

# Examination of the Importance and Level of Application of Digitization in the Rural Sector, the Case of Albania

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**Abstract:** - Agriculture continues to be one of the fundamental sectors for sustainable development in Albania, referring to its contribution to the gross domestic product and employment level. Nevertheless, it confronts ongoing structural issues concerning sustainable development. Farm size, productivity and competitiveness, intensification of production, the efficiency of resource use, access to finance, modernization of the value chain (VC), implementation of technology and information, quality and food security, are considered some of the main challenges of this sector for our country. The digitalization of agriculture emerges as a crucial instrument in dealing with these challenges, through the use of technology and information systems as an important instrument for increasing the competitiveness and sustainability of the rural sector. In this context, this paper aims to examine the importance and level of application of digital technology along the value chain in the agricultural sector. In function of the purpose of the study, the questionnaire was designed to provide and collect information on the importance of the application of the digitalization of agriculture, through the use of technology and information systems by agricultural farms and farmers in our country. Based on the data on the dominant activities and the typology of the farms according to the regions, the study areas have been determined, respectively for the districts of Kukës, Gjirokastrë, Fier, Berat, and Korçë. In total, 938 questionnaires were completed for the five respective districts, following the activities and typology of the respective farms. The variables were evaluated using the Likert scale (1-5), and data analysis was carried out through the SPSS program.

**Key-Words:** - Agricultural digitalization, research and innovation, productivity, competitiveness, sustainability, smart farming, digital technologies.

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## 1 Introduction

The rural sector in Albania contributes 19% to the gross domestic product and about 35% of total employment, [1], [2]. Agricultural and livestock activities are the main source of income and livelihood for residents in rural areas. The advancement of the rural sector is directed towards improving infrastructure, enhancing investment, preserving the environment, efficiently managing agricultural land, and ensuring food security, [3]. Limited access to quality inputs and adequate financial services for smallholder farmers, the consequences of low product quality, high post-harvest losses and high costs of transporting products to market, make it impossible for the agricultural sector to Albanian food to benefit from the opportunities of arable land and access to the market, [4]. The sustainable economic growth in

Albania is intricately linked to the performance of the agricultural sector. Nonetheless, the development of agriculture encounters numerous challenges, including uncertainties surrounding land ownership, limited market access for agricultural products, insufficient adoption of modern technologies, a lack of collaboration among farmers, the small size of the farms, price-cost squeezes, rural exodus and youth abandonment, high informality, [5]. The rural sector encounters challenges related to the establishment of market institutions, input prices, access to financing, marketing and sales of agricultural products, enhancement of distribution channel efficiency, and adherence to national and international standards for food quality and safety, as well as administrative capacities to support these processes. Developing human capacities, and

equipping farmers with the necessary knowledge and skills, will influence their decisions in the selection of agricultural crops, management of activities on the farm, sale of their products, as well as increasing income.

A crucial strategy to address these challenges is the digitization of agriculture, leveraging technology and information systems as pivotal tools to modernize the value chain and enhance the competitiveness of the agricultural sector in the country.

Digitalization of agriculture activities might contribute to the achievement of a country's goal for more economically, environmentally, and socially sustainable agriculture. Digital agriculture represents new knowledge or new combinations of existing knowledge transformed into technologies applied to agriculture activities and, as a result, aims to improve the sector's performance. Research shows that the implementation of technology and information affects the analysis and exchange of information, access to markets, access to finance and traceability of products. Information and communication technology (ICT) helps improve the effectiveness and efficiency of the agri-food value chain as well as agricultural activities, in terms of data on input purchase prices, their quality, product sales and food safety standards.

In developing countries, information technology provides several services to farmers as well as other actors (processors, wholesalers, retailers etc.), involved in the value chain, reducing transaction costs and facilitating communication between them. The digital economy in the modern conditions of innovation development extends to all sectors and becomes the basis of the competitiveness of enterprises, organizations and agribusinesses. According to, [6] technological change is viewed not only in terms of "physical" inventions or advancements but also as a process that interacts with shifts in people's behavior and institutional and socioeconomic structures. This encompasses changes in the market, organizational forms within businesses, consumer preferences, policy objectives, as well as the skills and knowledge of various actors. ICT can significantly contribute by providing accurate and timely information to farmers regarding inputs, markets, and prices. Often operating in challenging economic environments with poorly functioning markets and limited timely information, ICT plays a pivotal role in addressing this information and knowledge gap. Smallholder farmers face market integration challenges due to high transport costs

and their inability to deliver sizable, consistent, and high-quality quantities of their products. Digital technologies (e.g., artificial intelligence, robotics, innovation, Internet of Things, drones, etc.) are applied along the agricultural value chain to address challenges related to the food production system, [7].

Information and communication technology encompasses diverse applications and platforms, ranging from computers and the Internet to radio, television, and mobile telephony. The role and impact of ICT, vary significantly based on the specific technology adopted by farmers. SMS, voice messages, short video training, audio messages as well as virtual platforms effectively enable the sharing of information between farmers and other actors involved in the value chain. To have a positive impact, the information provided to farmers must be appropriate and specific, [8]. Enhancing the skills and capabilities of agricultural producers, particularly smallholder farmers, to effectively manage their farms necessitates ongoing investment.

Digital agricultural technologies, innovations, and data are reshaping business models and practices throughout entire value chains. They play a crucial role in mitigating bottlenecks related to productivity, postharvest handling, market access, finance, and supply chain management, [9]. Referring to the rapid changes that have occurred in the agri-food sector during the last two decades, the development and modernization of the value chain is a strategy for increasing income and well-being in rural areas.

Albania's agricultural sector needs to be transformed into a profitable economic activity that can guarantee food security, attract investment, and sustainable development and provide employment, particularly for the youth. Farmers often face constraints in the value chain due to a lack of information and knowledge, farm size, access to finance, technology, as well as support infrastructure. Most of the small farmers do not have access to stable and reliable information, therefore in their decision-making process, they rely on sources, traditional knowledge and experience. Insufficient extension services as well as poor access to information provision, leads to the lack of implementation of new technologies as well as to the reduction of productivity and competitiveness.

