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Digital Agriculture in Viet Nam: Conditions and Prospect of Development

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Abstract

The real context of climate change and pandemic has emphasized the enormous significance of agriculture to society and paved a path to digitization. Each country's agricultural digitalization strategies must not only focus on the technological aspects of the production system but as well present an overview of how this field of study is establishing and developing. To address this issue, a research was carried out to identify priority research questions concerning digital agriculture in Viet Nam, but with a view to also informing international contexts. The study applied a combination of methods including descriptive statistics, review of related researches reflecting the application of digital technology in agriculture, as well as systematic and institutional approaches to create the conditions for the development of digital agriculture. Concurrently, taking into account the readiness limitation of economic actors' for digital transformation is also presented in this study. Viet Nam is in the early stages of digital transformation in agriculture. Digital readiness is critical to grasping and implementing existing technologies and transforming agriculture. In order for the digital transformation to come into play in a positive way, the institutional decisions of the authorities are crucial to the major challenges facing Viet Nam's agriculture, such as digital inequalities, human resources, financial, and infrastructure constraints and inadequate awareness of existing technologies.

Keywords

Digital agriculture, conditions, readiness, transformation, challenges, Viet Nam.

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Introduction

Viet Nam is an agricultural country with the rural sector accounting for 63%, the average production value accounting for 17% of the national GDP and employing 60% of the national labour force (General Statistics Office of Viet Nam, 2020). However, the agricultural sector is confronted by three major challenges: firstly small, insufficient production model and lack of chain linkages (Mai and Van, 2019; Nguyen and Mitrofanova, 2021); secondly, availability of natural resources such as fresh water and productive arable land are becoming increasingly depleted (Duong, 2020); thirdly, the dual consequences of climate change and the Covid pandemic, such as decline in agricultural exports, harvest failure, and business bankruptcy of businesses (IFAD, IPSARD and ADB, 2020). This will require an urgent transformation of Viet Nam's current agricultural system.

Today, digital technology has become an effective instrument for the development of the agricultural industry around the world. Japan is considered to have an intelligent contemporary agriculture, which has helped to fulfill domestic food demand with only 2 million agricultural labourers working on 1.5 million hectares of cultivated area. The countries that are most vulnerable to climate change or have restricted agricultural production expanse like Taiwan, LED technology has provided optimal and best quality crop yields; meeting the demands to ensure food quality and safety (Ryan, 2017). Other countries such as Russia, the United States and Ukraine are commonly characterized by a large area of agricultural land and rapid aging population that prompts the utilisation of robotic technology in automatic agricultural processes, which raised labour productivity by 50-70 times with higher precision compared to manual labour (ITU and FAO, 2020). Therefore, digital technology is a strong incentive for Viet Nam to improve labour productivity within the agricultural sector and the whole economy in general, enabling businesses to compete on the international market more successfully

with existing conditions.

In reality, as a rule, agricultural production involves the usage of manual labour or mechanized equipment, which prevents a significant breakthrough in innovation and digital development (Davnis et al., 2019). The process of digital transformation in agriculture requires the formation of a scientific and practical foundation. Within this, the transformation methodology, the mechanisms to implement the terms and objectives of the program will be demonstrated (Ivanova et al., 2020). Therefore, the predominant purpose of this paper is to research the specifics of digital agriculture development in Viet Nam. In order to achieve this goal, we must first examine the concepts and characteristics of digital applications explicitly applied in agriculture, creating appropriate conditions for digital transformation in Vietnamese agriculture. Next, we research the extent of readiness in digital transformation within economic actors in agricultural production and identify their reported limitations. Our research questions are formulated as:

RQ1: What are the basic conditions in development of digital agriculture in Viet Nam?

RQ2: To what extent has digital agricultural transformation been employed in Viet Nam?

In order to address these questions, we employed a multi-method approach, as exploratory research indicated how digital applications have not been extensively utilized in Viet Nam. It must be noted that research results are aimed at generalizing the potential for digital transformation in Viet Nam within this sector, rather than identifying specific applications.

