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# Economic impact of digitalization on agriculture: a Korean perspective

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## Abstract

The global trade environment is rapidly changing. The spread of COVID-19 promotes digitalization, and online transactions are becoming the new normal. Currently, Korea is actively introducing information and communication technology (ICT) that uses the internet of things (IoT) in relation to agriculture. However, few studies have analyzed the impact of digitalization on trade in the agricultural sector. Thus, the purpose of this study is to examine how the introduction of digital technology can affect the economy and trade of Korea. In this study, we estimate the impact of introducing digital technologies using the computable general equilibrium (CGE) model. The results of this analysis indicate that the GDP could increase by 3.82% to 10.53%. Also, agricultural production and trade according to the model will significantly increase to 8.67% and 5.72%, respectively, through a productivity increase from Blockchain, IoT, and artificial intelligence (AI) technologies, despite logistics inefficiencies. Although the effects of digitalization could be significant, farmers are still struggling to introduce digital technologies, stemming from the fact that government support systems are concentrated in only a few sub-sectors. In this regard, support in this area must be expanded and diversified according to the current environment of agriculture in Korea.

**Key words:** CGE (computable general equilibrium) model, COVID-19, digital transformation, Korean agriculture



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## Introduction

The global trade environment is changing rapidly. Protectionism is expanding due to the trade conflict between the US and China, and the spread of COVID-19 has restricted the movement of individuals and streamlining logistics. The number of new regulations on imports was 387 from 29 major countries in 2020, which was greater than 2019 (283 cases). The spread of COVID-19 promotes digitalization, and contactless transactions have become a new normal (Expanded Trade Strategy Adjustment Meeting, 2021). Korea's processed food exports, through electronic commerce, increased 32.7% in 2020, and the growth rate of online exports increased from 43.0% in 2019 to 111.5% in 2020. In other words, global protectionism and COVID-19 are promoting the digitalization.

Recently, Korea has been actively introducing information and communication technology (ICT) on most of industries including agricultural sector (Lee et al., 2020). Particularly, the adoption of digital technology in agriculture can substantially increase the effectiveness and efficiency (FAO, 2019; World Bank Group, 2019). Thus, technologies such as Blockchain, IoT, and artificial intelligence (AI) are expected to be rapidly introduced in most of the agriculture field in the near future. For example, the introduction of artificial intelligence is one of the fastest growing fields, having annually grown by about 22.5% (Markets and Markets, 2020). However, few studies have analyzed the impact of digitalization on trade in agriculture.

After the Korea-US FTA Agreement was entered into force in 2012, the Korean government introduced "Facility modernization" as agricultural policy, the program intended to enhance Korea's competitiveness of agricultural field. The project is primarily aimed at repairing existing facilities in the livestock and fruit sectors, as well as supporting the introduction of ICT technologies such as sensors and automation process. However, the ICT introduction is not a main purpose of facility modernization. Thus, the effect of these policy analyzed does not examine the introduction of ICT technologies.

If the economic impact of digitalization in agriculture is not analyzed in a timely manner, the motivation to introduce technology for digitalization, which is rapidly changing, could weaken. In addition, if the government does not provide adequate support for introducing digitalization in the agricultural field, the damage will be even greater than that caused by the trade liberalization or COVID19. Therefore, this study presents digital technologies that can be introduced into the agricultural field and examines how much the digital technologies can increase the production and trade of agriculture in Korea. This study aims to fill the gap in research related to the introduction of digital technologies in the Korean agricultural field and provide policy implications.

The purpose of this study is to examine how the introduction of digital technology can affect production and international trade participation of agricultural sector. It reviewed advanced researches in Chapter 2, then the analysis model and data used for this study are described in Chapter 3. Chapter 4 presents the results of the analysis, and Chapter 5 presents conclusions and implications based on the analysis results.

## Literature review

### COVID-19 and digitalization

COVID-19 is disrupting the global value chain (Glauber et al., 2020; UN, 2020). In response to the pandemic, most countries have restricted the movements of the individual, which has limited the movement of logistics and labor forces (Ben et al., 2020; Galanakis, 2020; Hossain et al., 2020; Watanabe and Omori, 2020). In particular, the pandemic damages to the agricultural sector in an aspect of food security (Gustin, 2020; IFAD, 2020; Vacar, 2020), and the actual trade volume of agricultural products fell by about 20% (Nicola et al., 2020). As a result, the global value chain of agri-food has been harmed (Kerr, 2020), consumer panic buying has emerged, the movement of labor between countries has been restricted, and agricultural production has declined significantly (Glauber et al., 2020).

