ESJ Social Sciences Peer-reviewed

Drivers, Barriers, and Impact of Digitalization on Sustainable Rural Development, Focusing on Some Regions of Albania

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Doi:10.19044/esj.2025.v21n1p115

Submitted: 17 January 2025
Accepted: 31 January 2025
Published: 31 January 2025

Cite As:
Tomorri I., Keco R., Shima J. & Tomorri K. (2025). *Drivers, Barriers, and Impact of Digitalization on Sustainable Rural Development, Focusing on Some Regions of Albania*. European Scientific Journal, ESJ, 21 (1), 115. https://doi.org/10.19044/esj.2025.v21n1p115

Abstract

The rural sector is one of the most important sectors in Albania, referring to the contribution to economic growth, gross domestic product, and level of employment in the country. Increasing the productivity and performance of agricultural farms, efficiency of resource use, cooperation between small farmers, access to financing, implementation of technology, food quality and safety, are considered some of the main challenges for the sustainable development of this sector. An important instrument to face these challenges is the digitization of this sector, through the use of technology and digital platforms, with the aim of increasing the competitiveness and productivity of agricultural farms. The digitalization process holds the potential to bring about a significant change in how agriculture functions, in terms of tools, technologies, platforms and innovative approaches that support precision agriculture and efficient management of resources. In function of the

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

purpose of the study, the questionnaire was designed to collect information from the farmers (interviewers). Based on the data of INSTAT & MARD, (2023) for the dominant activities and typology of farms, 938 questionnaires were completed with farmers for the regions selected in the study. The methodology used for this paper is based on the collection, processing, analysis and interpretation of data and indicators, focusing on the drivers, barriers and impact of digitalization on sustainable rural development in Albania. The data were analysed and processed with the SPSS program, in accordance with the purpose and research objectives of the study. Based on the data collected in this study, digital technologies in agriculture are perceived positively by interviewed farmers. The results show that the digitalization process in the rural sector is slow and faces several barriers and challenges, such as the small size of the farms, limited digital skills of farmers, lack of resources to implement digital technologies, and limited digital infrastructure in rural areas.

Keywords: Digitalization, precision agriculture, sustainability, digital technologies, drivers and barriers

Introduction

The rural sector is becoming more and more intensive, related to farmers' knowledge, complex decisions they have to make about their farm activities, the agricultural products they grow, the markets in which they will sell their agricultural products, and other factors affecting their livelihood and the well-being of society as a whole (ITU & FAO, 2020). The development of the rural sector is oriented towards improving infrastructure and increasing investments, farm productivity, environmental protection, effective agricultural land management and food safety standards.

This sector remains the most important sector in the country's economy, contributing 20% to the Gross Domestic Product (GDP) as well as providing the income base for the majority of the population. The agricultural sector employs about 37% of the country's employed population (MARD, 2022). However, agriculture sector development is facing several challenges such as uncertainties about agricultural land ownership, market access for agricultural products, low levels of use of modern technologies, lack of cooperation among farmers, the small size of the farms, price-cost squeezes, rural exodus and youth abandonment, high informality (ITU &FAO, 2020). An important component to face these challenges and problems is the digitization of this sector, through the use of technology and information systems as well as digital platforms, with the aim of increasing the competitiveness and productivity of agricultural farms.

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The studies show that the application of technology and information, affects the exchange of information between actors, in terms of data on the prices of the purchase of inputs and the sale of products, helping to improve the effectiveness of the food value chain and agricultural activities. Access to and use of ICTs has increased considerably in recent decades in rural areas of developing and transition countries (Ma et al., 2023). Agribusiness can potentially add value to agriculture and the entire value chain, but it is difficult to achieve these goals without digitalization of this sector (Kitole et al., 2024). Technological developments lead to the organization of agricultural production, the consumption structure and the agribusiness system. According to Rolandi et al. (2021), technological change is not considered just in terms of "physical" inventions or developments, but as a process interacting with changes in people's behavior and the institutional and economic structures. The transition towards digitalised agriculture and rural areas can have huge socio-economic and environmental impacts (Basso & Antle, 2020; Lajoie-O'Malley et al., 2020).

In developing countries, such as our country, agriculture is one of the main sectors of the economy, so there is a need for a large number of extension agents to advise and interact with farmers on innovative production technologies that can be decisive for their activities. The digitalisation can contribute to improving the quality of work in traditionally rural activities, and can make it more attractive for young people (Brunori et al., 2022). In these countries, there has been a growing awareness of the many challenges facing agricultural extension systems and ICTs can be useful in addressing these problems (Spielman et al., 2021). Digital technologies (eg, artificial intelligence, robotics, innovation, Internet of Things, drones, etc.) are applied along the agricultural value chain to address challenges related to agricultural production systems (Benke et al., 2017; Rose et al., 2020). Building the human capacity, as well as the infrastructure needed to facilitate better connectivity and communication, is critical. Strengthening the skills and capabilities of agricultural producers, especially smallholder producers, to successfully manage their agricultural enterprises requires sustained investment. Digital agricultural technologies are helping to address bottlenecks in productivity, postharvest handling, market access, finance and supply chain management (Sylvester et al., 2021).

