewed methodologies, indicators that allow assessing the impact of digitalization on both the national economy and the development of agricultural sector have been identified. The relevance of identifying these indicators stems from the need to comprehend how digitalization transforms economic processes, especially in the agricultural sector in a more deep and accurate manner, since it plays a crucial role in ensuring food security and

sustainable development. All of the above once again confirms the relevance of the dissertation work and its importance for our country.

**Object and subject of research.** The object of the study is the agricultural sector of Azerbaijan. The subject of the study is the organizational and economic mechanisms for strengthening the positive effects of digitalization on the economic development of the agrarian sector.

**Research aim and objectives.** The purpose of the dissertation is to assess the impact of digitalization on the economic development of the agricultural sector in the Republic of Azerbaijan, to identify suitable resource opportunities, and to develop scientifically substantiated proposals and recommendations to consolidate the positive effects of digitalization.

To achieve above-mentioned aim, the following research objectives are to be addressed:

- Explaining the content, essence and defining essential characteristics of the digital economy;

- Investigating theoretical aspects of the digitalization of the agricultural sector;

- Examining methodological approaches to assessing the impact of digitalization on the economic development of the agricultural sector and putting forward the author's approach;

- Analysis of the current state of digital transformation in Azerbaijan;

- Analyzing the level of digitalization of the agricultural sector in Azerbaijan;

- Assessing the impact of digital transformation on the economic outcomes of the agricultural sector;

- Identifying ways to enhance the positive outcomes of digital transformation affecting the economic development of the agricultural sector;

- Identifying the prospects for establishing a digital agricultural sector in the post-conflict areas of Azerbaijan.

**Research methods.** In the dissertation, methods such as comparative analysis, statistical analysis, survey, mathematical-statistical analysis, and modeling were applied.

The information base of the research work consists of legislative

acts, strategic documents and state programs adopted in the field of ICT in Azerbaijan, materials of the State Statistical Committee of the Republic of Azerbaijan, the Ministry of Digital Development and Transport of the Republic of Azerbaijan, the Ministry of Agriculture of the Republic of Azerbaijan, Agricultural Research Center, the State Agency for Agricultural Credits, the Central Bank of Azerbaijan, reports covering various years of the Food and Agriculture Organization of the United Nations, the World Bank, the European Commission, the USDA Economic Research Service, the Global Food Security Index and a number of international indexes on digitalization, as well as factual materials collected from agricultural and agro-processing enterprises, agricultural cooperatives, relevant scientific research institutes whose activities were studied on site, and internet data from agroparks with websites.

**The main provisions defended.**

1. The results of a survey conducted to analyze the level of digitalization of the agricultural sector in Azerbaijan show that the application of digital technologies in the sector is mainly determined by the scale of enterprises. Therefore, in order to increase the digitalization potential of small farms in the agricultural sector of Azerbaijan, there is a need to organize digital agroclusters based on their integration with large agricultural enterprises.

2. Based on the analysis of the impact of international indexes on digitalization on the development indicators of the agricultural sector, it was determined that increasing the level of digitalization in upper-middle, lower-middle and low-income countries has a positive impact on the development of the agricultural sector. Increasing the production of mobile applications per capita, closing the gap in digital payments in rural areas, ensuring 4G mobile coverage of agricultural lands, and increasing the use of ICT by governments are factors contributing to the growth of value added per worker in agriculture, forestry and fishing.

3. Based on the analysis conducted on Azerbaijan, it was defined that increasing the ICT Development Index indicators is one of the factors that increases the gross output of agriculture, as well as the value added per worker in agriculture, forestry and fishing and food production.

4. The increasing value of services produced in the software development sector in Azerbaijan is one of the key factors influencing the growth of value added per worker in agriculture, forestry and fishing.

5. Based on the analysis carried out within Azerbaijan, it was defined that increasing the import of ICT products, which ensures the presence of ICT in the country and its wide application in all sectors of the economy, leads to an increase in the gross output of agriculture, value added per worker in agriculture, forestry and fishing, and food production. At the same time, an increase in the volume of investments in fixed capital by ICT enterprises affects only the growth of the gross output of agriculture.