COVID-19 has promoted national self-interest, and it shocked to multilateral trade system (Kerr, 2020). Although the World Trade Organization (WTO) allows each country to restrict its exports of food as a provision in the General Agreement on Tariffs and Trade (GATT) Article 11(2)(a)[1], the trade restrictive measures give considerable shock on agricultural value chains. The number of notified measures to the WTO is 290 since the beginning of the pandemic, and the measures to restrict the exports of food and other commodities account for 51% (148 cases) (WTO, 2021)[2].

Each country's closure and export restrictions have provided an opportunity to promote digitalization (Iida, 2020; Kim, 2020; Savić, 2020; Adler-Milstein, 2021). This is because non-face-to-face transaction methods have greatly expanded as population movement has been restricted. However, the agricultural sector is struggling to quickly adopt digital technology despite the changing trade environment caused by COVID-19 (Quayson, 2020). In particular, the agriculture sector in developing countries, wherein labor input is high, is struggling (Maloney and Molina, 2016; Larue, 2020; Workie et al., 2020). To respond to these changes to the trade environment, Korea is expanding the introduction of automation technology through capital input rather than production using the labor force in the agricultural field. The introduction of digital technology is expected to maximize agricultural efficiency in particular (FAO, 2019; Jouanjean, 2019; World Bank Group, 2019). The digital technologies that are expected to be introduced into the agricultural field can be broadly classified into blockchain, internet of things, and artificial intelligence.

· Blockchain refers to a technology that can increase data transparency and data reliability by encrypting all data with a jointly operated database (CSIRO, 2017). In the agricultural field, blockchain technology can be used to share data between sellers-consumers-transports-banks-customs authorities to reduce the disposal rate of agricultural products by enabling the rapid customs clearance of perishable agricultural products.

· Specifically, the electronic data interchange (EDI) system can prepare all necessary documents (e.g., packing list, delivery note, invoice, and customs declaration) through EDI messages when a company receives an order. In the case of insufficient stock, it can also be linked to other systems that reorder the main materials required for production (UNECE, 2018). However, the EDI system has a limitation in that internationally consistent codes are needed to utilize the EDI system.

· The internet of things was initially used for sensors, but in recent years it has evolved into a network that can collect data and exchange information between machines or between machines and people (OECD, 2016). IoT can be combined with big data analytics to introduce an automated system, and it is a technology with very high potential for application in the agricultural field.

· Artificial intelligence technology is expected to significantly improve the efficiency of the agriculture field, as related machines and systems will be able to perform intelligent actions by learning new knowledge (OECD, 2020). In addition, cognitive-based technologies enable computers to interact, reason, and learn like humans to make decisions, as well as operate production in a way that increases productivity in the agricultural field.

However, the digitalization of the agricultural field has been hindered by a number of factors. The factors limiting digitalization can be largely divided into (ⅰ) supply of low-quality data (e.g., data with low accuracy), (ⅱ) non-linkage between generated data, and (ⅲ) lack of data use experts (OECD, 2018; Lee et al., 2020).

## Korea's agricultural field support policy and effects

As of 2020, there are a total of 12 smart farm-related projects of the Ministry of Agriculture, Food and Rural Affairs. Among these projects, the smart farm Innovation Valley budget occupies the highest proportion. The Smart Farm Innovation Valley is a cluster that intensively supports startups and R&D (NABO, 2020). In addition, the Ministry of Agriculture, Food and Rural Affairs operates a Smart Farm big data center to share information on the growth and cultivation of crops. Korea's

Smart Farm support budget has increased by 85% annually since 2016, reaching 255 billion won in 2020 (Fig. 1). However, most similar projects are either divided by region or in the early stages, such as pilots.