In Albania, the farm structures are fully dominated by smallholders with many small farms and few large farms. The development of this sector is accompanied by challenges related to, increasing the productivity of agricultural farms, the size of agricultural farms, efficiency of resource use, cooperation between small farmers, access to financing, modernization of the value chain, food quality and safety, marketing and sale of agricultural products, as well as building administrative capacities to support these

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processes (Tomorri et al., 2024). Sustainable economic growth in Albania is therefore closely related to the performance of the rural sector (Domi and Arapi, 2021). Insufficient extension services as well as poor access to the provision of information, lead to the lack of implementation of new technologies as well as to the decrease in the productivity of their activities. The major barriers to digitization in agriculture, are the small size of the farm, limited financial resources, low level of familiarity with technology and the lack of digital infrastructure in rural areas, but also affordability, for both fixed and mobile broadband access (Mulliri et. al., 2022).

The rural sector in Albania should be transformed into a competitive sector that can guarantee sustainable development, attract investments, and provide employment, especially for youth. Farmers in their decision-making process often face constraints due to a lack of information and knowledge, farm size, access to finance, lack of investment and technology, as well as infrastructure and supporting human capacities (Tomorri et al., 2024).

The purpose of this study is to examine the drivers, barriers and impact of digitalization on sustainable development of the rural sector in Albania.

The main objectives of the paper are: 1) to identify the drivers and barriers that affect the implementation of digitization in the rural sector, 2) to evaluate the impact of digitization on the performance of agricultural farms and 3) to address the issues and challenges for the digitalization of the rural sector in our country.

Literature review

The rural sector plays an important role in the livelihood of the population and economic well-being in rural areas. Digital agriculture represents new knowledge or new combinations of existing knowledge transformed into technologies applied to agricultural farm activities, as a result, it aims to improve the performance of this sector. Digitalisation refers to the adoption of information communication technologies, including the internet, digital technologies and devices, to improve the collection, exchange, aggregation, access, analysis of data and information (Salemink et al., 2017; Wolfert et al., 2017; Shepherd et al., 2020).

Technologies such as smartphones, apps, global positioning systems (GPSs), Internet of things (IoT), sensors, drones, unmanned autonomous vehicles (UAVs) are part of digital agriculture (Rolandi et al., 2021; Salemink et al., 2017).

As a result, investing in the digitalization of agricultural activities should be associated with investments in building the required competences (i.e., skills, knowledge and attitude) for rural workforce. According to Reis et al., (2020), digitalization is the phenomenon of transforming analogue data into digital language which, in turn can improve business relationships

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between customer and companies, bringing added value to the whole economy and society.

Digital technologies can be divided into three groups: basic (phone calls, sms, emails, etc.), medium (online actions such as social media and e-commerce) and advanced (big data analytics, blockchain technologies, Internet of Things (IoT), artificial intelligence (AI), cloud computing, robotics) (Nogales & Casari, 2023; Stoyancheva & Doncheva, 2023). Digital technologies, the use of applications and platforms, increase the exchange of information and cooperation between farmers and other actors who are part of the value chain in the rural sector. Digitalization also offers many other opportunities for agriculture and the food value chain all the way to the consumer to become smarter, more efficient and more connected (ITU & FAO, 2020).

According to Rijswick et al. (2019), "digitalisation is often used to describe the socio-technical processes surrounding the use of digital technologies that impact on the social and institutional context that require and increasingly rely on digital technologies". Digitalisation, as in other sectors, will have an important impact on agriculture. In developing countries, ICT applications are crucial in reducing information costs and sharing information between actors. The spread of the internet and mobile telephony in rural areas has already brought significant changes in the rural sector. Digital platforms increase access to information and capacity-building opportunities, bringing tangible benefits to farmers, in terms of better quality inputs, increased productivity, reduced post-harvest losses, and better market access (Nakasone et al., 2014). Digitalization has also been observed to be a driving force of the evolution of Agricultural Knowledge and Innovation Systems (AKIS).

Digitalization in agriculture is expected to provide technical optimization of agricultural production systems, value chains and food systems (Klerkx et al., 2019). Economic growth is driven by the advancement of ICTs, which are also a key driver for innovation and change (ITU & FAO, 2020). The digitalization technology transformation of entrepreneurship is the main driving force to achieving sustainable development goals (Prasetyo & Setyadharma, 2022; Sridhar et.al., 2023). The sustainable development of rural areas means a dynamic growth of potential in increasing productivity, and competitiveness and improving the standard of living of the population in these areas. The digitalization process holds the potential to bring about a significant change in how agriculture functions, in terms of tools, technologies or practices, and to offer a path for innovation and new ways of organising production and supply chains (Accorsi et.al., 2017).