6. The analysis of the level of ICT development in agricultural enterprises of the regions of Azerbaijan shows that the increase in ICT expenditures and the degree of ICT use in these enterprises leads to an increase in the total volume of production and profits of these enterprises.

7. Based on the analysis of the pre-occupation period and current potential of the post-conflict territories of Azerbaijan, as well as the restoration and construction work currently underway in these territories, the prospects for creating a new agricultural sector based on the application of digital technologies have been defined.

#### **Scientific novelty of research.**

- An author's definition has been given to the concept of digital economy, systematization and classification of the directions reflecting the specific features of the digitalization process in the agricultural sector of Azerbaijan has been carried out.

- The impact of digitalization on the economic development of the agricultural sector in Azerbaijan was assessed using an approach that encompasses digitalization at the macro and micro (agricultural enterprises in 13 economic regions of the country) levels. [22, p.89-93], [12, p.1013-1017]

- Based on a survey conducted in 6 large agricultural enterprises and 10 agricultural cooperatives in Azerbaijan, the level of digitalization of large agricultural enterprises was assessed based on the criteria suggested by the author.

- A digital agrocluster model has been proposed based on the

integration of small farms in the country into large agro-processing and agricultural enterprises equipped with digital technologies.

- Prospective directions of the digital agricultural sector in the post-conflict areas of Azerbaijan have been put forward.

### **Theoretical and practical significance of the research.**

The theoretical significance of the study lies in systematization and expansion of the scientific foundations of digitalization, formation of a methodological approach to assessing the impact of digitalization on the economic development of the agricultural sector. Here, the digital economy is associated not only as a technological innovation, but also with systemic changes in economic relations. This approach is of particular relevance for the agricultural sector, drawing attention to the efficient use of limited resources.

The practical significance of the study is that the obtained results and scientifically substantiated proposals can be used in developing strategies for the digital transformation of the agricultural sector. Furthermore, the approaches proposed in this research regarding the creation of a digital agricultural sector in post-conflict regions of Azerbaijan may be applied in the formulation of state policies on land reform and digitalization in these areas, as well as in the teaching of related academic disciplines.

**Approbation and application.** A number of provisions of the research work, the results obtained and the approaches and proposals put forward in the work have been published in national and international journals and were subject to discussion at scientific conferences. A total of 13 articles (four abroad, one in Scopus), 6 conference materials, 5 theses (two abroad) have been published.

**The organization where the dissertation was performed.** Institute of Economics of the Ministry of Science and Education of the Republic of Azerbaijan.

**The structural sections of the dissertation and the scope of the work.** The total volume of the dissertation is 335837 characters. The volume of the work, excluding tables, diagrams, figures, a list of 280 references and appendices, is a total of 237319 characters, including the title page and table of contents (2549 characters), introduction (16860 characters), three chapters (1st chapter 71187 characters, 2nd chapter 96189 characters, 3rd chapter 39936

characters), conclusions and proposals (10598 characters). In total, the dissertation contains 29 tables, 16 diagrams and 4 figures.

## THE MAIN CONTENT OF DISSERTATION

The "**Introductory part**" of the dissertation work defines the relevance and degree of development of the topic, presents the object, subject, goals and objectives of the research, research methods, main provisions put forward for defense, scientific novelty, theoretical and practical significance, approval and application of the research.

In the first chapter of the dissertation titled "**Theoretical and methodological foundations of assessing the impact of digitalization on the development of the agricultural sector**", the content, essence and main characteristics of the digital economy are clarified, theoretical aspects of the digitalization of the agrarian sector and methodological approaches to assessing the impact of digitalization on the economic development of the agrarian sector are studied. It should be noted that information and communication technologies (ICT) are becoming a key factor in the transformation of the agricultural sector. Studying the nature and main features of the digital economy based on the use of ICT and data is the basis for analyzing how modern technologies can transform the agricultural sector, increase its productivity and competitiveness.

Based on the reviewed methodologies and taking into account both the scale of assessment and the available statistical data, it is deemed appropriate that the proposed methodological approach to evaluating the impact of digitalization on the economic development of the agricultural sector should encompass the following areas:

- Assessment of the impact of indicators ensuring the existence and development of ICT at the republican level on the economic indicators of the agricultural sector;

- Assessment of the impact of the digitalization of the agricultural sector on the economic indicators of these enterprises as a result of the widespread integration of ICT into agricultural enterprises, as well as the effects of the first approach.

