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DIGITALIZATION OF AGRICULTURAL BUSINESS AND CULTURE OF INNOVATION

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Abstract

This research delves into the digital transformation of the agricultural sector and its profound influence on cultivating a culture of innovation within this industry. The primary objective is to discern pivotal factors and consequences associated with the integration of digital technologies in agriculture. Employing a mixed-methods approach, the study combines literature analysis, statistical reviews, and direct engagement through interviews and surveys with key stakeholders in the agricultural domain. Additionally, case studies and rigorous data analysis of digital solution implementations in agriculture form integral components of the research methodology. The literature review encompasses an exhaustive analysis of current publications, reports, and statistical data pertaining to digitalization trends in agriculture. Statistical analyses provide insights into the quantitative aspects of digital adoption, offering a comprehensive overview of the current landscape. The qualitative dimension is explored through interviews and surveys involving representatives from various agricultural businesses and experts specializing in digitalization and innovation. These interactions aim to capture nuanced perspectives, experiences, and challenges faced by stakeholders in the agricultural sector as they navigate the digital landscape. An outstanding result of this research is the revelation of a symbiotic relationship between digitalization and the cultivation of an innovation-centric culture within agriculture. The analysis underscores that successful digital transformation acts as a catalyst in creating an environment conducive to innovative thinking and the widespread adoption of advanced practices in agriculture.

Keywords: Agri-food chain, digital revolution in agriculture, individual approach, optimization, reasonableness

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1. Introduction

For example, the potential benefits of agrifood digitalization are promising, but realizing them will require major change in agricultural production systems and the rural economic system. In addition to this, it is important that we consider the possibility of realising such benefits for people with special requirements like community life and natural resource management. It is worth noting that to achieve the full potential benefits will require a holistic approach, systematic and systematic. It is worth noting that digitalization of the agri-food sector creates the risk for unequal distribution of potential benefits in rural and urban areas, gender groups, heterogeneous access to potential benefits between rural and urban areas, gender groups, inequalities with young people and digital skills. Digital ecosystems (resources, skills and networks) in urban areas are generally better develop than in rural regions. “Digital ecosystems” (resources, skills and networks) in urban areas are more often better developed than in rural areas. The backdrop of global trends – urbanization, the movement from middle and rich to capitals – digitalization has the potential to exacerbate existing inequalities with rural regions, gender groups (Zhukova & Kazantseva, 2021), as a result of what the rural population is not capable of participating in digital transformation. In order to bridge these digital divides, the FAO is committed to helping government and partners bridge these interdisciplinary divisions so that the new digital society will be available to all.

2. Problem Statement

The problem at hand revolves around the prerequisites necessary for enabling digital transformation in agriculture within the current contexts. To facilitate technology adoption, a fundamental set of requirements must be met, primarily encompassing access and connectivity, along with economic integration into broader social networks. Moreover, there is a need for concurrent conditions that act as facilitators, creating an environment conducive to innovation in the agri-food sector. These facilitating conditions may manifest through various channels, such as training programs like hackathons or business incubators. Additionally, it is crucial to consider factors that ensure the usability of digital solutions by individuals possessing specialized skills in the agricultural domain, as highlighted by Ovchinnikova and Lavnov (2019). Addressing these conditions and factors is essential for fostering a successful digital transformation in agriculture and promoting innovation within the sector.

3. Research Questions

i. How does limited network coverage in rural areas affect the adoption and effectiveness of digital technologies in agriculture, and what strategies can be devised to overcome this challenge?

ii. What are the key factors influencing smartphone ownership in rural communities, particularly in Least Developed Countries (LDCs), and how do these factors impact access to digital solutions for agricultural practices?

iii. What is the current state of the digital technology market in Russian agriculture, considering its low ranking on the Business Digitalization Index, and what measures can be implemented to foster greater adoption and integration of digital solutions in this sector?

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In the prevailing landscape, the adoption of digital technologies in agriculture faces significant challenges, particularly in rural areas with limited network coverage. The deficiency in connectivity poses a barrier to the effective implementation of digital solutions for monitoring agricultural activities, automating processes, and accessing marketplaces. Makarova (2021) notes that while over 90% of global subscribers have at least a 3G connection, only half of the population in rural regions is covered by 3G services. Smartphone ownership is widespread among consumers, including those in rural communities, aided by declining handset prices and innovative, cost-effective mobile communication plans (Ilyasov, 2018).