In particular, the agricultural sector is seeing a set of transformative trends due to digitalisation, such as a greater focus on precision agriculture, the internet of things and the use of big data to drive production and farm

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efficiencies. Digital agriculture will create systems that are highly productive, anticipatory and adaptable to climate changes. This, could lead to greater food security, profitability and sustainability (Trendov et al., 2019). For farmers, digital technologies support better decision-making on farms, helping to boost innovation and improve agricultural productivity, and sustainability (OECD, 2022). Digital technologies could also offer opportunities for new sources of efficiency, supporting research and innovation, the creation of new services for the sector, and improved traceability and more efficient transactions in value chains (Ayre et al., 2019). ICTs can contribute to agro-food sustainability transition by increasing resource productivity, reducing inefficiencies, decreasing management costs, and improving food chain coordination (El Bilali & Allahyari, 2018). The use of digital applications and platforms, increases the exchange of information and cooperation of farmers and other actors who are part of the value chain in the rural sector (Ehlers et al., 2021). In this context, digitalisation and digital technologies allow for precision farming that may attenuate the environmental externalities of agriculture while enhancing efficiency, productivity and profitability for farmers (Martens and Zscheischler, 2022).

Agricultural farms and agribusinesses, through digital platforms, access a wealth of information and services that directly connect the farmer with other actors along the value chain (Khanna, 2021). The Internet of Things (IoT) has drawn attention in recent years for its potential to transform agriculture and food systems (Mahdad et al., 2022). The application of IoT in agriculture aims to empower farmers with decision tools and automation technologies that seamlessly integrate knowledge, products, and services to achieve high productivity, quality, and profit (Abbasi et al., 2022). Inclusion, efficiency and innovation are key mechanisms for digital technology to drive development in rural areas (Miller et al., 2013).

Studies show that the use of digital platforms affects the exchange of information, access to markets, access to financing, and the effectiveness of the operation of the value chain, bringing tangible benefits to farmers and the productivity of agricultural farms. According to Reis et al. (2018), the digital transformation includes three important elements: 1) Technological (use of new digital technologies such as social media, mobile, or embedded devices); 2) Organizational (a change in organizational process); 3) Social (a phenomenon that is influencing all aspects of human life). Digitization can have positive impacts in terms of sustainability and community prosperity in rural areas (Ferrari et al., 2022). Most of the empirical research examines, the impact that ICT has on the sustainable development of the rural sector, the modernization of the value chain, and innovative approaches in rural entrepreneurship (Burkitbayeva and Swinnen, 2018; Nakasone et al., 2014). Through various types of applications and digital platforms, ICT will enable

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the effective sharing and exchange of information and data about inputs, prices and markets between farmers and other actors involved in the value chain (Birner et .al., 2021). In smart farming systems, farmers can monitor and control operations remotely, based on real-time digital information instead of direct observation and manual tasks on-site (Verdouw et al., 2021).

The agricultural sector has shown traditionally poor propensity, especially in the case of small and medium-sized farms, in the implementation of innovation and digital technologies (Giua et al., 2020). Agriculture also faces many challenges, including those posed by the impact of climate change, increased volatility in food prices and dysfunctional supply chains. Linking knowledge to innovation is critical to resolving the agricultural sector's information and knowledge gaps. The impact of digitization concerns the production side of the agri-food sector, where new technologies allow customers to have complete traceability and visibility of the production process and consumer behavior of agricultural products (Passarelli et al., 2023). Digitalization is generally perceived as a positive process, and that also includes some challenges that must be addressed by internal and external actors in the agri-food sector (Kukk et al., 2022).

Digitalization provides farmers with important information for decision-making, which allows them to improve economic performance in farm activities (Šermukšnyte & Melnikiene, 2024; Fielke et al., 2020).

In terms of sustainable development of rural areas, the economic and environmental requirements for digital agricultural technologies should be specified, and the elimination of the existing and expected barriers should be researched (Balayev & Mirzayev, 2022). More specifically, digital technologies implemented can promote cooperation among stakeholders in the agriculture value chain, increase the market access and the bargaining power of small farmers (Rolandi et al., 2021). According to Poppe et al. (2021), the future monitoring system should result in a smart combination of innovations in current statistics, combined with data from satellites and sensors, and a better overall harnessing of data flows within the agricultural sector. The benefits of applying digital technologies along the agriculture value chain are mainly in the economic, environmental and social fields for all the actors involved (Rolandi et al., 2021). Studies show that digital platforms can reduce specific transaction costs and promote the integration of smallholders into value chains. These processes have important implications for developing countries. The digital transformation of agriculture can promote the increase in farmers' income, by improving production efficiency, broadening sales channels, and promoting the upgrading of agricultural structure (Finger, 2023). The rural sector has already undergone many changes that have led to a significant transformation of production processes and activities on agricultural farms (Lieder & Schlaack, 2021; Mathidle et al., 2022). In this

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context, policymakers should design strategies and define actions aimed at developing collaborations between actors involved in the agri-food chain and the use of digital technologies to support rural development (Monda et al., 2023; World Bank, 2016).

