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The role of Artificial Intelligence in agribusiness: Opportunities and Challenges in Georgia

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Abstract

As the world's population continues to grow, environmental challenges become more pressing, the agribusiness sector, which includes all operations related to producing and distributing food, plays a crucial role in addressing climate change, resource scarcity, and sustainability.

The research focuses on Georgia, a nation with a rich agricultural history and immense potential, aiming to analyse the role of artificial intelligence (AI) and agricultural technologies in the agroindustry. To accomplish this objective, a quantitative research methodology was utilised by gathering farmers' opinions regarding the implementation of AI in their businesses. Additionally, measuring farmers' attitudes towards AI and agricultural technologies was the main element in determining the significance of these technologies in the agribusiness sector of Georgia. Based on theoretical and empirical research in this field, the study evaluates the role of AI in agribusiness, assesses how agricultural technologies affects production, and the benefits and methods of utilizing AI. Furthermore, the research explores Georgia's opportunities and challenges in advancing AI and agricultural technologies within the agribusiness sector.

According to the research and the obtained results, one of the significant obstacles faced by farmers in adopting modern agricultural technologies and AI applications is their lack of skills and knowledge in using them. Despite not having technological skills, the assessments' findings indicate that most respondents hold positive attitudes towards the impact of AI applications and modern technologies on production yield and the realisation process in agribusiness. Moreover, the research highlights the importance of considering gender differences when examining farmers' attitudes towards agricultural technologies. Results provide evidence that there are significant differences in the attitude towards agricultural technologies based on the age of farmers, younger farmers display a more positive attitude towards embracing AI and agricultural technologies. Furthermore, the educational level of farmers influences their perception of the importance of AI and agricultural technologies. Finally, this thesis aims to contribute to the development of a sustainable and prosperous agro-industrial sector in Georgia by reinforcing the adoption of AI and agricultural technologies.

Keywords: Artificial Intelligence, Agricultural technologies, Agribusiness, Agripreneurs.

Resumo

À medida que a população mundial continua a crescer, as questões das alterações climáticas e a escassez de recursos ligados à sustentabilidade tornam-se mais críticas. O *agribusiness*, que inclui todas as operações relacionadas com a produção e distribuição de alimentos, tornou-se um sector importante na luta contra estes problemas.

Neste seguimento, a investigação centra-se na Geórgia, uma nação com uma história e um potencial agrícolas ricos, e pretende-se analisar o papel da inteligência artificial (IA) e das tecnologias agrárias na agroindústria. Para tal, seguiu-se uma metodologia de investigação quantitativa que permitiu recolher a opinião dos agricultores sobre a implementação da IA e da agroecologia nas suas empresas. Ainda, medir as atitudes dos agricultores em relação às tecnologias agrícolas foi o principal elemento para determinar o papel dessas tecnologias no *agribusiness*. Com base na investigação teórica e empírica, neste domínio, esta dissertação avaliou o papel da IA no *agribusiness*, a forma como as tecnologias agrícolas influenciam a produção e quais são os benefícios e as formas de utilização da IA. Em seguida, discutiram-se as oportunidades e os desafios da Geórgia no que respeita ao avanço da IA e das tecnologias agrárias no sector do *agribusiness*.

De acordo com a investigação e com os resultados obtidos, um dos principais obstáculos para os agricultores centra-se na adoção de tecnologias agrárias modernas, aplicações de IA, a sua falta de competências de conhecimentos de IA e sobre a sua utilização. Apesar de não serem detentores de competências tecnológicas, a maioria dos inquiridos continua a considerar que a utilização de ferramentas de IA e de tecnologias agrícolas são importante para as suas empresas agrícolas porque leva a um aumento da produtividade e facilita o processo de realização de planos *agribusiness*. Além disso, a investigação salienta a existência de diferenças, por sexo, quando se analisam as atitudes dos agricultores em relação às tecnologias agrícolas. Os resultados sugerem, ainda, a existência de diferenças estatisticamente significativas na atitude em relação às tecnologias agrícolas em função da idade dos agricultores, sendo que os agricultores mais jovens apresentam uma atitude mais positiva em relação à adoção da IA e das tecnologias agrícolas. Além disso, o nível de instrução dos agricultores influencia a sua perceção da importância da IA e das tecnologias agrícolas. Por último, esta tese visa contribuir para o desenvolvimento de um sector agroindustrial sustentável e próspero na Geórgia, promovendo e reforçando a adoção da IA e das tecnologias agrícolas.

Palavras-chave: Inteligência Artificial, Tecnologias Agrícolas, *Agribusiness*, Empresários agrícolas.

აბსტრაქტი

მსოფლიოს მოსახლეობის ზრდასთან ერთად, კლიმატური ცვლილების, რესურსების სიმცირისა და მდგრადობის საკითხები უფრო და უფრო კრიტიკული ხდება. აგრობიზნესი, რომელიც მოიცავს ყველა პროცესს, სურსათის წარმოებიდან დისტრიბუციამდე, გახდა ამ პრობლემების წინააღმდეგ ბრძოლის მნიშვნელოვანი იარაღი.

კვლევა ფოკუსირებულია საქართველოზე, ქვეყანაზე, რომელსაც აქვს მდიდარი სასოფლო-სამეურნეო ისტორია და პოტენციალი, რომლის მიზანია შეისწავლოს ხელოვნური ინტელექტის (AI) და აგრარული ტექნოლოგიების როლი აგრობიზნესში. იმისათვის რომ დაგვედგინა ფერმერთა დამოკიდებულება ხელოვნური ინტელექტისა და აგროტექნოლოგიების აგრობიზნესში დანერგვის მიმართ, გამოყენებული იქნა რაოდენობრივი კვლევის მეთოდი. სფეროში არსებული თეორიული და ემპირიული კვლევების საფუძველზე, მოცემული ნაშრომი აფასებს ხელოვნური ინტელექტის როლს აგრობიზნესში, რა გავლენას ახდენს თანამედროვე აგრარული ტექნოლოგიები წარმოებაზე და რა არის ხელოვნური ინტელექტის გამოყენების გზები და სარგებელი სექტორში. აგრეთვე, განიხილება რა შესაძლებლობებისა და გამოწვევების წინაშე დგას ქართული აგრობიზნესი ხელოვნური ინტელექტისა და აგრარული ტექნოლოგიების ათვისებაში.

კვლევის მიხედვით, ფერმერებისთვის ერთ-ერთი ყველაზე დიდი დაბრკოლება თანამედროვე აგრარული ტექნოლოგიებისა და ხელოვნური ინტელექტის დანერგვაში, მათი გამოყენების, ციფრული უნარებისა და ტექნოლოგიების ცოდნის ნაკლებობაა. ტექნიკური უნარების არქონის მიუხედავად, კვლევამ აჩვენა, რომ რესპონდენტთა უმრავლესობა პოზიტიურად არის განწყობილი ხელოვნური ინტელექტისა და აგრარული ტექნოლოგიების მნიშვნელოვნად დადებით გავლენაზე წარმოებისა და რეალიზაციის პროცესში. შედეგები ხაზს უსვამს გენდერულ დისბალანსს ფერმერთა დამოკიდებულებას შორის ზემოთ ხსენებული ტექნოლოგიების მიმართ. ასაკობრივმა ჯგუფებმაც მნიშვნელოვნად დიდი სხვაობა აჩვენა შედეგებში. ნიშანდობლივია, რომ ახალგაზრდა ფერმერთა კატეგორია მეტად პოზიტიურ დამოკიდებულებას ავლენს ხელოვნური ინტელექტისა და აგრარული ტექნოლოგიების დანერგვის საკითხში. ასევე, გამოიკვეთა განათლების დონის გავლენა ფერმერთა შეხედულებებზე თანამედროვე აგრარული ტექნოლოგიებისა და ხელოვნური ინტელექტის მიმართ. საბოლოოდ უნდა აღინიშნოს, რომ ეს ნაშრომი მიზნად ისახავს ხელი შეუწყოს საქართველოში მდგრადი და წარმატებული აგრობიზნესის სექტორის განვითარებას ხელოვნური ინტელექტისა და აგრარული ტექნოლოგიების დანერგვის გაძლიერებით.

ძირითადი საძიებო სიტყვები: ხელოვნური ინტელექტი, აგრარული ტექნოლოგიები, აგრობიზნესი, აგრიპრენერი.

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Acronyms

AI: Artificial Intelligence

DCFTA: Deep and Comprehensive Free Trade Agreement

EU: European Union

FDI: Foreign Direct Investments

GDP: Gross Domestic Product

GeoStat: Georgian National Statistics Centre

GFA: Georgian Farmers Association

H: Hypothesis

ICRISAT: The International Crop Research Institute for the Semi-Arid Tropics

MAI: Moisture Adequacy Index

O: Objective

Q: Question

UN: United Nations

WB: World Bank

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Introduction

The agriculture industry has several challenges in the 21st century. The population is rapidly increasing and along with this, the demand of food and employment is rising. According to the Food and Agriculture Organization in order to feed the 9.3 billion people on the planet by the year 2050, 60% more food must be produced. The traditional methods that are currently used by the farmers are insufficient to achieve these needs and meet such a high demand of production. The industry must adopt more effective and sustainable production methods to handle these challenges. It must also quickly adjust to the demands of climate change, which adds new uncertainties and disruptions to the sector (FAO, 2009).

In recent years, Artificial Intelligence (AI) has emerged as a transformational technology with the potential to revolutionise various sectors of the economy. The integration of AI into agribusiness has opened up new horizons for the agricultural industry, offering opportunities to enhance productivity, optimise resource allocation, and overcome traditional challenges. Agriculture automation is an important concern and subject of discussion all over the world (Talaviya et al., 2020). AI in agroindustry has attracted a lot of interest from many researchers across the world. As a result, different world organisations, government officials, extension specialists and academics are focused to adopt AI technology to address problems in agribusiness production (Javaid et al., 2023).

AI is developing rapidly. Many different sectors start to benefit from artificial intelligence and so is an agribusiness where AI is revolutionising traditional methods by creating different applications and technologies. For instance, AI sowing app that increases production yield, price forecasting by gathering information from satellite and analysing different aspects that impacts product pricing. Applications that can detect plant disease and suggest different ways to the farmer to increase production, drones that easily cover large areas and many more. Studies confirm the positive affect of AI and agricultural technologies on agribusiness industry and as many authors highlighted the importance and use of artificial intelligence in business processes it is evident that adopting AI technologies is achievable in each stage of the agribusiness process, which combines the production and commercialization of agricultural goods.