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.

Based on the above discussion, the purpose of this study is to evaluate the impact of digitization on the level of competitiveness as well as the productivity of farmers and agricultural farms along the value chain in the agricultural sector.

To achieve this purpose, the main objectives are:

1. to evaluate the level of digitization of the value chain in agriculture with a focus on the agricultural farm;
2. to evaluate the knowledge and skills of farmers in the application of digital technology in the rural sector;
3. to analyze the level of knowledge of farmers about information technology exchange;
4. to evaluate the activity-technology adaptation by farmers according to the respective districts;

## 2 Literature Review

The agriculture sector, plays a crucial role in bolstering the economic prosperity of the rural population through the creation of employment opportunities within the agribusiness sector, thereby establishing a pathway to enhanced economic well-being. Research institutions must prioritize the enhancement of technology transfer, establish more effective connections between researchers and farmers, strengthen agricultural innovation systems, and develop value-inclusive chains. Digitalization of the agriculture value chain might be a path to address these complex challenges. There are several definitions used to describe the digitalization of agriculture. Digital agriculture according to, [10], [11], e-agriculture, [3], precision agriculture, [6], and smart farming, are used to describe the innovation in agriculture. Mostly digital agriculture, smart farming and e-agriculture are concepts used interchangeably. In fact, the digital agriculture (DA) concept includes broad changes along the entire agricultural value chain, [6]. Digital agriculture is defined by, [11], "as the use of detailed digital information to guide decisions along the agricultural value chain". Technologies such as smartphones, apps, global positioning systems (GPSs), Internet of Things (IoT), sensors, robotics, drones, and unmanned autonomous vehicles (UAVs) are part of digital agriculture. As a result, investing in the digitalization of agricultural activities should be associated with investments in building the required competencies (i.e., skills, knowledge and attitude) for the rural workforce. Well-equipped

human resources will precede the future challenges of digitalization of the agriculture value chain. Economic development in Albania is therefore strongly associated with the performance of the agricultural sector, [12]. Albania, being a small developing country, also faces particular challenges related to digital agriculture. In particular, farmers face a great variety of complex problems, among them the low level of digital technologies implemented. Digitalization encompasses the integration of information communication technologies, such as the Internet, mobile technologies, and devices, alongside data analytics. This integration aims to enhance processes like collection, exchange, aggregation, analysis and access. In developing countries, ICT applications are crucial in reducing information costs and sharing information between actors. The evolution of Agricultural Knowledge and Innovation Systems (AKIS) is notably propelled by digitalization. In agriculture, digitalization is anticipated to contribute to the technical optimization of production systems, value chains, and food systems, [13]. Agriculture also faces many challenges, including those posed by the impact of climate change, increased fluctuations in food prices and disruptions in supply chains. Farmers need to adjust their strategies for obtaining and utilizing information. The process of digitalization has the potential to stimulate a substantial transformation in agricultural operations, encompassing tools, technologies, and practices. It provides a pathway for innovation and introduces new methods for organizing production and supply chains. Digital agriculture is on track to develop systems known for their elevated productivity, proactive nature, and flexibility in responding to changes, particularly those triggered by climate change. This transformation could contribute to increased levels of food security, profitability, and sustainability, [14]. The digital revolution in agriculture stands to offer various advantages to public and private participants within agro-food value chains and the broader Agricultural Innovation System (AIS). Farmers can enhance decision-making on their farms through the support of digital technologies. This, in turn, has the potential to stimulate innovation and enhance productivity, [15]. Digital technologies have the capacity to create opportunities for increased efficiency, the provision of new services for the sector, and the enhancement of traceability and transaction efficiency within value chains, [16]. Additionally, policymakers have the opportunity to utilize digital technologies for the enhancement of

policy design, implementation, and monitoring, facilitating the development of more effective policies for the agriculture sector. This is achieved by increasing resource productivity, minimizing inefficiencies, reducing management costs, and improving coordination throughout the food chain, [17]. Digital technology, the use of ICT applications and platforms, increases the exchange of information and the cooperation of farmers and other actors who are part of the value chain in the rural sector. Certain applications and platforms provide data on soil moisture, temperature, rainfall, crops, etc., enabling farmers to achieve higher yields by optimizing and reducing losses and increasing their income. SMS, voice messages, short video training, audio messages as well as virtual platforms effectively enable the sharing and exchange of information between farmers and other stakeholders. 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, [18]. 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. The Internet of Things (IoT) has drawn attention in recent years for its potential to transform agriculture and food systems, [19]. Studies show that the use of digital platforms affects the exchange of information, access to markets, access to financing, the effectiveness of the operation of the value chain, bringing tangible benefits to farmers and the productivity of activities on agricultural farms. The increased use of digital technologies creates benefits for all actors involved in the value chain, through more effective communication and information exchange. Inclusion, efficiency and innovation are key mechanisms for digital technology to drive development in rural areas, [20]. Digital agriculture represents new knowledge or new combinations of existing knowledge transformed into technologies applied to agricultural activities and, therefore, aims to improve the performance of this sector. Public and private extension services face tremendous challenges to not only reach the many diverse farmers that require their services but to reach them when and where the farmers need the services, [21]. The majority of empirical research focusing on the implementation of information and communication technology in agriculture primarily assesses its impact on the modernization of value chains and the sustainable development of the rural

sector, [22], [23]. Building the human capacity, as well as the infrastructure needed to facilitate better connectivity and communication, is critical. Through different types of applications, and platforms, from computers and the Internet, ICT will effectively enable the sharing of information and data about inputs, prices and markets between farmers and other actors involved in the value chain. 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, [24]. Farmers need to adapt and start using Internet technology more intensively in the promotion and sale of products to increase competitiveness, reach a larger number of customers and ensure adequate prices for their products [25].

