A Study on the Change of Farm Using Artificial Intelligence - Focused on Smart Farm in Korea

Chun Hyunjin 1,a

1 Arts College, Nanjing University of Aeronautics and Astronautics, NJ 211106, China No. 29 Jiangjung Road, Jiangning District, Nanjing 211106, Jiangsu, China

a tough4324@naver.com

Abstract. With the recent climate change, the agricultural environment is rapidly changing. Also, most of the labor population in rural areas moves into cities, which causes a serious labor shortage in rural areas. To solve this problem, governments around the world try to use cutting-edge technologies such as smart farms in agriculture. In Korea, for example, where labor problems are serious, huge research funds are invested in smart farms. And, in this study, I analyzed the technology status of smart farms in Korea. In addition, this research analyzed the operational status of smart farms and predicted future changes in agriculture. The results of the study are as follows. Agriculture has been considered the primary industry of each nation until now, but in the future it will be transformed into a high-value industry combined with artificial intelligence. Also, in agriculture, artificial intelligence will not only be used in crop production, but also in packaging and transporting agricultural products based on big data and clouding technology. As a result, there will also be many changes in the distribution structure of agricultural products. As such, the latest technologies such as artificial intelligence will not only improve the productivity of crops, but also enhance the efficiency of the overall agricultural industry. This results can be used as theoretical basic data when making smart farms using artificial intelligence.

1. Introduction

1.1. Research Background and Purpose
Recent developments in the global economy have caused rapid changes in climate change in Asia. Due to the climate change, the agricultural environment is rapidly changing. There are many problems in the agricultural industry around the world due to abnormal weather conditions such as heavy rain and heat wave. To solve these problems, a change from traditional farming methods to new farming techniques is urgently needed. Especially, agriculture using advanced technology is being developed due to the Fourth Industrial Revolution. Recent agriculture uses latest technologies such as artificial intelligence to create smart farms. In particular, Korea, which has a rapidly decreasing farming population, is investing a lot of research money to create smart farms. In this study, I analyzed the current technology status of smart farms in Korea. I also analyzed smart farm cases using artificial intelligence technology. Finally, this study was to predict the future of the agriculture based on new technology. The findings can be used as theoretical basic data when creating smart farms using artificial intelligence.
1.2. Literature Review

Climate change has a great impact on agricultural production. And governments in each country make various efforts to improve the output of agriculture. In particular, many studies have been conducted on agriculture using cutting-edge technologies such as artificial intelligence. There are also a lot of researches on smart farm. Related researches such as smart farm are as follows. Kim Joo Tae etc. (2017) summarized the opportunities about IoT and smart farm [1]. Kim Tae Hyeong etc. (2017) examined the growth environment information of agricultural crops [2]. Moon Ae Kyeung etc. (2015) investigated evaluating fidelity of lossy compression on spatiotemporal data from an IoT enabled smart farm [3]. Chae Cheol Joo etc. (2018) proposed an authentication method that performs minimum encryption and decryption operations by combining session key and public key to securely control smart farm system [4]. Muangprathub Jirapond etc. (2019) proposed the wireless sensor networks' development for watering crops to optimize agriculture to design and develop the control system between node sensors in the field of crops and the data management via smartphone and web application [5]. O'Grady Michael J etc. (2017) presented an overview of models within the farming enterprise; it then reviewed the state-of-the art in smart technologies that promise to enable a new generation of enterprise-specific models that will underpin future smart farming enterprises [6]. Francisco B. Culibrina etc. presented fuzzy logic algorithm for Power Efficiency, Reliable Irrigation, and Temperature Control (PERITC) of Smart Farm [7]. Existing researches are mostly about the latest technology related to smart farms. But researches on agricultural changes due to new technologies are lacking. There are also lack of researches on rural changes by smart farms. So this study analyzed the current smart farm technology and future changes in agriculture. In addition, this study suggested a direction for future agriculture based on the results of the research. And these findings can be used as theoretical basis for smart farm research using new technologies such as artificial intelligence.

2. Research Method

The research method of this study was literature survey on smart farm using new technology such as artificial intelligence. The literature survey data used in this study were related papers, newspapers, books, news, and reports. And then, based on the literature survey, the field survey of the target areas related to smart farms was conducted. In particular, the research targets were smart farms located in Korea. This is because the Korean government actively invest smart farms that use high-tech technologies. And, I visited smart farms that were practically operating in Korea and conducted in-depth interviews with related people, including farmers. Subjects to in-depth interviews were divided into farmers who run smart farms and experts who are policy technical experts. Based on these in-depth interview results, this study evaluated the operation of smart farms. In addition, this study analyzed future transformations in agriculture.

