

A Study on the Analysis of Agricultural and Livestock Operations Using ICT-Based Equipment

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Abstract

The paradigm of agriculture is also changing to address the problem of food shortages due to the increase of the world population, climate conditions that are increasingly subtropical, and labor shortages in rural areas due to aging population. With the development of Information Communication Technology (ICT), our daily lives are changing rapidly and heralds a major change in agricultural management. In a hyper-connected society, the introduction of high-tech into traditional Agriculture of the past is absolutely necessary. In the development process of Agriculture, the first generation produced by hand, the second generation applied mechanization, and the third generation introduced automation. The fourth generation is the current ICT operation and the fifth generation is artificial intelligence.

This paper investigated Smart Farm that increases productivity through convergence of Agriculture and ICT, such as smart greenhouse, smart orchard and smart Livestock. With the development of sustainable food production methods in full swing to meet growing food demand, Smart Farming is emerging as the solution. In overseas cases, the Netherlands Smart Farm, the world's second-largest exporter of agricultural products, was surveyed. Agricultural automation using Smart Farms allows producers to harvest agricultural products in an accurate and predictable manner. It is time for the development of technology in Agriculture, which benchmarked cases of excellence abroad. Because ICT requires an understanding of Internet of Things (IoT), big data and artificial intelligence as predicting the future, we want to address the status of theory and actual Agriculture and propose future development measures. We hope that the study of the paper will solve the growing food problem of the world population and help the high productivity of Agriculture and smart strategies of sustainable Agriculture.

Keywords: *Smart Farm, ICT (Information Communication Technology), Agriculture, Livestock*

1. Introduction

The agricultural industry is an economic paradigm that fosters new markets and industries through the fusion and integration of agriculture, rural areas, science and technology and ICT to create quality jobs. [1]. In a hyper-connected society, ICT is the foundation of a creative economy and information and com

munication technology that combines information technology and communication technology. Big data, wearable, mobile, and the IoT are open to creative possibilities for connecting people and people, people and things. ICT is an information and communication technology that combines information technology and telecommunication technologies. Examples of the ICT industry include mobile content, enterprise-wide mobile programs, e-learning, social networks, platforms, smartphones, apps for tablet PCs, cloud and remote classes as shown in Picture 1 [2].



Figure 1. Smart farming

IoT is an environment where embedded technologies are applied and information is shared by connecting objects to wired and wireless networks. Big data is called big data technology, which means a variety of data, which is scientifically analyzed and utilized in industrial sites. ICT enhances existing goods and services and creates new ones. The fast and convenient Internet transforms our economy into a digital economy, and this service means customized, personalized services and beyond the limits of time and space, it serves as the basis for connecting and communicating anytime, anywhere.

ICT in Agriculture observes farms through CCTV of the organic monitoring system, and controls farms with a control equipment drive system based on optimal reproductive conditions through big data analysis. ICT Agriculture aims to have higher productivity and sustainability than conventional farming methods. In other words, with the development of sustainable food production methods in full swing to meet growing food demand, Smart Farm is emerging as the solution. The automation of Agriculture using Smart Farms allows producers to harvest agricultural products in an accurate and predictable manner, addressing food problems in the world's population and enhancing agricultural productivity.

2. Main text

2.1 Smart Farm Orchard

Agriculture, which has recently been in trouble, has recently been converging with cutting-edge technology to transform itself into "Smart Agriculture" [3]. Green technology using solar power, LED, geothermal heat and power plant waste heat plays an important role in smart farming. Smart Farm is a combination of smart and farm, a word that refers to a system that improves productivity by incorporating artificial intelligence, big data, the IoT and information systems into traditional farming-style Agriculture [4]. Smart Farm monitors temperature, humidity, and weather conditions through PC or mobile, and increases productivity by remote, automatic irrigation, and pest control. Using technologies such as the IoT, big data, artificial intelligence, etc.,

the environment of growing crops, Livestock and marine products can be properly maintained and managed remotely through PCs and smartphones, enhancing not only efficiency of production but also convenience. [5]

Smart Farm technology using ICT technology enables precise management and prediction of each stage of production based on accurate data on environmental information (temperature, relative humidity, light volume, carbon dioxide, soil, etc.) and information on growth, thereby enhancing profitability by improving yields and quality. In addition, production costs can be reduced by efficiently managing labor and energy. In preparation for the fourth industrial revolution, Yonam College, which is the only Smart Farm major in Korea, has a state-of-the-art smart greenhouse practice environment through technology agreements with the Netherlands. Practical hands-on training in high-tech raw crop production, crop monitoring, big data management in greenhouses, ICT and agricultural bio (Green-bio) fields is being conducted using Smart Farm facilities equipped with state-of-the-art environmental control systems. The Smart Farm orchard consists of the outside and inside of glass greenhouses, and crops such as paprika and strawberries are being grown as shown in Picture 2 [6].



