

A STUDY ON CONVERGENCE OF INTELLIGENT INFORMATION TECHNOLOGY OF 6TH INDUSTRY FOR SUSTAINABILITY

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ABSTRACT. *The purpose of this study was to explore the sustainable development direction of the 6th industry in accordance with the paradigm change of the present which emphasizes the concepts of mutual growth, win-win cooperation and the fourth industrial revolution. Innovation based on intelligence information technology in the era of the fourth industrial revolution is expected to have a large impact on agriculture. Therefore, this study presents the limitations of Korea's agriculture and 6th industry by examining related cases and researches, and suggests directions for creating shared value as a way to overcome problems of rural areas. This paper can be used as a basic data for the study of ecosystem growth through social co-operation and community consciousness on agriculture.*

Keywords: Convergence, Intelligent information technology, 6th industry, Agriculture, Sustainability, Creating shared value

1. **Introduction.** Rural issue in Korea is one of the most important social issues. Rural areas are suffering from rapid population decline and aging, and income inequality between urban and rural areas is steadily increasing in Korea [1,2]. Since agriculture is inevitably related to the survival of humankind, and is recognized as an industry that should not disappear, the government is proceeding with 6th industrialization of agriculture to overcome these problems and to revitalize agricultural economy. However, as the government-led agriculture policy expansion alone is not expected to revitalize rural areas, a new paradigm seems necessary. In the early stages of the 6th industrialization, the government departments and agencies support the farmers directly to establish the foundation. However, in order to secure competitiveness through creating new value, it is necessary to consider ecosystem growth through the establishment of cooperative governance of government, business, academy, and farm at the growth stage. In particular, since Korean agriculture has a small business size and a family farming system, it is necessary to increase efficiency through cooperation and network in order to improve the cost and marketing competitiveness [3]. In other words, for the sustainable development of the 6th industry, it is necessary to set the direction and search for the task according to the paradigm of the present era, which emphasizes the concepts of mutual growth and win-win cooperation. Meanwhile, the fourth industrial revolution, which has emerged as a global issue, is regarded as a new business paradigm not only for manufacturing but also for society at large. Since agriculture is a labor-intensive industry, the impact of the fourth industrial revolution on agriculture is expected to be large. Advanced countries are already engaged in mechanization, automation, and modernization to solve problems in rural areas such as climate change and aging, and the fourth industrial revolution has accelerated the scale-up and commercialization of agriculture [4]. In the case of Japan,

which has been doing 6th industrialization 10 years earlier than Korea, technological development and application are being promoted to replace the scarce labor force due to aging and to improve the profits of farmers. Japan is actively promoting the use of cutting-edge technology such as ICT (Information and Communications Technologies) for practical effects such as environmental management, reduction of production cost, improvement of crop quality and work efficiency [5]. This can be understood as an industrial convergence between the 6th industry and the technology industry in the era of the fourth industrial revolution and these issues are likely to be accessible in terms of CSV (Creating Shared Value). In this regard, this study aims to present the sustainable development direction and task for the 6th industry in accordance with the paradigm of the times by systematically examining various secondary data. The structure of this study is as follows. This paper reviews prior studies on the 6th industrialization of agriculture and the utilization of intelligent information technology in agriculture respectively in Chapter 2 and Chapter 3 following the introduction of Chapter 1. Chapter 4 analyzes the cases of the use of the fourth industrial revolution technology in agriculture. Chapter 5 examines CSV for sustainability in the 6th industry. Finally, Chapter 6 summarizes the results and suggests implications.