The studies reinforce the perspective that facilitating access to profitable markets for agricultural products in developing countries can empower smallholders to take advantage of these opportunities. The digital transformation in agriculture has the potential to increase production efficiency, reduce excessive input application, and improve farm profitability, [26]. The agricultural sector has traditionally demonstrated a limited inclination for innovation, particularly concerning small and medium-sized farms. Exploring the development of dynamic capabilities in conjunction with the adoption of digital innovation highlights the potential for business model innovations in the agri-food sector, [27]. Concerns about the shortage of agricultural raw materials, alongside the enforcement of more stringent food safety and quality standards by government agencies, have prompted increased collaboration and coordination among producers, processors, and retailers, [28]. Smallholder farmers frequently seek to capitalize on the opportunities afforded by expanding markets, given their restricted access to resources such as land, financing, advisory services, and timely information on market prices, [29]. These constraints of smallholders highlight the importance of policies and programs for the digitization of agriculture. According to [30], the envisioned monitoring system for the future should involve a strategic integration of innovations in current statistics, incorporating data from satellites and sensors. It should also entail a more efficient utilization of data flows across the agricultural sector, including aspects like farm management, invoicing, tracking, certification and labelling. The key concept of integrated Value Chain Development (VCD) models is to engage all stakeholders in the value chain and establish

connections between smallholders and input suppliers, processing factories, or marketing agents, [31]. The benefits of applying digital technologies along the agriculture value chain are mainly in the economic, environmental, governance, and social domains. This data exchange between farmers and other actors increasingly occurs through digital means. Information and communication technology (ICT) will lead to the revitalization of extension services and agricultural advisory in developing countries, [32]. Management information systems are the basis for chain information systems that support tracking, food safety management and sustainability schemes.

The studies show that reducing specific transaction costs (for example, by investments in infrastructure, farmers' associations, the implementation of ICT in agriculture, etc.) can enhance the integration of smallholders in value chains. These processes carry significant implications for developing countries. The rising demand for high-value products and increasing prices in international food markets present opportunities for these nations to achieve economic growth by expanding and diversifying their agricultural exports. The current trend of digitalizing all facets of production is poised to bring about technical enhancements in agricultural production systems, value chains, and food systems. Agriculture has already experienced numerous changes, resulting in a notable transformation of its production processes, [33]. The digitization of agriculture boosts efficiency by incorporating precise mechanization, automation, and enhanced decision-making processes, [34]. More specifically, digital technologies implemented can promote cooperation (i.e., due to data sharing among users) among stakeholders in the agriculture value chain, increase the market access and the bargaining power of small farmers, and reduce social asymmetries by breaking down traditional social gaps such as the gender gap, age-advantages and territorial differences, [6]. Accessing information on agriculture will help smallholder farmers to become more knowledgeable, and as a result make more informed decisions, [35]. In this vein, digitalization goes beyond the level of a single entity, and as a result, it affects all actors in the whole value chain.

### 3 Methodology

Digital innovations manage climate risks throughout the entire agrifood system, encompassing producers, markets, value-chain

services, and policymakers. An important component of the sustainable development of the rural sector is the digitization of agricultural farms through the use of technology and information systems as an important instrument of modernizing the value chain and increasing the competitiveness of the agricultural sector in the country. E-agriculture involves the conceptualization, design, creation, analysis, and implementation of innovative methods utilizing ICTs in the rural sector. Policy-making for agriculture is significantly shaped by the shared ambition of many countries in the region to enhance collaboration with the European Union (EU). Aiming to prioritize digitalization, the Albanian government has drawn up several strategic documents. The earliest strategic document was "Cross-cutting Strategy for the Information Society 2008-2013". This strategic document, it was aimed to urge the use of information technologies and the development of information technology infrastructure as the key to its successful implementation. The national "broadband development plan" was another strategic document that aimed to improve the networking coverage and its speed. Later it was compiled the Cross-Cutting Strategy "Digital Agenda of Albania" (2015- 2020) which had three main objectives (1) increasing and promoting electronic services for citizens, businesses and administration; (2) the use of ICT in education, bridge the digital divide and to enable youth, and (3) consolidation of digital infrastructure throughout the territory of Albania. Agriculture was part of two strategic priorities in this document in terms of e-government services and the development of ICT infrastructure and electronic communications. Another important document related to digitalization is the economic reform program 2019-2021. In the framework of this program, Albania will further strengthen the process of cadastral, with the aim of consolidation, defragmentation, registration and digitization of agricultural land.

Lately, there is compiled another strategic document named "National Plan for sustainable development of broadband digital infrastructure 2020- 2025". This plan aims to expand high-speed broadband infrastructure at the most cost-effective to cover the whole country, and in particular to shift more attention to the coverage of rural areas. 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). This platform is conceived as a one-stop electronic

office, where the citizens, representatives of the businesses and NGOs register using their personal/business identification documents. The platform offers several services to the stakeholders along the agriculture value chain, mostly related to the grant schemes. The electronic service “Application for the National Support Scheme for Farmers” involves securing financial support for agriculture and rural development, provided by the Albanian government and the Ministry of Agriculture and Rural Development. The aim is to transition from the traditional method of physically applying for the financial support scheme to an innovative approach, using an electronic service through the e-Albania platform. The Regional Agency of Agricultural Extension (RAAE) also supports applicants for grants and subsidies schemes by using the e-Albania platform. This agency plays an important role in supporting farmers to upload the required documents to their e-Albania account, as well as facilitating the process of knowledge transfer in terms of using digital technologies in farm activities. International donor organizations too have supported initiatives about digitalization of the agriculture value chain in Albania. “The SARED” program implemented by GIZ, has created in Korca region a meteorological station where local farmers are equipped with data and information about the weather, and prediction of pests and diseases due to the weather conditions. The Japan International Cooperation Agency (JICA) in collaboration with the Albanian Agribusiness Committee (AAC) has designed the

