

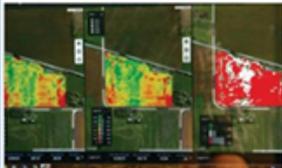
PRECISION AGRICULTURE CREATES NEW BUSINESS OPPORTUNITIES

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CURRENT STATUS AND FUTURE PROSPECT OF SMART AGRICULTURE

Precision agriculture is generally defined as systematic agriculture for the purpose of expanding farmers' profits by utilizing technology to analyze collected data with regards to weather, soil, growth of crops, etc. This report is specifically intended to present a system to support the management of farmers for the above purpose (Figure 1). The system described below consists of a sensor, with which the information such as growth is collected, the data analysis obtained by that sensor, and software that presents optimal fertilizer, etc. based on the analysis results. Around 2000, in the agricultural sector, remote sensing instruments with GPS started to be put into practical use, and thereby, the growth of crops for each farm started to be made available as digital data. Subsequently, in conjunction with relevant technological advancement, top US agriculture machinery manufacturer John Deere and leading US fertilizer and seed company Monsanto, as the main players, have been promoting widespread utilization of precision agriculture. Currently, Monsanto is planning to expand the cultivation area, primarily in the U.S., adopting the fee-based Precision Agriculture System¹ provided by Monsanto-affiliated The Climate Corporation from 5.6 million ha in 2016 to 120 million ha (about 60% of the North American cultivation area in the U.S.) in 2025. On top of that, precision agriculture is expected to be a technological solution for global issues such as population growth, uneven distribution of resources, climate change, environmental pollution, constraints on appropriate locations for food production, and the growing seriousness of food shortages due to the decrease in agricultural population.

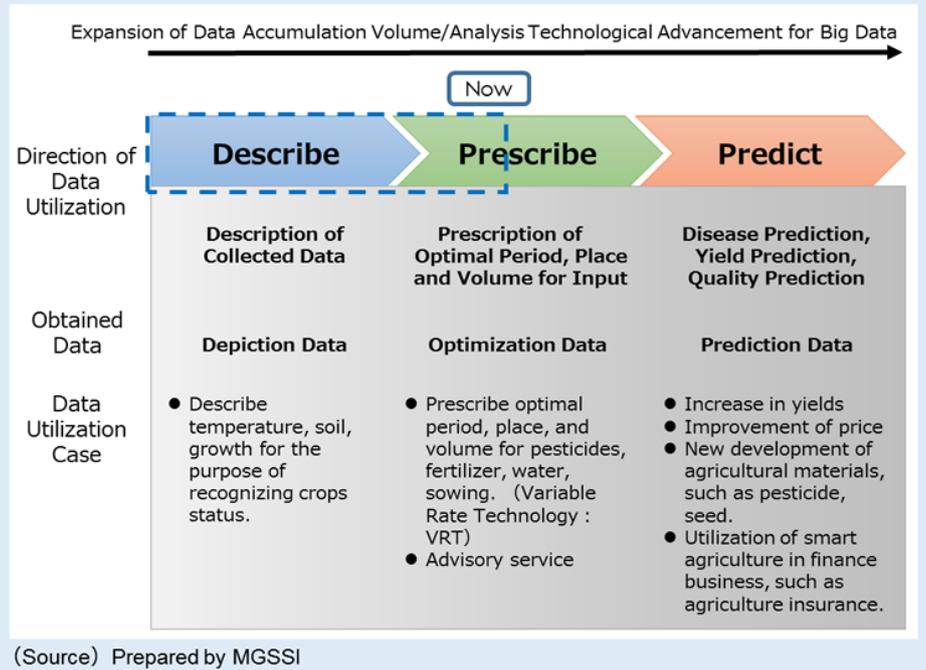
Figure 1: Reference Example of Smart Agriculture

	Soil Sensor	Remote Sensing of Farm	Harvest Sensor	Agricultural Machinery Equipped with Software
Image				
Overview	Contribute to analyzing a moisture status of soil by measuring temperature, humidity, wind speed, amount of precipitation.	Contribute to making a judgement on harvest time by measuring growth situation with GPS.	Contribute to analyzing nutrition status of soil, etc. by measuring water volume, nutrients, etc. of the harvest at harvest time.	Fertilize appropriately the relevant field, based on data obtained by sensor, etc. and analysis results.