The current state of digital transformation in Azerbaijan, as

well as the country's position in international rankings, is first extensively analyzed in Chapter 2 of the dissertation entitled “**Current Status of Digitalization in Azerbaijan and Assessment of its Impact on the Agricultural Sector**”. Analysis of international indicators on digitalization shows that the country still faces significant challenges in the development of high technologies and the ICT sector, as well as in terms of use of advanced digital tools. This hinders the global digital transformation and reduces the pace of knowledge-based economic development.

An analysis of the current state of the agricultural sector in Azerbaijan shows that due to the fact that the country's agriculture consists mainly of small farms, the land reclamation situation is currently considered unsatisfactory, especially owing to outdated land reclamation and irrigation systems that do not meet modern requirements, the problem of water shortage, as well as the use of arable land as pasture and hayfields, illegal use, the use of heavy machinery, and the erosion of soils have made their efficient use much more difficult<sup>6</sup>.

As a result of our official appeal to the State Statistics Committee of the Republic of Azerbaijan to investigate the current state of digitalization of the agricultural sector in our country, grounded in the analysis of indicators on the application of ICT in agricultural enterprises in 14 economic regions of Azerbaijan, it was found that in 2022 the highest level of digitalization was observed in the Baku, Absheron-Khizi and Guba-Khachmaz economic regions, medium-level digitalization was observed in Ganja-Dashkan, Gazakh-Tovuz, Shirvan-Salyan, Sheki-Zagatala, and the weakest level of digitalization was observed in the Mil-Mugan, Lankaran-Astara, Karabakh, Central Aran and Nakhchivan Autonomous Republic<sup>7</sup>.

A subsequent appeal was submitted to the Ministry of Agriculture to initiate an investigation into the application of digital technologies within the production processes of Azerbaijan's

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<sup>6</sup>Texnika və İnnovasiyalar. Azərbaycan Respublikası Kənd təsərrüfatı Nazirliyi: [Elektron resurs]. URL: <https://agro.gov.az/az/texnika-ve-innovasiyalar/diger-texnika/suvarma-ve-meliorasiya>

<sup>7</sup>Calculated by the author based on the data in Appendix 3 and Appendix 4 of the dissertation.

agricultural sector. Hence, based on the results of the research conducted in 2023 in a total of 6 large agro-enterprises (including agro-parks and the Scientific Research Institute of Vegetable Growing) and 10 agricultural cooperatives across the country, and then based on the results of surveys conducted among small individual entrepreneurs and family farms operating in Absheron, Lankaran-Astara, Guba-Khachmaz regions and Nakhchivan, it was determined that the application of digital technologies in the agricultural sector is determined by the scale of the enterprise in this sector. In other words, the larger the agricultural enterprise, the more feasible the adoption of innovative technologies becomes. Implementing digital technologies in the agricultural sector requires both financial resources and an adequate level of knowledge — both of which are often limited in small farms across the regions of the republic. Consequently, large farms gain a significant advantage over smaller ones, leading to a substantial decline in the competitiveness of small-scale agricultural producers. As a result, digital transformation in the country's agricultural sector remains largely out of reach for small farmers. It should be noted that various mechanisms — such as state support, digital platforms, business incubators, and collaborative innovations — are employed in international practice to enhance small farmers' access to digitalization. In Azerbaijan, similar models can be adapted to local conditions, particularly through state support and partnerships with large agricultural enterprises. Thus, in our country, by selecting large enterprises capable of applying digital technologies (for example, in the production of fruits or vegetables), digital agroclusters can be created, consisting of their association with small farmers. This model can be described as follows:

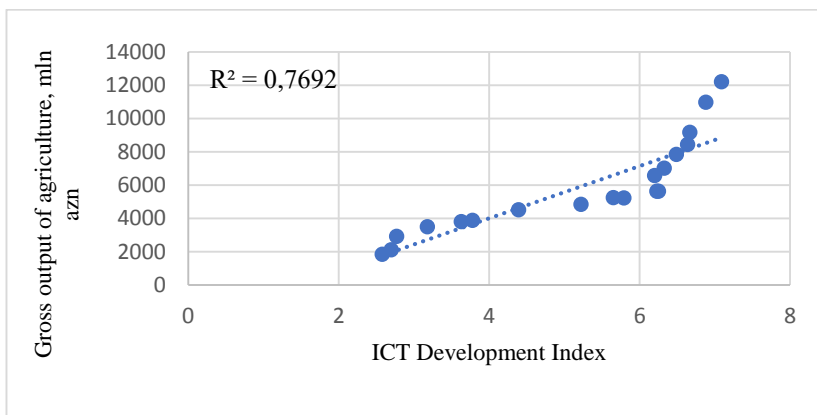
- A large agribusiness becomes an operator that provides small farmers with access to its digital technologies, infrastructure and experience on a rental or subscription basis, and provides its technologies to small farmers for a fee;

- Small farmers can use modern technologies without investing in their acquisition.

Using a large enterprise as an operator to transfer technologies to small farmers on a rental or subscription basis on the basis of a digital

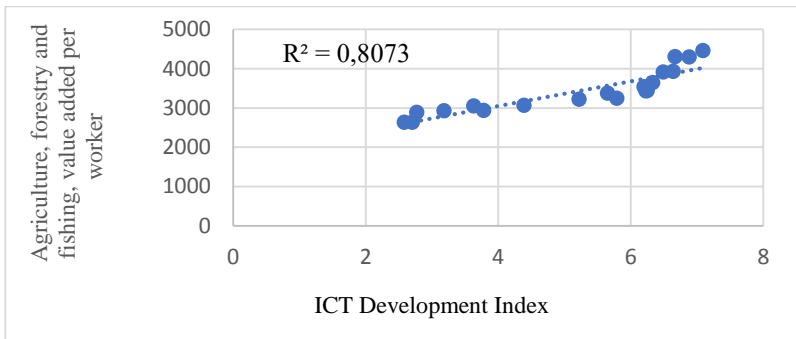
agrocluster can be considered a new way of interaction in the agricultural sector.

In paragraph 2.3. of the dissertation, the impact of digital transformation on the economic development of the agricultural sector is analyzed first at the international level, based on international indices on digitalization, and then taking into consideration assessments conducted within the country. Thus, using some sub-indexes of the Network Readiness Index and the Agricultural Digitalization Index, the analyses conducted showed that increasing the number of active mobile applications per capita in upper-middle, lower-middle and low-income countries, eliminating the gap in digital payments in rural areas compared to cities, ensuring 4G mobile coverage of agricultural lands, and increasing online services (government use of ICT) can lead to an increase in added value per worker in agriculture, forestry and fishing. According to domestic-level analyses, it was concluded that the indicators included in the ICT Development Index can become an important factor in the development of the agricultural sector, as well as in ensuring food security in the country.



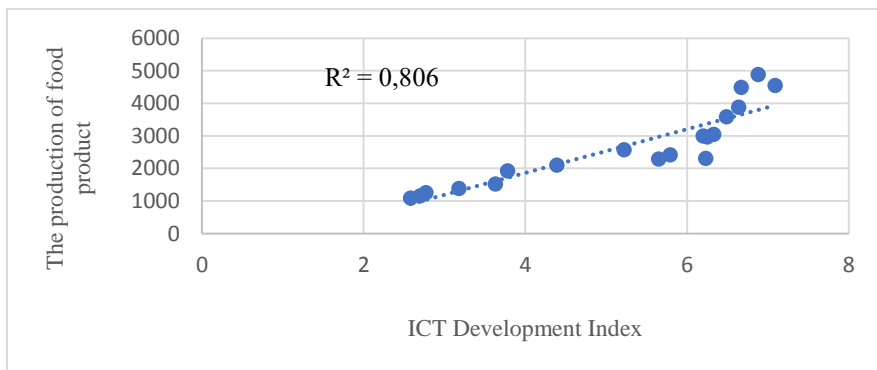
**Chart 1. Relationship between ICT Development Index and gross output of agriculture in Azerbaijan (2005-2023).**

**Source:** Developed by the author based on the “Indicators on ICT” and “Gross output of agriculture” of the State Statistics Committee of the Republic of Azerbaijan ([https://www.stat.gov.az/source/digital\\_development/](https://www.stat.gov.az/source/digital_development/); <https://www.stat.gov.az/source/agriculture/>).