Figure 2. Yonam college smart farm orchard

2.2 Smart Flower Farm

Smart Flower Farm monitors the temperature, humidity, and CO₂ of greenhouses through PC or mobile CCTV, and maintains and manages the optimal growth environment by remotely controlling the opening and closing of windows and supplying nutrients. Flower Farm, located in Chuncheon, has installed a CES carbon fiber heating system in a vinyl house to operate the farm with energy saving and heat control. The CES Carbon Fiber Heating System is a direct-heat-free heating system that is optimized for smart farm greenhouse heating, as well as reduces the energy costs of electric and fossil boilers as shown in Picture 3 [7].



Figure 3. Smart flower farm

The "energy-reducing greenhouse heating and air conditioning system" is a technology that allows carbon fiber heating cables to be inserted into heating air-conditioning tubes to save energy 70 to 80% and 45 to 50% compared to fossil boilers. Another characteristic of the technology is that it does not require ancillary heating facilities such as boilers and heat accumulators, which are efficient in space utilization and can prevent fires due to the nature of carbon fiber that cannot be ignited. It is evaluated as an optimal heating system in the Smart Farm field as it is free to design by type, such as partial heating or individual heating. It suggests the possibility of a depressed floriculture industry due to increased output and increased profitability.

Growpipe, which is used only for glass-greenhouse heating, is heated closer to the growth point of the crops in soil cultivation, making it more efficient to control the temperature at the time of birth. During the heating period, the height of the crop is adjusted according to the growth of the plant so that the growth point is kept warm as shown in Picture 4 [8].



Figure 4. Growpipe, CES Carbon Fiber Heating

2.3 Smart Livestock

Smart Livestock refer to high-tech farms that combine with Livestock and Livestock facilities to manage Livestock and Livestock environment through smart phones, regardless of time and location. By utilizing ICT or smart technologies, the government automatically or remotely manages diseases, feed automation, odor improvement, and screening of Livestock, ICT is technology such as CCTV, sensor, IoT, AI, and Big data.

The smart Livestock automatically adjusts the temperature, humidity, and odour of congratulatory speech, measures the amount of exercise and body temperature of Livestock to detect diseases early on, predict conception at the right time, and automatically supply feed and water as shown in Picture 5 [9].



Figure 5. Smart livestock < Rural Development Administration >

The Ire Farm, a model farm in Yangju, Gyeonggi Province, South Korea and the Netherlands, is a model farm built under the "Korea Pocket Productivity Improvement Project". It was established with 1,815m² of "Development raising hog house" which stays until the pig is slaughtered after it is milked, and 2,831m² of "Breeding hog house" where the pig is born and lives with its mother pig while it is being fed. It is a smart congratulatory speech with state-of-the-art facilities and advanced technologies in the Netherlands such as automatic pay systems and ventilation systems that automatically supply feed as shown in Picture 6 [10]. The best strength of smart Livestock, facilities and well-ventilated mechanized system. With the introduction of information and communication technology, we are conducting scientific analysis and technology-based manpower management, and farm operations are moving on smartphones. If the ventilation system has the optimum inlet and exhaust air flow according to temperature and humidity, the ventilator will automatically turn and maintain the correct value. The farm stops after automatically setting the proper environment for power outages. In addition to ventilators for ventilation, a humidity control system and CCTV that examines the condition of money-losing are operated and checked. If there is a problem with the system, the smart phone will notify you immediately, so you can respond quickly. Prior to the introduction of ICT, the company operated with "feel" from experience, but proper figures such as temperature and humidity are also dataized and automatically operated as shown in Picture. At the beginning of the farm operation, the rate of closure decreased from 30% to 0.3%, and the number of units shipped per pack is increasing and productivity is improving.