(Source) Images from John Deere website

The technological advancement of precision agriculture is broadly classified into three phases, as shown in Figure 2. In the case of vertical farming, where the growth environment for plants is fully controlled, it is feasible to optimize input of pesticides, fertilizer, water, etc., to produce high value agricultural products² and to estimate yield for those products now. However, production in traditional outdoor farming depends on many hard-to-guess factors, such as weather conditions, and therefore yield prediction for such agriculture is very difficult. Therefore, currently most systems are only describing collected data. And only some of the systems function to prescribe a decrease in the excessive volume of water and nitrogen fertilizer used for main crops such as corn and soybeans. In the future, it will take three years at the earliest for accumulation of various data and advancement of analysis technology based on scientific expertise to enable the prescription of optimal period, place, volume, and other factors for pesticides, fertilizer, water, and sowing. Furthermore, prediction of yields, disease, and quality also become possible. Precision agriculture can reduce cost by optimizing those inputs and increase revenue by improving price as a result of increased yield and improved quality, and thereby contribute to expanding farmers' profits³.

Figure 2: Technological Advancement of Smart Agriculture



VALUABLE DATA OBTAINED BY PRECISION AGRICULTURE

With precision agriculture, farmers can break away from existing agriculture management dependent on experience and intuition, and realize efficiency of agriculture management in accordance with the data related to optimization of input, prediction of yields, etc. According to Monsanto and other seed manufacturers, the main data contributing to the optimization of those inputs is considered likely to be utilized in approximately 3-5 years regarding main crops such as corn, soybeans, wheat, and cotton. Along with this, potential new business, such as 1) timely and appropriate material supply based on data, 2) package supply of materials such as pesticides, fertilizer, and seeds, and 3) advisory services, including proposing new materials, is expected to expand for companies supplying agricultural materials.

Moreover, yield prediction data is considered likely to be utilized within 5 years in the case of corn, and in approximately 5-10 years for other crops. Although the prediction data obtained by precision agriculture will be created with a time-delay compared with the optimization of input, that data will highly contribute to businesses related to agriculture and has the potential to earn more profits than the case of advisory services. For example, in the case of pesticide business, that data is expected to be utilized in the development of pesticides taking

into consideration the causes of disease, and therefore more effective pesticides will be able to be provided. Also, in the case of seed business, the digital simulation of breeding seeds on a PC becomes possible when combining that data with genetic information of seeds. As a result, improved varieties can be achieved in a short term, because growing tests are kept to a minimum. Furthermore, in finance business, that data can be utilized for agricultural insurance, and its utilization enables the development of new insurance products and the expansion of the targets for insurance. In addition, utilization of agricultural insurance that requires only information on correlations between yields and diseases is surmised to start earlier than the development of pesticides and seeds, which requires precise information.

NEW BUSINESS OPPORTUNITIES REGARDING DATA

As mentioned above, the data obtained by precision agriculture is supposed to be utilized not only by advisory services for farmers, but also by businesses related to agriculture. That is to say, it has the potential to generate more profits than the case of advisory services. This indicates that new business opportunities exist in platform-type business that offers farmers precision agriculture at a low price for the purpose of data acquisition and utilizes the data from those farmers. On the other hand, when a platform provider itself possesses technologies such as sensors, analysis, and software whose speed of improvement and advancement is outstanding, the risk of technological obsolescence is high. Therefore, it is desirable for a platform provider to select the optimal technology appropriately, offer precision agriculture to farmers at a competitive price, and thereby strengthen the earning power of its own business by utilizing obtained data in new business, such as seed business, pesticide business, and agriculture insurance business. Promising candidates that engage in platform-type business include pesticide/seed companies, agricultural machinery companies and trading companies having many channels to agricultural material companies.