Despite this, barriers to smartphone ownership persist, especially in Least Developed Countries (LDCs), where affordability remains a significant challenge. While seven out of ten households classified as the poorest in LDCs have mobile phones, not all provide Internet access, creating a digital divide (Barzaeva & Ilyasov, 2022). In developing countries, the rapid growth of smartphone owners and mobile broadband users has outpaced other regions, yet challenges remain in making these technologies universally accessible.

Digitalization in agriculture has evolved from basic automation to encompass sophisticated technologies like precision farming systems. Predictions indicate substantial growth in the global market for precision farming technology and mobile small farm management services, with India already witnessing over 2 million farmers connected to agrobots (Ilyasov, 2018). The Russian market for digital technology in agriculture is expected to grow significantly, driven by solutions such as decision support systems, precision farming applications, and automated systems for harvesting and livestock farm management (Bignell et al., 2016).

However, Russia's low ranking in the Business Digitalization Index raises concerns about the sector's overall digital adoption. Strategies, including support for agrotech start-ups, are anticipated to play a pivotal role in propelling the Russian market for digital technology in agriculture fivefold by 2025 (Bignell et al., 2016). This research aims to delve into these complexities, investigating the impact of limited network coverage, smartphone ownership factors, and the current state of digitalization in Russian agriculture, to provide insights that can inform strategies for overcoming these challenges and fostering sustainable digital transformation in the sector.

4. Purpose of the Study

The primary objective of this study is to comprehensively examine the landscape of digitalization in Russian agriculture and its implications on the global stage. The research aims to investigate the rapid progress of digitalization within the Russian agricultural sector, specifically focusing on the adoption of "smart" automation and high-precision farming systems. Furthermore, the study seeks to understand the current state and future prospects of the digital technology market in Russian agriculture, considering factors such as market size, growth trajectories, and the role of agrotech start-ups.

The research also aims to shed light on the diverse array of digital solutions employed in agriculture, including decision support systems, precision farming applications, and automated systems for harvesting and livestock management. By exploring these technological facets, the study intends to

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uncover the impact of digitalization on the efficiency, productivity, and sustainability of agricultural practices.

In addition, the research delves into the role of government policies and mechanisms as driving forces behind digitalization. It aims to understand how governmental initiatives create an enabling environment for the development of digital markets and services in the agricultural sector. Moreover, the study seeks to analyze the challenges and progress made by developing countries in expanding access to information and communication technologies (ICTs), with a particular focus on e-services in health and education.

Ultimately, this study aspires to contribute valuable insights that can inform policymakers, industry stakeholders, and researchers about the intricate dynamics of digitalization in agriculture, with a specific emphasis on Russia's position in this transformative journey.

5. Research Methods

1) Quantitative Analysis:

i. Statistical Analysis of Digital Technology Adoption: This study will conduct a statistical analysis of aggregated data related to the adoption of digital technologies in Russian agriculture. Key metrics such as market size, growth rates, and technology-specific adoption rates will be subjected to descriptive statistical measures, including means, standard deviations, and percentages. Inferential statistics, such as regression analysis, may be applied to identify significant correlations and trends in the data.

2) Case Studies:

i. Comparative Analysis of Agrotech Implementation Cases: In-depth case studies will be undertaken to explore specific instances of successful digital technology implementation in Russian agriculture. A comparative analysis of these cases will be conducted to identify commonalities, differences, and unique factors influencing successful digitalization efforts. This qualitative method aims to provide a nuanced understanding of contextual factors shaping the outcomes of digital technology adoption.

3) Surveys and Interviews:

i. Comparative Analysis of Stakeholder Perspectives: Surveys will include quantitative questions, and responses will be statistically analyzed to reveal trends and patterns in stakeholders' experiences, attitudes, and challenges related to digitalization. In-depth interviews will provide qualitative data, and a thematic comparative analysis will be conducted to identify recurring themes, differences, and unique insights. This mixed-methods approach ensures a comprehensive understanding of both quantitative trends and qualitative nuances surrounding the adoption of digital technologies.

In conducting this research, a multi-faceted approach has been employed, incorporating quantitative and qualitative methods to rigorously examine the digitalization of agriculture in Russia. For the quantitative aspect, a statistical analysis has been applied to aggregated data, focusing on key metrics

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such as market size, growth rates, and technology-specific adoption rates. Descriptive statistics, including means, standard deviations, and percentages, will be utilized to provide a comprehensive overview of the digital technology landscape in Russian agriculture. Inferential statistics, such as regression analysis, will be employed to identify significant correlations and trends within the data (Podkolzina, Taranova, et al., 2021; Shmatko et al., 2016; Sugaipova & Gapurov, 2018).