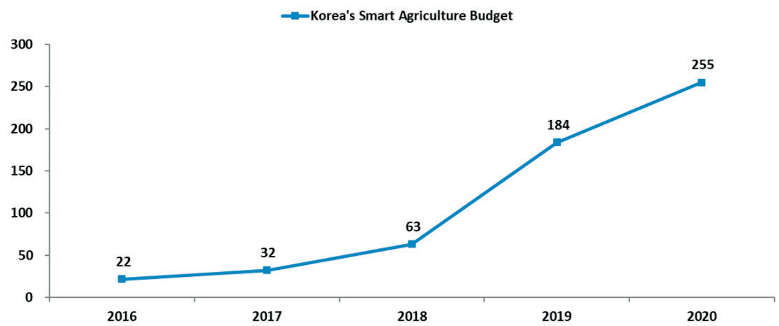


**Fig. 1.** Changes in Korea's smart agriculture budget from 2016 to 2020. The y axis on the left shows the budget in units of KRW 1 billion. Source: NABO, 2020.

As the dissemination of digital technology continues, the dissemination of digital technology is also rapidly increasing in the agricultural filed. In Korea, various digital support policies are provided for the agricultural field. In particular, since the conclusion of the Korea-US FTA Agreement, the Korea government has supported providing ICT facilities to livestock households through feedlot modernization projects, and various studies have been conducted to analyze the effects of such projects after implementation (KREI, 2014; Ahn, 2016).

The details and effects of those projects are as follows. KREI (2014) analyzed livestock housing facilities among the feedlot modernization projects. The analysis found that the introduction of ICT-related technologies had the greatest effect in reducing the mortality rate. The mortality rate for households participating in the project was 16% lower than the national average, while the effect of reducing working hours was about 5% lower than the national average, and the average weight of livestock products increased about 2% over the average of total livestock households. In addition, Ahn (2016) analyzed the impact of the government's ICT facility support on productivity improvement using the propensity score matching (PSM) method. The analysis showed that the average labor force decreased by 12.3% through the provision of government support, and the average working hours per person was found to be 10% less than that of all livestock households.

In addition to government support, the number of farmers who have individually introduced smart farming into their practice is also increasing. Lee and Seol (2019) analyzed the productivity effects of 59 households that introduced 'Smart Farm' from August to October 2016. As a result of the analysis, the average productivity of households with Smart Farm aspects was 28% higher than it was before the smart farm aspects were introduced, and labor costs decreased by 16%. In addition, Lee and Seol (2019) conducted a satisfaction survey on farmers who have introduced Smart Farm. In the results of the satisfaction survey, the satisfaction with the productivity improvement effect of the introduction of Smart Farm was 5.3/7.0 points, the satisfaction with the cost reduction was 6.1/7.0 points, and the recommendation intention was 6.1/7.0 points.

The government's support for smart farms is expanding, and its effectiveness and satisfaction are also proven. However, various researches has examined to estimate the productivity of digitalization in agriculture, but the effects do not consistent. In other words, the estimation of productivity of digitalization is quite challenging. However, it is clear that the digitalization has a positive effect on productivity, and institutional support will cumulatively have a greater productivity increase in the long term. Therefore, it is reasonable to consider productivity increase when analyze the effect of digitalization.

## Model and data

In this study, to analyze the impact of digitalization in the agricultural field on trade, we use the global trade analysis project (GTAP) model, which is widely used in international trade analysis. Particularly, this study utilize the GTAP-Melitz model, which is based on the basic GTAP model and reflects the Melitz (2003) theory. The GTAP model is the most widely used model in CGE research, and has the advantages when the research questions consider multi-region and multi-sector. Variables in the GTAP model have mutually linked and finds a new equilibrium when the initial equilibrium is shocked. GTAP is a model in which production, consumption, and international trade are linked across goods and services trade. As presented in Fig. 2, it shows the structure of linkage in one country. The Regional household collects regional inputs and spends. The collection is divided into private household (consumer), government, and saving. The model determines the goods and services required by the household and the government. In addition, savings determine the size of savings and investment by region. The model includes the behavior equations of economic agents by industry. By industry, companies have profit maximization assumption based on production factors and production functions using intermediate goods. Companies pay wages and rental rates to local households. Companies sell their outputs to other companies in the form of intermediate goods, and final goods to the government and household. A company is the subject of exporting or importing goods. International trade contains bilateral trade information. In Fig. 2, it is expressed as Rest of World, but Rest of World actually contains many of each countries. The different relationship between supply and demand functions and market cleaning conditions is shown in detail in Hertel (1997).

