AGRICULTURAL DATA COLLABORATION PLATFORM: WAGRI
- SYSTEM STRUCTURE AND OPERATION -

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ABSTRACT

The National Agriculture and Food Research Organization (NARO) established the Research Center for Agricultural Information Technology in October 2018 to lead data-driven agriculture. The research center's missions are agricultural AI study, the operation of agricultural data collaboration platform (WAGRI), and the construction of infrastructure for the study of AI, including database and supercomputer systems. The WAGRI prototype was developed through the Cross-ministerial Strategic Innovation Promotion Program (SIP) funded by the Cabinet Office of Japan as a data infrastructure with a hub function connecting agricultural data for private sectors. Private sectors will evolve new businesses using data connection; in other words, WAGRI is a central system in the corporate area. WAGRI began full operation by NARO from April 2019, since the basic system of WAGRI was completed. WAGRI offers agriculture-related data such as on fertilizers, pesticides, farmlands, weather, soil, rice varieties, and so on. NARO provides research findings, such as soil maps and crop growth models, to WAGRI. Besides these, NARO has licensed some programs (algorithms) to private companies to connect with WAGRI. Several private companies have begun seeking new business services using WAGRI's data. Considering global data science, the rapid growth of utilization of agricultural big data is a major international trend. Global collaboration will be necessary among agricultural data platforms in Asia and worldwide.

Keywords: Data collaboration platform, big data, application programming Interface (API), ICT service

Introduction

The new era of data-driven agriculture has begun. The Japanese government promotes "Smart Agriculture," including robotic technology, ICT services, big data analysis, artificial intelligence (AI), and data collaboration (Ministry of Agriculture, Forestry and Fishery, 2019). The promotion of smart agriculture is not isolated to these domains but extends to safety rules for robotic tractors, the education of farmers (improvement of ICT literacy), open innovation, standardization of agricultural terms, and so on.

At present, agricultural data, such as yield, temperature, water level, and tractor work, are collected but stored privately by each company. These data formats were varied, as shown in Figure 1. Therefore, the collected data are limited to being used within companies or institutes. Conversely, data collection and big data analysis are extensively internationally driven by data platforms such as GAFA, a leading AI application service. These data collections include understanding private purchase behavior, matching supply and demand, optimal operation of machines or systems, autonomous driving, etc. Open innovation would be expected as a result of sharing data. Therefore, the agricultural data collaboration platform (WAGRI) was developed.

The prototype of WAGRI was developed through the Cross-ministerial Strategic Innovation Promotion Program (SIP) funded by the Cabinet Office of Japan as a data infrastructure with a hub function connecting agricultural data for private sectors on a public cloud (Shinjyo, 2018). As a result, private sectors can evolve new businesses using data connection. In other words, WAGRI is a central system in the corporation area. WAGRI commenced full operations under NARO in April 2019 after its development by SIP. In its full operation it would be important to consider a stable system operation,

increased content, the preparation of data handling rules, the usage fee, and the promotion of WAGRI.

This paper describes the structure and operation of WAGRI and discusses the future vision of agricultural data collaboration.