**Chart 2. Relationship between the ICT Development Index and value added per worker in agriculture, forestry and fishing in Azerbaijan (2005-2023).**

**Source:** Formulated by the author based on the “Indicators on ICT ” of the State Statistical Committee of the Republic of Azerbaijan and data from the World Bank. ([https://www.stat.gov.az/source/digital\\_development/](https://www.stat.gov.az/source/digital_development/); <https://data.worldbank.org/indicator/NV.AGR.EMPL.KD>).



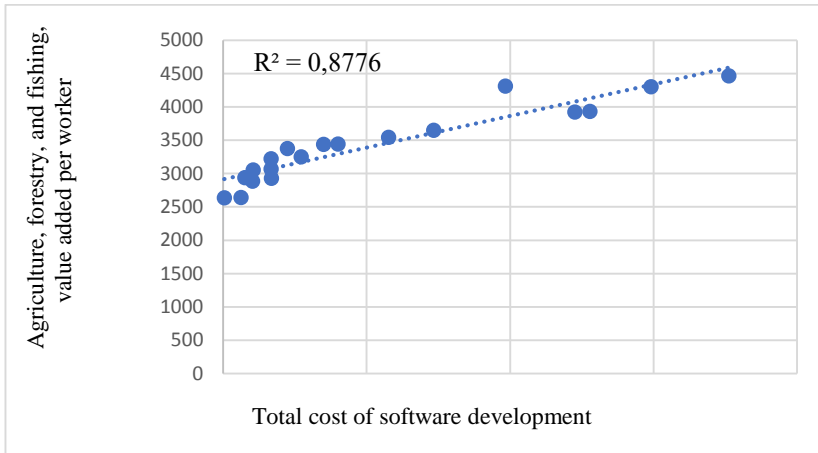
**Chart 3. Relationship between the ICT Development Index and food production in Azerbaijan (2005-2023).**

**Source:** Developed by the author based on the data of the State Statistics Committee of the Republic of Azerbaijan “Indicators on ICT” and “Value of industrial products (works, services)” ([https://www.stat.gov.az/source/digital\\_development/](https://www.stat.gov.az/source/digital_development/); <https://www.stat.gov.az/source/industry/>).

In the dependencies reflected in Charts 1, 2 and 3, the high determination coefficients in the relationships between the ICT Development Index and the gross agricultural product ( $R^2 = 0,76$ ),

labor productivity ( $R^2 = 0,80$ ) and food production ( $R^2 = 0,80$ ) indicators confirm that the level of ICT development has a significant positive impact on these areas.

According to the investigations conducted in agricultural enterprises of the country, optimizing the usage of resources, increasing efficiency of irrigation, and increasing efficiency of production processes depend upon the operation of software.



**Chart 4. Relationship between the total cost of software development in Azerbaijan and the value added per worker in agriculture, forestry and fishing (2005-2023, in manats).**

**Source:** Developed by the author based on the data of the State Statistics Committee of the Republic of Azerbaijan "Output of product and rendering of services in ICT sector" and data from the World Bank.

([https://www.stat.gov.az/source/digital\\_development/](https://www.stat.gov.az/source/digital_development/);  
<https://data.worldbank.org/indicator/NV.AGR.EMPL.KD>).

As can be seen from the results in Chart 4, there is a strong positive relationship (coefficient of determination  $R^2 = 0,87$ ) between the total cost of software development in our country and the value added per worker in the agricultural sector. This suggests that increasing the cost of software development can have a significant impact on labor productivity in agriculture.