This thesis explores the role of AI in agribusiness, focusing specifically on the opportunities and challenges it presents for the agricultural sector in Georgia. Before examining the role of AI in Georgian agribusiness, it is essential to gain a comprehensive understanding of the agricultural sector in the country. This involves analysing key statistics and providing a general overview of Georgia's agricultural industry, including its contribution to the national economy and the challenges faced by farmers and stakeholders. The literature review explored one of the biggest obstacles - although 39.9% of Georgia's population is involved in agricultural activities, only 7% of the GDP comes from the sector (Geostat, 2022).

The purpose of this research is to identify farmers' attitudes regarding AI applications and agrarian technology, as well as to examine opportunities and difficulties in the industry viewed from farmers. The study will determine what are the benefits of AI tools and applications in agribusiness, how Georgian farmers view and recognise the usage of AI in their agribusiness.

To capture the real-world perspectives and experiences of farmers, primary research was conducted by engaging with individuals involved in the agricultural sector. Their attitudes and perceptions towards AI technologies in agribusiness were explored, shedding light on their acceptance, concerns, and expectations.

The objective of this thesis is to provide a comprehensive analysis of the role of AI in agribusiness and its implications for Georgia. By identifying the opportunities presented by AI technologies and addressing the associated challenges, this study aims to contribute to the understanding of how Georgia can leverage AI to enhance the efficiency, sustainability, and profitability of its agricultural sector.

This thesis begins with an introductory chapter that presents a brief idea of the topic as well as the structure of the work. The following section is focused on developing a literature review that establishes a foundation by defining AI and exploring its applications across different sectors. In this chapter, we will look at formulation of agribusiness from agriculture, its fundamental components that comprise this modern approach to production. Additionally, the review discusses best practices of using AI in agribusiness. Second part of the work is country profile, agricultural statistics of Georgia and agribusiness ecosystem is deeply explored. The research methods are then introduced, explaining the purpose of the study, how the data will be collected, and how the data will be analysed as well as why they were selected. The research's findings are presented and discussed in the next section. Customer profiles, descriptive analyses, and research hypotheses are all included. Finally, the thesis concludes by identifying potential avenues for future research. This includes exploring specific AI applications in different subsectors of agribusiness, conducting comparative studies with other countries, or investigating the impact of AI on specific agricultural outcomes. Suggestions for further research will help to extend the knowledge in this field and guide future studies.

1. Literature Review

1.1. Artificial Intelligence: The concept of Artificial Intelligence

Artificial intelligence (AI) is one of the greatest technological challenge of the 21st century. In the global information environment, machines and software that "think" like humans have already made considerable progress. AI made it possible to develop expert systems that can provide users with advice based on analysis of the data they submitted. AI is a technology that is transforming all aspects of human life. It is an adaptable instrument that enables individuals to examine how we integrate information, analyse data, and use the resulting insights to make better decisions (West, & Allen, 2020). AI is an innovative method of developing innovations in any field of human activity that is linked to the accumulation of a large amount of data. Big Data accumulated in all fields as developed nations transformed into a post-industrial economy, including science, the production of goods and services, the process of natural sciences, and humanities research (Enukidze, & Dgebuadze, 2020). AI made it easier to analyse massive amounts of data. Using data analysis, artificial intelligence will greatly increase predictability and enhance supply chain management (Qian, 2019). Today, artificial intelligence systems are widely used in healthcare - to make the correct diagnosis (Lorica & Nathan, 2022**)**, marketing - to deliver targeted advertising to the user (Marketing evolution 2022), manufacturing - to create self-driving cars (Lutkevich, 2019), the banking sector - to detect and prevent financial fraud (SQN Banking Systems 2022) and many more.

Different areas where AI is implemented and successfully used are shown in Table 1.

Table 1. Different areas where AI is implemented.

Areas	Use of AI applications	Companies that integrate	References
Web Search	AI collects users' searches and uses them to determine what this user can search for in future—designed to get the best possible outcome for each inquiry. This involves providing the most relevant search results and the best user experience on the site, both in content and overall quality.	Google Microsoft	(Kaput, 2022)
E-commerce	AI collects personalised interests and gives suggestions and recommendations to customers based on their previous experience.	Amazon	(Manole, 2022)
Machine Translation	Text-based or spoken language translation software employs artificial intelligence to provide and improve translations.	Google Translate	(Strach, 2022)

Table 2. Different areas where AI is implemented (cont.).

Managing Pandemic	AI is being used to provide data to monitor the disease's spread; AI-driven techniques are used in the diagnosis, treatment, trend analysis, medicine development, and prevention of the Pandemic.	CT-scans Canada's Covid-19 chatbot CRUZR robot	(Equbar, Masood & Khan2022)
Manufacturing	AI robots utilize machine learning algorithms to automate repetitive and decision-making tasks in manufacturing facilities. As these algorithms are self-learning, they continue to improve in dealing with their assigned processes. AI robots do not need breaks and are less susceptible to making errors than humans.	Toyota Amazon Intel	(Gray, 2022)
Food and farming	AI systems are beneficial in raising and improving the overall accuracy and quality of the crop. AI technology aids in the detection of pests, plant diseases, and undernutrition in farms. Artificial intelligence (AI) sensors can recognise and target weeds before determining which herbicide to apply in the region.	Merlin Robot Milker Rosphere Harvest Automation Orange Harvester	(Revanth, 2019) (Dolezal, 2021)
Public administration and services	AI delivers warnings of natural disasters and enables effective planning and impact reduction by using a wide range of data and pattern recognition.	Ororatech Global navigation satellite system	(Albayrak & Kuglitsch, 2022)

Source: Authors' own elaboration.

1.2. From Agriculture to Agribusiness

Agriculture has traditionally been viewed as a single, integrated sector where both production and distribution could be regulated through existing market processes, most frequently through government involvement. This method does not take into consideration the activities carried out by private organisations or farmers. The traditional agricultural paradigm has changed as a result of technological development. Agriculture has greatly benefited from the adoption of the steam engine, electric motor, and many other advanced technologies. According to Davis and Goldberg (1957) agriculture was viewed as a typical farm where families produced their own food, and for the economy to survive on such a basis, it was necessary for 80% of the total workforce to be employed in agriculture; else, there would not be enough food for the entire population. After Davis and Goldbergs' (1957) publication, the general perception of agriculture as a sector went through a major change. Their contributions created the framework for the current understanding of agribusiness and provided a unique perspective on how to see and interact with the agricultural sector. From that point on, the industry was seen as an ecosystem that brought together a variety of people and organisations to produce and create food. According to the Cambridge dictionary, agribusiness stands for the different companies involved in growing, processing, and distributing agricultural products. Agribusiness is the entire agricultural value chain, from the resources and raw materials required to produce products to the distributors and retailers that deliver goods to final customers (Lip, 2022). Simply described, it is a business ecosystem of an agricultural operation that brings

together farmers, distributors, and consumers. It is important to understand that agribusiness refers to all commercial operations that are connected to agriculture and farming businesses.

Agribusiness is characterised by components listed in Table 2.

Table 3. Components of agribusiness.

Main Components	Role & Definition
Agricultural input sector	Gives farmers access to the equipment, chemicals, feed, seed, credit, and other resources they require to operate. Improves productivity of production sector.
The production sector	A series of operations that produce a final good that is sold at retail.
Processing-manufacturing sector	Set of commercial operations to process agricultural products and deliver retail food products to consumers. Insurance to production sector to decrease waste and provide customer with value.

Source: Rahman (2021).

According to Beierlein, Schneeberger and Osburn (2014), agribusiness covers more than just farming and manufacturing of products. Compared to the results of Rahman (2021) provided in Table 2, they discussed the agribusiness ecosystem components in greater detail. The following elements of the agribusiness system were highlighted by the authors:

- Input suppliers – Firms producing and selling necessary equipment for agri-food production.
- Producers – Agribusiness companies or farmers that produce agricultural goods.
- Commodity processors – Companies that purchase agricultural products and prepare them for sale.
- Food manufacturers – Companies that purchase processed agricultural products and produce prepared food.
- Food distributors – Firms that transport agricultural products, proceed goods or prepared food.
- Food retailers – Companies that sell all the aforementioned agricultural goods.

Beierlein, Schneeberger, and Osburn (2014) summarised that it is essential for agribusiness enterprises to stay on top of quickly evolving customer needs and that to do so, the application of science and technology is required.

1.3. Artificial Intelligence in agribusiness

Artificial Intelligence (AI) is a simulation of human intelligence that gives society the potential to transform any traditional approach to managing work or business processes virtually for good and it is used for a wide range of agricultural applications, including automated water systems, sensor technology, self-driving machines and many more. Due to the limited availability of human resources, there is an increasing tendency toward the necessity to incorporate artificial intelligence (AI) into digital technology. Over the past two decades, modern agriculture has made significant

advancements. The practices of farming have changed from using traditional ways to using digital instruments as a result of numerous advance technologies. Artificial intelligence development is now being used in this industry to optimise resources in order to meet expanding demands (Sharma, 2020). Agribusinesses must run more effectively in order to remain their competitiveness, which requires investments in new technology, methods of fertilising and watering crops, and mechanisms of connecting to the global market (Chen, 2021). Farmers need consulting, assistance, and forecasting to effectively manage their agribusiness. With the help of AI, various users can offer farmers useful recommendations based on soil analyses, location, weather forecasts, and statistical data analyses, which will ensure their success and the growth of agriculture. Min (2010) emphasized the importance of analysing large amounts of data using AI technology to greatly improve weather predictability due to its huge impact on the product. An ecosystem for smart farming is being created by the advancement of new technologies, including AI, machine learning, satellite pictures, and big data. Combining all these technologies allows farmers to increase average yield and improve price control (Bagchi, 2000). The ultimate purpose of AI in agribusiness is to maximise production and ensure food safety.