Materials and methods

In order to contribute to the development of digital agriculture in the literature related to the description, conditions and readiness for digital transformation in agriculture of a country, there is a lack of selection, extraction, assessment, evaluation and quantification of data from a number of research samples published in scientific journals.

The methodology applied here is based on standard systematic review procedures that incorporate search strategy, record extraction, and reporting of results (Kitchenham and Charters, 2007). Such assessment is appropriate as a research method when the objective is to explore specific topics, theoretical perspectives, problems within a field of study or expertise in order to determine elements of a concept or a new approach (Snyder, 2019). It is currently being employed on a large scale in agricultural research (Koutsos et al., 2019).

Therefore, we have created a category of scientific articles using keywords related to digital agriculture: digital(ization) agriculture, digital/smart farming, technology and agriculture 4.0. The majority of the documents were published between 2017 and 2021. Deductive content analysis is used to analyze retrieved documents, in order to identify conditions and potentials for digital agriculture development.

In response to '*RQ1: What are the basic conditions in development of digital agriculture in Viet Nam?*', we reviewed the abstracts to verify that the topic was about agriculture with reference to applications of digital technology. Then, we systematized the concepts, nature of digital agriculture and extracted attributes that help us identify the necessary conditions for digital transformation in agriculture. Finally, with the assistance of official statistics, a general description has been advance for digital agricultural transformation in Viet Nam.

During the pandemic, the basis for the transformation, modernization of most sectors and areas of economic activity, as well as the emergence, development of new business models and forms of interaction adapting to the new reality is digitization. The indicators of the digital economy are determined to include whole complex relationships formed when using digital technology in the system of production, distribution, exchange and consumption of tangible and intangible goods (Mirolyubova et al., 2020). This approach allows attention to the need for interconnected operations of technology, economic and social subsystems where information management is a key determinant prompting value of the whole system. Therefore, to answer '*RQ2: To what extent has digital agricultural transformation been employed in Viet Nam?*', we searched within the materials for cases to identify ways in which digital technology has been applied in agricultural production in Viet Nam. In conclusion, we examined the results of the study and drew conclusions about the prospects for digital agriculture development in Viet Nam today.

Results and discussion

Literature review of digital agriculture

Agricultural modernization and the use of digital technology have fostered new concepts such as precision agriculture, digital agriculture

and intelligent farming. Although these terms are often employed interchangeably, there is a subtle difference in the definition. Precision agriculture is defined as a modern farm management concept that utilizes digital technologies to monitor and optimize agricultural production processes (European Parliament, 2016). The crucial component is optimization. As opposed to employing a similar management amount of chemicals across the entire field, precision agriculture entails measuring soil variations on fields and accordingly adjusting management strategies. This leads to optimization of production units, saving costs and minimizing impact on the environment (Banu, 2015). Smart agriculture is the implementation of 4.0 achievements into agriculture. The focal point is on the permission to access technology data and information technology applications (cloud technology, drones, universal internet, sensors, robots, etc.) – how information accumulated could be intelligently utilized (Sundmaeker et al., 2016).

In the agricultural sector, digitalization format is considered as a function of four components, including: smart agriculture, smart technology, smart design and smart business (Elijah et al., 2018). Digital agriculture implies advancing beyond the presence and availability of data, initiating active intelligence and amplifying meaningful value from that data. According to the German Agricultural Association, digital agriculture is integrating both notions – precision farming and smart farming (German Agricultural Society, 2018). It has been perceived as the consistent application of precision and smart farming techniques, internal and external farm networking, and employment of web-based data platforms along with large data analytics.

Analysis of various digital agriculture notions and characteristics is immensely crucial for research. The nature of digitalization and its impact on economic development could be structured; this is grounded on generating value from data, including the following fundamental characteristics:

- Large information, data and machines become vital incentives with significant value in agricultural production. Along with traditional and developing resources that are closely interlinked with high technology, information and human intelligence. In particular, the development of digital technology enables data collection from various sources, constructing large data and the capacity of this data produces high agricultural production value (Wolfert et al., 2017);