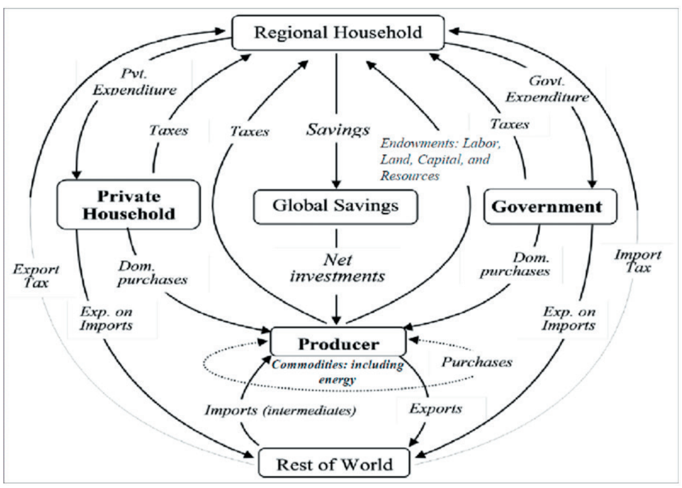


**Fig. 2.** An overview of standard global trade analysis project (GTAP) model (Hertel, 1997).

In the GTAP model, the external shocks on an industry could indirectly affect other industries reflecting the value chains. In particular, the linkage between industries considers the indirect effects between agricultural sectors since the GTAP model was developed firstly based on Agricultural Economics. On the other hand, the model mainly used in Korea called KASMO is a partial equilibrium model, which only considering agricultural sector. In this regard, this study used GTAP model to consider the indirect impact of digitalization on agriculture and manufacture. Also, Melitz theory is included in the model. This theory has substantially contributed to the development of modern trade theory by reflecting the heterogenous between firms. Accordingly, various studies have been conducted in attempts to apply Melitz theory to CGE (Oyamada, 2015; Akgul et al., 2016; Bekkers and Francois, 2018; Dixon et al., 2018; Feenstra, 2018; Balistreri and Tarr, 2020).

In this study, we use the GTAP-Melitz model because there is expected to be a heterogenous in productivity between firms or farmers that have introduced digital technologies. CGE models are mainly based on Armington elasticity. The Armington model assumes incomplete substitution of imported and domestic products. Therefore, there is a limit in not reflecting changes in productivity between firms. Rather than being reflected at the national level, there is a large difference in the will to introduce digital transformation by firm or farms. Since the Melitz model reflects the heterogeneity of firms, the model estimation could better to reflect the practical environment. The analysis model is a model developed by Dixon et al. (2018, DJR) which constructs and analyzes scenarios based on this model. In general, the results of the analysis by Melitz theory show a greater impact on international trade and welfare as competition intensifies than the conventional Armington model (Balistreri et al., 2011; Melitz and Trefler, 2012; Balistreri and Rutherford, 2013; Demidova and Rodriguez-Clare, 2013). The DJR model used in this study is interchangeable between the GTAP model and the GTAP-Melitz model by exchanging the endogenous and exogenous variables (Fig. 3).

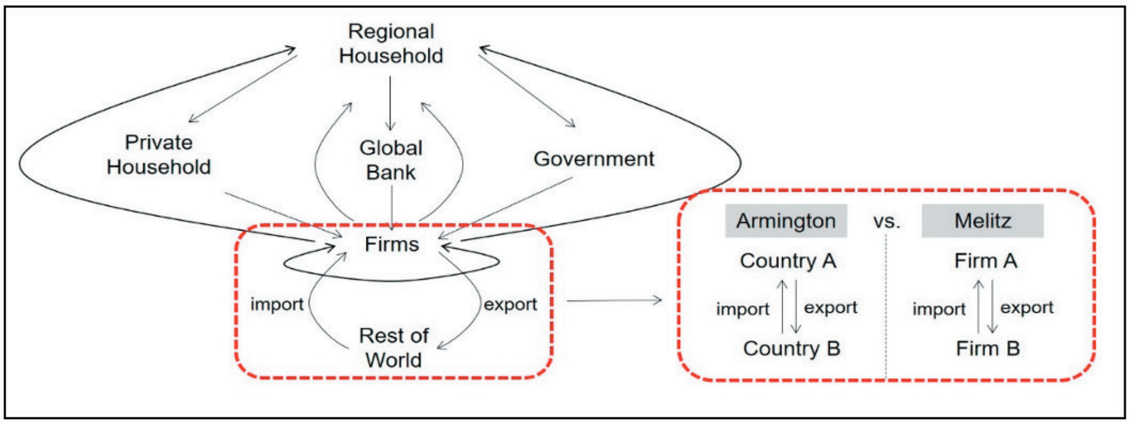


**Fig. 3.** Diagram depicting Armington and Melitz model's mechanism in global trade analysis project computable general equilibrium (GTAP CGE) model. The diagram was depicted by the author based on Hertel (1997) and Dixon et al. (2018).