3. A Theoretical Study on Smart Farm

3.1. Smart Farm

Smart farm is a farm that can automatically manage crops and livestock by utilizing advanced technologies. Until now, farmers have produced crops based on intuition and experience. However, cutting-edge technology has been able to automatically produce crops. Farmers can also manage their farms regardless of time and place based on accurate environmental data. If there is a problem with the farm, the farmer can immediately solve this problem based on the plant information data. And smart farms will be able to improve the productivity of their crops based on artificial intelligence. Artificial intelligence can also be used in the distribution of crops. And governments in each country have strong interest in the technology of smart farms because they want to strengthen their agricultural competitiveness by creating smart farms in the countryside. So governments are willing to invest a lot of money in creating smart farms.
3.2. Application of Smart Farm

Modern agriculture combines a variety of technologies, unlike that in the past. And, smart farm has a variety of technologies. Typical technologies used in smart farms include the following: First, information management system is located in smart farm. This information management system analyzes the growth environment of crops in real time. The system also provides the most appropriate environmental information, while the environmental information of crops is a very important factor in improving crop productivity. And, artificial intelligence analyzes the growth information of crops through multiple sensors. Second, there is an integrated equipment system in smart farms that controls hot water and humidity. Temperature and humidity are very important factors because they have a great influence on crops. And, artificial intelligence can controls temperature and humidity (figure 1).

![Figure 1 Application Principle of Smart Farm](image)

4. South Korea's Smart Farm

4.1. South Korea's Smart Farm Technology

![Figure 2. Korea's Smart Farm Greenhouse Utilizes the Latest Technology](image)
The Korean government tries to spread smart farms to improve the productivity of agriculture. Especially, smart farms in Korea invest a lot in greenhouses (figure 2). The purpose of building smart farms is to improve the productivity of crops. And smart farms provide the most appropriate environment for crops. In addition, smart farms can develop accurate crop growth models by predicting the timing and yield of crops. Also, greenhouse cultivation is very important in Korea because there are four distinct seasons, due to which there are many studies of greenhouse in Korea. When crops are produced in greenhouse, their growth process is analyzed using imaging devices. And the government collects plant data and analyzes the plant growth model. Data analysis utilizes big data technology. In that way, the Korean government wants to complete the smart farm platform and distribute it to rural areas. And there are several successful smart farm operations in Korea. The success story has come out in the cultivation of tomatoes. Tomato production has increased by 30% and fuel costs have decreased by 40% compared to previous data.

4.2. Smart Farm Using the Internet of Things

The Internet of Things is a communication technology among various objects. In other words, it is a technology in which each objects communicate with each other through the Internet. In general, the Internet is connected through a computer or smartphone. However, the Internet of Things means the technology to connect various objects such as chairs and beds. This connection expands into space, not just within objects. Also, space is connected to objects through the Internet. Internet of Things can have a lot of influence in a variety of fields. In particular, Internet of Things is being applied to smart farms. The greenhouse in smart farms automatically adjusts the temperature according to the outside temperature. Currently, people directly adjust the temperature according to changes in the outside temperature. However, with the development of Internet of Things technology, various objects will be able to replace people's work. Internet of Things basically attaches sensors to various objects. And various objects with sensors communicate with each other. There are many different objects on the farm. And the output of crops varies greatly depending on the external environment. So various objects can automatically provide the best environment for crops. Until now, humans have directly provided a suitable environment for the crops themselves. However, the development of the Internet of Things will cause farms to solve problems themselves without human manipulation. Sensors, in particular, collect environmental information on crops such as temperature, humidity, and heat. Sensors then share plant information among various other objects. Currently, Korea is increasing productivity of farm products by adjusting light, water and temperature through the Internet of Things.

4.3. Plant Factory

Plant factory is an important technology in smart farms that produces crops based on various electronic technology in indoor spaces. It artificially controls the environment, such as light, temperature, and water, to improve the production of crops, and can also produce crops regardless of season and space, just as factory produces products. Especially in Korea's smart farm technology, plant factory is very important. Generally, the technology of plant factory can be used in greenhouses, thus the Korean government invests a lot in greenhouses now. However, there is a significant difference between a plant factory and a greenhouse. Greenhouse is a technology to increase indoor temperature by blocking some of the external environment, while plant factory is a technology that controls all environments artificially by blocking all outer space. So many electronics companies invest in plant factory business based on electronic technology. The Japanese electronics company builds a plant factories in Dubai to produce strawberries [3]. Also, Korean companies invest heavily in the construction of plant factory. Especially, LED lighting technology is important to produce factories regardless of weather since it can not only increase production but also shorten the cultivation period. In many advanced countries, there are many researches on the technology of producing crops in space. Many researchers also study techniques that utilize plant factories in polar region such as the South Pole and the North Pole. Moreover, they build plant factories in the urban area to produce crops.
5. Change of Future Farm
Due to a decline in the global farming population, agriculture meets the problem of labor shortage. To solve this problem, most countries around the world try to develop smart farm technology to agriculture. Especially when artificial intelligence is applied to agriculture, it will have a great impact on the productivity of the crops. Also, the artificial intelligence will turn greenhouses into intelligent greenhouses. As a result, crop production will be very high and farm income will be improved. And agriculture will further develop into a high-value industry in the future. Specific changes to future farms are as follows (figure 3).