- The development of Artificial Intelligence, robotics, universal internet, cloud computing are the foundations for a new qualitative infrastructure. Cyber physical systems play a predominant role in developing innovative solutions to monitor and manage procedure within agribusiness (Herlitzius, 2017), universal industrial internet components such as sensors and cloud computing are implemented to monitor soil parameters and weather conditions to activate smart irrigation solutions, preventing pests insects and the use of pesticide (Elijah et al., 2018). Smart sensors and applications will help scrutinize the occurrence of undesirable events and conditions that can ultimately pose potential risks, such as impacting the food production through the supply chain (Lioutas et al., 2019);

- The emergence of many advanced agricultural business models with intelligent methods of interaction and information operation (such as high-tech agribusiness models, e-commerce, online advertisement, etc.) are the prioritized solutions to satisfy consumer demands for high value-added products, minimize transaction costs, compliance with food safety and traceability regulations (Vlachopoulou et al., 2021). Moreover, only the participants' enforcement of digital software guarantees their access to the most advanced segments of the global market in the coming decades (Okenova, 2019). Practical development indicates that, if there’s no preparation for the digital infrastructure development, this won’t usher a fundamental change in any field of technology and production at the national level amid global competitiveness;

- Due to the complications in agro-production processes within digital agriculture, there are many business partners involved (farmers, businesses, agricultural contractors, consumers etc.), as well as a variety of information sources, extensive and distinguished communication structures. Common data from different parties within the production chain is gathered in a place that permits obtaining latest quality information, exploring designs, generating additional value for all parties involved, employing contemporary scientific resolutions and determining viable decisions to minimize risks, improving the manufacturer’s business operation and customer experience (Faskhutdinova et al., 2020).

Nevertheless, the digital transformation process in agriculture is inevitably confronted by a dispute between the old and contemporary operation of economic mechanisms, especially when

the value system and mechanisms have not yet been formed. In order to shape digital transformation within different circumstances, fundamental conditions are required, such as infrastructure, internet connectivity, affordability, educational degree in information technology (IT) and institutional support. Moreover, there are factors that facilitate convenient conditions for technology implementation: the use of the internet, mobile phones, social media, digital skills, supporting corporate culture and innovation (Trendov et al., 2019, p.2). For example, Research on digital agriculture in Russia also demonstrated that there are two fundamental conditions required to achieve digital transformation: (1) an intelligent machine that can receive, send, produce (via sensors) and process data; (2) connected machines, communication and interface standards should provide unimpeded data exchange between machines, people and information (Faskhutdinova et al., 2020).

Therefore, various factors will impact the penetration of digital technology into the agricultural sector. This penetration is a long procedure that leads towards a high cohesion of infrastructure elements and the emergence of new forms of business partnerships – beginning with relations within scientific agriculture.

Conditions for the development of digital agriculture in Viet Nam

The revolutionary change in digital agriculture compared to traditional agriculture provides opportunities for farmers and businesses to elevate efficiency in utilizing resources, reducing labor, and minimizing damages caused by natural disasters, epidemics, environmental safety, saving costs at every stage in the supply chain (World Bank, 2019b; Klerkx and Rose, 2020). Technologies such as internet-connected sensors, LED technology, unmanned aerial vehicles, agricultural robots and smart financial farm management etc., assisted the agricultural industry to achieve high production efficiency (Herlitzuis, 2017; Elijah et al., 2018; Lioutas et al., 2019; Wolfert et al., 2021). The potential benefits of digital agriculture are convincing, but it will require major transformations in agricultural systems, rural economies, communities, and natural resource management. Therefore, in order for digital agriculture to become a reality in Viet Nam, from a macro-management perspective this requires the creation of necessary conditions.

First of all, forming suitable mechanisms and policies to develop digital agriculture

According to the macro-management approach, the state requires an appropriate strategy to maneuver the evolution of digital agriculture. Many economies worldwide have in advance incorporated strategic development plans for digital transformation in agriculture within their digital economy development national programs. For instance, in Russia, the Center for Digital Agriculture Competence was established in June 2018. It is expected that the project will pave a fundamental premise for the Smart Agriculture Strategy, contributing to the FoodNet initiative and being integrated into the Russian Digital Economy Program (ITU and FAO, 2020). The Department of Agricultural Engineering and Technology in Turkey was established under the General Department of Agricultural Reform. An associated unit has been appointed to develop policies and strategies regarding the use of advanced technology and mechanization in agriculture, operating with the public-private sectors and universities on digital transformation, conduct testing on suitability of new agricultural technologies in the agricultural sector, perform and disseminate the use of these technologies (ITU and FAO, 2020).