In the last ten years, Albania has made progress in terms of developing digital infrastructure. In order to prioritize digitalization, the Albanian government has drawn up several strategic documents. These documents and strategies, it was intended to encourage the use of information technologies and the development of information technology infrastructure as the key to its successful implementation. E-Albania is the online government platform where public services, previously provided at the physical offices, are now provided electronically to the society (citizens, businesses, and NGOs). The platform offers several services to the stakeholders along the agriculture value chain, mostly related to the grant schemes. The e-service "Application for the National Support Scheme for Farmers" involves securing financial support for agriculture and rural development, provided by the Albanian government. In the framework of digitalization, the Agriculture and Rural Development Agency opened the network of "Agro Points" or "Farmer's Windows" (AGROPIKA). This provides farmers with information for applications, access to finance, extension support and other services, (FAO, 2020). Regional Agricultural Extension Agencies (RAAE) also support applicants for grant and subsidy schemes using the e-Albania platform. These agencies play an important role in supporting farmers to upload the required documents to their account in e-Albania, as well as in facilitating the process of knowledge transfer in terms of the use of digital technologies in agricultural farms.

International organizations, research institutions, and universities, have also supported initiatives for the digitalization of agriculture in Albania such as, (The "SARED" program implemented by GIZ, the Japanese International Cooperation Agency (JICA) in collaboration with the Albanian Agribusiness Committee (AAC) have designed the "ABA" online digital platform, as well as several other platforms such as, "Agroalbania.al", "Agrotime.al", "UBgreen", "Agroweb". These digital systems and platforms provide online information about production technologies at the farm level, technical knowledge related to animal breeding and crop production, fostering contacts and cooperation among farmers and other stakeholders along the agriculture value chain (Tomorri et al. 2024).

Data and methodology

In accordance with the purpose of the study, primary data have been collected from the completion of questionnaires with farmers as well as secondary data published by national and international institutions.

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The methodology used for this paper is based on the collection, processing, analysis and interpretation of data and statistical indicators, focusing on the drivers, barriers and impact of digitalization on sustainable rural development in Albania.

Based on the objectives of this study, the methodology is structured to provide a comprehensive analysis, combining quantitative and qualitative research approaches.

The European Commission's Digital Agenda proposes making better use of the potential of ICT to foster innovation, economic growth and progress. Agricultural Knowledge and Information Systems (AKIS), according to EU standards, include; (Agricultural statistics, Farm Accountancy Data Network (FADN), for monitoring the financial processes, and Market Information Systems.

Digital technologies are helping rural entrepreneurs improve market access, improve product quality, and facilitate the production and sale of products.

Table 1. Impact of digital technologies on sustainable development of agricultural farms

Indicator	Economical	Social	Environmental
Increase in income	Increasing income provides the opportunity to invest in equipment and inventory	Farmers' quality of life improves. Better equipment improves working conditions	Investments can be made in storage facilities to reduce agricultural product losses
Increase in quality of production	Improving the quality of the produce allows it to be sold at a higher price	Increasing the supply and variety of local food for consumers.	Reduces the amount of agricultural production that can be thrown away
Increase in farm efficiency	The efficiency of production types is evaluated, and unprofitable production is eliminated	The competitiveness image of small organic farms in society is strengthened	The economic efficiency of environmental solutions can be calculated
Decrease in farmer's labor costs	It provides additional time to develop the agricultural farm	Better balance between professional and family interests. Opportunities to combine farming with other economic activities	Saved time can be invested in processing produce and reducing agricultural production losses
Increase in harvest	Higher harvest leads to increased customer numbers and increased revenues	Increasing the supply and variety of local food for consumers	Sustainable technologies increase harvest without increasing chemical pollution
Decrease in agricultural product losses	Farm income increases because of reduced production losses	Positive image of the farm in the community and among consumers.	Reduces the amount of agricultural production that can be thrown away