To convert the Armington model into the Melitz model in the DJR model, the Elasticity of substitution among imports (ESUBM) and the Elasticity of substitution between domestic and imported goods (ESUBD) must be set to be equal to each other. This is because a difference between domestic and imported goods can arise in Melitz theory. In addition, inter-company substitution can occur even between domestic goods in Melitz theory. Next, the ads (c.s) variable is introduced so that the demand of a specific agent can be revealed by reflecting the consumer's preference for each company. Finally, the variables aoMel(c,s), txMel(c,s,d), d_revtxMel(c,s,d), d_revMeltot(c,s), pmarket(c,s,d), and pbundle(c,s) are added to enable compatibility between models.

## Scenario

Several studies related to productivity were referred to for scenario setting. First, in the case of Russia, labor productivity was expected to increase by three to five times according to the digitalization of the agricultural sector (Marinchenko, 2021). However, estimating the increase in productivity through digitalization does not show the consistent results. Therefore, rather than focusing on productivity estimation, this study focuses on the impact of digitalization on agricultural production and trade.

On the other side, previous research has indicated that the digital transformation was most affected by COVID-19. Therefore, it reflects that there may be differences in digital transformation depending on the damage of COVID-19. However, even if the impact of COVID-19 decreases in the long-run, digital transformation should be regarded as a structural change, not simply as a response to COVID-19.

Moreover, because of the COVID-19, countries have imposed lockdown measures and restricted movement of individual while limiting land and sea transport. Production in agriculture has also declined due to restrictions on the cross-border movement of essential labor forces. Although vaccines to prevent COVID-19 have been approved and released, many countries still have low vaccination rates, and even when COVID-19 is terminated, trade-restriction measures are expected to continue for a considerable period of time.

This analysis uses GTAP Database version 10 and the base year of 2014. GTAP database contains input-output table data by country and international trade data. GTAP data is divided into 65 industries and 141 regions. The main macroeconomic data are from the World Bank and the United Nations. Trade data is based on UN COMTRADE, and customs data is based on international trade centre market access map (ITC MacMAP) data. However, to more focus on the analysis, the industries are aggregated as seven sectors including agriculture, manufacturing, and services. Agriculture was further divided into grains, fruits-vegetables, livestock, food, and other agricultural products (Table 1).

**Table 1.** Global trade analysis project (GTAP) data base.

| Industries subject (7) |
|---|
| Agriculture (grains, fruits-vegetables, livestock, food, and other agricultural products), manufacturing, service industries |

Other_agr includes oil seeds, sugar cane, plant-based fibers, crops nec, wool, forestry.

Quantifying the currently placed measures is a very challenging task that is ignored herein and recommended as a separate research topic. Therefore, the scenarios are set up by referring to similar literatures that have been analyzed in the past.

The recent economic conditions were not reflected due to data limitations. In this regard, the COVID-19 damage was considered to substitute the current economic environment. Studies related to the logistics efficiency of COVID-19 have shown that the efficiency can be reduced by 1% up to 15% (ADB, 2020; Yoo et al., 2020; Lim et al., 2021). The gap of logistics inefficiency through COVID-19 is high by analysis, thus, this study follows the results of ADB (2020), which is publicly and widely cited. The ADB (2020) shows that the logistics efficiency could reduce by up to 2% in the long run. Additionally, this study assumed the logistics inefficiency could be up to 5% in the short-term.

The productivity increase of digitalization was 6 - 10% in the manufacturing industry (OECD, 2017; Yusuf, 2021). OECD (2017) predicted that although the increase in productivity by country and industry is different, digitalization will increase production in the manufacturing industry by about 10%. It is predicted that productivity growth in the service industry, such as the finance, could be larger. Therefore, it assumed that the productivity of the manufacturing industry increases by 10% in the long run, reflecting the study results of the OECD (2017). For agriculture, 7% increase of productivity is assumed, referring manufacture (Table 2).