From 2005 until today, Viet Nam has issued many policies regarding the development of digital agriculture. Table 1 demonstrates the legal framework of the digital agriculture development in Viet Nam. This is a paramount legal basis for regulating behaviour and supporting the actors in economic interactions within the agricultural sector. It is also a critical condition for Viet Nam's agriculture to adapt to the robust digital economy development, enabling investors to invest with content.

The policies fundamentally guarantee conformity to socio-economic characteristics in Viet Nam, ensuring the vital conditions for digital agricultural development such as telecommunications infrastructure development, e-commerce market, network security, IT human resource development, etc. In particular, the steering committee was established to command the execution of tasks of the Ministry of Agriculture and Rural Development specified in the Decision No. 749/QD - TTg on 03/06/2020; research, propose policies, develop programs and schemes on digital agricultural transformation; promoting digitalization in business

manufacture chain, constructing new smart rural areas across the country. However, there remains an inconsistency between the regulations proposed and the implementation of the documents. It is an inevitable fact that regulations often do not keep up with the speed of digitalization of the economy (Cameron et al., 2019) (Table 1).

Secondly, developing infrastructure for digital agriculture

Database systems, infrastructure and digital services are crucial factors that foster the foundation for digital agriculture development. The development of the information and communication technology industry in recent years has shown a shift and readiness in the digital transformation process of nations. Regarding information technology infrastructure, in comparison with other nations in the world, Viet Nam's average data speed is 20.66 Mbps, ranking 87 out of 224 countries (Cable, 2021). Inclusive Internet Index is ranked 56 out of 120 countries (Economist Intelligence Unit, 2020); E-Government development index measures the e-government development of the United Nations Member States based on three dimensions of online services, telecommunication connectivity, and human capacity. Viet Nam's E-Government development index moved from 0.45 in 2010 to 0.67 in 2020, which was above the world average of 0.60 (Union Nations, 2020).

In addition, Viet Nam possesses about 126 million mobile subscribers in 2019, including around 62.5 million subscribers using 3G and 4G. The proportion of the population is covered by 4G mobile network accounts for 95.3% (Ministry of Industry and Trade, 2021). The population using social network accounts for 37% (in which 73% are interactions served for work); new digital consumers grow steadily at an average of 63% per year; an average internet usage of about 4 hours/day; the annual increasing value of information technology and telecommunications equipment transactions has established an ideal platform to promote digital transformation (World Bank, 2019a).

Last but not least, improving the quality of human resources, especially digital human resources

In 2020, the population of Viet Nam was estimated to be approximately 97.58 million people. In comparison to the previous year, the labour force was estimated around 48.3 million people, reduced to 849.5 thousand people. The percentage of trained workers in 2020 with credentials and certifications from elementary onwards is 24.1%, 1.3 times higher than in 2019 (General Statistics Office of Viet Nam,

No.	Document	Text symbols
1	Intellectual property law	50/2005/QH11
2	Law on Electronic Transactions	51/2005/QH11
3	Law on Advanced Technology	21/2008/QH12
4	Decision of the Ministry of Information and Communication on approving the master plan on development of information technology human resources in Viet Nam to 2020	05/2007/QD-BTTT
5	Decree of the Government on internet services and electronic information on the internet	97/2008/ND-CP
6	Decision of the Prime Minister on competence, order and procedures for recognition of hi-tech agricultural enterprises	69/2010/QD-TTg
7	Government Decree on e-commerce	52/2013/ND-CP
8	Decision of the Prime Minister stipulating criteria, competence, order and procedures for recognition of hi-tech agricultural areas	66/2015/QD-TTg
9	Government Decree on financial support for rural development programs to advance agricultural research and technology transfer	57/2018 / ND-CP
10	Decision of the Prime Minister approving the National Digital Transformation Program until 2025	749/2020/QD-TTg
11	Decision of the Prime Minister approving the Master plan for e-commerce development for the period 2016 - 2020	1563/2017/QD-TTg
12	Decision of the Prime Minister approving the e-Government development strategy towards digital government in the period of 2021 -2025, with orientation to 2030	942/2021/QD-TTg
13	Decision of the Ministry of Agriculture on the establishment of a Steering Committee for Digital Transformation in the agricultural sector	2588/2021/QD-BNN-TCCB

Source: Compiled by the author from Legal documents that is available at https://thuvienphapluat.vn.