ABAonline digital platform. This platform provides online information about production technologies at the farm level, technical knowledge related to animal breeding and plant production, fostering contacts and cooperation among farmers and other stakeholders along the agriculture value chain. ABAonline also provides the opportunity for farmers to contact agriculture and rural development experts and discuss issues related to agriculture activities. Another digital platform that has urged farmers to use digital technologies to access the market is the platform Agrotime.al. There are also other web-based portals providing data, information and or advice to the stakeholders along the agriculture value chain. These online platforms are created and managed by academia and/or NGOs (e.g., Ubgreen, Agroweb), [12]. Referring to the above data (Table 1), it is observed that the utilization of ICT platforms and digitalization in agriculture provides farmers various benefits, such as enhanced connections with fellow farmers and stakeholders, improved farm management, increased information exchange regarding prices and markets, etc. To achieve the objectives of this study, data has been collected from interviews and questionnaires completed by farmers of the respective regions. For this purpose, the questionnaire was designed to provide and collect information on the importance of the application of the digitalization of agriculture, through the use of technology and information systems by agricultural farms and farmers in our country.

Table 1. Challenges and benefits of farmers and rural entrepreneurship from digitization

Benefits from ICT platforms	Challenges faced by farmers and rural entrepreneurship			
	Lack of market information prices	Bureaucratic procedures, poor transparency	Lack of knowledge of market standards by farmers	Lack of access to extension services and research
Enhanced connections to members	Fairer relationship between farmer and traders	ICT platforms can make it easier to source information about organic products or other certifications	A well-informed farmer can categorize produce according to specified standards.	Information increasingly used to contact and solve problems
Improves management and transactions	Transaction systems, financial management software, ensure fairer relations between farmers and other actors	Reduces need for employees, transactions, time and improves transparency	Financial information makes statistics easier for farmers to understand	Information available, interactivity possible
Information exchange increases	Farmers can improve information on prices and markets.	Through ICT platforms, farmers can increase connections with other actors	Farmers are better informed on standards and information can be accessed online	Information exchange enables farmers to discuss and solve their problems

Source: Authors' composition, 2023

The questionnaire is composed of five main sections, to provide information on:

- farmers and agricultural farms, (family members, gender, age, education, employment and income);
- data on productive resources (land, owned/leased, activities, capacity, investments);
- technology data (devices, applications, platforms, etc.);
- data on income and expenses;
- data on socio-economic factors.

Based on the data of, [1], for the dominant activities and the typology of farms according to the regions, the study areas have been determined: Kukesi and Gjirokastra, Districts for livestock production farms, Fier and Berat, Districts (for vegetables in greenhouses), Korça, District (for fruit cultivation). In order to identify the farms and ensure the possibility of generalizing data on the structure and level of use of information and communication technology (ICT) in the selected farms, the selection will be made randomly in the farm database, referring to the above-mentioned activities. The completion of the questionnaires was carried out, face-to-face with the farmers, for the five districts (Kukës, Gjirokaštër, Fier, Berat and Korçë).

This process took two months. In total, 938 questionnaires were filled in all the regions selected as study areas in accordance with the activities and typology of the respective farms. After completing the questionnaires, the data were entered into the database and analyzed with the SPSS program, in accordance with the research objectives and questions of the study. The indicators used are evaluated with the Likert scale: (1-5).

The research questions of this study are:

- What is the level of use of digital technology by farmers and agricultural farms in the regions selected in the study?
- What is the level of skills and knowledge of farmers regarding the application of digital platforms in our country?
- What impact does digitization have on the productivity level of agricultural farms, and the modernization of the value chain in the rural sector?
- Why is digitization and the use of communication and information technology important in the development of the rural sector?
- What are the policies and strategies that the government and public agencies should

undertake to support digitization in the rural sector?

## 4 Results and Discussions

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. However, the development of the rural sector still faces problems regarding limited access to the market for agricultural inputs, insufficient implementation of modern technologies, lack of cooperation between farmers, small size of farms and abandonment of young people.

An instrument for overcoming these obstacles is the adoption of technology and information systems for the digitization of agricultural farms, thus increasing the productivity of enterprises in the rural sector. The data on the performance and contribution of this sector to the gross domestic product and the number of employees in the country are presented below.

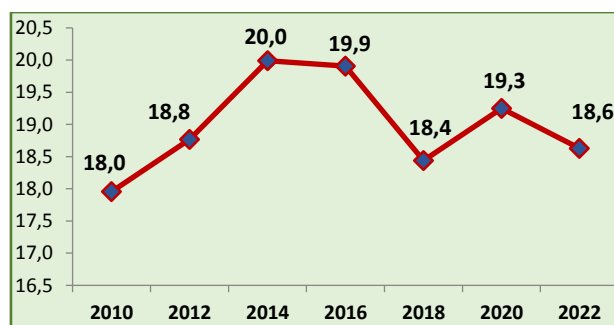


Fig. 1: Agriculture, value added % of GDP\_Albania

Source: World Bank, 2023

Table 2. Employment and population in rural sector Albania

Years	2010	2012	2014	2016	2018	2020	2021
Employment	43.9	47.4	42.9	40.7	37.3	36.4	34.6
Population	47.8	45.7	43.6	41.6	39.7	37.9	37.0

Source: World Bank, 2023

Referring to the above data (Figure 1, Table 2), rural sector contributes about 19% to the gross domestic product and includes about 35% of the number of employees in the country, [2].

Based on the purpose of the study, the data gathered from the questionnaires, for the selected districts were analyzed as follows.