Source: Šermukšnyte-Alešiuniene & Melnikienem, 2024; Authors' composition, 2024

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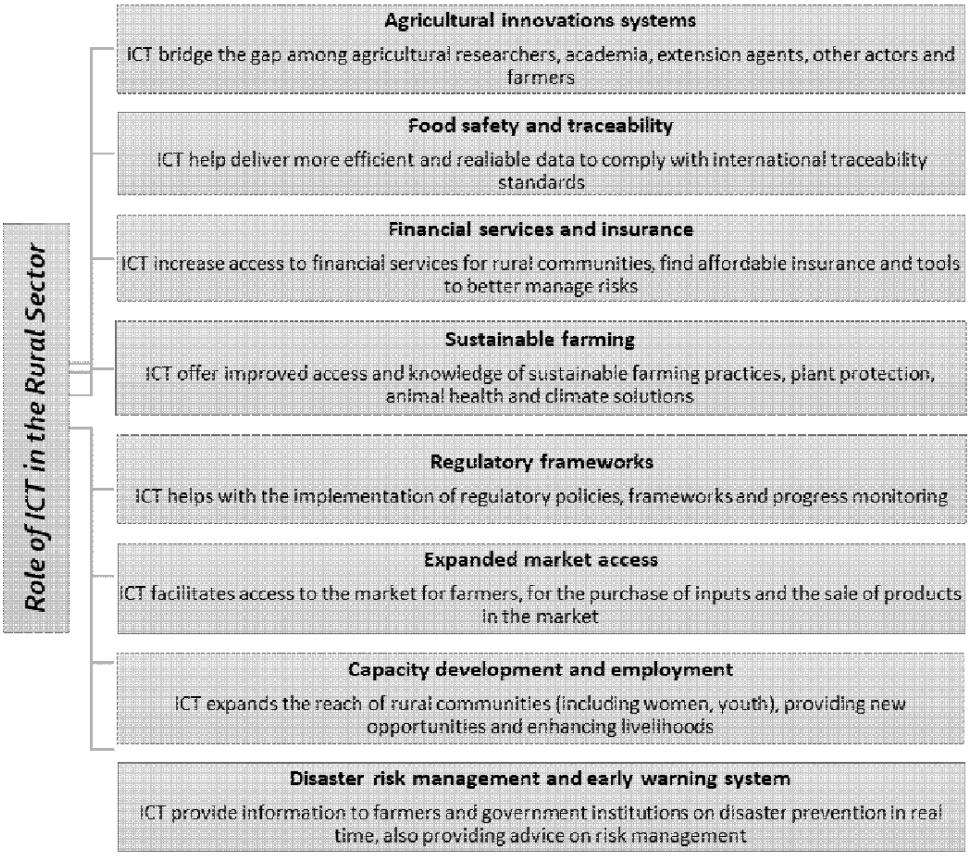
Figure 1. Role of information and communication technology in the rural sector



Source: ITU & FAO, 2020; Authors' composition, 2024

Referring to the above data, it can be observed that the use of ICT platforms and digitalization in the rural sector offers farmers various benefits, such as improving agricultural advisory and services, food safety, product traceability and certification, increasing access to financing, risk management, improving the decision-making process, integrating small farmers into the agricultural value chain, increasing the cooperation of farmers with other stakeholders, improving market access, improving farm management, increasing the exchange of information on prices and markets.

In order to achieve the purpose and objectives of the study, a questionnaire was designed to collect information and data from the interviewed farmers. Based on the data of INSTAT, (2023) for the dominant activities and the typology of farms, the questionnaires were completed face to face with farmers for the five regions selected of the country (Korçë, Kukës, Berat, Fier, Gjirokastër). In total, 938 questionnaires were filled out. After completing the questionnaires, the data were processed and analysed with the

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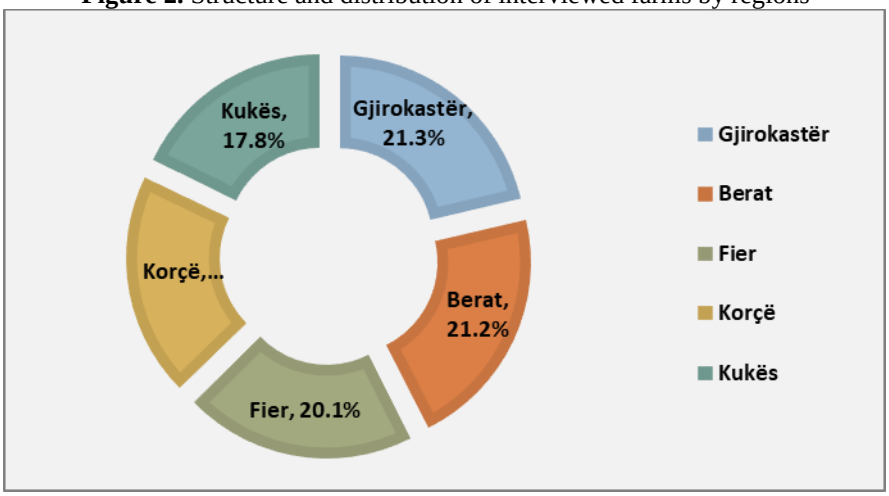
SPSS program. The indicators analysed in the study are evaluated with the Likert scale: [1-5].

Results and discussions

The role of digitalization is multiple: it facilitates the collection and processing of data for inputs and products, improves their traceability, improves access to information and communication between the stakeholders of the value chain, increasing the possibility of providing products and services in compliance with customer requirements; improves competitiveness, reduces costs, increases income; affects the increase of employment opportunities in rural areas, enables farmers to react more quickly to changing weather or market conditions, improving the productivity and sustainability of agricultural farms.

The rural sector is one of the priority sectors of the national economy and the government's objectives, where the main focus is the development and consolidation of this sector in the future. During the last decade, there have been significant positive developments in the rural sector in Albania, in terms of government initiatives and strategies to support farmers' activities through grants and subsidies.