2. The 6th Industrialization of Agriculture. The 6th industrialization means activities to promote the activation of the local economy by creating new value-added and local jobs through the convergence of primary industries (production), secondary industries (processing and manufacturing) and tertiary industries (distribution, sales, tourism) that utilize rural resources [6,7]. Internal factors for the 6th industry include the need for income sources and jobs for small and medium farmers and aged farmers, and the need for restoration of rural communities. The external factors for the 6th industry are increasing interest in the pluralistic functions of agriculture, increasing consumer demand for safe agricultural products, and convergence of agriculture and technology. The sixth industrialization of Korea is being implemented through the enactment of related laws and policies, and as of 2016, 6th industrialization certification companies surged more than three times in 2014 [8]. The certification system is a system that the government judges the growth potential, differentiation from existing products, and business mind, etc. among the 6th industrial companies that use local agricultural products and verify the qualification every three years. As the importance and necessity of the 6th industrialization are emerging, related researches are also increasing. The early research on the 6th industrialization was mostly the study on the concept and function of the unfamiliar 6th industrialization and the research on the 6th industrialization situation in Korea [9,10]. After that, there were researches suggesting implications through the case of overseas, mainly in Japan, the 6th industry success case study in Korea, and comparative study between countries [11]. There have been studies of specific perspectives such as studies on the classification of the 6th industry [12,13], studies on the evaluation indicators [14,15], and studies on effects of 6th industrialization [16,17]. Recently, efforts to solve the problems faced by Korean agriculture using the technology of the fourth industrial revolution era have begun to appear, and it seems necessary to conduct research.

3. Intelligence Information Technology and Agriculture. The development of technology has a great impact on economics and business activities, and the fourth industrial revolution based on intelligent information technology has appeared. Since the WEF (World Economic Forum) in 2016, the fourth industrial revolution has been a global issue, but there is still much controversy over the exact nature of the fourth industry [18,19]. However, based on various documents, the fourth industrial revolution can be said to be a change in society, economy and lifestyle of mankind by intelligently connecting and fusing all objects, spaces, industries and people based on the Internet platform [20,21]. In other

words, the fourth industrial revolution means the emergence of a new business model due to optimization through convergence of technology and industry, and weakening of the boundary between industries [20]. The characteristics and technology of the fourth industrial revolution are shown in Table 1 [20].

TABLE 1. The key characteristics and technology of the fourth industrial revolution

	Velocity	Scope	Systems Impact
Characteristics	<ul style="list-style-type: none"> • Rapid technological progress 	<ul style="list-style-type: none"> • Breaking the boundaries and fusing technology 	<ul style="list-style-type: none"> • System dimension changes such as production, management, and governance
	<ul style="list-style-type: none"> • Shorten the time to implement technology 	<ul style="list-style-type: none"> • Broad coverage 	<ul style="list-style-type: none"> • Changes in all systems of society, economy, culture and environment
Technology	Artificial Intelligence (AI), Robotics, Big data, Internet of Things (IoT), Autonomous (Unmanned) driving technology, 3D printing, Nanotechnology, etc.		

The transition to an intelligent information-based industrial society through the 4th industrial revolution can be an opportunity for the agriculture sector with low ICT adoption and digital business. Agriculture is at the initial stage of application of intelligent information technology compared with other industries, so innovation using intelligent information technology is likely to act as a catalyst for problem solving [20]. Agriculture will evolve from past experience-based agriculture to data-based intelligent agriculture by intelligence information technology and in data-based agriculture, the following is possible: determining when to seed based on environmental data, determination of harvest based on quality/distribution information, quality standardization based on commercialization, distribution and sales based on real-time market information, etc.

Kim and Han [22] reviewed the possibility of smart agriculture and high technology convergence through interviews of farmers who successfully operated smart farms. Yu and Lee [23] presented a new model of mobile application social curation commerce service for revitalizing distribution of agriculture, and tried to find a way to communicate smoothly between producers and consumers. Yeo et al. [5] introduced research trends in Korea and abroad on the application of information and communication technology in agriculture sector, and made suggestions for future technologies that can be utilized.

Although related researches are increasing and Korea is a strong country in information and communication technology, the utilization of technology in agriculture is still in its early stage. Therefore, this study will review obstacles to convergence between agriculture through case studies and intelligent information technology and propose an activation plan.