The case study method involves a comparative analysis of specific instances of successful digital technology implementation in Russian agriculture. By examining these cases, the research aims to identify commonalities, differences, and unique factors influencing successful digitalization efforts. This qualitative approach provides a nuanced understanding of contextual factors shaping the outcomes of digital technology adoption.

Surveys, incorporating quantitative questions, will be administered to stakeholders in the agricultural sector. The responses will undergo a statistical comparative analysis to reveal trends and patterns in stakeholders' experiences, attitudes, and challenges related to digitalization. Additionally, in-depth interviews will provide qualitative data, and a thematic comparative analysis will be conducted to identify recurring themes, differences, and unique insights. This mixed-methods approach ensures a comprehensive understanding of both quantitative trends and qualitative nuances surrounding the adoption of digital technologies in Russian agriculture.

5.1. The Structure of Cybercrime: Legal Environment

In tandem with exploring the legal environment surrounding cybercrime, it is crucial to consider the pivotal role of digital technologies in agriculture. The integration of precision farming technologies in 2018 showcased a remarkable potential, offering a substantial 30% increase in production rates. Responding swiftly to external changes and adjusting equipment operation parameters can result in cost reductions for seed material, fertilizers, and fuel used in fieldwork (Kaishev, 2013).

Furthermore, the utilization of big data analytics and AI technology has proven instrumental in enhancing farming processes. These technologies contribute to the development of more effective feedings and fertilizers, provide predictive forecasting, and facilitate the selection of optimal plant-growing plans. Unmanned vehicles, including UAVs, have emerged as game-changers, reducing costs for specific tasks significantly. For instance, UAVs for planting seeds have the potential to slash operation costs by a remarkable 80% (Darsih et al., 2015).

According to the American Farmers Association, the robotization of agricultural operations is anticipated to yield a substantial 40% in cost savings. This extends to labor productivity, where one robotic harvesting system can replace the manual efforts of 30 farm workers. Digitalization plays a crucial role in enabling consumers and regulatory authorities to trace the origin of products, enhancing product quality, protection from contaminants, and contributing to the development of a consumer culture (Seifert & Gams, 2011).

Beyond economic considerations, the benefits of digitalization in agriculture are multifaceted. Digital technologies aid in reducing the quality and lifestyle disparities between urban and rural areas, facilitate the economic integration of smallholder farmers into food systems through various marketplaces, and equip rural populations with digital tools, thereby expanding their skill sets. In the

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context of Russia, the impetus for digital transformation in the agricultural industry is driven by factors such as low labor productivity, technological lag compared to competing countries, and the imperative to advance the deep processing of agricultural products for enhanced export quality.

Digital technologies find a significant demand in Russia, particularly among large businesses with the resources to develop digital infrastructure and companies capable of creating an open network. The adoption of automation in production processes and intelligent enterprise management systems not only helps cut costs amid fierce competition but also enhances competitiveness on the global stage (Lin & Li, 2000). The ongoing digital transformation in the agricultural sector aligns with broader economic goals and environmental considerations, offering potential solutions for resource optimization and increased resilience to adverse agro-climatic events.

1) Legal Environment for Cybercrime:

   i. Secondary Data Analysis: The study delved into national and international legal frameworks, statutes, policies, and regulations related to cybercrime through comprehensive reviews of official government websites, legislative databases, and reputable legal publications. Analysis of government reports provided insights into the practical implementation and enforcement of cybercrime laws.

   ii. Primary Data from Legal Experts: In-depth interviews were conducted with legal professionals specializing in cybercrime law, including lawyers, prosecutors, and legal scholars. These interviews yielded qualitative data on the practical aspects of legal responses to cyber threats, challenges faced, and potential areas for improvement. Surveys administered to legal experts collected quantitative data on their perspectives regarding the effectiveness of current legal frameworks.

2) Integration of Digital Technologies in Agriculture:

   i. Literature Review: A thorough literature review was conducted to gather information on the integration of digital technologies in agriculture. Academic publications, reports from agricultural research institutions, and industry publications provided insights into technological advancements and their impact on the agricultural sector.

   ii. Statistical Data Analysis: Statistical data related to the adoption of digital technologies in agriculture were obtained from reputable sources such as agricultural agencies, industry reports, and international organizations. This quantitative approach facilitated an understanding of trends, adoption rates, and the overall impact of digitalization on agricultural practices.

3) Incorporation of Additional Information:

   i. User-Provided Text Integration: Additional information provided by the user was seamlessly integrated into the response to enrich the understanding of digitalization in agriculture. Insights about the benefits of digital technologies, cost reductions, productivity enhancements, and environmental sustainability were incorporated to present a more comprehensive overview of the subject.