Analysis of statistical indicators of Azerbaijan demonstrates that

production of ICT products and services are not in a sufficient level, majority of ICT equipments and software are imported from abroad. That is why, an import level of ICT products is considered one of the basic indicators characterizing digitalization level of the country. [21]

Country-wide analyses examined the impact of fixed capital investments and ICT product imports by ICT enterprises in the Republic of Azerbaijan covering the years 2005-2023 on the gross agricultural product, value added per worker in agriculture, forestry and fishing, and food production indicators, which determine the economic development of the agricultural sector (Table 2). [22]

**Table 1.**

**Final results of assessment**

Name and symbol of the independent variable	Effect of 1% increase in independent variables on the dependent variable, in/ %		
	Gross output of agriculture	Value added per worker in agriculture, forestry and fishing	Food production
Investments in fixed capital by ICT enterprises (X <sub>1</sub> )	0,25	-	-
Import of ICT products (X <sub>2</sub> )	0,50	0,17	0,46

**Source:** formulated by the author based on the results of the assessment.

The results obtained from the assessment of the impact of ICT indicators on the agricultural sector in Azerbaijan in 2005-2023 make it appropriate to examine the impact of these technologies on the economic indicators of the sector at the level enterprise.

In this regard, the results of the assessment conducted based on the EViews application software package showed that the application of ICT in agricultural enterprises in the 13 economic regions of Azerbaijan during 2019-2022 had a more noticeable impact on the total profit of those enterprises (Table 2). [12]

**Table 2.****Final results of assessment**

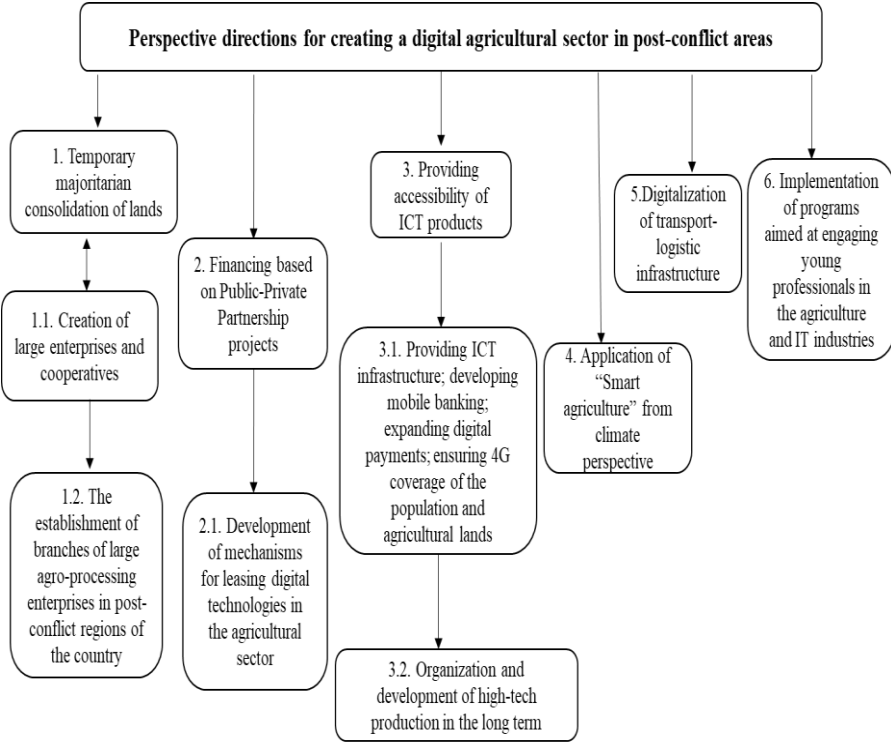
Number	Name and symbol of the independent variable	Effect of 1% increase in independent variables on the dependent variable, in %	
		Total agriculture harvest	Total profit
1.	Number of enterprises using computers (X1)	0,0158	0,0541
2.	Number of employees using computers (X2)	0,0412	0,1412
3.	Number of computers in enterprises (X3)	0,0435	0,1489
4.	Number of computers with Internet access (X4) (X4)	0,0451	0,1545
5.	ICT expenditure (X5)	0,0224	0,0766
6.	Number of employees using the Internet (X6)	0,0432	0,1481
7.	Number of businesses with websites (X7)	0,0067	0,0229

**Source:** The results were developed by the author based on the results obtained using the EViews application software package.

An investigation of ways to strengthen the positive results of digital transformation affecting the economic development of the agricultural sector and the prospects for establishing a digital agricultural sector in the post-conflict areas of Azerbaijan were carried out in Chapter 3 of the dissertation titled "**Directions for Strengthening the Role of Digital Transformation in the Development of the Agricultural Sector in Azerbaijan**".