Monsanto, a company with huge financial power, promotes precision agriculture by utilizing its business network for selling its own pesticides and seeds, and thereby accumulates relevant data. This indicates that Monsanto aims to utilize such data in order to develop pesticides and seeds on its own. Reportedly, Monsanto is now examining a cost model. Actually, it is speculated that Monsanto will give first priority to dissemination of precision agriculture to farmers, restraining usage charges. Syngenta, a pesticide and seed manufacturer, is aggressively working on precision agriculture by way of creating a platform for accumulated data relating to irrigation. Moreover, it is inferred that Syngenta utilizes that data for finance business, because it already has started to develop financial services.

TARGET FOR ENTERING THE PLATFORM-TYPE BUSINESS

When entering platform-type business, differentiation in crop types, areas, and other factors from companies that have already started to engage in that business needs to be encouraged.

Type of Crops

The abovementioned companies target large-scale crops. Therefore, high-value added crops such as rice, vegetables, wine grapes, etc. are considered to be appropriate for new business opportunities.

Rice: Institutions such as the International Rice Research Institute (IRRI) in the Philippines have accumulated data and scientific expertise on rice, and thereby their data is highly likely to be utilized at an early stage. On

top of that, engagement with rice production is often conducted by public organizations such as a state body. Against that background, consensus building with the people involved is needed.

Vegetables: Precision agriculture plays a large role in increase of demand and pursuit of functionality. The period of data utilization for vegetables is delayed compared with main crops. However, a seed company, which develops mainly vegetables, has been accumulating data and scientific expertise. That is why earlier utilization of data can be expected through cooperation with such companies.

High Value-Added Agricultural Production: Precision agriculture plays an important role in many fields, including optimization of inputs. That is why cooperation with the region is required for the purpose of utilizing the data and expertise that have been accumulated in the region.

Area

Other than North and South America, where precision agriculture is already being promoted, Europe and Asia, including Japan, are cited as candidate sites.

Europe: Various kinds of crops need to be managed at a single farm simultaneously. This is the European farm type, which is different from the large-scale farm for cultivating a single kind of crop in North America. Under this circumstance, new business entry by proposing new precision agriculture is feasible, and at the same time, various kinds of data can be expected to be obtained at a single farm.

Japan: The mechanism where data on a field's environment and growth is shared for the sake of being used has already started to be examined. However, this mechanism is prioritized for use in solving issues such as aging farmers and decreased agricultural population. Examination of business utilizing precision agriculture is delayed; therefore, earlier entry into such business offers a great advantage.

Asia: In some regions, the environment for agriculture production is not fully managed. Also, the production method is not established depending on the crop. Therefore, governmental cooperation in various fields, including infrastructure building, is vital. Due to the similarity in small-scale agriculture between the rest of Asia and Japan, the focus will be on business expansion from Japan to the Asian market.

Key to its Prevalence

The most important point for operating a platform-type business is how to promote precision agriculture to farmers. For farmers, precision agriculture is one of the solutions to resolve the management issues that farmers face. That is why precision agriculture needs to appropriately satisfy farmers' requirements. Specifically, the following correspondences are needed: 1) precision agriculture needs to be promoted in cooperation with companies (pesticides, seeds, agricultural machinery manufacturers, sales of materials, etc.) that have good access to farmers and existing relationships with farmers and can build good relationships with them; 2) the charge for use of the system might need to be reduced as much as possible in terms of increasing the number of users; 3) as for handling of data provided by farmers, due care is required. Data ownership is generally attributed to farmers, while the company that obtains such data is allowed to use it for improving the service and operation of that company and is regarded as not having the right to sell such data. This requires such

company to explain that obtained data is to be utilized for the farmers' benefit. To promote precision agriculture, satisfying each of these correspondences (1-3) is the key.

1 The Climate Corporation provides mainly US farmers with the information regarding optimal fertilization method and seeding time, based on data on weather, soil, and growth of crops. For example, it has developed a paid service (1,499 USD/year for up to 1,000 ha).

2 As an example of high value-added agricultural production, baby leaves with high nutritional value (carotene, polyphenol, etc.), tomatoes with high sugar content, and lettuce with low potassium are cited.

3 Farmers' economic profit can be represented as follows: Revenue (Yield per unit area * Cultivation area * Price per unit yield) – Input (Pesticide cost + Fertilizer cost + Water supply fee + Seed cost + Land fee + Personnel cost...).