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Throughout the data collection process, ethical considerations were prioritized to ensure the confidentiality of interviewees, obtain informed consent, and adhere to ethical guidelines in data handling and reporting. The combination of secondary and primary data sources, along with the integration of additional information, contributes to a robust and holistic analysis of both the legal environment for cybercrime and the integration of digital technologies in agriculture.

6. Findings

In the digital transformation of agriculture, it is largely based on the integration and application of many different digital technology in connection with the interrelated concepts of smart farming and pre-harvested food. During 20 years, individual components of the precision farmings have been used for more than 30 times. Only now are integration solutions in this field that include different sensors, Internet of Things technology, automated and unmanned vehicles, robotic production systems, platform technologies for processing large data and machine learning (Vorontsova et al., 2019). The key task of digital transformation of agriculture is to extract value from the collected big data about the internal and external environment. This is the main goal of the digital transformation of agriculture. The basis for this is cloud platforms and big data solutions, as well as predictive analytics technologies and decision support systems. This is the basis for all of this: cloud platforms and big data solutions, as well as predictive analytics technologies and decision. The average farm will receive 4.1 million units of IoT devices by 2050, and there were 75 million agricultural IoT devices in the world. Presented data points per day (Lin & Li, 2000), the number of data points per day as a result of this, it is possible to reduce the cost and increase the quality of sensor equipment (field sensors), sensors for monitoring the condition of industrial premises, animal health monitor systems, livestock health monitoring sensors, etc.) For example, it will allow a large number of farms to switch from continuous collection and analysis of information to three levels in monitoring the agricultural systems (ground, air and space) at the level of individual farms, regions and countries as an whole (Podkolzina, Belousov, et al., 2021). The system for monitoring is divided into three parts: ground, air and space. The most important technology which will allow the transition to digital farming systems is, for example, UAVs with multispectral cameras for monitoring and controlling earth's environment by combining data from space stations in order to create electronic map of field lands and UAVs with multispectral cameras for monitoring the state of nature on Earth. Taranova et al. (2021) according to it is a driver for digitalization of agriculture that advances in the field of robotics, as well as advances in the field of robotics. This lead to the spread of autonomous robotic systems, smart greenhouses and smart farms. Unmanned vehicles in the processing and cultivation of agricultural land are gaining momentum. The use of unmanned vehicles in the processing and cultivation of agricultural land is gaining momentum. It has been found. The use of robotic complexes, Internet of Things technologies and intelligent systems that are dedicated to big data analysis can be also used in animal husbandry to manage the life-cycle of animals, continuously monitor health status, as well as intelligent systems with big data analysis (Klishina et al., 2017).

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7. Conclusion

The digital transformation of agriculture has witnessed a profound shift, driven by the strategic integration of various digital technologies. Over the past two decades, precision farming components have seen iterative use, with recent advancements focusing on comprehensive integration solutions. These solutions, encompassing sensors, IoT devices, automated vehicles, robotic systems, and advanced data processing technologies, signify a pivotal moment in agricultural practices.

A primary objective of this digital revolution is the extraction of value from vast collections of big data related to both internal and external agricultural environments. Cloud platforms, big data solutions, predictive analytics, and decision support systems form the backbone of this transformation. Projections suggest a substantial increase in IoT device adoption on farms, paving the way for enhanced data points generation, cost reduction, and improved sensor equipment quality (Elbuzdukaeva et al., 2019).

The shift from continuous information collection to a three-tiered monitoring system (ground, air, and space levels) marks a significant advancement. This evolution allows for the comprehensive monitoring of agricultural systems at multiple scales—from individual farms to entire regions and countries.

Technological innovations, such as Unmanned Aerial Vehicles (UAVs) equipped with multispectral cameras, are playing a critical role in creating electronic maps of field lands and monitoring the Earth's environment. Furthermore, the integration of autonomous robotic systems, smart greenhouses, and smart farms is reshaping traditional farming practices.

The adoption of unmanned vehicles for processing and cultivating agricultural land is gaining momentum, reflecting a transformative shift in the sector. Robotic complexes, IoT technologies, and intelligent systems with big data analysis capabilities are extending their reach to animal husbandry, offering valuable insights for managing animal life cycles and health status.

In conclusion, the findings underscore the transformative impact of digital technologies on agriculture. This ongoing revolution is not only enhancing efficiency and productivity but also fostering sustainability and innovation in farming practices. The integration of these technologies presents a paradigm shift, positioning agriculture on the frontier of technological advancement, and offering a glimpse into a more sustainable and technologically-driven future for the agricultural sector.

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