Table 1: Legal framework related to digital agriculture development.

2020). The number of employees in the information technology industry in Viet Nam consists of more than 1.1 million people, the number of working employees primarily oriented in the hardware sector account for more than 75% of the total number of employees within the industry (Ministry of Information and Communications, 2020). Abundant human resources, increasingly improved quality of human resources are considered as Viet Nam's strengths in the industrial revolution 4.0 era.

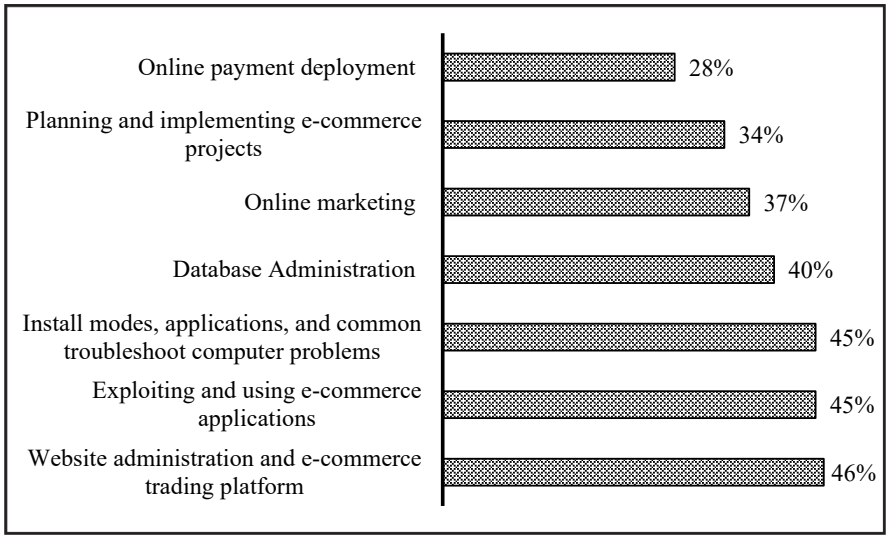
Although the demand for information technology human resources increases, Viet Nam's labour market remains in a constant state of shortage. In 2021, 500,000 people are required and predicted a shortage of 190,000 people (XM, 2020). In 2020, the survey results of the Ministry of Information and Communications indicates that information technology human resources remain with inadequate quality, insufficient dynamism and creativity, and have not fulfilled/met the standard skills proposed by employers (illustrated in Graph 1). This is a major barrier and restriction to Viet Nam's human resources in the 4.0 industrial revolution.

In contrast to other countries in Southeast Asia in terms of digital human resource index, Viet Nam is ranked behind Malaysia, Thailand, Philippines, and is only roughly equivalent to Cambodia (Cameron et al., 2019). The Logistics performance index in 2019 was ranked by the organization as 92/160 countries. Measures the ability to foster, attract, develop and retain talent. Furthermore, it measures degree of vocational, technical and global knowledge (such as knowledge, problem solving, and creativity) (INSEAD, 2019). English Proficiency Index (65 out of 100 countries) measures people's English proficiency (primarily over 18), who are still actively learning English (Education First, 2020).

Moreover, Viet Nam is deprived of an elite group to guide the digital transformation process. Creativity and innovation are yet to be Viet Nam's fundamental strengths; the most apparent evidence is that majority of recent Viet Nam's digital products are application platforms for different industries, with very few any new products, especially in the agricultural sector (Cameron et al., 2019).