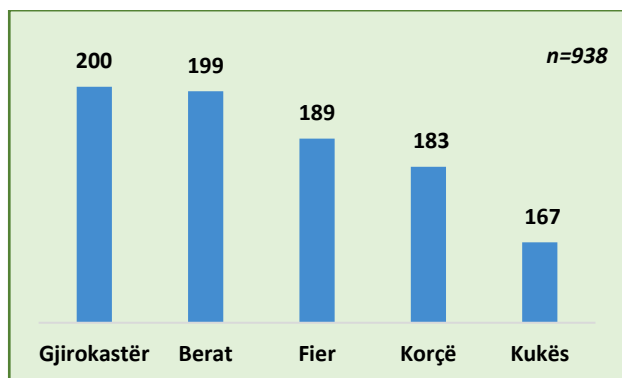


Fig. 2: Distribution of interviewed farms according to districts

Source: Authors' results, 2023

Regarding the distribution of data by districts (Figure 2), it is important to note that 938 farms were represented in this study. These farms are distributed in five different districts of Albania, and the percentage of each county in the entire sample is as follows:

- Gjirokastrë (21.3%): Gjirokastrë is one of the main districts that contributed to our study, with over a fifth of the data contained in this region. This distribution shows a significant presence of selected farms in this area.
- Berat (21.2%): The district of Berat is also represented with a percentage similar to that of Gjirokastrë. This shows that this district has been an important partner in this research.
- Fier (20.1%): Fier is in third place in data distribution, with a percentage of about 20%. This shows that even here the study has had an important presence in the farms of this region.
- Korçë (19.5%): The Korçë district is also well represented in the study, although with a lower percentage than the above districts. This distribution shows that even in the area of Korça there was interest in the research.
- Kukës (17.8%). This distribution shows that this district was also important in achieving the goals of the study.

In the analysis of the above data (Figure 3), it was found that only 6.4% of farms are run by women. This distribution shows that, in most cases, farm managers are men. In Korça district, the percentage of farms run by women is higher, with 12%. This suggests a relatively higher presence of women farm managers in this district, who have an important role in agricultural management. Meanwhile, in the district of Gjirokastrë, the lowest

percentage is 2.5%, which shows a small percentage of farms run by women in this area. This information is important to understand the role and concentration of women in the management of agricultural farms in Albania. Differences in their gender distribution between districts provide a rich panorama of the structure of farm owners and managers in the country, and this may have implications for the design of specific policies to improve the position and contribution of women in the agricultural sector.

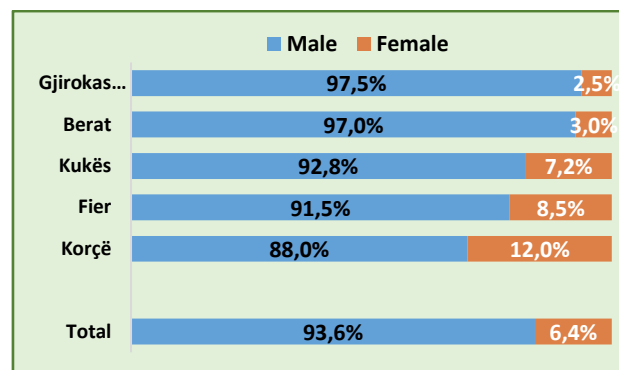


Fig. 3: Distribution of farms to its managers according to gender

Source: Authors' results, 2023

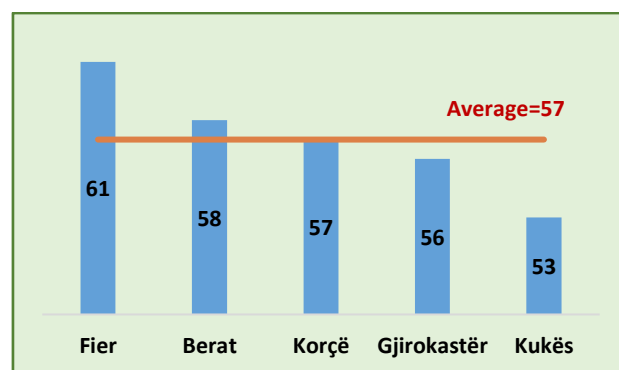


Fig. 4: The average age of managers of agricultural farms

Source: Authors' results, 2023

Referring to the data (Figure 4), from all the farms interviewed, it was revealed that the average age of the farm managers is 57 years old. This fact shows a rich experience and deep knowledge on the part of the managers of the farms involved in the study. If we investigate further, we can notice interesting differences in the ages of farm managers in the different districts of Albania. For example, in Fier district, farm managers have an average age of 61 years, which is higher compared to other districts. This shows long experience and rich knowledge in farm management in this area.



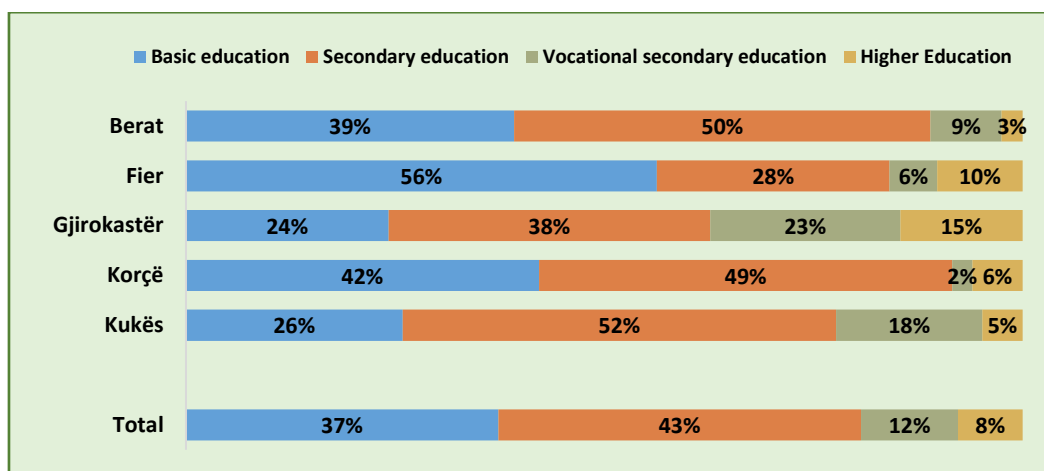


Fig. 5: The level of education of the farm manager  
Source: Authors' results, 2023

Meanwhile, in the Kukës district, farm managers have an average age of 53 years, which is lower compared to other districts. This aspect can have an impact on the dynamics and challenges they face in managing their farms. This information is important to understand the profile and experience of agricultural farm managers in Albania.