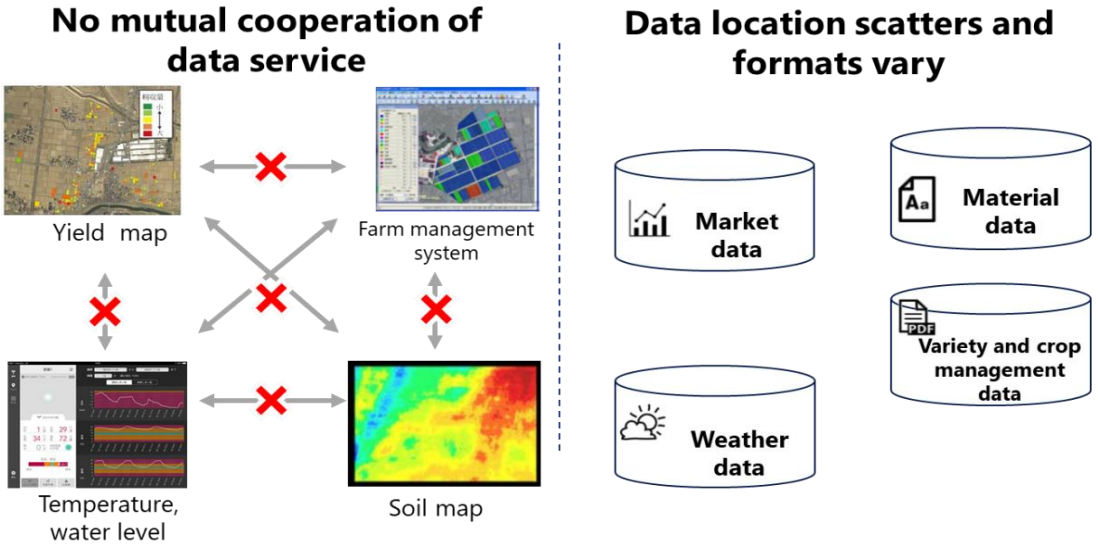

Figure 1. Current state of agricultural data

THE STRUCTURE OF WAGRI

The WAGRI commenced full operations under NARO in April 2019. The full operation means its social implementation in business. Accordingly, NARO recruits private companies, universities, and public institutions to participate, for a fee.

Figure 2 shows the structure of WAGRI. WAGRI is an agricultural data collaboration platform connecting data between data providers and users, such as data concerning the climate, farmlands, maps, and soils, using the Microsoft cloud system. Information is stored publicly. WAGRI also has a private and master data area. Each data set has an Application Programming Interface (API), resulting in data users being able to withdraw information and improve their service easily. Eventually, farmers will be able to select a service that fits their farming scale and style. As shown in Figure 1, WAGRI aims to achieve a business-to-business-to-customer model (B2B2C model).

WAGRI has three main functions: data linking; sharing; and provisioning. The data linking function enables ICT vendors and agricultural machinery makers to connect their data across company borders and create new agricultural ICT services for farmers. The data sharing function enables farmers to compare their crop growth data to derive tacit knowledge. The data provisioning function enables companies or institutions that have valuable data to open up their data, leading to its free flow in the future.

All services provided by WAGRI are based on a unified API request format. WAGRI has a program-less API generation function using a Graphical User Interface and script (Kosugi *et al.*, In press).