4. Case Study. Korea has a small proportion of processing that can be said to be the core of 6th industrialization compared to Japan, which has been doing 6th industrialization 10 years earlier than Korea [3]. This is believed to be due to the lack of technology, capital, and marketing ability. Therefore, innovation efforts to increase added value should be strengthened for sustainable development and competitiveness of Korean 6th industrialization. Therefore, this paper tries to identify limitations of current situation and suggest implications by analyzing cases of agricultural sector applying fourth industrial revolution technology. Table 2 summarizes the cases, and it can be seen that, in the case of advanced agriculture, private companies continue to develop and practicalize the fourth industrial revolution technology related to agriculture. On the other hand, Korea tends to be developing technology by government so far, and it seems that the private technology or private capital investment in agriculture is needed. It seems necessary to

TABLE 2. The synthesis of domestic and overseas cases applied to the 4th industrial revolution technology in agriculture

		System (Nation)	Core content and achievements
IoT	overseas	• Robot arm garden management (USA)	• Establish standardization of garden management
		• Sparked (Netherlands)	• Early prevention of livestock disease
		• PREMIVM (Portugal)	• Grape management and production management
		• Akisai (Japan)	• Optimal allocation of agricultural materials, increased yield 20 ~ 30%
		• PigWise (Italy)	• Management of pig objects, improving animal welfare
		• SoundTalks (Belgium)	• Prevention of pig disease, antibiotic and decreased mortality rate
	domestic	• N.THING, Inc.	• Mobile growing diary app. (Internet connection)
		• FutureTek, Inc.	• Sensor monitoring, remote strawberry cultivation
		• Clean Seongju Melon Farm Creation Village	• Excellent cultivation information, DB of production farm record, theft prevention
Big data	overseas	• FieldScripts (USA)	• Maximize selection of breeds and seeds
		• Progressive Famer (USA)	• Unmanned agricultural machinery using satellite information, business management
		• SeedStar Mobile (USA)	• Advanced equipment for agricultural machinery, maximize production, decision making
		• Climate Fieldview Pro (USA)	• Climate prediction model, increased profit
		• IoF2020 (EU)	• Datafication all fields of agriculture and link them to business
	domestic	• Korea Animal Health Integrated System	• Predicting the spread of AI in conjunction with KT
		• http://data.mafra.go.kr	• Integrated provision of public and private data
		• Harim bigdata farm	• Accurate forecast
	Robot /Drone	overseas	• Airnov (France)
• Autonomous tractor (USA)			• GPS and data-driven paths and autonomous selection of crops
• Harvest Automation (USA)			• Robots to manage pots: work 9 hours a day
domestic		• Government-supported dissemination pilot project	• Developing self-driving agricultural machinery
		• Rural Development Administration	• Determining amount and timing of milk replacer for calf, realization of welfare
AI	overseas	• LettuceBot (USA)	• Automatic weeding of agricultural machinery, 90% reduction in use of chemicals
		• APP to judge crop disease (USA)	• Identifying disease through deep learning the state of the leaves, 99% accuracy
		• GNSS (Germany)	• Satellite positioning system, ground-based and geological features analysis
		• AgBot (Australia)	• Judge self-fertilization on its own by combining artificial intelligence and drones
	domestic	—	—

recognize that the development of intelligent information technology related companies (industries) and the development of agriculture are going together. This is because the technology convergence of agriculture can be understood as an industrial convergence between agriculture and technology companies. We can hope for the following virtuous cycle structure [24]: intelligent information technology development → commercialization

of intelligent information technology companies → applied to agriculture → improving agricultural product quality and productivity, new product development → increase added value of agriculture, increase farm income → qualitative and quantitative growth of agriculture → increased demand for intelligence information technology and facilities → simultaneous development of intelligence information technology companies (industries). It is time to change direction to develop agriculture and related industries at the same time. Therefore, this study will explore these aspects through CSV.