From all the farms interviewed (Figure 5), it is revealed that the education structure of the farm managers is as follows:

- Slightly more than 1 in 3 farm managers interviewed have basic education (37%). This shows that a significant part of farm managers has a low level of education.
- 2 out of 5 farm managers (43%) have graduated from high school, indicating that a significant part of them have a secondary level of education.
- (12%) of farm managers have graduated from vocational high school, showing a smaller percentage of people who have certain specializations in different fields.
- Only (8%) of farm managers have graduated from university. This percentage is lower and shows that a small number of farm managers have a high level of education.

This information helps determine the structure of farm manager education in Albania and may have important implications for the development of training programs and policies to improve the

capacity and knowledge of farm managers in the agricultural sector.

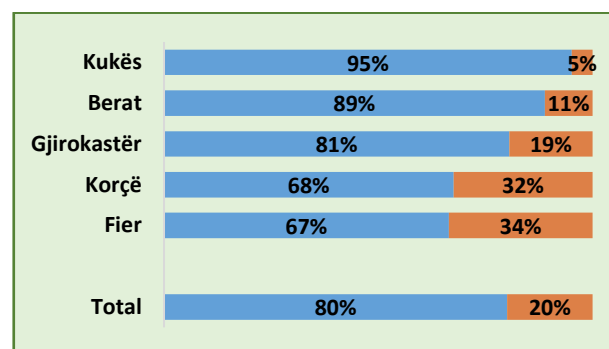


Fig. 6: It is farm work, the main employment of the farm manager?  
Source: Authors' results, 2023

From the analysis of the survey data (Figure 6), it appears that only 1 in 5 interviewed farm managers do not have work on the farm as their main job (20%). This shows that most farm managers are employed in the agricultural sector. For example, in Fier district, the percentage of farm managers who do not have farm work as their main job is higher, while in Kukës district, this percentage is lower. This information gives a clear picture of the nature of the work of farm managers in Albania. The differences in this aspect between the districts indicate possible changes in the work structure and are important for the design of policies and measures that improve the development of the rural sector.

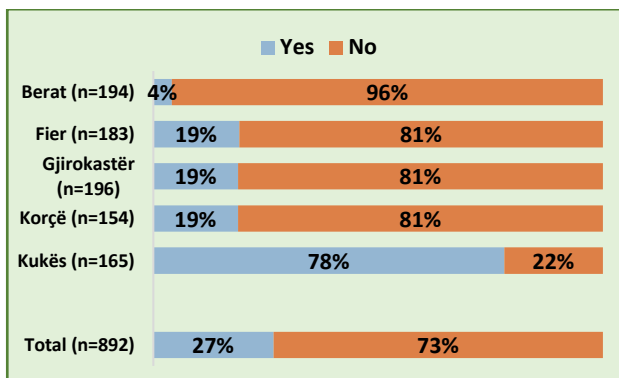


Fig. 7: Do you have plans for future investment on the farm?

Source: Authors' results, 2023

From the analysis of the above data (Figure 7), it is noted that 27% of the farm managers interviewed have plans to invest in the farm in the future. This fact shows that a significant part of farmers is motivated to develop and modernize their farms. For example, in the district of Kukës, the highest percentage of farm managers who have investment plans is 78%. This shows the high interest and commitment of farmers in this district to invest in their farms. In contrast, the district of Berat has the lowest percentage, with only 4% of farmers having investment plans. This may be the result of the different conditions of the economy and the structure of agriculture in this area.

This information is important to understand the ambitions and plans of farm managers for the future and can help develop tailored policies and assistance programs to encourage investment in Albania's agricultural sector.

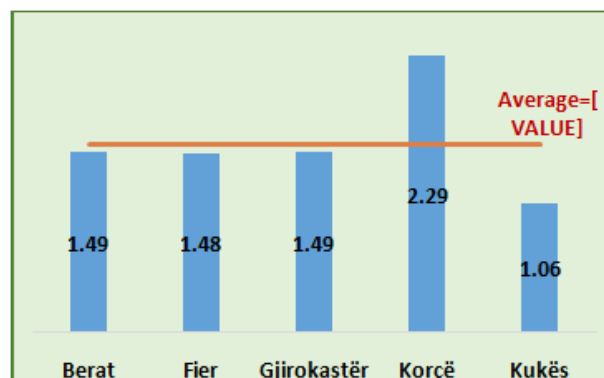


Fig. 8: The indicator of the use of technology by farmers according to districts

Source: Authors' results, 2023

Regarding the use of technology by the interviewed farmers according to the relevant indicators (Figure 8), the average was evaluated with Likert Scale: [1] Not at all, [2] Less, [3] Sometimes, [4] Often, [5] Very often. From the analysis of the survey data, it is noted that in total, 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. For example, in the district of Korça, the average is higher, with a value of 2.29. This shows that in this county, 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.