Particularly interesting is the collaboration of The International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) and Microsoft to create the AI Sowing App, which determines when to plant seeds, prepare the soil, and apply fertiliser. Additionally, it contains a feature that determines the moisture sufficiency index in the present and the future. The program gathers information from historical climate trends, typically spanning a few decades, and applies it to the current. Microsoft launched pilot program in India for 175 farmers. All these farmers had been using traditional methods to determine the sowing date. They would often choose to seed in early June to take advantage of the wet season, which typically lasted from June to August. However, weather patterns have changed in recent years, making it difficult for farmers to determine the ideal sowing date, which reduced crop yields. AI sowing app analysis historical climate of the region covering more than 30 years, it calculates Moisture Adequacy Index (MAI) to estimate the ideal sowing period. The standardized method known as MAI is used to evaluate how well rain and moisture levels meet the potential water needs of crops. Finally, AI analyses all these data and suggests farmers the best date to sow crops. All 175 farmers from the program achieved an average of 30% greater production per acre (Microsoft news center, 2017).

Nowadays, there are various AI applications used to improve agribusinesses. The examples shown in the following table illustrate how these applications can be used and what the benefits are.

Table 4. AI applications adopted in agribusiness.

AI applications	How it works	Country	Results
AI Sowing app	Determines when to plant seeds, prepare the soil, and apply fertiliser.	India	30% increased yield
Harvest CROO Robotics	Live Harvester pick monitoring Farm-to-industry comparative analytics Harvester scheduling & control Gathering information on individual plants for performance & auditing Autonomous inspection (pack/process/reject) Direct control over the Harvester.	USA	Reducing waste and minimising the impact on the environment. Reduces CO2 emission by 96% vs traditional manual picking
Price forecasting	The algorithm gathers information from satellites such as crops sowing area, production, yield, and weather to forecast the date of grain arrival in the market and their volume, which would impact their pricing.	Karnataka, India	Protects farmers from high inflation and price crash
Plantix	A database of 100,000 photos of sick plants is used by AI-powered image recognition to identify over 60 diseases. Farmers upload pictures of the infected plant, and the app will diagnose the disease.	Around the world. Focus in India	Pest control Yield increase
CropIn	Farmers submit complex information in an app, such as pictures of crops, information about planting and many more. This data is combined with other information in the application, and the algorithm produces recommendations for sales, risk management and storage.	India	Improve yield and quality

Source: Authors' own elaboration.

Modern technologies, especially artificial intelligence, are the most important factors for transforming traditional agriculture into a profitable agribusiness. Smart technology-based urban farming is an adaptable, effective, and promising technique for the transformation of traditional agriculture (Podder et al., 2021).

Particularly interesting is the innovative experience of Singapore as a technologically advanced country in ensuring food security and ecological well-being at the same time. Traditional approaches are no longer sufficient to address the requirements of the planet. To maximize limited food resources, agriculture should adopt technologically advanced approaches and Singapore is very good example of a small city that is increasing food production by using modern methods, like vertical farming, aquaponics and hydroponics (Mok, Tan & Chen, 2020).

Several authors discuss the importance of AI in agribusiness, main opportunities and challenges of implementing AI in producing and commercializing agricultural products. According to Cook and O'Neill (2020), the following are some of the benefits of AI in agribusiness:

- Developing of innovative, cost-effective business models;
- Access to the necessary information for small farmers on developing markets;
- Achieving Sustainable Development Goals (SDGs) relating to agriculture.

Min (2009) describes AI as a beneficial tool for inventory control and planning, purchasing and supply management, demand planning, and forecasting. Several AI applications for resolving various business difficulties are mentioned by Qian (2019) including:

- Improving retail pricing accuracy;
- Increasing demand prediction;
- Optimising distribution.

Given that, Russia is a major producer of agricultural goods, has one of the largest crop reserves in the world, examining its perspectives on artificial intelligence, and advanced technologies in agribusiness is particularly interesting. Gorlov et al. (2021) investigated how conceptual methods for predicting and planning agricultural production are transforming in the context of technological advances. They examined technologies used to manage farm production in Russia and demonstrated how artificial intelligence-based digital technologies are transforming traditional approaches to economic planning. Authors conducted that modern agricultural technologies have created the potential for product diversification and added value creation in agribusiness by lowering production costs.

The main concepts behind AI in agribusiness are its adaptability, accuracy, and cost-effectiveness. (Hussain et al., 2022).

Xiaoxue Du, Xuejian Wang and Patrick Hatzenbuehler (2022) showed the impact of digital technologies on agribusiness. The authors claim that the entire food supply chain is rapidly changing as a result of digital agriculture, with innovations in e-commerce and artificial intelligence being especially important for the agri-food industry. For instance, remote sensing provides manufacturers with accurate data in a cheaper cost, meanwhile, artificial intelligence enables producers to make quick and accurate decisions, reduce costs, and create new business models like food delivery, where people can buy agricultural products online, while businesses can target potential customers based on data and algorithms.

As many authors highlighted the importance and use of artificial intelligence in business processes it is obvious that adopting AI technologies is achievable in each stage of the agribusiness process, which combines the production and commercialisation of agricultural goods.

2. The Country Profile: Georgia

2.1. General Overview

After the collapse of the Soviet Union, Georgia went through a long, difficult path of development. During the last decade, the economic situation of Georgia has significantly improved. According to United Nations (UN) Georgia as a developing country counts one of the high developed economies. Georgia's gross domestic product (GDP) currently stands at $18.7 billion and $5, 039 per capita. Between 2011 and 2021, economic growth was 4 percent annually on average. The poverty rate in Georgia decreased from 69 percent in 2011 to 53 percent in 2021. Despite the promising improvement, several issues still need to be solved, including the need for high-quality job creation and low productivity. Majority of the population is self-employed mostly in the agricultural sector. Around 70 percent of Georgia's active workforce is currently unemployed or self-employed (WB, 2022).

The pandemic had a significant impact on Georgia's economy, which experienced 6.8 percent decrease and let to a recession. As a result of the government's effective actions, the economy recovered relatively quickly. In 2021 economic growth amounted to 10.2 percent meaning that it not only made up for the losses brought on by the pandemic but also improved its economy by 2.9 percent over pre-pandemic levels (Gharibashvili, 2022).

Figure 1. Statistical overview of Georgia.

Source: GeoStat (October, 2022).

Georgia's export-import balance with the EU is negative. Every year, the balance shifts in favour of imports, and the gap grows. The country's dependence on imports getting worse. Data from January through April 2021 show that Turkey, which accounts for 18% of Georgia's imports, is the biggest opponent of domestic producers. Russia comes in second with 11.6% of the market, followed by China with 8.3%, Azerbaijan with 6.7%, the United States with 6.6%, and the rest of the world with 48.8% (GeoStat, 2021). In addition, the World Food Security Index has not been calculated for Georgia, as the country depends on imports.

2.2. Agricultural statistics

Georgia's territory covers more than 69,000 square meters, most of which is composed of agricultural land. The percentage of land use in Georgia is shown in Figure 2.

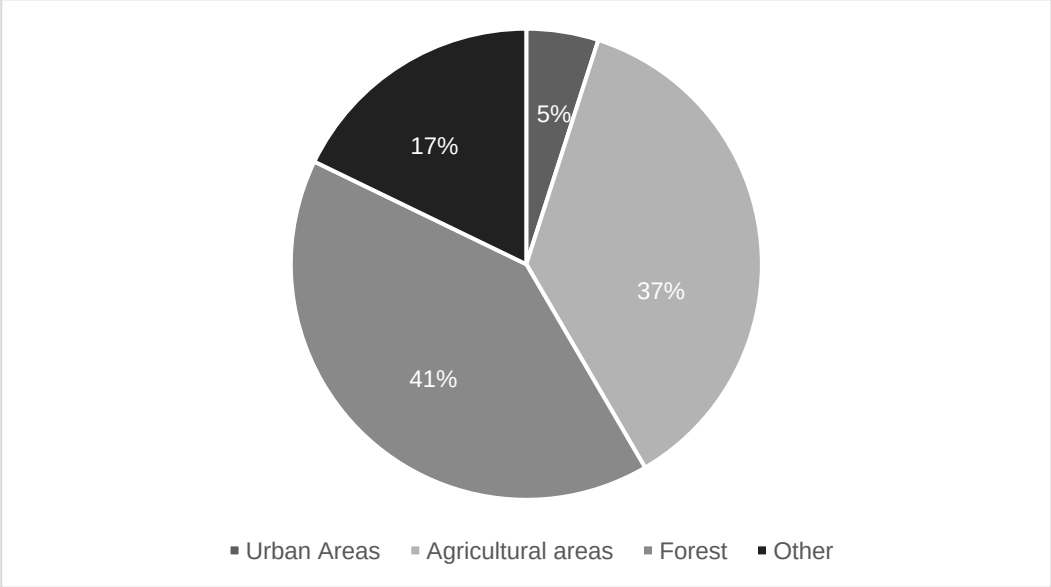

Figure 2. Land use in Georgia.

Source: WorldData (2022).

According to National Statistics Office of Georgia (Geostat, 2022) agricultural sector is characterised by the following data: 41.7% of population lives in rural areas from which 75 percent is employed in agribusiness and from the whole population the amount of workforce engaged in agricultural sector is 39.9 percent. With the involvement of 39.9 percent of the population of Georgia in agricultural activities, only 7% of GDP is created. Rukhaia (2015) describes the negative balance in the share of the economy because of inappropriate policy in the agricultural sector of Georgia, which hinders the development of international trade policy within the framework of the EU Deep and Comprehensive Free Trade Agreement (DCFTA).

The share of agriculture in GDP from 2010 to 2021 in Georgia is presented on Figure 3.