Readiness for digital agricultural transformation in Vietnam

Digitization leads to the necessity of expanding cooperation in the value chain: involving new partners, developing new forms of interaction, providing new types of services (Rachinger et al., 2019). By integrating digital resolutions into the agricultural value chain therefore, parties involved are able to foster more informed decisions that address significant challenges in food production (Lezoche et al., 2020; Bura et al., 2021). This provides end-to-end solutions on the journey towards agricultural autonomy and operational excellence. Objects in the digital agriculture field can be categorized into three main groups, consisting of production, distribution and consumption. Each group possesses its own resources, needs and is confronted with its own challenges in which digital agriculture can offer solutions. The groups are not mutually exclusive; any particular individual can participate in many various groups.



Source: Ministry of Industry and Trade, 2021

Graph 1: Necessary skills in information technology that Vietnamese labour workers have not yet fulfilled requirements of employers.

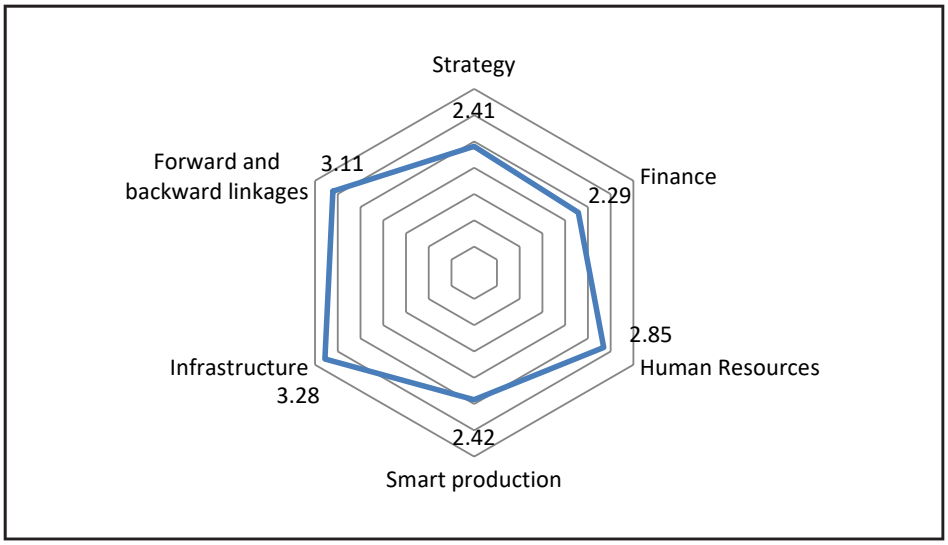
- Production group: fundamentally consists of farmers and actors that supply inputs to agricultural production, such as seeds, fodder, agrochemicals, machinery, and finance. In reality, the tendency of implementing digital technology in the horticulture field is advancing in Viet Nam (Pham, 2018; Vo, 2018; Ngo et al., 2019). The majority of basic digital technology groups in agriculture have been initiated or deployed for trial in our country. Within this trial, the technologies that are being utilized the most are digitized machinery systems, attached to sensors and connected to the internet (IoT sensors) and/or combined with nethouse, glasshouse, and membrane house systems to form an intelligent indoor farming system, which is controlled automatically or semi-automatically with a closed system, such as the rice production area of Loc Troi Group; VinEco's safe vegetable production areas, of Cau Dat Farm company, Da Lat GAP company etc.

Aside from sensor technologies, smart indoor farming systems, technology that uses monochrome LEDs to provide enough light to help generate plant growth has also been employed at many dragon fruit growing facilities from Binh Thuan to Tien Giang, or in mushroom and flower production in several localities such as Vung Tau, Ha Noi. The software applications applied in management, monitoring production and distribution processes of crop products have also been promoted by Vietnamese enterprises, such as Agricheck software of Dai Thanh Company; VIFARM's software globally connects each production package, enables to trace the source, origin, production process, processing procedure and preservation time (Hoang and Do, 2020).

Researchers also emphasized obstacles implementing 4.0 Industry. Some of the main challenges encountered, such as credit access, small farm scale, insufficient progress of land consolidation, poor infrastructure, inadequate market information and lack of well-organized distribution channels (Do, 2018). Moreover, the employment of digital technology remains restricted in Viet Nam, partially due low technology proficiency, investment and development in research is not appropriate (Le et al., 2014).