As mentioned earlier, COVID-19 will reduce logistics efficiency, and the digital transformation in agriculture will dramatically increase productivity. Therefore, the scenario seeks to simultaneously consider the deterioration of logistics efficiency (ams) under COVID-19 and the increase in productivity (afe) resulting from the digital transformation. Specifically, the COVID-19 impact scenario was set to -5% (short-term), -3% (medium-term), and -2% (long-term) while targeting all countries in the world (Table 3).

**Table 2.** Literature reviews related in this research scenarios.

| Literature | Content | Scenario |
|---|---|---|
| Lim et al. (2021) | Impacts of reverse global value chain (GVC) factors on global trade and energy market | COVID-19 shock on logistics efficiency: -10% |
| Yoo et al. (2020) | The impact of COVID-19 and Korea's new southern policy on its GVC | Damage of COVID-19 on trade efficiency -3 to -15% |
| ADB (2020) | Assessment of the economic impact of COVID-19 | Higher trade cost linked to global supply chain: -1 to -2% |
| Yusuf (2021) | The impact of industry 4.0 on the Indonesian economy | Labor productivity improvement for non-service industries: 6% |
| OECD (2017) | The digitalization (IT) of production | Productivity growth: 10% for the manufacturing sector, higher for the services |

**Table 3.** Digital transformation scenarios.

| Scenario | COVID-19 effect (world) | Digital transformation (Korea) | | |
|---|---|---|---|---|
| | Logistics efficiency (variable: ams) (%) | Increased productivity (variable: afe) (%) | | |
| | | Agriculture | Manufacturing | Service industry |
| S1 | -5 | 3 | 5 | 7 |
| S2 | -3 | 5 | 7 | 10 |
| S3 | -2 | 7 | 10 | 12 |

S1, S2, and S3 represent short-term, mid-term, and long-term effects, respectively.

The effects of productivity growth varied from 2 - 30%, as has been seen in previous studies, but in this study, the effects of productivity growth were set relatively conservatively at 3 - 7% (Table 3). In addition, the productivity growth scenarios were divided into the agricultural, manufacturing, and service industries. However, in the manufacturing and service industries, the timing of the introduction of digital technology is faster and wider than it is in agriculture (Tamegawa et al., 2014; Malgouyres et al., 2019; Cette et al., 2021), reflecting the relative effects of digital transformation in increasing productivity, which are in the order of service industry > manufacturing > agriculture (Table 3).

# Analysis results

As a result of the analysis, the effect of digital transformation was substantial, despite of COVID-19. Korea's GDP increased by up to 10%. It shows that digital transformation could offset the damage of COVID-19. Although trade was more affected by COVID-19 in the short and mid-term, it increased when the productivity increase was sufficiently achieved. This is because logistics efficiency could be stabilized in the long-term, as mentioned in ADB (2020). Macroeconomic effects emphasize the need of digital transformation. In other word, digitalization is necessary to rapidly recover the damage of COVID-19 (Table 4).

**Table 4.** GDP Analysis Results by scenario in Korea (%).

| Korea (2019) | | Scenario1 | Scenario2 | Scenario3 |
|---|---|---|---|---|
| GDP | 1.647 (Trillion $) | 3.82 | 7.64 | 10.53 |
| Trade (exp + imp) | 1.045 (Trillion $) | -3.91 | -0.59 | 1.73 |

For Korea's GDP and trade data, the World Bank database and Korea Statistical Information Service were used.

Agricultural production in Korea increased from 4.99% to 8.67% due to digital transformation (Table 5). In particular, the effect of digital transformation was greatest in the livestock industry. Considering the government's ICT support for the livestock industry is already being made, the results show the validity of the policy. As the analysis results disclosed, it is necessary to further expand the support for digitalization. The effect of digitalization was also shown in grains and vegetables. Grain production increased by up to 6.61%, while vegetables increased up to 5.14%. The increase in productivity has a positive effect on the overall agriculture production.

**Table 5.** Effects of agricultural production in Korea by scenario (%).

| Scenario | Grain | Vegetable | Livestock | Food | Other_agr | Agriculture |
|---|---|---|---|---|---|---|
| S1 | 5.29 | 3.22 | 6.12 | 4.14 | 7.56 | 4.99 |
| S2 | 5.73 | 4.15 | 8.49 | 6.84 | 7.99 | 6.96 |
| S3 | 6.61 | 5.14 | 10.54 | 8.92 | 8.79 | 8.67 |

S1, S2, and S3 represent short-term, mid-term, and long-term effects, respectively.