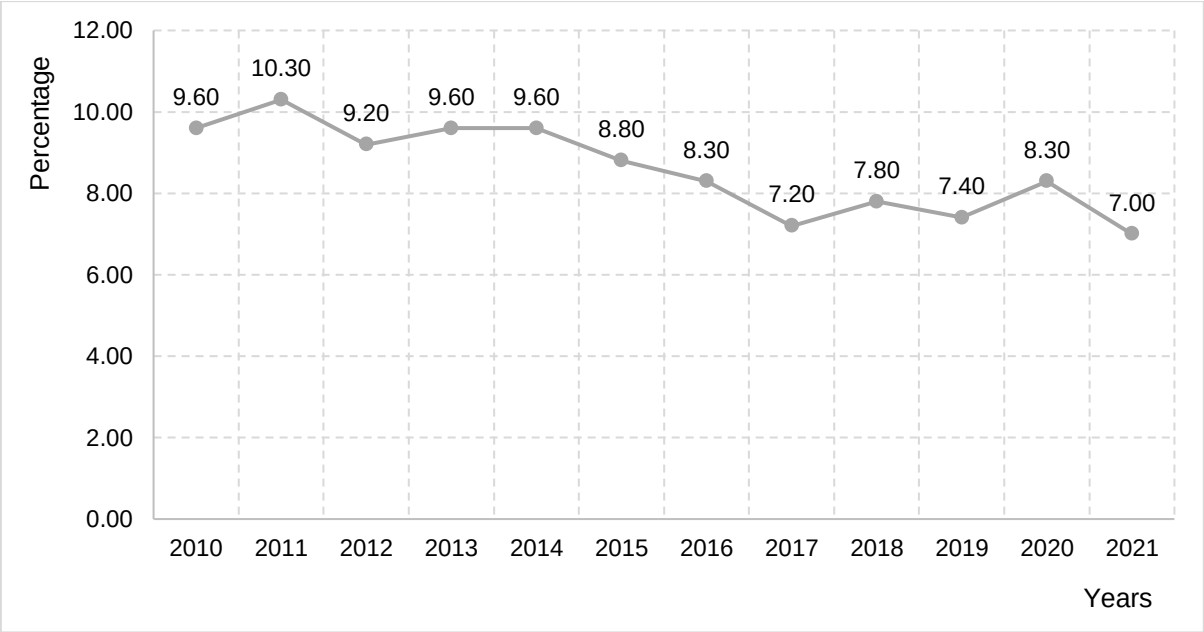

Figure 3. Share of Agriculture in GDP.

Source: GeoStat, General Agro Sector Statistics (2022).

During the 2014 Agricultural Census in Georgia, 642,200 farms were registered, of which 640,000 were households and 2,200 were legal entities (GOV, 2019). Distribution of these agricultural holdings by agricultural orientation is shown on the following figure.

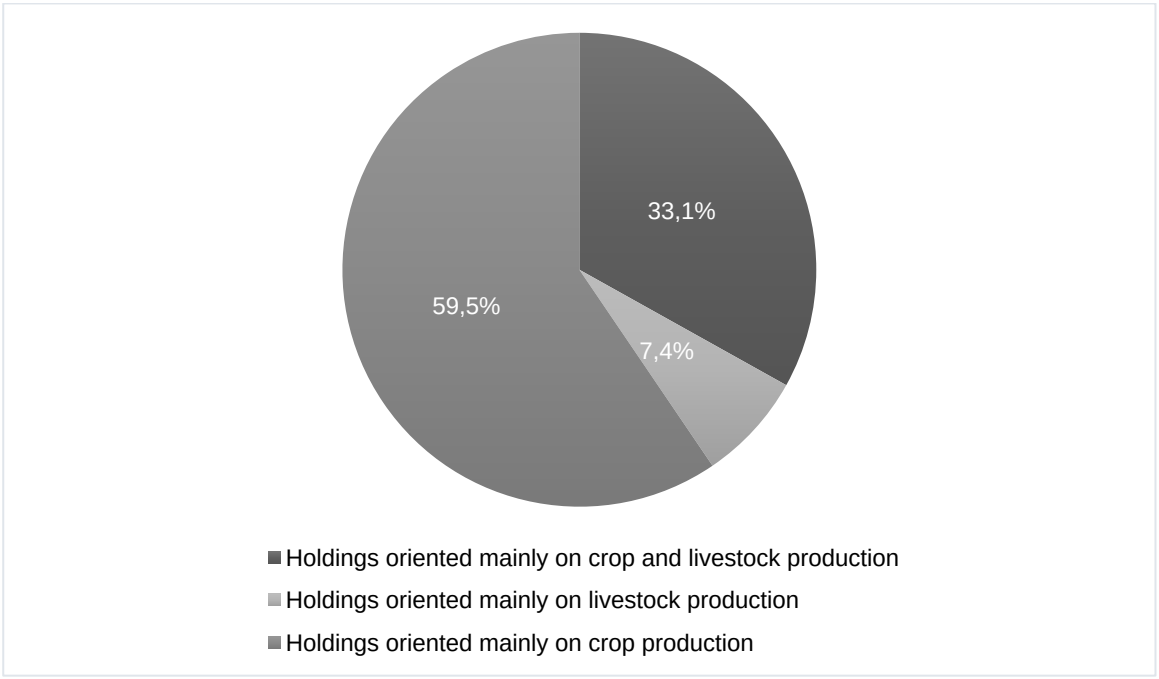

Figure 4. Distribution of Agricultural Holdings by Agricultural Orientation, 2021, %.

Source: Geostat (2022).

Foreign direct investment (FDI) in agriculture is relatively low compared to other industries in Georgia. From 2010 to 2019, the share of total FDI in agriculture was just 1.5%. According to Geostat,

just 0.9% of total FDI was directed towards agriculture in 2022. Lack of a qualified workers and unfavourable infrastructure are the two main reasons why there is less interest from investors in the sector. The profitability of projects rises because of improved infrastructure, which lowers capital and operating expenses, makes it easier to access markets, and reduces the cost of farming. Which ultimately reflects in the attractiveness of the sector (Bancuri, 2020). Considering the post-war and pandemic crises the amount of funding provided by international donor organisations may decline, in addition to the aforementioned issues, due to the nation's wrong and inconsistent policies.

Table 5. Strengths and Weaknesses in agricultural sector.

Strengths	**Weaknesses**
Need (Food is a Basic Need)	Soviet paradigm (land ownership, consumption, market positioning)
Availability of Natural Resources (Water, Agro-ecological zones)	Lack of general and sectoral education
Uniqueness (Original production approaches; Unique Cultures)	Conservatism (scepticism towards new knowledge, ideas, approaches and methods)
Traditions	Technological backwardness

Source: Mamulaidze (2022, p.94).

2.3. Agribusiness Ecosystem in Georgia

2.3.1. Challenges in Agribusiness

Georgian Farmers Association (GFA) with the support of European Union (EU) conducted a survey and presented a report about labour market in different sectors in Georgia, where authors suggested implementing dual educational programs in order to develop agribusiness, also this suggestion can answer to one of the greatest challenges of the agricultural sector in Georgia - lack of knowledge. Farmers in the higher age categories exhibit a greater deficit in knowledge compared to younger farmers when it comes to using advanced agricultural technologies (GFA, 2021). Georgia's agricultural land is fragmented. Households' lands are too small to be profitable. Experience has shown that due to old production methods and a lack of knowledge, small farms generate products at a high cost. Farmers still do not use technological opportunities occurred for agribusiness sector. Adopting different machinery is not financially feasible for such small farms, which has a direct impact on production and efficiency. Furthermore, due to the small scale of production, it is challenging to maintain a consistent supply. As already noted, 39.9% of the population works in agricultural activities; the sector's contribution to GDP is only 7percent. Due to the aforementioned realities, small-scale farming is no longer competitive on local and export markets.

The development of industrial farms is a way to solve the above-mentioned problems faced by traditional production. Large farms do not have difficulties related to access new techniques and advance technologies and there are generally less barriers to entry into European or other export markets (Bancuri, 2020).

The agricultural sector is characterised by conservatism, especially in Georgia. There is nothing wrong with traditional fields being conservative, but conventional thinking frequently puts a barrier in

the way of innovative growth. The Soviet agriculture sector, which lasted almost until 1990, was very different from what it is now. During that period, the share of the sector grew every year, at the expense of the production of high-value products, and exports in agriculture exceeded imports by 70%. Jobs were created by plantations and processing factories that allowed for a continuous chain of production. Primary agricultural production has been steadily declining since 1990, along with its contribution to the gross domestic product, while the number of individuals categorized as self-employed in the agribusiness is growing. For the country, the traditional sector's setbacks have been explained in previously published studies and opinions as the result of poorly implemented reforms after the collapse of the Soviet Union. The consideration of the agrarian sector in the traditional paradigm and the recommendations developed based on it have only prioritized individual sectors, which cannot affect the overall results. In the modern, extremely dynamic era, it is very difficult to focus on any one aspect of the current problem, which means that it is necessary to simultaneously see the general picture and focus on individual details. The agriculture sector faces several challenges, one of which is information gaps among farmers and modern technologies (Sharma, Kumar & Sharma, 2022). According to several studies, there are still problems with the traditional paradigm: lack of adoption modern technologies; low productivity; quality; and realisation.

2.3.2. Agribusiness AI tools in Georgia

Artificial intelligence has recently gained a lot of relevance for the agroindustry in Georgia. In order to help farmers and agribusinesses improve their operations and efficiency, several platforms and applications have been developed. GFA developed the smartphone app Agronavti in 2017 with the purpose of supporting farmers in selling their products. A simple and adaptable electronic technology opens doors to new markets. A farmer can access information on weekly market pricing for agricultural products, agricultural research and developments, local weather forecasts, climates, soil conditions, and other important data based on regions, trade shows, and exhibitions. Farmers can place their products in the app by indicating price and quantity for realisation (GFA, 2020).

Particularly interesting is digital platform TABCo created in 2015 with the purpose to turn farming into successful business in Georgia. Internationally renowned technologies and processes are integrated into an online platform that is used to manage the farm. The platform includes: gross margin calculations for 40 different crops; database of production costs; farm gate prices; inputs; and input prices.

This software assists farmers in keeping financial records and carrying out business analyses (TABCO, 2022).

Another application working and empowering farmers operating in Georgia is AI Farmer that uses AI to help farmers enhance their efficiency. Founders of the platform in an interview with Caucasus Business Platform (2023) discussed the main obstacles they explored after a deep research of Georgia’s agribusiness industry that was the lack of access to modern technology and infrastructure. Another key issue discussed by the founders of AI Farmer is a lack of cooperation and information

sharing. The AI Farmer platform integrates a combination of software and hardware elements, providing farmers with comprehensive tools to enhance their operations and boost productivity. The hardware component comprises sensors and other equipment, enabling data collection on various aspects of farming activities. This advanced technology empowers farmers to remotely manage multiple greenhouse operations, including water supply, lighting, and more. The collected data is then transmitted to the platform, where it is processed into a user-friendly interface, facilitating easy access and interpretation (CWB, 2023).

3. Research Methodology

3.1. Objectives of the study and research hypotheses

Literature study showed that AI had grown considerably in recent years, and it can widely be used in agribusiness to develop innovative cost-effective business models. Even though there are several applications created to increase production yield, Georgia still has significant problems with low productivity as 39.9% of the population works in agricultural activities, the sector's contribution to GDP is only 7%.

The literature review revealed that low productivity is the main challenge agribusiness faces in Georgia and the lack of adoption of new technologies might be the reason of this low production.