Figure 6. Smart ventilation system, Automatic supply system

3. Overseas Smart Livestock Cases (Netherlands)

The Netherlands, the world's second-largest exporter of farm products, has Smart Farms with a variety of ICT solutions including precision equipment, IoT, sensors, geo-positioning, big data, unmanned aircraft, robots and more as shown in Picture 7 [11]. It has been grafted. Based on the above technologies, it has higher

productivity and sustainability than conventional farming methods by accurately and efficiently using resources. With the increase of the world's population, food production should be more than 70% higher than the current level by 2050, and with the development of sustainable food production methods in earnest to meet the growing food demand, Smart Farming has been introduced as the solution. The use of smart equipment allows a small workforce to manage a wide area of arable land, reducing labor costs, creating a yield map that shows the yield by area, or obtaining information on the estimated yield.

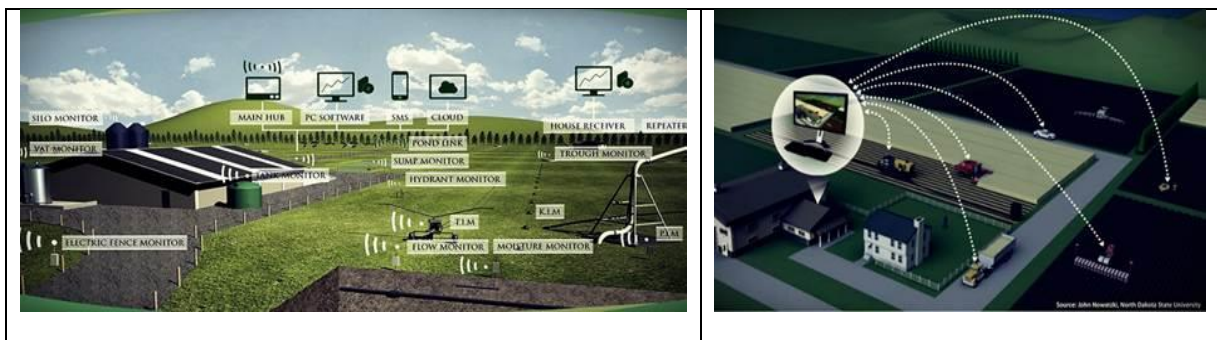


Figure 7. Utilizing smart technology

The Smart Dairy Farming Foundation, launched in 2011, was established by the Dutch government and companies to promote the introduction of innovative technologies into dairy farming, such as the digitalization of cattle. Smart Dairy Farming is increasing cow health by supporting dairy farmers with technologies to manage cows individually, resulting in increased cow life and milk production. To this end, various kinds of sensors, decision models, products for process description and advice were developed. The process in which precision-accelerated specification (PLF) technology is used is as follows. The growth process of Livestock, including breeding and beef, improved quality of milk and increased egg production, observation of aggressive behavior of Livestock or sensitive behavior that can be seen in pregnancy. Early detection of infectious diseases such as individual Livestock diseases or avian influenza, control of temperature and ventilation, and improve hygiene and cleanliness of congratulatory speech through the management of excrement. The OVALERT product is attached to a cow's feet or neck to indicate its reproductive capacity. The information from cattle collected through OVALERT can be accessed through the farmer's smartphone or tablet PC through software called Veemanager as shown in Picture 8 [12]. Based on the information collected, the farm owner can quickly take action in the event of a problem with the reproductive capacity of the cow. Through this process, Livestock are managed in an optimal way and productivity is increased.



Figure 8. OVALERT products from CRV

4. Conclusion

Smart Farm is a fusion of modern information and communication technology, or ICT, into Agriculture, and is called the third green revolution after genetics. With the development of sustainable food production methods in full swing to meet the growing demand for food, Smart Farms are an essential solution. Now, the development and utilization of Smart Farms technology to respond to changing market conditions and demand are important. Also, we need more development of our technology to meet the reality of our Agriculture rather than introducing Smart Farms technology overseas. The use of big data, the dismissive of Smart Farms, plays a key role in the development of sustainability in Agriculture, so information sharing on various Livestock-related data collected should be made. The continued development of Smart Farms will play a major role in securing domestic Livestock competitiveness, so we plan to conduct further research.

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