Agricultural trade increased in the mid to long term. If the effect of increasing productivity is high enough, trade could also increase in the long-term. In Scenario 1, agricultural trade decreased by 1.92%. However, productivity growth increased agricultural trade by up to 5.72%. it shows that the digitalization could expand participation in international trade. In particular, grain trade increased significantly by up to 8.31%. In other agricultural sectors, excluding grain, trade expansion was relatively lower than production growth (Table 6).

**Table 6.** Effects of agricultural trade in Korea by scenario (%).

| Scenario | Grain | Vegetable | Livestock | Food | Other_agr | Agriculture |
|---|---|---|---|---|---|---|
| S1 | 2.12 | -1.72 | -6.14 | -3.57 | -0.81 | -1.92 |
| S2 | 5.87 | 1.73 | 1.65 | 1.00 | 3.22 | 2.68 |
| S3 | 8.31 | 3.73 | 6.95 | 3.95 | 6.08 | 5.72 |

S1, S2, and S3 represent short-term, mid-term, and long-term effects, respectively.

Although the increase in productivity expanded production and trade, it decreased the exports of agriculture (Table 7). The productivity increases the demand for intermediate goods required for production. However, the logistics inefficiency leads the decrease of exports even in the long-term. It means that the productivity growth could not offset the damage of international trade resulted from the COVID-19. In other words, the trade creation through digitalization could only achievable when the logistics efficiency fully recovered. Therefore, in order to secure the economic benefits of digitalization on agricultural sectors, support for the recovery of export logistics is substantially required.

**Table 7.** Effects of agricultural exports in Korea by scenario (%).

| Scenario | Grain | Vegetable | Livestock | Food | Other_agr | Agriculture |
|---|---|---|---|---|---|---|
| S1 | -19.80 | -13.85 | -16.76 | -6.90 | -7.56 | -7.97 |
| S2 | -14.76 | -9.67 | -12.92 | -4.82 | -6.83 | -5.84 |
| S3 | -11.25 | -6.89 | -11.81 | -4.28 | -7.12 | -5.24 |

S1, S2, and S3 represent short-term, mid-term, and long-term effects, respectively.

## Conclusion

This study presents important implications by analyzing the impact of the digital transformation triggered by COVID-19 on the Korean economy and agriculture. If the digital transformation is carried out quickly as a means of responding to COVID-19, Korea can lay the foundation for rapid economic recovery. Increasing productivity through digitalization could expand agricultural production and trade, and particularly digital transformation of the livestock is expected to have the largest effect on production growth. The Korean government needs to expand and reorganize its current ICT support could promote the benefits of digitalization. In addition, the expansion of digital technology could enlarge opportunities for Korean agriculture to participate in international trade. However, in order to expand agricultural exports, the logistics inefficiency remains an urgent task to be resolved.

As we have seen before, blockchain, internet of things, and artificial intelligence technologies offer great advantages in maximizing the productivity of agri-food companies. However, in Korea, it is still difficult for farmers to introduce digital technology. Korea has actively supported the introduction of ICT technologies related to sensors and automation since the signing of the KORUS FTA to enhance the competitiveness of agriculture, but no support has been provided that focuses on the introduction of digital technologies.

This study is meaningful in that it analyzed the economic effects of the introduction of digital technologies in agriculture in a timely manner. It also suggests that Korea's agriculture industry, which has traditionally had a strong perception of being a weakened sector, could expand its participation in international trade through the introduction of digital technology, and that digital technology and logistics support should be urgently introduced in agriculture in preparation for the post-COVID-19 era.

The purpose of this study is to simultaneously analyze the damage of COVID-19 and digitalization on agriculture. However, as the base year of the GTAP database used in this analysis was 2014, current trade environment is not reflected in the simulation. Updating the GTAP database requires numerous work that could be even conducted as a separate study. In this regard, the study examined assumes that the agricultural structure of Korea does not significantly change compared to the base year.

## Footnote

1) preventing or mitigating a significant shortage of food and other commodities indispensable to export contracting parties.
2) In the case of imports, various measures were taken to temporarily extend the certification period necessary for quarantine or to eliminate import tariffs, which accounted for 38% of the total (113 out of 290 cases). (https://www.wto.org/english/tratop_e/covid19_e/trade_related_goods_measure_e.htm).

## Conflict of Interests

No potential conflict of interest relevant to this article was reported.


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