According to country-wide analyses, one of the indicators that has a significant positive impact on the economic performance of the

agricultural sector is the import of ICT products. Eliminating the gap in digital payments in rural areas or ensuring 4G mobile coverage of the population, as well as agricultural lands, also depends on the availability of basic ICT products. Paragraph 3.2. of the dissertation deals with the perspective directions of the digitalized agricultural sector in post-conflict areas. The generalization of the results acquired from the analyses conducted during the research allows for the development of a concept for the establishment of a digital agricultural sector aimed at increasing the competitiveness and economic development of post-conflict areas. It should be noted that this concept may include the perspective directions presented in the following figure.



**Figure. Perspective directions for creating a digital agricultural sector in post-conflict areas**

**Note:** Author’s formulation.

In the "**Conclusion**" section of the dissertation the following results were obtained based on the research:

1. Studies show that compared to other countries, a small number of enterprises in Azerbaijan have access to the Internet, the provision of enterprises with computers is also in unsatisfactory level, and our country lags behind many countries in the world in terms of the availability of websites, which limits the opportunities to benefit from digital solutions.

2. An analysis of the situation in the sphere of e-commerce demonstrates that there are factors hampering the development of e-commerce in Azerbaijan. Thus, there are significant limitations in the development of online shopping due to the weak mechanisms for returning goods purchased over the Internet and the weak logistics infrastructure in the country.

3. Despite the high level of coverage of 3G and 4G mobile networks at the population level in the country, a significant lag in providing rural areas with access to modern mobile networks, especially 4G, limits the digitalization of the agricultural sector.

4. Analysis of Azerbaijan's indicators on the Network Readiness Index showed that the strengths of our country include state promotion measures for digitalization, the literacy level of the adult population and the spread of the Gig economy, while the weaknesses include the use of digital payments in rural areas, online access to financial accounts, the legal environment for ICT and the volume of annual investments in telecommunications services.

5. Analysis of Azerbaijan's indicators on the Global Innovation Index shows that less innovative products are produced in our country compared to the resources directed to innovation.

6. A study of the current state of the agricultural sector in the republic shows that despite significant state support for agriculture, there are problems that need to be solved in the production of a number of strategic products, as well as in the protection and efficient use of soil fertility and other areas.

7. Analysis of the Global Food Security Index shows that Azerbaijan's zero score on the indicators of sustainable agricultural practices, facilitating the application of innovative technologies in agriculture, the activity of community organizations and "smart

agriculture" in terms of climate, has caused our country to significantly fall behind countries belonging to different income groups in these areas.

8. An examination of the level of ICT application in various sectors of the economy in Azerbaijan shows that the digitalization of the agricultural sector is weaker than in other sectors. Digitalization in the sector is mainly in the areas of management and services, and the application of digital technologies in agricultural production is not at a satisfactory level.

9. Moreover, field studies conducted at agricultural enterprises within the country have identified a significant "digital divide" in the adoption of digital technologies, which is closely correlated with the scale of the enterprises. The digitization process in the agricultural sector is predominantly concentrated in large-scale enterprises, primarily due to their greater financial stability, better access to resources, and enhanced capacity to implement modern technologies.

10. Results of the assessment based on the use of Network Readiness Index indicators (for upper-middle, lower-middle and low-income countries):

- Internet domain registration, online access to financial accounts, number of active mobile applications per capita and government online service index have a significant positive impact on GDP per capita, PPP;
- Increasing the number of rural residents using digital financial services and the number of active mobile applications per capita have a positive impact on value added per worker in agriculture.

11. Based on the study of the impact of the sub-indices of the Agricultural Digitalization Index developed by the World Bank on labor productivity in agriculture, it was concluded that providing 4G mobile coverage of agricultural lands has a positive impact on the value added per worker in agriculture, forestry, and fishing.

12. As a result of the analysis conducted on Azerbaijan, it was determined that there is a positive relationship between the ICT Development Index and the gross output of agriculture, value added per worker in agriculture, forestry and fishing, and food production. This indicates that increasing the ICT Development Index in the country can contribute to the optimization of production processes in agriculture, increasing labor productivity, expanding total product production, and

ensuring the sustainability of food supply.