- Distribution group: includes all actors in the value chain between farmers and consumers; this involves traders, carriers, processors and others. The main distributors in Viet Nam are traditional outdoor markets and large supermarkets. Both subgroups have similar connection rates (i.e. SMS, 39 fixed broadband, mobile networks), but traditional distributors have less similar access potential, through technologies like smartphones. Both traditional distributors and supermarkets are also constrained by the lack of information sharing and communication with parties involved in the value chain (Burra et al., 2021).

Furthermore, the industry's readiness for digital transformation remains low, and due to technical and financial issues, Vietnamese enterprises face difficulties in exerting new technologies (Graph 2).



Note: Adoption level: Level 1 – Outsider; Level 2 – Beginner; Level 3 – Intermediate; Level 4 – Experienced; Level 5 – Pioneer/Expert
Source: Cameron et al., 2019

Graph 2: Digital Adoption levels across dimensions in agricultural enterprises.

The survey results also demonstrate that most agricultural enterprises have employed information technology in production, mainly in daily business management activities, contacting suppliers, customers via email and website. Farm households account for low adoption rate of 25%. Besides that, due to inadequate awareness in the role of digital technology, approximately 35% of formal enterprises in the agricultural sector have schemes to invest in smart technologies.

- Consumer group: involves consumers of both raw materials and processed agricultural products – in fact, the entire population. Among one of the fastest-growing internet economies within the region, Viet Nam's e-commerce market value reached around 12 billion U.S. dollars in 2020, ranking only after Indonesia, Thailand, and Singapore. Many significant changes occurred in Viet Nam's consumer behaviour during the Covid pandemic. The proportion of new online consumers in Viet Nam accounted for 41%, the highest in Southeast Asia, followed by Indonesia and the Philippines with 37% (Table 2). Especially during the epidemic outbreak, consumers invest more time online shopping compared to before (3.1 hours/day), with an average of 4.2 hours/day. In Viet Nam, the present digital population and rising internet penetration provide suitable conditions for e-commerce businesses to grow.

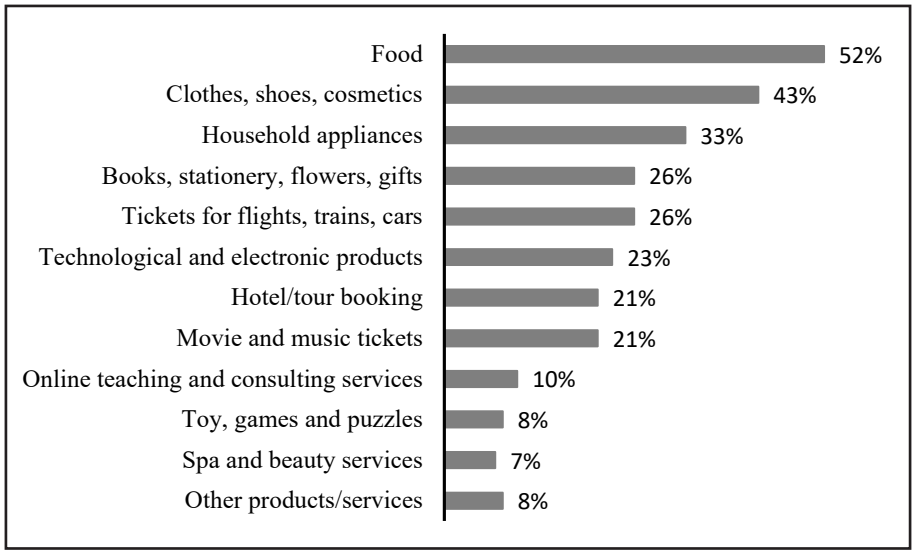
Graph 3 demonstrates that food is the most chosen by consumers whilst online shopping is 52 percent, followed by clothes and cosmetics (37%), household appliances (33%).