Figure 2. Structure and distribution of interviewed farms by regions



Source: Authors' results, 2024

Referring to the data in the figure above, the completed questionnaires according to the respective regions are: Gjirokaster (200 questionnaires, 21.3%), Berat (199 questionnaires, 21.2%), Fier (189 questionnaires, 20.1%), Korçë (183 questionnaires, 19.5%) and Kukës (167 questionnaires, 17.8%).

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Table 2. Characteristics of respondents by gender, age, education and employment

No	Characteristics	Frequency	Percentage
I	**Gender**		
a	Female	60	6.4%
b	Male	878	93.6%
*	**Total**	**938**	**100%**
II	**Age**		
a	18-30	21	2.2%
b	31-40	79	8.4%
c	41-50	181	19.3%
d	51-60	266	28.4%
e	Over 60	391	41.7%
*	**Total**	**938**	**100%**
III	**Education**		
a	Basic education	350	37%
b	Secondary Education	406	43%
c	Vocational Education	109	12%
d	Higher Education	73	8%
*	**Total**	**938**	**100%**
IV	**Employment**		
a	Employed on the farm	751	80%
b	Not employed on the farm	187	20%
*	**Total**	**938**	**100%**

Source: Authors' results, 2024

The above data show that (93.6%) of interviewed farmers are male and only (6.4%) of them are female. In terms of their age, the majority of interviewees (41.7%) are over 60 years old, (28.4%) are aged 51-60, (19.3%) are aged 41-50, (8.4%) are aged 31-40 years old, and (2.2%) are aged 18-30 years old.

Regarding the level of education, it turns out that (37%) of the farm managers interviewed have basic education, (43%) have secondary education, (12%) have vocational education and (8%) have higher education. As for employment, most of the interviewees (80%) are employed in their farms and (20%) are employed in other sectors.

In accordance with the purpose and objectives of the study, the collected data from the questionnaires are analyzed as follows.

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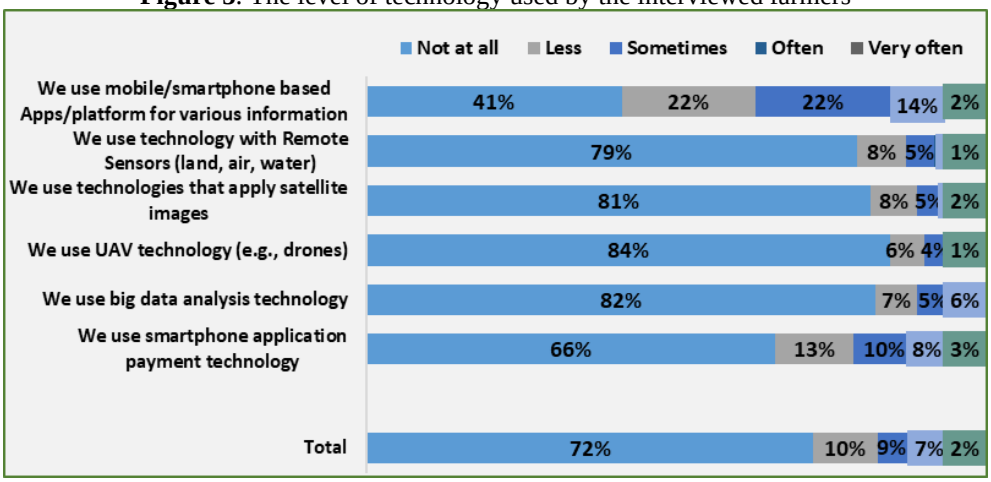
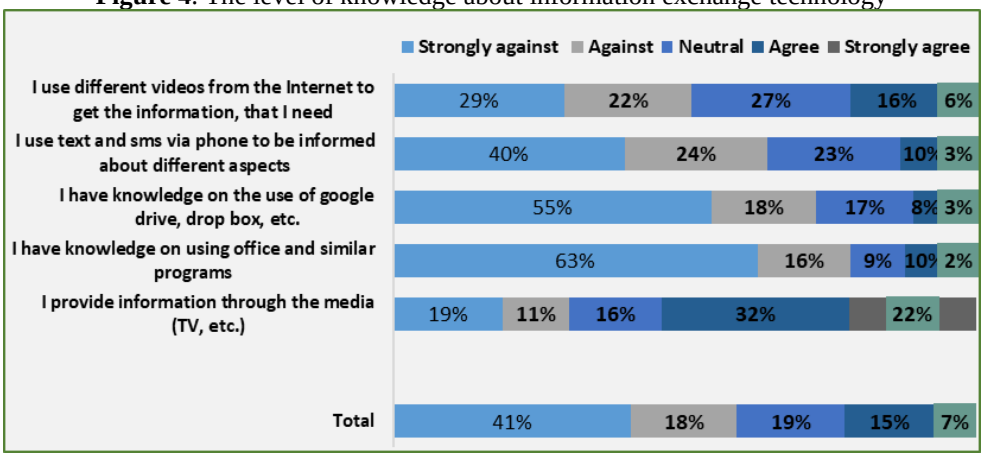
Figure 3. The level of technology used by the interviewed farmers