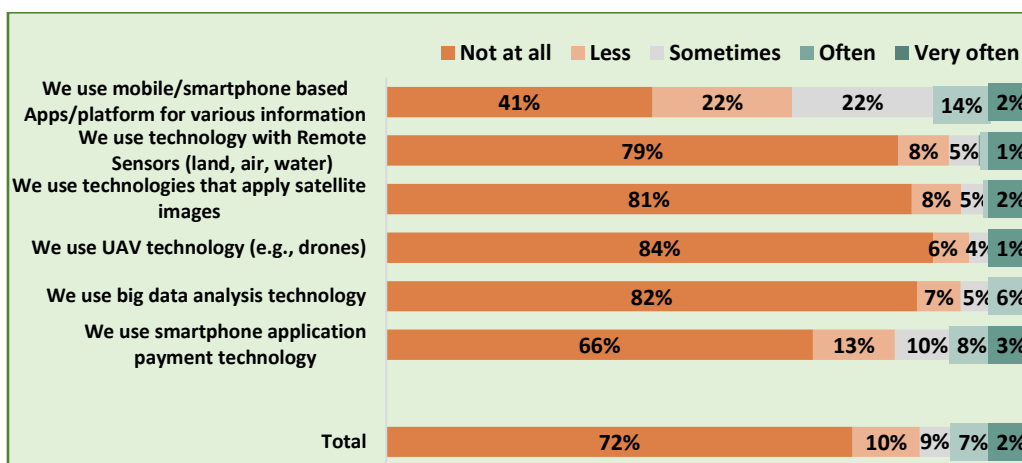


Fig. 9: Distribution of the level of technology used by the interviewed farmers

Source: Authors' results, 2023

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 technology used by the interviewed farmers (Figure 9), 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. This wide distribution indicates a low level of use of advanced agricultural technologies in the Albanian agricultural environment. 2 out of 10 farmers state that they have used such technologies a little or sometimes. This group indicates a limited level of experimentation with new agricultural technologies. Frequent or very frequent use was reported by less than 10% of respondents. 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 use between districts help identify areas where more support and training is needed for farmers in the use of these technologies.

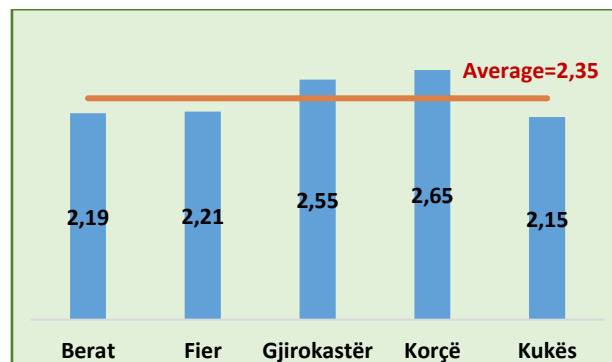


Fig. 10: The level of knowledge of farmers about information exchange technology, according to districts

Source: Authors' results, 2023

Regarding the level of knowledge of the interviewed farmers for information technology exchange, from the analysis of the data (Figure 10), it is noted that in total, 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.

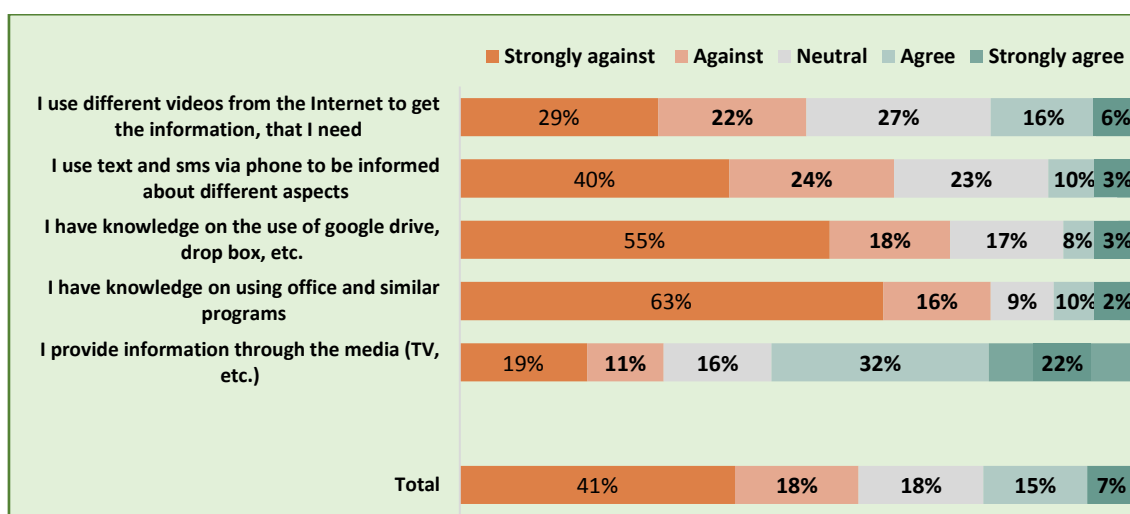


Fig. 11: Farmers' level of knowledge about information exchange technology

Source: Authors' results, 2023

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 analysis of the survey data (Figure 11), it can be seen that in total, the majority of interviewed farmers are strongly against (41%) or against (18%), while 22% of them agree (15%) or strongly agree (7%). This shows that farmers' knowledge about 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 trainings can help farmers efficiently use modern technologies to obtain and share information that can improve the production and management of their farms.

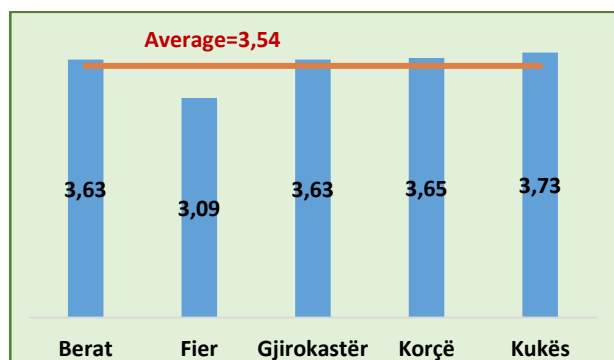


Fig. 12: Adaptation activity-technology, according to districts

Source: Authors' results, 2023

Regarding, the adaptation activity-technology indicator, from the analysis of the survey data (Figure 12), it is noted that in total, 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 rate as the total. This indicates that in Fier, there is probably a need for more improvements and investments in farm technology to increase the adaptability and availability of technology.

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.

From the analysis of the survey data for the adaptation of the activity-technology indicator by farmers (Figure 13), it is observed that in total, most of the interviewed farmers agree (45%) or completely agree (12%) with such statements. This indicates that a significant proportion of farmers feel adapted and comfortable with the use of technology in their daily work on the farm. A smaller percentage of farmers, about 11%, express against (6%) or completely against (5%) such statements. 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.