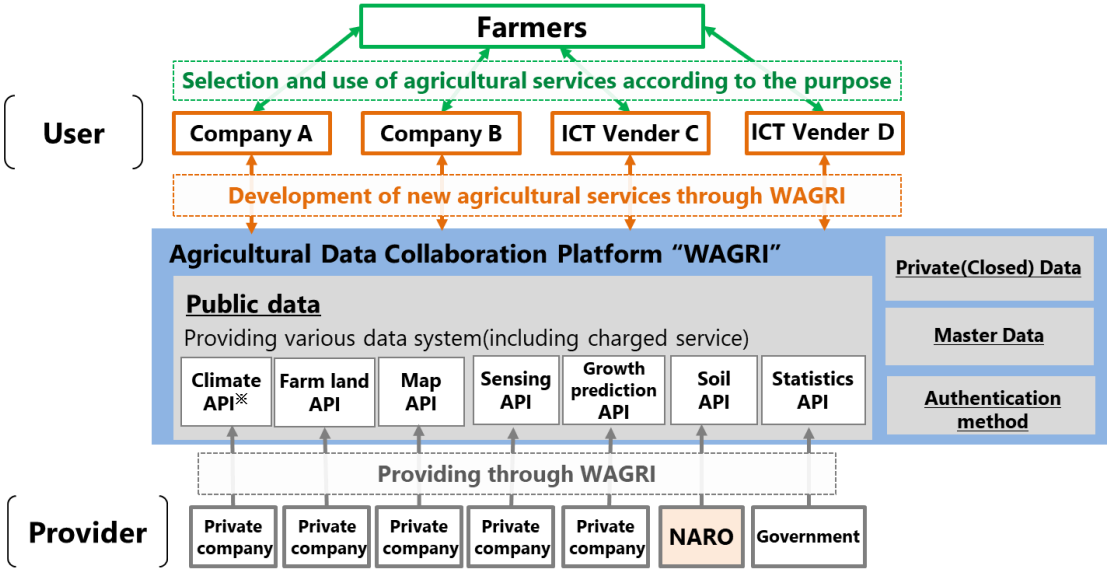

Figure 2. The Structure of WAGRI

LINKED DATA

WAGRI has approximately 60 APIs as of July 2019, and they are categorized into five groups: Master Data, Map and soil maps, Farmlands, Weather, and Cultivation management. The main data are listed in Table 1. The data providers in WAGRI are NARO, the Ministry of Agriculture, Forestry, and Fishery (MAFF), and private companies. NARO provides research findings on soil maps, crop growth models, and more. In addition to providing research findings, NARO provides master data on fertilizers and pesticides, and general weather forecasts with permission from the Food and Agricultural Materials Inspection Center and the Japan Meteorological Agency, respectively. NARO has also licensed some programs (algorithms) to private companies and others connected to WAGRI. Since these data are mainly related to paddy fields or open field farming, expanding the volume of data would be indispensable for the development of WAGRI.

Table 1. Main data/systems within WAGRI

Group	Content	Provider
Master data	Brand name of registered fertilizer	NARO
	Registered pesticide	NARO
	Database of rice variety and property	NARO
	Common Agriculture Vocabulary (CAVOC)	NARO
Maps	Map data, image data from aerial photos	private company
	Digital soil map (soil type and distribution)	NARO
Farmlands	Plot of farmland	MAFF
	The contour of farmland plots and development of irrigation channel status	MAFF
	Latitudinal/longitudinal farmland data	National Chamber of Agriculture
Weather	Weather forecasts for up to three days (1km mesh)	private company
	Weather forecasts for up to 26 days (1km mesh)	private company
	General weather forecasts	NARO
Cultivation management	Growth prediction model for paddy fields	private company
	Growth prediction system for open field vegetables	NARO

OPERATION

The WAGRI office of NARO runs the full operation of WAGRI. Data users and providers need to make monthly payments of 465 USD and 280 USD to the WAGRI office, respectively. In addition to monthly payments, data users pay data charges to the providers based on a contract between them, if it is not free data.

The WAGRI office has set several rules for data handling, pioneering a data collaboration platform in Japan. Its rules accommodate agricultural circumstances in a field in which many farmers feel anxious sharing their data. Moreover, agricultural data are distinctive; therefore it is difficult to ensure accuracy and completeness because of the effect of climate, location (locality), acquisition methods, and so on. WAGRI users need to agree to the rules and submit the application to the WAGRI office.

CONCLUSION

The National Agriculture and Food Research Organization (NARO) established the Research Center for Agricultural Information Technology in October 2018 to lead data-driven agriculture (NARO, 2018). The research center promotes the study of agricultural AI, the operation of an agricultural data collaboration platform (WAGRI), and the construction of infrastructure for studying AI, including the database and supercomputer systems. The rapid growth of utilization of agricultural big data is an international trend. The EU has run IoF2020, aiming to accelerate IoT in the food industry and agriculture with a budget of 34 million Euro (CORDIS, 2017). In the US, the nonprofit organization AgGateway is seeking data collaboration among private companies using the ADAPT framework (AgGateway, 2019), including Monsanto, Dupont, AGCO, and Syngenta. While WAGRI plans global collaboration with them, it needs to design a collaboration scheme with Asian countries also.

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