Source: Authors' results, 2024

Regarding the level of technology used by the interviewed farmers, from the analysis of the survey data, it is noted that in total, (72%) of the interviewed farmers state, that they have not used such technologies, (10%) a little, (9%) sometimes, (7%) often and (2%) very often. This distribution indicates a low level of use of advanced agricultural technologies in the agricultural sector. This shows that a small percentage of farmers are active and involved in the use of advanced agricultural technologies. This information is important to understand at what stages is the use of agricultural technologies in Albania. The low level of use shows that there are challenges and potential for the development and promotion of agricultural technologies in Albanian agricultural farms. Differences in the use of technology between districts help us identify areas where more support and training is needed for farmers in the use of these technologies.

Figure 4. The level of knowledge about information exchange technology



Source: Authors' results, 2024

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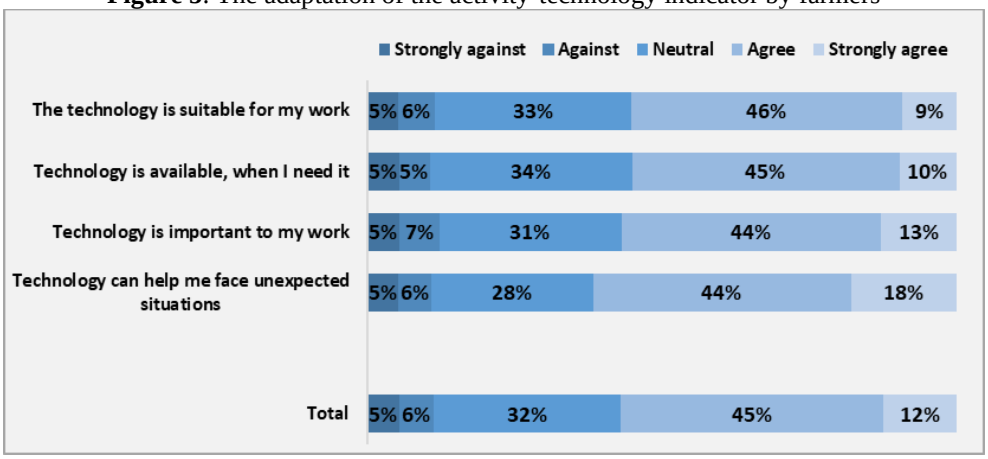
From the analysis of the survey data, it can be seen that in total, the majority of interviewed farmers (41%) are strongly against, (18%) against, (15%) agree and (7%) strongly agree. These data show that farmers' knowledge of information exchange technologies is generally limited. This information is important to understand that most of the interviewed farmers need training and education to increase their level of knowledge regarding the use of information exchange technologies. Such training can help farmers efficiently use modern technologies to obtain and share information that can improve the production and management of their farms.

Figure 5. The adaptation of the activity-technology indicator by farmers



Source: Authors' results, 2024

From the analysis of the survey data for the adaptation of the activity-technology by farmers, it is observed that in total, most of the interviewed farmers (45%) agree and (12%) completely agree. A smaller percentage of farmers, about (6%) expressed against and (5%) completely against. This indicates that a significant proportion of farmers feel adapted and comfortable with the use of technology in their daily work on the farm. This information provides an important perspective on farmers' attitudes and perceptions regarding technology and can help develop strategies and policies for more extensive and efficient use of technology on their farms.

Table 3. The indicators for the use of technology, information exchange technology and adaptation activity-technology, by regions

Region	Use of technology	Knowledge of information exchange technology	Adaptation, activity-technology
Berat	1.49	2.19	3.63
Fier	1.48	2.21	3.09
Gjirokastër	1.49	2.55	3.63
Korçë	2.29	2.65	3.65
Kukës	1.06	2.15	3.73
Average	**1.55**	**2.35**	**3.54**

Source: Authors' results, 2024

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The above indicators are evaluated with the Likert scale: [1-5]. From the analysis of the survey data, related to the use of technology by the interviewed farmers, it is noted that the average of this indicator is (1.55), which reflects a relatively low degree of use of such technologies. This indicator shows that, in general, the interviewed farmers have limited use of advanced agricultural technologies. In the district of Korça, the average is higher, with a value of (2.29). This shows that in this district, farmers have a higher level of adoption of advanced agricultural technologies, using applications, mobile platforms, remote sensors, and other technologies with more regularity. While in the district of Kukës, the average is lower, with a value of (1.06). This indicator shows that in this district, the use of agricultural technologies is very limited. This information is important to understand where there is a need to promote and encourage the use of agricultural technologies in agricultural farms in Albania. Differences in the use of these technologies among districts indicate the potential and challenges in changing and modernizing agricultural practices in the country.