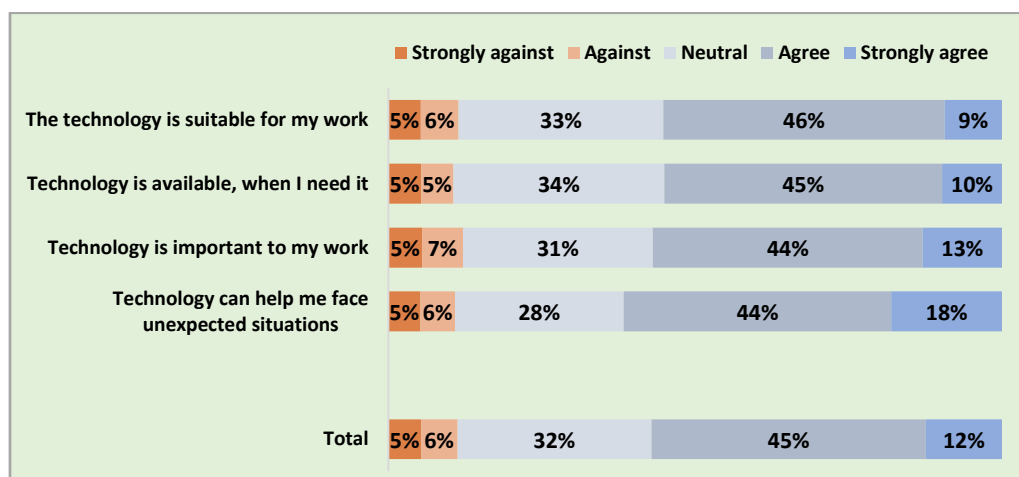


Fig. 13: The adaptation of the activity-technology indicator by farmers

Source: Authors' results, 2023

From the data analysis, we conclude with some main findings:

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

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

*Technological knowledge gap:* The evident lack of technological knowledge indicates a significant need for initiatives and strategies, in addressing this knowledge gap.

*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.

## 5 Conclusions and Recommendations

Through this study, the importance and level of application of digitization in the agricultural sector for the regions selected in the study in Albania were examined. The findings of the paper, have provided data regarding the identification of opportunities and obstacles in the adoption of digital technologies in rural areas.

In total, 938 questionnaires were filled out, and distributed in 5 districts: Gjirokastrë (21.3%), Berat (21.2%), Fier (20.1%), Korçë (19.5%) and Kukës (17.8%). From the analyzed data it turns out that, the average size of the farmers' families interviewed for the districts selected in the study consists of 4.3 members. Of the interviewed farmers, it turns out that only (6.4%) of them are managed by women. The average age of the interviewed farm managers is (57 years old).

The data show that (37%) of the farm managers interviewed have basic education, (43%) of farm managers have secondary education, (12%) of them have finished vocational secondary education and only (8%) of them have higher education. From the above data, it results that (80%) of the interviewed farmers have as their main activity, work on the farm. As for making investments in the farm, it turns out that (27%) of the farmers interviewed have plans to invest in the farm in the future. Regarding the use of technology by the farmers interviewed, it shows a relatively low level of technology use in their farms.

Concerning the level of knowledge about the exchange of information 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 work/activity.

Based on the data collected in this study, digital technology in agriculture is perceived positively by all interviewed farmers. They see it as an opportunity to optimize inputs, increase productivity and business competitiveness, improve resources, and efficiency, and speed up work processes. 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.

The ICT platforms can help to reduce price market distortions, better market access, increase production and income, and improve productivity and household living standards in rural areas. Applying digital technologies along the agriculture value chain is seen as a tool that might promote cooperation among stakeholders, increase market access, and strengthen the bargaining power of small-scale farmers.

Digitalization can decrease agricultural production costs, enhance crop yields, and augment farmers' income. It is essential to pay special attention when designing strategies for the integration of digital technologies among 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. Applying digital technologies is creating the opportunity to integrate smallholder farms into the agriculture value chain, and foster socializing even among farmers and other stakeholders along the agriculture value chain.

Digital platforms offer best practices, incorporating innovative technologies, facilitating interaction among stakeholders, and providing data access to ensure the effective utilization of ICTs in agriculture. Most respondents have shown a high interest in applying technology in their business, but on the other hand, they also face difficulties in accessing information about digitization. The main obstacle to the application and maintenance of technology is the lack of knowledge and skills. To address the challenges facing the digitalization of the agricultural value chain in Albania, it would be

reasonable to undertake training related to innovation and different types of digital technologies along the agricultural value chains. This multi-stakeholder approach would ensure the inclusiveness of those stakeholders related to the development of the agricultural value chain and accelerate the acceleration of digital technologies.

The digitization of agriculture must be inclusive, equipping those stakeholders especially smallholder farmers, with the necessary digital competencies.

Policymakers should consider digital technologies as a tool to transform the labor market and attract youth engagement in rural areas. Vocational schools in Albania should offer study programs and/or courses specifically related to the digitization of agriculture. Digital technologies applied in the agriculture value chain are an important tool to empower women and, as a result, reduce the gender gap in this sector. Stakeholders that can play an important role in engaging youth and women in agriculture through digital technologies are the government, the private sector, and non-governmental organizations (NGOs).

Also, in the function of the digitization of agricultural value chains, it is necessary the update of curricula and the development of study programs and courses in vocational schools and universities. This strategy should be seen in two directions; first, digital tool for knowledge transfer and second, building competencies for technologies applied to activities along the agricultural value chain. To build professional competencies about digital technologies applied in the agriculture value chain, it must update the curricula program by creating study programs and or courses that specifically is related to the digitalization of the agriculture value chain. Encouragement and cooperation between government institutions, international organizations, researchers, academic communities as well as business actors to exchange knowledge and experiences as well as to promote best practices for the digitalization of agriculture.

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

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### **Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)**

The authors have contributed together in the preparation of the paper, according to the respective sections: conceptualization, questionnaire preparation, project administration, literature review, methodology, data collection and analysis, results, supervision, writing, revision and editing of the paper.

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### **Conflict of Interest**

The authors have no conflict of interest to declare.

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