The purpose of the study is to examine how people working in the agriculture sector view and recognise the usage of AI in their business. How do their sociodemographic characteristics reflect their viewpoints and capabilities, as well as how they feel about employing agricultural digital technologies. A quantitative research method was selected to analyse the openness of actors involved in agricultural sectors (Agripreneurs), to technologies as means of process optimisation and challenges in the sector seen from actors operating in the sector.

Considering the theoretical background discussed in the previous chapter, one main research objective (O) was established:

O_1: To identify and characterise the role of AI on the production in agribusiness.

Based on the research's main objective several hypotheses (H) were developed to complete the research.

H_1: There are relationship between farmers' attitude towards modern technologies and the openness of implementing AI in their businesses.

The findings of a systematic literature review indicate that age is a significant factor influencing farmers' attitudes towards agrarian technology (GFA, 2021), and that the impact of age on these attitudes may vary depending on the specific technologies and contexts involved. According to the literature review, H_2 was formulated:

H_2: There are differences between sociodemographic variables and farmers attitude towards agricultural technologies.

H_{2a}: There are differences between male and female attitude towards agricultural technologies.

$H_{2b:}$ There are differences between the age of farmers and their attitude towards agricultural technologies.

H_3: There is an association between farmers education level and how they evaluate the importance of agricultural technologies on their agribusiness.

3.2. Description of Data Collection

Random sampling technique was used for the survey participants for quantitative research. The survey was conducted on Georgian farmers. According to National Statistic office of Georgia the last census of farmers was conducted in 2014 according to which 642,200 farms were registered in Georgia.

The study population for this research comprises Georgian farmers. As per the agricultural census conducted in Georgia in 2014, a total of 642 thousand farms were registered, thereby forming the basis of the population for this study. To ensure the reliability and validity of the research, multivariate techniques were employed, considering a pessimist proportion hypothesis of 50-50%. With a confidence level of 95%, the sample size for this study was determined to be 201 respondents, providing a sampling error of 6.9%.

The questionnaire was developed based on literature review and experts, including members of the Georgian Farmers Association who have a close relationship with farmers and are familiar with their characteristics. It was pilot tested with a small group of farmers to ensure that it was clear and understandable. Modifications were made to the questionnaire based on feedback received during the pilot test. More specifically, it was necessary to include the response “None of the above” in Q7, which asked respondents to identify any AI tools or applications they had heard of. It appeared that some farmers had not heard of any of the applications or tools listed in the question.

The study was conducted using online platform Google Forms that is a web-based survey tool developed by Google, allows researchers to create and conduct surveys online and export and analyse data in Excel. The purpose of using Google Forms in the study was to collect data from participants in an efficient and convenient way.

Data for the study was collected from the different social media groups that were established for those engaged in agricultural activities. Additionally, a questionnaire was issued to the administration of the farmers' support centres in various regions of Georgia, and they conducted interviews with farmers who visited them throughout the study period. The survey was carried out between February and May 2023.

To guarantee the confidentiality of the data obtained throughout the research, several measures were used. One such technique involved eliminating any questions from the questionnaire that would provide personal identifying information, such as the questions about name, surname, personal number, and residence. Consequently, it was simpler to guarantee that the data collected was anonymous and could not be used to pinpoint participants. By taking these steps to protect the privacy of the study population, the researcher was successful in maintaining ethical standards and ensure the validity of the research findings. These attempts to maintain anonymity, which also

enhanced the overall quality of the study, generally protected the rights and privacy of the research participants.

In order to assess the reliability of the perception towards technologies, Cronbach's alpha consistency was calculated, that is represented on the Table 5. According to the result, the reliability of the test is good.

Table 6. Reliability of the perception towards technologies.

Group	Item	Cronbach's alpha	Reliability
Farmers Perceptions of AI in agribusiness	3	0.865	Good

3.3. Description of Data Analysis

Data analysis process looks through the data that was gathered during the study period and summarises the information collected during the research.

Data analysis is a crucial step in the research process as it enables the identification of patterns and links in the data as well as the formulation of findings that have useful value. The SPSS, version 29, was used for the data analysis.

Sociodemographic profile of the respondents will be analysed using descriptive statistics. In order to give a thorough picture of the data, frequency analysis tables will be used to present absolute and relative frequencies as well as determine the mean and standard deviation to answer to the main research objective.

In this study, inferential statistics will be employed to examine the relationships, associations, and differences among multiple variables. These statistical analyses will serve to measure how the collected data aligns with the research hypothesis. The study employs several statistical methods to validate or challenge the assumptions made in order to accomplish the primary objective. The choice of methods depends on the nature of the data and specific research goals. The Spearman nonparametric test is used when the assumptions of sample size and normal distribution are violated, allowing for the examination of relationships between variables using ranked data. The parametric Student's t-test compares means of normally distributed interval variables for two independent groups, while the Kruskal-Wallis non-parametric test is used when assumptions of normality and equal variances are violated, enabling the comparison of medians among multiple groups. Additionally, the Fisher’s exact test examines the relationship between qualitative variables. The objectives, research hypotheses, and methodologies used to gather the data are summarised in Table 6.

Table 7. Objective, Hypotheses and Statistical techniques.

Label	Objective or research hypotheses	Statistical techniques
O	To identify and characterise the role of AI on the production in agribusiness	Mean and Standard deviation Frequencies
H_1	There is relationship between farmers' attitude towards modern technologies and the openness of implementing AI in their businesses	Spearman's Rho
H_2	There are differences between sociodemographic variables and farmers attitude towards agricultural technologies	Student's t-test Kruskal-Wallis
H_{2a}	There are differences between male and female attitude towards agricultural technologies	Student's t-test
H_{2b}	There are differences between the age of farmers and their attitude towards agricultural technologies	Kruskal-Wallis
H_3	There is an association between farmers education level and how they evaluate the importance of agricultural technologies on their agribusiness	Fisher's Exact Test

4. Analysis of Results

4.1. Introduction

This section aims to analyse and present the main result of the study. First is to provide a detailed description of the respondents who participated in the study, including their demographic characteristics such as age, gender, education level, type of production and other details. This information is essential for understanding the sample and the context in which the study was conducted.

4.2. Demographic Data of Respondents

Data were gathered from Georgian farmers to conduct an empirical outcome analysis. 201 Farmers participated in the study.

The sociodemographic profile and the professional information of individuals involved in Georgian agribusiness industry is shown on Table 7.

According to the table out of 201 respondents, 122 are male and 79 are female, making up a percentage of 60.7% for men and 39.3% for women. 36.8% of respondents, or most of the farmers who took part in the survey, are in the age range of 29 to 39. At the same time, the smallest percentage of the respondents are over the age of 65, with only 6% of respondents. Out of the total respondents, majority that is 144 farmers, representing 71.6 percent, reported having a higher education. In contrast, 55 respondents, equivalent to 26.9% of the sample, reported having a secondary education. Merely 1.5 percent of the sample reported attending a vocational collage. Most of the respondents, 74.1% or 149 farmers, have small-sized farms, while 23.9% or 48 farmers have an average-sized farm and a small number of participants 2% or 4 farmers have large-sized farms, indicating that most farmers in Georgia operate on a small to average scale. These findings imply that the productivity and profitability of small-scale farms, which make up most farms in the nation, might be significantly impacted by the application of AI and agricultural technology in agribusiness. In order to identify possible adoption hurdles and establish measures to encourage their usage in the sector, it is crucial to understand the attitudes and views of these farmers regarding these technologies.

The data analysis of the respondents' years of agricultural production revealed a mean value of 13.85 years, indicating the average duration of agricultural experience among the participants. A larger standard deviation 10.2 suggests greater variation among the respondents in terms of their years of

agricultural production. This suggests that the respondents' years of agricultural production exhibit some diversity, with individual values ranging from below the mean to above it.

In order to determine the prevalence of different agricultural product types among Georgian farmers, participants in the study were asked to select all product types that they produce. As presented in Table 7, the results indicate that vineyard cultivation is the most commonly pursued agricultural activity, with 38.3% of respondents engaging in winemaking. Fruits and vegetables are the second most popular product type, produced by 33.9% of participants. Livestock production is also observed among a considerable proportion of respondents, with 15.9% of participants reporting engagement in this activity. In contrast, fishery and crops are found to be the least popular agricultural product types in Georgia, with only 0.7% and 8.7% of respondents, respectively, involved in these activities.

Table 8. Profile of respondents and professional information.

Variables	**n**	**%**
Age	**201**	**100%**
18 - 28	16	8%
29 - 39	74	36.8%
40 - 50	51	25.4%
51 - 65	48	23.9%
65 and more	12	6%
Gender	**201**	**100%**
Male	122	60.7%
Female	79	39.3%
Education Level	**201**	**100%**
Secondary School	54	26.9%
Vocational School	3	1.5%
Higher Education	144	71.6%
Farm Type	**201**	**100%**
Small	149	74.1%
Average	48	23.9%
Large	4	2%
Type of Agricultural Product	**277**	**100%**
Crops	24	8.7%
Fruits and vegetables	94	33.9%
Livestock	44	15.9%
Fishery	2	0.7%
Vineyard	106	38.3%
Other	7	2.5%
Years of agricultural Production	**Mean** 13.85	**SD** ±10.2

4.3. Descriptive Analysis

The literature review identified several important and useful applications of AI and agricultural technologies that are currently well-known among farmers. To assess the extent to which farmers in Georgia are aware of these tools and applications, a survey question was included in the study, and the results are presented in Table 8. Out of 200 respondents who participated in the study, 166 indicated that they were aware of at least one of the AI tools and applications listed in the survey question, while 34 participants reported having no awareness of these technologies. These findings suggest that a significant majority of farmers in Georgia have some level of familiarity with AI tools and applications, although a minority remain unaware of these emerging technologies. This highlights the need for targeted efforts to increase awareness and promote the adoption of AI tools and applications in the agricultural sector.

Based on the results two of these technologies are clearly highlighted since they were chosen by over 46% of participants: AI based application, Agronavti (19.8%) and different types of drones used in agriculture (26.9%). On a smaller scale but still high number of farmers have heard of AI powered image recognition to identify plant diseases (16.1%). Agribusiness management software called TABCo is known to 12.6% of those surveyed. Significantly fewer respondents are familiar with AI sowing app (5.8%), Price forecasting for agriproducts (6.2%) and Harvesting scheduling & controlling (6.5%).