Nevertheless, the fundamental success of the value chain will depend on the method and capability of the relationships between the stakeholders (Ilyas et al., 2015). In underdeveloped value chains, trust and coordination are often low. This could be due to a variety of reasons, including lack of management ability, distrust of partners, zero-sum prospects, or simply perceived inequalities in cooperation (McKague and Siddiquee, 2014). In other words, inequality affects a range of actions of parties,

Country	E-commerce market value (Billion Dollar)	The rate of new digital consumers out of total service consumers (%)	The rate of consumers paying with mobile banking apps (%)	Average hours spent online per day (personal use)
Indonesia	44	37	44	4.7
Malaysia	11.4	36	33	4.8
Philippines	7.5	37	53	5.2
Singapore	9	30	17	4.5
Thailand	18	30	5	4.6
Viet Nam	14	41	73	4.2

Source: Google, Temasek, Bain and Company, 2020.

Table 2: Some indicators of E-commerce in Southeast Asia.



Source: Ministry of Industry and Trade, 2021

Graph 3: Main products that were purchased more often shopping online.

through the unequal allocation of risks and benefits, their ability to access, control allocation and use their resources, as well as through knowledge asymmetries. An analysis of 84 publications, orientated in 28 countries and regions, through a system of documents by Hackfort (2021), revealed the existence of five types of structural inequality in the agricultural systems and demonstrate the power of the enterprise, including: 1) in digital technology development; 2) in the distribution of benefits from the use of digital technologies; 3) sovereignty over data, hardware and digital infrastructure; 4) on skills and knowledge ('digital literacy'); and 5) in defining problems and problem-solving capabilities.

The above analysis indicates that Viet Nam is still in the early stages of digital transformation. The high connection and registration rates thanks to affordability, accessibility, and exceptional government support. The employment of e-commerce for agricultural products has achieved considerable success. This presents important opportunities for digital solutions to the following major challenges facing Viet Nam's agriculture:

- Shaping a common vision of digital collaboration and a digital future must become a priority;
- Differences in the perception of the economic impacts values in the digitalization of agriculture by different economic actors;
- Institutional decisions and technology choices to provide participation of small and medium agricultural producers and farmers in digitization processes
- Digital inequalities between urban and rural areas related to Internet access and digital literacy levels of residents;
- Lack of capital to invest in machinery and technology;
- Lack of digitally competent agricultural workforce.

The chances of solving these problems are mostly determined by the institutional decisions of the authorities. For example, developing the sharing economy could become an institutional decision promoting the digitization of small farms. In particular, the sharing of agricultural machinery is actively experienced in developing countries among small groups of farmers with close social ties. Regarding the practice in Northern Thailand, an information-oriented model was chosen to address the IT-related problems affecting the economic agribusiness of small-scale farmers (Raungpaka and Savetpanuvong, 2017). In India, Gold Farm's digital access-based solution can help overcome the financial constraints faced by farmers in accessing expensive agricultural equipment (Sengupta et al., 2019).

Conclusion

According to the United Nations Sustainable Development Goals, digital agriculture has the enviable potential to increase economic contribution through expanding market opportunities, agricultural productivity and cost-effectiveness (Trendov et al., 2019). This study provides a general idea of the potential for digitization in agriculture for a particular country.

The concept of digital agriculture is very useful to identify the current agricultural development subject and help relevant departments to make rational agricultural development planning within the framework of digitalization of agriculture (Klerkx et al., 2019). In this regard, when determining the conditions affecting the viability of digital agricultural transformation, the following issues could be distinguished. These are: forming an institutional framework for digital agricultural development; the need for information infrastructure development; forming digitally comprehensive human resources.

This study has employed the concept of digital agriculture to the problems related to the development of digital agriculture in Viet Nam today. The key findings indicate that Viet Nam is in the early stages of digital transformation in agriculture. Digital technology is gradually spreading in the agricultural field. However, the adoption is hindered by digital inequalities, constraints on human resources, finance and infrastructure, as well as inadequate awareness of existing technologies. In fact, digital transformation is an ongoing process, in which future technological developments and its impacts are highly uncertain and difficult to predict. Development occurs in very different ways and therefore the future outcomes are quite different (Daum, 2021). Hence, for the digital transformation to come into play in a positive way, institutional decisions by regional governments are indispensable to shape the development of digital agriculture. In this context, in-depth studies play an important role in verifying and affirming

the authors' empirical conclusions.

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