5. Creating Shared Value for Sustainability. This study is to present the CSV activities for agriculture of the enterprises as a way to solve the rural issues in a sustainable manner. As the influence of the enterprise expanded, expectations and demands for the social role as well as the economic role for the company spread. In this context, CSR (Corporate Social Responsibility) activities that recognize the social problems as corporate costs were considered [25]. However, sustainability is not a simple donation but a win-win relationship that harmonizes corporate interests and social value [26]. Therefore, CSV (Creating Shared Value) presented by Porter and Kramer [27] is attracting attention as an alternative to redefine the social role of a company. CSV considers corporate competitiveness and creation of social value to be interdependent relationships, so for the sustainable development of enterprises, prosperity of society should be preceded, which leads to a virtuous cycle structure that promotes corporate growth [27]. CSV can pursue sustainability by addressing social problem solving and profit creation at the same time.

The convergence of advanced technology and agriculture in Korea is at an early stage and it is having difficulty in spreading the technology to the field [5]. On the farm side, the burden of facility cost, maintenance and difficulty in using technology are being investigated as obstacles to the convergence of agriculture and high technology [28]. Therefore, the utilization of advanced technology in the 6th industry is inevitable to be linked with private companies, and social co-operation through CSV is necessary. The Japanese NTT group is proposing new forms of agriculture using ICT. NTT has developed a system to manage direct sales of agricultural products on the Internet and supports operations such as sales information and sales analysis. The Sunrise Advanced Agricultural Consortium, with Sumitomo, Panasonic and Nissan Motors, is a collaborative project that aims to create a new production model for agriculture by a team of high-tech companies and agricultural corporations [8].

Researches on CSV in Korea can be categorized into conceptual review, effectiveness study, and case study and CSV research on 6th industry is rarely found. In Korea, the study of CSV in the agricultural sector is conducted by Lee et al. [29] and Kang et al. [30] which analyzed case studies of CSV activities conducted by food companies in rural areas. The CSV study or case of technology companies in agriculture is still lacking. However, it is possible to confirm the possibility through ZeroPay (SeoulPay) recently introduced in Seoul. ZeroPay is a direct payment system where money is transferred from the buyer's account to the seller's account when the buyer recognizes only the seller's QR code as an app on the smartphone. The project was started to alleviate the burden on small businesses due to card fees and involved five private payment platform operators and eleven banks. With this system, consumers can enjoy convenient and economical benefits, and sellers can significantly reduce the burden of payment commissions. And for private payment platform operators, this is an opportunity to expand from the online (mobile) market to the offline market. It is still early to judge the achievements, but this is a good example of social co-operation and can be seen as a CSV case for technology companies. This study is meaningful to suggest this possibility of this business model as a solution for sustainability of the 6th industry.

6. Conclusions. It is preferentially necessary to seek the power of development from the inside of the rural area and to revitalize the function of the local community in order to achieve the 6th industry's performance from the viewpoint of sustainability, which is a global issue today. And small-scale agricultural management bodies should increase their efficiency with a network model that cooperates in solidarity with other competent companies due to the nature of the 6th industry, which needs to diversify its business from production to processing, distribution, and tourism. In addition, innovation based on advanced technology will ensure the sustainability of the 6th industry in the era of the fourth industrial revolution. However, it is not easy to innovate value at the farmhouse level, so it has to externally support the high technology and create a new market. In this study, the case of agriculture using intelligent information technology was examined. Through case studies, it can be seen that the utilization of advanced technology in agriculture has the effects such as reduction of production cost and labor intensity, high quality, preservation and safety enhancement. In contrast to the advanced countries in agriculture, Korea has been under the government-led technology development, so it is necessary to cooperate with private companies. Therefore, this study introduces the concept of creating shared value and suggests that social interest in agriculture is important. Although farmers' efforts should be made for the development of agriculture, companies should also take consideration of the public nature of agriculture and move away from the strategy of pursuing only the economic value of the enterprise and need a philosophy about creating shared value that can strengthen economic competitiveness while pursuing economic value and social value together. Companies should strive to create new blue ocean of agriculture based on creating shared value philosophy and government need to mitigate the restrictions on the private sector's entry into agriculture and to have a system to cooperate in this process. This study proposes a new business model of agriculture, but has a limitation that it does not present specific major components of the business model. It is necessary to discuss CSV for agriculture sustainability in more detail in the future. We hope this paper will be the basis for the future research on creating shared value and social cooperation in agriculture.

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