Table 9. Frequency table of AI tools and applications awareness among farmers.

Please tick the options of technologies/applications you have heard of.	**n**	**%**
Agronavti	112	19.8%
TABCo	71	12.6%
AI sowing app	33	5.8%
Price forecasting for Agriproducts	35	6.2%
AI powered image recognition to identify plant diseases	91	16.1%
Harvesting scheduling & control	37	6.5%
Drones	152	26.9%
None of the above	34	6.0%
Total	**565**	**100.0%**

Table 9 presents the results of a survey question asking farmers about their perceptions of the benefits of AI applications and agricultural technologies. The majority of respondents, 36% or 164 farmers, indicated that they believe these technologies have a positive impact on the production process by simplifying it. Also, high majority of respondents, 28.3% or 129 farmers, indicated that benefit of these technologies is realisation of the product. Increased production yield and planning production process was named by 16.9% and 10.3% of respondents as a benefit of AI applications and agricultural technologies. 7.5% of farmers believe that it decreases costs and wastes of production and 1.1% of farmers indicated there are other benefits of using AI and agricultural technologies in agribusiness such as product quality improvement and labour force optimisation.

Table 10. Farmer perceptions of the benefits of AI and agricultural technologies.

How Can agricultural technologies/applications benefit your business?		
Answers	**n**	**%**
Planning production process	47	10.3%
Simplifying production process	164	36.0%
Decreased costs and wastes	34	7.5%
Realisation	129	28.3%
Increased Production yield	77	16.9%
Other	5	1.1%
Total	**456**	**100.0%**

Table 10 shows the results of the survey question asking farmers about the main challenges they face with adopting AI applications and agricultural technologies. Question revealed several key insights. Of the 201 respondents, the most chosen answer was the lack of availability of modern agricultural technologies, with 34.1% of farmers or 103 respondents and not knowing how to use these technologies with 25.2% or 76. On the other hand, smaller percentage of farmers 5% that makes 15 respondents reported that they did not need these technologies in their agribusinesses and only 11 participants, or 3.6% of the farmers, mentioned internet connection issues as a barrier. These findings suggest that while many farmers in Georgia face challenges in adopting AI applications and agricultural technologies, a significant portion do not perceive these challenges or have already overcome them. Efforts to address the challenges related to availability and information access, as well as education and training on the use of these technologies, could help to promote their adoption among farmers.

Table 11. Challenges in adopting modern agricultural technologies: Farmer Perspectives.

What are the difficulties you face with using modern agricultural technologies/applications?		
Answers	**n**	**%**
No internet connection	11	3.6%
No access to information	36	11.9%
Do not know how to use	76	25.2%
Not available	103	34.1%
I do not need	15	5.0%
I do not have difficulties	61	20.2%
Total	**302**	**100.0%**

The provided Table 11 presents data on respondents' attitudes and perceptions regarding digital skills and the impact of AI applications and modern technologies in agribusiness. All 201 respondents from the survey rated their digital skills on a scale of 1 to 5, with 1 representing very low skills and 5 indicating very high skills. Here are presented some of the main points from the results. The distribution shows that an important number of participants 24.5%, or 51 respondents have very poor

digital abilities, compared to 32 respondents' or 15.9% extremely high digital skills. Based on the results, the lowest mean and the highest standard deviation (mean=3 points and SD=1.453) was revealed with the question about farmers digital skills. Mean for digital skills is 3.00, suggesting an overall moderate level of digital proficiency. Additionally, the standard deviation of 1.453 suggests a variation in the distribution of digital skills among the respondents.

When asked about the extent to which they agree or disagree with the view that using AI applications and modern technologies in agribusiness increases production yield, respondents' answers were as follows: 0% chose 1, 17.4% selected 2, 17.4% chose 3, 23.9% opted for 4, and the majority, 57.2%, chose 5. The mean score for this question is 4.37, with a standard deviation of 0.821. These findings suggest that most respondents had a positive view of the impact of AI applications and agricultural technologies on production yield in agribusiness. The mean score for this question is 4.37 points, which indicates overall a very high level of agreement on the question and the standard deviation is 0.821.

The majority of respondents strongly agree that using AI applications and modern technologies can facilitate the realisation process in agribusiness (Mean=4.48 points and SD=0.813) which is the highest mean and lowest standard deviation from all the questions below.

At the end of the table the global mean is represented, which combines all the questions from 10 to 13. Overall, when considering the global attitude towards these questions collectively, the mean score is 3.9950, with a standard deviation of 0.84334. This suggests that, on average, respondents hold positive attitudes towards digital skills, the impact of AI applications, and the importance of modern technologies in agribusiness.

Table 12. Data on Farmer's attitude towards AI and agricultural technologies.

Q_{10}: ***From 1 to 5, please choose the number which the best describes your digital skills, where 1 is very low skills and 5 is very high skills?***						
1	**2**	**3**	**4**	**5**	**Mean**	**SD**
51(24.5%)	26(12.9%)	28(13.9%)	64(31.8%)	32(15.9%)	3.00	1.453

Q_{11}: ***With what extend do you agree or disagree with the view that using AI applications and modern technologies in agribusiness increases production yield?***						
1	**2**	**3**	**4**	**5**	**Mean**	**SD**
0(0%)	3(17.4%)	35(17.4%)	48(23.9%)	115(57.2%)	4.37	.821

Q_{12}: ***Do you agree or disagree that modern technologies/Applications are very important for your agribusiness?***						
1	**2**	**3**	**4**	**5**	**Mean**	**SD**
0(0%)	4(2%)	61(30.3%)	40(19.9%)	96(47.8%)	4.13	.920

Q_{13}: ***With what extend do you agree or disagree with the view that using AI applications and modern technologies in agribusiness makes realisation process easier?***						
1	**2**	**3**	**4**	**5**	**Mean**	**SD**
0(0%)	1(0.5%)	38(18.9%)	26(12.9%)	136(67.7%)	4.48	.813

Global Mean	
Mean	**SD**
3.995	0.8433

Table 12 shows the openness of respondents towards AI applications and agrarian technologies, which combines Q12 and Q13. According to the table, the mean score for this variable is 4.3060, indicating that, on average; farmers have a positive level of openness towards adopting and utilizing AI and agricultural technologies in their agricultural practices. The standard deviation of 0.79036 suggests a relatively low level of variability among the responses. This data suggests that farmers are receptive to the potential benefits and advancements offered by AI and agricultural technologies in their farming operations.

Table 13. Farmers' openness towards AI and Agricultural technologies.

Variable	Mean	SD
Farmers' openness towards AI and agricultural technologies	4.3060	.79036

Table 13 presents the analysis of farmers' attitudes towards AI and agricultural technologies, specifically comparing the responses between male and female gender groups. The data shows that both male and female farmers generally have positive attitudes towards AI and agricultural technologies. However, the female group exhibits a slightly higher mean score, indicating a relatively more favourable perception of the potential benefits and adoption of these technologies. Additionally, standard deviation for female perception is slightly lower and indicates the lower variability in answers.

Table 14. Attitudes towards AI and Agricultural technologies in Gender groups.

Gender	n Mean	SD
Male	122 3.885 points	.8559
Female	79 4.165 points	.7995

The provided table 14 presents farmers digital skills across different age groups. Digital competence was rated as "High skills" or "Very high skills" by most respondents in the 18-28 age group (both 37.5%). With a mean score of 3.94, indicating this age group demonstrated high level of digital abilities. In the age group 29-39 considerable proportion rated their digital competence as "High skills" (56.8%) or "Very high skills" (27%) resulting in a notably high mean score of 4.08 points. In contrast, respondents in the 40-50 age group assessed their digital skills predominantly as "Low skills" (37.3%) or "Neither low nor high" (21.6%), yielding a mean score of 2.86 points. This suggests a less than moderate level of digital skills within this age group. A significant portion of respondents aged 51-65 considered their digital skills to be "Very low skills" (81.25%), with a mean score of 1.38 points, indicating a lower level of perceived proficiency compared to other age groups. Likewise, respondents above 65 years old primarily rated their digital skills as "Very low skills" (58.4%), resulting in a mean score of 2.17 points. Overall, the data shows that younger age groups tend to rate their digital skills higher, while older age groups perceive their skills to be lower.

Table 15. Comparison of Digital Skills across five Age Groups.

From 1 to 5, please choose the number, which the best describes your digital skills, where 1 is very low skills and 5 is very high skills.								
Age	Very low skills	Low skills	Neither low nor High skills	High skills	Very high skills	**Total**	**Mean**	**SD**
18 - 28	1(6.25%)	1(6.25%)	2(12.5%)	6(37.5%)	6(37.5%)	**16**	**3.94**	**.295**
29 - 39	0	2(2.7%)	10(13.5%)	42(56.8%)	20(27%)	**74**	**4.08**	**.083**
40 - 50	4(7.9%)	19(37.3%)	11(21.6%)	14(27.4%)	3(5.8%)	**51**	**2.86**	**.153**
51 - 65	39(81.25%)	4(8.4%)	3(6.25%)	0	2(4.1%)	**48**	**1.38**	**.135**
Up to 65	7(58.4%)	0	2(16.6%)	2(16.7%)	1(8.3%)	**12**	**2.17**	**.441**
Total	**51**	**26**	**28**	**64**	**32**	**201**		

4.4. Validation of Research Objective

In order to address the main research objective, O – *"To identify and characterise the role of AI on the production in agribusiness",* Mean and Standard Deviation were calculated. The finding revealed notably high mean score of 4.37 points indicating a positive perception among respondents and a standard deviation of .821 suggests relatively low variability in their responses. When examining the agreement levels with the statement regarding the impact of AI on production yield, 57.2% of respondents strongly agreed and an additional 23.9% agreed, resulting in a combined total of 81.1% expressing positive feedback. Since, literature review revealed that the realisation process is one of the most important elements of agribusiness, to answer the main objective it is important to find out the influence of AI and agricultural technologies on the realisation process. According to table 15, the mean of Q_{13} is 4.49 and standard deviation .813 implying a positive perception and a low variability of respondents.

Based on the results, farmers perceive the implementation of AI and agricultural technologies as having a highly positive influence on production yield and realisation process in agribusiness.

Table 16. Perception of Georgian Farmers on the impact of AI and Agricultural technologies on Production Yield and Realisation.