![Figure 3 Changes in the Future Farm](image)

First, smart farms will automatically regulate the temperature through sensors and automatically supply the right nutrients to the crops. Second, farmers will use cameras installed on their farms to check the status of their crops and remotely control the environment for their crops. Third, farmers will use artificial intelligence to pinpoint the harvest time of their crops. Fourth, the government will use big data to provide farmers with information on the exact timing of their planting and the optimized environment. This information will improve agricultural production [8]. The Government in each country will also make international standards on agriculture based on big data. This standardization of agriculture will develop the agricultural industry around the world. Fifth, farmers will use robots to replace farm machines. And hard work will be replaced by robots. Robots will also have the ability to grow crops and harvest crops.

6. Changes of Agriculture
In the future, Great transformation will be undertaken in industries related to agriculture. In agriculture, artificial intelligence does not just end up in crop production. Artificial intelligence will be applied to in various rural areas. For example, in agricultural areas, people can utilize artificial intelligence to use education, culture and tourism in the local communities. Through this technology, local economic revitalization of rural areas will be achieved. And based on big data and clouding technology, artificial intelligence will also be available in packaging and transporting agricultural products. As a result, there will also be many changes in the distribution structure of agricultural products. As such, the agricultural industry will change greatly in the future by utilizing artificial intelligence. And this technology will not only enhance the productivity of crops but also enhance the efficiency of agriculture. Also, in the future, more and more young people would like to participate in agriculture-related work.
7. Conclusion
Climate change is rapidly affecting the agricultural environment around the world. Due to this change, governments of most nations invest heavily in smart farm research based on cutting-edge technologies such as artificial intelligence. South Korea, which has a rapidly decreasing rural population, is particularly interested in smart farm technology. So, this study analyzed the state of technology for smart farm in Korea. The results of this study about smart farm in Korea are as follows. First, Korea's smart farm to identify the state of crops and provide the most appropriate environment with the help of artificial intelligence. Second, smart farms can develop accurate breeding models by predicting the timing of crop yields. Third, in greenhouse, imaging devices can be employed to analyze the growth process of crops. In the meanwhile, changes in future agriculture are as follows. Artificial intelligence will be used in a variety of rural areas. However, artificial intelligence in agriculture does not just end up in crop production. For example, based on big data and clouding technology, artificial intelligence could also be used in packaging and transporting agricultural products. As a result, there will also be many changes in the distribution structure of agricultural products. With the use of artificial intelligence in the future, the agricultural industry will change greatly. This study presented the future direction of agriculture through the application of the latest technology. And the results of this study can be used as theoretical basis for smart farm research using artificial intelligence. Future research are suggested to evaluate the operation and results of various smart farms.

Acknowledgments
The project was supported “the Fundamental Research Funds for the Central Universities”, NO. NJ2020040. The author expresses their gratitude for the fund support.

References
[1] Kim Joo Tae et al. 2017 Agricultural Management Innovation through the Adoption of Internet of Things:Case of Smart Farm. Journal of Digital Convergence. 15 Vol 3 pp 65-75
[2] Kim Tae Hyeong et al. 2017 A Model Study for Development of Evaluation Criteria for Smart Farm Horticultural. Journal of the Korean Convergence Society. 8 Vol 9 pp 339-345
[3] Moon Ae Kyeung et al. 2018 Evaluating fidelity of lossy compression on spatiotemporal data from an IoT enabled smart farm. Computers and Electronics in Agriculture. 154 pp 304-313
[4] Chae Cheol Joo et al. 2018 Enhanced secure device authentication algorithm in P2P-based smart farm system. Peer-to-peer networking and applications. 11 Vol 6 pp 1230-1239
[5] Muangprathub Jirapond etc. 2019 IoT and agriculture data analysis for smart farm. Computers and Electronics in Agriculture. 156 pp 467-474
[6] O’Grady Michael J et al. 2017 Modelling the smart farm. Information Processing in Agriculture. 4 Vol 3 pp 179-187
[7] Francisco B. Culibrina et al. 2018 Fuzzy Logic Implementation for Power Efficiency, Reliable Irrigation, and Temperature Control of Smart Farm. Journal of Advanced Computational Intelligence and Intelligent Informatics. 22 Vol 5 pp 699-703
[8] Hong-Keu Jo et al. 2018 Design and Implementation of Smart Farm Wireless Network: LoRa and IEEE 802.11 Wireless Backhaul Network. The Journal of Korean Institute of Communications and Information Sciences. 43 Vol 5 pp 850-1862