Regarding the level of knowledge about information exchange technology of the interviewed farmers, from the analysis of the data, it is noted that the average of this indicator is (2.35), which reflects a degree close to the average. This shows that, in general, farmers have a limited level of knowledge about information exchange technologies. In the district of Korça, the average is higher, with a value of (2.65). This shows that in this district, farmers have more advanced knowledge about the use of information exchange technologies. Gjirokastra is closely followed with an average of (2.55), the highest indicator after Korça. While in the district of Kukës, the average is lower, with a value of (2.15). This indicator shows that in this district, farmers' knowledge of information exchange technologies is more limited. This information is important to understand how many farmers are equipped with knowledge and skills in using information exchange technologies. Differences between districts help identify areas where training and knowledge improvement are needed in this area to improve interaction and information sharing among farmers.

From the questionnaire data, regarding the adaptation activity-technology indicator, it is noted that the average of this indicator is (3.54), which reflects a degree above average. This shows that, in general, the interviewed farmers feel adapted to the technology and evaluate it positively for their work. However, the lowest value of this indicator is in Fier (3.09), while other regions have almost the same level as the total. This information is important to understand what farmers think about the role of technology on their farms and what can be done to improve their use and adaptation to technology.

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Some of the main findings from the data analysis of the study are:

Limited technology usage: This highlights the importance for public institutions and agencies to encourage and support farmers in accessing and utilizing technologies, thereby enhancing productivity and sustainability in farming activities.

Regional differences in technology use: Discrepancies in the adoption of technologies among districts highlight the importance of tailoring the development and implementation of agricultural policies.

Adaptability to technology: The analyzed data indicates a positive inclination among most farmers toward technology. However, it is crucial to provide support to facilitate their adaptation to technology effectively.

Conclusion

This paper examined the drivers, barriers, and impact of digitalization on sustainable development of the rural sector in Albania. The findings of the study have provided data related to the drivers, barriers and benefits of the adoption of digital technologies in agricultural farms for the regions selected in the study.

Based on the data collected in this study, digital technologies in agriculture are perceived positively by interviewed farmers. Digitization can help farmers optimize production processes and have better access to market sales, increase productivit,y and improve resources and efficiency on their farms.

Regarding the indicator of the use of technology by the interviewed farmers, it shows a relatively low level of technology use in their farms. Concerning the level of knowledge about the information exchange technology, this indicator results in an average degree of use by the interviewed farmers. The data of the questionnaires for the indicator, adaptation activity-technology, show an above-average assessment of the need by farmers for the use of technology in their activities.

The results show that the digitalization process in the rural sector is slow and faces several barriers and challenges, such as the small size of the farms, limited digital skills of farmers, lack of resources to implement digital technologies, and limited digital infrastructure in rural areas.

The digitization of economic activities, especially of small farms, increases the potential to strengthen and diversify agriculture as part of a sustainable development model that will improve livelihoods and create more jobs in rural areas.

Digitalization has the potential to drive economic growth in Albania's rural areas by facilitating market access, improving supply chains, and supporting value-added activities. Digital technologies empower rural

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communities to diversify income sources through new ventures such as agritourism, agribusiness and digital marketing.

Digital platforms facilitate interaction and collaboration among farmers and other stakeholders along the agricultural value chain. Digitization and innovative technologies promote sustainable rural development by providing farmers with advanced equipment and technology and better resource management in agriculture.

The digitization of agriculture must be comprehensive, providing and empowering especially small farmers with the necessary digital competencies. Digital technologies applied in the rural sector, are an important instrument for the empowerment and engagement of youth and women in this sector.

Increasing investment and support from government and public institutions for digital infrastructure, to bridge the digital divide between rural and urban areas.

To address the challenges faced by digitalization in agriculture in Albania, it would be reasonable to undertake training related to innovation and digital technologies along the agricultural value chain. One of the main barriers to the application of digital technology is the lack of knowledge and skills. It is essential to pay special attention when designing strategies for the adoption of digital technologies by small farmers. This involves employing innovative approaches while also acknowledging and respecting the experience and traditional practices in agriculture. A well-functioning rural advisory service can play a crucial role in supporting these endeavors. Extension services should be renewed and improved, including practical training for farmers on the use of digital platforms and technologies.

Stakeholders, such as government, universities and non-governmental organizations (NGOs), can play an important role by providing training for farmers to use digital technologies in their activities.

In the function of the digitization of agriculture, to provide professional competencies in the application of digital technologies, it is necessary to update the curricula and develop programs and courses of study in vocational schools and universities.

Cooperation between government institutions, businesses, international organizations, researchers, and academic institutions is very important for addressing challenges, designing strategies, sharing knowledge and experiences, and promoting best practices for digitization in the rural sector.

Exchange and sharing of experience and best practices among farmers through regional online forums regarding the use of digital technologies. Digitization pilot projects are an important instrument for introducing successful experiences of digitization of agricultural farms, and support for such projects can be an incentive for further digitization of the rural sector.

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The design and implementation of national strategies for digital agriculture should be oriented towards achieving digital transformation and realizing the Sustainable Development Goals (SDGs) of the rural sector in Albania.

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

Funding Statement: The authors did not obtain any funding for this research.

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