13. There is a highly positive correlation ( $R^2 = 0,87$ ) between the total cost of software development in our country and the value added per worker in agriculture. This confirms that software development is one of the important factors in increasing labor productivity in agriculture.

14. A 1% increase in imports of ICT products in Azerbaijan leads to an increase in the gross output of agriculture by 0,5%, in the value added per worker in agriculture, forestry and fishing by 0,17%, and in the production of food products by 0,46%. A 1% increase in investments in fixed capital by ICT enterprises affects only a 0,25% increase in the gross output of agriculture and does not have a significant impact on other relevant areas.

15. An assessment of the application of ICT in agricultural enterprises in 13 economic regions of Azerbaijan shows that during 2019–2022, the integration of digital technologies had a positive impact on the total profit of more enterprises than on the total agriculture harvest.

16. An analysis of international digitalization indexes relevant to the agricultural sector indicates that the performance of these indicators is closely linked to the educational level of the workforce and the expertise of ICT professionals. Highly qualified personnel play a critical role in enhancing economic outcomes in agriculture by reinforcing the relationship between the development of digital infrastructure and the creation of mobile applications. Thus, the development of human capital is a decisive factor for the realization of the potential of digitalization.

17. Conclusions based on the examination of ways to expand the import of ICT products:

- Analysis of foreign countries shows that the increase in the import of ICT products depends on the development of the investment climate. Although a strong positive correlation was found between foreign direct investment and the import of ICT products in the 43 countries analyzed, a weak correlation was observed between domestic loans to the private sector and ICT imports in 38 countries. This indicates that the credit and financial system does not stimulate ICT imports and that an individual approach is important.

- There is a positive correlation between foreign investments and credit investments directed to the economy in Azerbaijan for 2005-2023 and the import of ICT personnel.

18. The goals set for the rehabilitation of Azerbaijan's post-conflict territories include the use of digital technologies in the agricultural sector to be formed there. Such an approach includes both the efficient use of land and the scale and organizational model of agricultural enterprises.

### **Recommendations**

In order to advance the level of digitalization in the country and to strengthen its influence on the economic development of the agricultural sector, the following measures are considered appropriate for implementation:

1. A national strategy for the digitalization of the agricultural sector should be developed, setting short-term and long-term goals, including measures aimed at facilitating the application of digital technologies.

2. Action directions should be developed for the implementation of early warning measures and a climate-adapted “Smart Agriculture” model for the agricultural sector in the country, as well as special procedures and mechanisms for planning public investments that include the application of sustainable agricultural methods.

3. The regulatory legal framework governing the use of digital technologies in the agricultural sector should be improved, taking into account the characteristics of high technologies (drones, artificial intelligence, blockchain).

4. Since digital technologies in the agricultural sector in Azerbaijan are mainly available to large agricultural enterprises and the majority of the sector is made up of small farms, digital agroclusters should be created to support them.

5. In order to develop mobile applications in the agricultural sector, expand the use of ICT, especially mobile banking, and increase the use of digital payments in the regions, the creation of virtual operators that will offer individual tariffs using the existing infrastructure should be accelerated, given that the mobile communications market in Azerbaijan is limited to three main operators (Azercell, Bakcell, and Nar).

6. The introduction of new specialties combining agricultural sciences and IT in higher education institutions should be achieved

through the creation of special training programs to train personnel with advanced digital skills and increase the number of IT specialists in the agricultural sector.

7. In order to accelerate the digitalization of the agricultural sector in the country, priority should be given to the widespread implementation of public-private partnership projects in this area.

8. In order to achieve the organization of a digital agricultural sector in post-conflict areas:

- temporary majority consolidation of lands and the establishment of large agro-processing enterprises should be identified as priority areas;

- The establishment of branches of large agro-processing enterprises operating in the republic in post-conflict areas should be encouraged;

- A wide sales network should be created in the region through leasing of digital technologies;

- In order to ensure a qualified workforce in the IT and agricultural fields, the issue of granting appointments to graduates of relevant universities with education in the fields of agriculture and IT should be considered.

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