Question	**Mean**	**SD**
With what extend do you agree or disagree with the view that using AI applications and modern technologies in agribusiness increases production yield? (Q_{11})	4.37	.821
With what extend do you agree or disagree with the view that using AI applications and modern technologies in agribusiness makes realisation process easier? (Q_{13})	4.49	.813

4.5. Validation of Research Hypotheses

The first research hypothesis is H_1: "*There is relationship between farmers' attitude towards modern technologies and the openness of implementing AI in their businesses".* For this hypothesis, non-parametric spearman RHO test was used.

According to the results the p-value is less than 0.001 so the null hypothesis, which is there is no relationship between farmers' attitude towards modern technologies and the openness of implementing AI in their businesses was rejected and H_1 was verified. Moreover, the correlation between these two variables is 0.910 suggesting very strong positive relationship between the variables. These findings provide evidence that farmers' attitude towards modern technologies plays a significant role in their openness towards implementing AI in their agribusinesses.

Table 17. Spearman's Rho.

		Openness	Result
Global attitude	**Spearman Rho Correlation**	.910	**Verified**
	p-value	<.001	
	n	201	

To answer the second research hypothesis H_2: *"There are differences between sociodemographic variables and farmers attitude towards agricultural technologies"* H_{2a}*:" There are differences between male and female attitude towards agricultural technologies"* was formulated and the analysis of the independent samples Student's t-test was conducted. The results from Table 17 indicate that the mean attitude towards agricultural technologies for females is 4.1446, while for males it is 3.8852. Although the difference in means is slight, it is important to assess the statistical significance. The p-value being lower than 0.05 suggests that there is a significant difference in the attitude towards agricultural technologies between male and female farmers that means H_{2a} was verified.

Table 18. Student's t-test.

Gender	n	Mean	SD	p-value	Result
Male	122	3.8852	.85591	.021	**Verified**
Female	79	4.1646	.79953		

The analysis of the Kruskal-Wallis test was performed to investigate the differences in the attitude towards agricultural technologies among different age groups, addressing the research hypothesis H_{2b}: *"There are differences between the age of farmers and their attitude towards agricultural technologies"* is also part of H_2. Table 18 below shows the result of the Kruskal-Wallis test according to which the p-value is less than 0.05 indicating there is a significant difference in the attitude towards agricultural technologies across the various age groups of farmers.

Table 19. Kruskal-Wallis Test.

	Value	Degrees of freedom	p-value	Result
Kruskal-Wallis Test	83.635	4	< .001	**Verified**

To answer the H_3: "*There is an association between farmers education level and how they evaluate the importance of agricultural technologies on their agribusiness (Q12)".* Non-parametric Fisher's Exact test was used. Table 19 presents the results of the Fisher's Exact test. The calculated p-value is less than 0.05, indicating that the null hypothesis was rejected and there is indeed an association between farmers' education level and their evaluation of the importance of agricultural technologies. This finding implies that the educational background of farmers plays a significant role in shaping their perception and understanding of the importance of AI and agricultural technologies in agribusiness.

Table 20. Fisher's Exact Test.

	Value	**p-value**	**Result**
Fisher's Exact Test	64.945	<.001	**Verified**

4.6. Main Results

Table 20 provides the concise summery of the results of the research objective and hypotheses, aiming to facilitate a clear understanding of the findings. The mean and standard deviation are used to present the results for the research objective, while the hypotheses are indicated as either verified or not.

Table 21. Main Results.

Label	**Objective or research hypotheses**	**Main Results**	
		Mean	**Standard deviation**
O_1	The Impact of AI and Agricultural technologies on Production Yield	4.37 points	.821
	The Impact of AI and Agricultural technologies on Realisation	4.49 points	.813
H_1	There is relationship between farmers' attitude towards modern technologies and the openness of implementing AI in their businesses	Verified	
H_2	**H_{2a}:** There are differences between male and female (Q1) attitude towards agricultural technologies.	Verified	
	H_{2b}: There are differences between the age (Q2) of farmers and their attitude towards agricultural technologies.		
H_3	There is an association between farmers education level (Q3) and how they evaluate the importance of agricultural technologies on their agribusiness (Q12).	Verified	

Conclusions, Recommendations, Limitations and Future Suggestions

Current ecological challenges prevalent in the world have placed agriculture and agribusiness at the top of global concerns. Alarming predictions by experts and researchers indicate that if current production rates persist, humanity soon will face a threat of widespread hunger. To avert such a catastrophic scenario, the integration of artificial intelligence (AI) and advanced agricultural technologies into production systems has emerged as a major priority and topic of forming the main point of discussion in this study. Due to AI's transformational potential, it gained substantial attention across different industries. Its potential to transform agricultural methods and address the complex challenges facing the sector cannot be underscored. Farmers and agribusinesses may improve efficiency, increase production yield, reduce environmental impact and simplify realisation by utilizing AI-powered solutions.

Development of agribusiness is one of the priority directions in Georgia. Agriculture and agricultural areas occupy an important part in the population of the country; Even though 39.9 percent of the population of Georgia is involved in agricultural activities, only 7 percent of GDP is created. The problem can be solved by adopting AI and agricultural technologies to increase efficiency and production.

This research aims to explore the role of AI applications and modern technologies in agribusiness, focusing on challenges and potential Georgia faces in terms of adopting AI in the processes. Specifically, the purpose of the survey was to determine the attitude of Georgian farmers towards AI and agricultural technologies and find out their perceptions about the importance of implementing AI in their businesses.

The 201 respondents participated in the survey where most of the farmers were 60.7% male and 39.3% female. Through an empirical investigation and analysis of farmers' attitudes and perceptions, valuable insights into their acceptance and openness towards these innovations have been gained. The findings highlight the positive impact of AI and agricultural technologies on production yield, as well as the ease they bring to the realisation process.

To ensure the successful completion of the current research project, several key activities were undertaken. First and foremost, a comprehensive literature review was conducted to gather relevant information and establish a theoretical framework for the study. This involved discussing existing articles and researches about AI and agribusiness, examining Georgia's agricultural statistic and agribusiness ecosystem. Following the literature review, a survey was designed to collect data from respondents. Data gathered from the survey provided the basis for the following data analysis both

descriptive and inferential. Finally, we presented main results and developed recommendations and future suggestions for the research.

According to the answers, it was revealed that in all groups, according to age, gender and education level most farmers hold very positive attitudes towards AI applications and agricultural technologies. The majority of respondents 36% believe AI and agricultural technologies simplify production processes and 28.3% perceived realisation is one of the greatest benefits. These findings emphasize the importance of further exploring and promoting the adoption and integration of AI and agricultural technologies to support the agricultural sector's growth and sustainability.

Most respondents had a positive view of the impact of AI applications and agricultural technologies on production yield in agribusiness with the mean score of 4.37 points. Notably, female farmers have a more positive attitude towards AI and agricultural technologies compared to male farmers. This is evident from the higher mean score of 4.1646 among female respondents, indicating a stronger positive perception. In contrast, male farmers have a slightly lower mean score of 3.8852. These findings highlight the importance of considering gender perspectives when implementing and promoting AI and agricultural technologies in agribusiness. Understanding and addressing any underlying factors contributing to the gender disparity in attitudes can help ensure that both male and female farmers can fully benefit from and participate in the adoption of these technologies.

Another important point raised in the survey is respondents' perception regarding difficulties they face in adopting AI and modern agricultural technologies, where the majority of respondents, comprising 34.1%, identified the unavailability of these technologies as a major difficulty. Additionally, 25.2% of respondents expressed a lack of knowledge and understanding on how to use these technologies, indicating a need for education and training programs to enhance digital literacy among farmers. Addressing these challenges by improving access to technologies and providing training opportunities can help farmers overcome barriers. Moreover, it was revealed that there is a generational difference in the perception of digital skills. Specifically, the younger age group 18-28 predominantly rated their digital competence as "High skills" or "Very high skills," with a combined percentage of 75%. In contrast, the older age group 51-65 primarily rated their digital skills as "Very low skills," with a striking percentage of 81.25%. When developing initiatives or training programs for digital skills in the context of agribusiness, it is essential to understand this gap between generations. Targeted initiatives can be taken to give older farmers the assistance and training they need to improve their digital abilities and close the generational gap in the agricultural industry.

The research objective of identifying and characterizing the role of AI on production in agribusiness was assessed through two questions: the impact of AI on production yield (Q11) and the impact of AI on the realisation process (Q13). The mean and standard deviation were calculated to provide insights into the respondents' perceptions. The findings from these assessments indicate that most of the respondents hold positive attitudes towards the impact of AI applications and modern technologies on production yield and the realisation process in agribusiness.

An important aspect of this research was the formulation and testing of hypotheses. During First hypothesis it was calculated the global mean of the questionnaire to assess the relationship between

farmers' attitudes and their openness to implement AI and modern technologies in agribusiness. The hypothesis was verified, indicating a significant relationship between farmers' attitudes and their willingness to adopt AI and modern technologies.

The second hypothesis focused on exploring the differences in attitudes between males and females towards AI and agricultural technologies. It was used the Student's t-test to compare the means of these two groups. The results confirmed the hypothesis, demonstrating that female farmers had a more positive attitude towards AI and agricultural technologies compared to the males.

The third hypothesis investigated the differences in attitudes towards AI and agricultural technologies among different age groups. We employed the Kruskal-Wallis test to evaluate these differences. The analysis verified the hypothesis, indicating that age group had a significant influence on farmers' attitudes towards these technologies.

Lastly, the fourth hypothesis examined the association between respondents' educational level and their perception of the importance of AI and agricultural technologies in their businesses. Fisher's exact test was used to assess this association, and the results indicated a significant association between educational level and perception.

The research contributes to our understanding of farmers' attitudes towards AI and agricultural technologies in agribusiness. It provides empirical evidence of positive attitudes among farmers and highlights the factors that influence these attitudes, such as gender, age, and educational level. According to the study, the biggest challenge of AI and agricultural technologies in Georgian agribusinesses is the lack of know-how and low digital skills between farmers. The information gathered from the research is statistically significant and valuable for policymakers, agricultural organisations, and stakeholders involved in promoting the adoption of AI and agricultural technologies. Using this information, will enable stakeholders and the government of Georgia to develop targeted interventions and initiatives to support farmers in integrating these technologies into their practices to increase production and the share of agriculture in GDP that is critically important in such ecological, political and economic environment.

Based on the research findings, it is evident that there is a critical need to raise awareness and promote the adoption of AI and agricultural technologies in agribusiness. To achieve this, it is essential to actively involve farmers in understanding the potential benefits and efficiency gains offered by these technologies. One effective approach is to establish programs and initiatives that focus on improving farmers' digital skills and providing them with the necessary knowledge and resources to effectively utilize AI and agricultural technologies. Additionally, it is crucial for the government to play a significant role in supporting and facilitating these efforts through policy interventions, funding initiatives, and collaboration with industry stakeholders. By collectively addressing these aspects, we can create an environment that fosters the widespread adoption of AI and agricultural technologies, ultimately enhancing the overall productivity and sustainability of agribusiness.

The limitations of the research are the following: the results may not be fully generalisable to a larger population as the research findings are based on a specific sample of farmers in a particular geographic region specifically Georgia. Additionally, there is a little information about Artificial intelligence and agricultural technologies in Georgian scientific literature. Moreover, the research mentions that the last agricultural census conducted in Georgia was in 2014. The reliance on such old census data may affect the representativeness and accuracy of the sample. It is important to consider any changes or developments in the agricultural sector since the census was conducted to ensure the relevance and validity of the research findings.

Future studies could aim to address these limitations by incorporating larger and more diverse samples, conducting updated agricultural censuses, and conducting in-depth literature reviews to ensure a more comprehensive understanding of the topic.

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Appendix

Questionnaire. (English Version)

Dear Respondent,

Please participate in the research conducted for the master's thesis on the role of Artificial Intelligence in agribusiness, opportunities and challenges for Georgia. Specifically, the purpose of the study is to determine the farmers' attitude towards modern technologies including Artificial Intelligence in their agribusinesses.

Thank you for taking the time to assist me in carrying out this research. The data obtained is confidential and will be used for academic purposes only.

Please answer the following questions by choosing answers from the list.

Questionnaire - Assessing farmers' trust in digital technologies/AI

Q1. Your Gender:

1. Male
2. Female

Q2. Your Age:

1. 18 – 28
2. 29 – 39
3. 40 – 50
4. 51 – 65
5. 65 +

Q3. Education Level:

1. Secondary school
2. Vocational school
3. Higher education (Bachelor, Master, PHD)

Q4. Farm Type:

1. Small
2. Average
3. Large

Q5. Years of agricultural production:

- Short answer

Q6. The main type of agricultural business:

1. Crops

2. Fruits and vegetables
3. Livestock
4. Fishery
5. Vineyard
6. Other

Q7. Please tick the options of technologies/applications u have heard of (Multiple choice):

1. Agronavti
2. TABCo
3. AI sowing app
4. Price forecasting for Agriproducts
5. AI powered image recognition to identify plant diseases
6. Harvesting scheduling & control
7. Drones
8. None of the above

Q8. How Can agricultural technologies/applications benefit your business? (Multiple choice)

1. Planning production process
2. Simplifying production process
3. Decreased costs and wastes
4. Realisation
5. Increased Production yield
6. Other

Q9. What are the difficulties you face with using modern agricultural technologies/applications? (Multiple choice)

1. No internet connection
2. No access to information
3. Do not know how to use
4. Not available
5. I do not need
6. I do not have difficulties

Q10. From 1 to 5, please choose the number which the best describes your digital skills, where 1 is very low skills and 5 is very high skills.

1. Very low skills
2. Low skills
3. Neither low nor High
4. High skills
5. Very High skills

Q11. With what extend do you agree or disagree with the view that using AI applications and modern technologies in agribusiness increases production yield?

1. Strongly Disagree
2. Disagree

3. Neither agree nor Disagree
4. Agree
5. Strongly Agree

Q12. Do you agree or disagree that modern technologies/Applications are very important for your agribusiness?

1. Strongly Disagree
2. Disagree
3. Neither agree nor Disagree
4. Agree
5. Strongly Agree

Q13. With what extend do you agree or disagree with the view that using AI applications and modern technologies in agribusiness makes realisation process easier?

1. Strongly Disagree
2. Disagree
3. Neither agree nor Disagree
4. Agree
5. Strongly Agree

Thank you for your collaboration!

Questionnaire. (Georgian Version)

გთხოვთ, მონაწილეობა მიიღოთ კვლევაში, რომელიც ტარდება სამაგისტრო ნაშრომისთვის და ეხება თანამედროვე ტექნოლოგიების, მათ შორის ხელოვნური ინტელექტის გამოყენებას აგრობიზნესში. კონკრეტულად, კვლევის მიზანია, განსაზღვროს ფერმერთა დამოკიდებულება თანამედროვე ტექნოლოგიებისა და აპლიკაციების მიმართ მათ საქმიანობაში.
მადლობა, რომ დამითმეთ დრო და დამეხმარეთ აღნიშნული კვლევის განხორციელებაში. მიღებული მონაცემები კონფიდენციალურია და გამოყენებული იქნება მხოლოდ აკადემიური მიზნებისთვის.

გთხოვთ უპასუხოთ შემდეგ კითხვებს:

Q1. თქვენი სქესი:

1. მამრობითი
2. მდედრობითი

Q2. თქვენი ასაკი:

1. 18-28
2. 29-39
3. 40-50
4. 51-65
5. 65+

Q3. განათლების საფეხური:

1. საშუალო
2. პროფესიული
3. უმაღლესი

Q4. მეურნეობის ტიპი:

1. მცირე
2. საშუალო
3. მსხვილი

Q5. რამდენი წელია რაც სასოფლო-სამეურნეო საქმიანობას ეწევით?

Q6. წარმოებული პროდუქციის ტიპი (შეგიძლიათ აირჩიოთ ერთზე მეტი პასუხი):

1. მარცვლეული
2. ხილი და ბოსტნეული
3. მეცხოველეობა
4. თევზჭერა
5. მეღვინეობა/მევენახეობა

6. სხვა.

Q7. გთხოვთ მონიშნოთ ქვემოთ ჩამოთვლილი აგრარული ტექნოლოგია/აპლიკაციები, რომლის შესახებაც აქამდე გსმენიათ: (შეგიძლიათ აირჩიოთ ერთზე მეტი პასუხი)

1. Agronavti AI - აგრონავტი
2. TABCo - ტაბკო
3. AI სათესი აპლიკაცია
4. აპლიკაცია ფასის პროგნოზირებისათვის აგროპროდუქციაზე
5. გამოსახულების ამოცნობა მცენარეთა დაავადებების იდენტიფიცირებისთვის
6. აპლიკაცია მოსავლის აღების დაგეგმვისა და კონტროლისთვის
7. სხვადასხვა სახეობის დრონები აგრო წარმოებაში
8. არცერთი ზემოთ ჩამოთვლილი

Q8. თქვენი აზრით, რაში შეიძლება დაეხმაროს აგრარული ტექნოლოგიები/აპლიკაციები თქვენს ბიზნესს? (შეგიძლიათ აირჩიოთ ერთზე მეტი პასუხი)

1. წარმოების პროცესების სწორ დაგეგმვაში
2. წარმოების პროცესების გამარტივებაში
3. ხარჯებისა და ნარჩენების შემცირება
4. პროდუქციის რეალიზაცია
5. მოსავლიანობის გაზრდაში
6. სხვა.

Q9. რა სახის სირთულეებს აწყდებით თანამედროვე აგრარული ტექნოლოგიების/აპლიკაციების გამოყენებისას? (შეგიძლიათ აირჩიოთ ერთზე მეტი პასუხი)

1. ინტერნეტ კავშირი
2. არ მაქვს ინფორმაცია ციფრული ტექნოლოგიების შესახებ
3. არ ვიცი როგორ გამოვიყენო
4. არ არის ხელმისაწვდომი
5. არ მჭირდება
6. არ ვაწყდები სირთულეებს

Q10. 1-დან 5-მდე შეაფასეთ საკუთარი ციფრული უნარები(ტექნოლოგიებთან დამოკიდებულება), სადაც 1 არის ძალიან დაბალი, ხოლო 5, ძალიან მაღალი).

1. ძალიან დაბალი
2. დაბალი
3. არც დაბალი არც მაღალი
4. მაღალი
5. ძალიან მაღალი

Q11. ეთანხმებით თუ არა მოსაზრებას, რომ აგრარული ციფრული ტექნოლოგიების/აპლიკაციების გამოყენება გაზრდის თქვენს წარმოებას?(გთხოვთ აირჩიოთ ციფრი 1 დან 5-ის ჩათვლით, საიდანაც 1 - კატეგორიულად არ ვეთანხმები, 2 - არ ვეთანხმები, 3 - არც ვეთანხმები, არც ვუარყობ, 4 - ვეთანხმები, 5 - სრულად ვეთანხმები).

1. კატეგორიულად არ ვეთანხმები
2. არ ვეთანხმები
3. არც ვეთანხმები და არც ვუარყობ
4. ვეთანხმები
5. სრულად ვეთანხმები

Q12. ეთანხმებით თუ არა მოსაზრებას, რომ თანამედროვე აგრარული ტექნოლოგიები/აპლიკაციები ძალიან მნიშვნელოვანია თქვენი ბიზნესისათვის? (გთხოვთ აირჩიოთ ციფრი 1 დან 5-ის ჩათვლით, საიდანაც 1 - კატეგორიულად არ ვეთანხმები, 2 - არ ვეთანხმები, 3 - არც ვეთანხმები, არც ვუარყობ, 4 - ვეთანხმები, 5 - სრულად ვეთანხმები).

1. კატეგორიულად არ ვეთანხმები
2. არ ვეთანხმები
3. არც ვეთანხმები და არც ვუარყობ
4. ვეთანხმები
5. სრულად ვეთანხმები

Q13. ეთანხმებით თუ არა მოსაზრებას, რომ თანამედროვე აგრარული ტექნოლოგიების/აპლიკაციების გამოყენება ამარტივებს აგროპროდუქციის რეალიზაციის პროცესს? (გთხოვთ აირჩიოთ ციფრი 1 დან 5-ის ჩათვლით, საიდანაც 1 - კატეგორიულად არ ვეთანხმები, 2 - არ ვეთანხმები, 3 - არც ვეთანხმები, არც ვუარყობ, 4 - ვეთანხმები, 5 - სრულად ვეთანხმები).

1. კატეგორიულად არ ვეთანხმები
2. არ ვეთანხმები
3. არც ვეთანხმები და არც ვუარყობ
4. ვეთანხმები
5. სრულად ვეთანხმები

მადლობას გიხდით კვლევაში მონაწილეობისათვის!