

NTT Group's Initiatives Regarding Food and Agriculture

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Abstract

Agriculture is a key industry in rural areas of Japan; however, it faces various problems such as long-term decline in the working-age population, aging of the population, natural disasters due to climate change, and securing sales channels. To solve these problems, *AgriTech*—which uses biotechnology, the Internet of Things, big-data analysis, artificial intelligence, and robots in the field of agriculture—is attracting attention. Since its privatization in 1985, NTT has been required to have a mission with both public and corporate aspects. In consideration of this dual mission, NTT is striving to create a *smart world* to solve social issues through its business activities. With agriculture positioned as a priority, we are working to create *Smart Agri* by using information and communication technology developed for telecommunications business to solve problems faced by the agricultural industry through cooperation with leading partners. The direction of initiatives by the NTT Group, specific examples, and future plans are introduced in this article.

Keywords: food and agriculture, food value chain, global

1. Issues being faced regarding food and agriculture

In agriculture, the working population is declining and aging simultaneously. Specifically, the number of workers decreased about 60% in 30 years and more than 60% of them are over 65 years old. Moreover, new farmers are not significantly increasing in number owing to unstable income due to fluctuations in yield and quality (which depend on the weather) and uncertainties regarding disasters, damage due to wildlife, etc. Accordingly, the area of agricultural land is decreasing [1]. Another issue is securing transportation and sales destinations (sales channels) after agricultural production. After farming, it is necessary to not only produce agricultural products but also sell them at a profit. To meet these requirements, it is effective to understand the needs and trends of consumers in a timely manner and devise *market-in* agriculture that reflects those needs in production. In the meantime, it is said that given the current state of the world, a population explosion would lead to com-

petition for food and water. To develop Japanese agriculture from now onwards, it is necessary to (i) increase the number of younger people employed in agriculture, (ii) expand the scale and improve the productivity of food and agriculture as a whole (including distribution, sales, and consumption), and (iii) develop agriculture with the global market in mind. Under these circumstances, given the aim of transforming Japan into Society 5.0 and a data-driven society, the Council on Investments for the Future of the Japanese government has heralded an offensive agriculture, forestry, and fisheries industry focusing on creating world-class *smart agriculture* and *smart food chain* using information and communication technology (ICT) [2].

2. NTT Group's initiatives: "Food and Agriculture × ICT"

The NTT Group has also positioned agriculture as a priority, and the Research and Development Planning Department of NTT took the lead in launching a

Agricultural production				Livestock and fisheries	Shared
Advanced greenhouse farming		Greenhouse farming	Open-field cultivation (paddy, upland farming, etc.)	NTT DOCOMO	
Sunlight	Artificial light	Steel frame greenhouse		Sensing	HALEX
NTT AgriTechnology	NTT WEST	NTT Facilities	NTT EAST	Data analysis	Weather
Construction	Sensing	Construction	Sensing	NTT TechnoCross	NTT GEOSPACE
Sensing	Environmental control and data analysis	Sensing		Sensing	Map/topography
Environmental control and data analysis		Environmental control and data analysis	NTT DOCOMO	Data analysis	
Production and sales	NTT Smile Energy		Sensing	Cows and pigs	NTT DOCOMO, NTT Comware
Supply chain	Sensing	NTT EAST, NTT DOCOMO, NTT TechnoCross	Work recording	NTT EAST	Supply chain
	Environmental control and data analysis	Sensing		Data analysis	
		Environmental control and data analysis	NTT DATA, NTT EAST, NTT DATA CCS, NTT DOCOMO, NTT, etc.	Pigs and birds	NTT
			Data analysis (growth and pest diagnosis)	NTT Comware	Data analysis (fog forecast)
				Data analysis (poaching-boat countermeasures)	
				NTT	NTT FIELDTECHNO
				Sensing, etc. (countermeasures against damage from wildlife)	Food recycling

Fig. 1. Solution map.

cross-group project called “Agriculture Working.” In addition to working with the major operating companies of the NTT Group (namely, NTT EAST, NTT WEST, NTT DOCOMO, NTT DATA, and NTT Communications), we are cooperating with about 30 other group companies with outstanding services and research laboratories to work on a wide range of activities from formulation of overall strategy, creating services, research and development (R&D), etc. in agricultural production, distribution, sales, consumption, food, and globalization. We are providing customers with technologies and solutions concerning the food and agriculture sector, in which we plan to use the nationwide telecommunications infrastructure and assets held by each group company, network services, artificial intelligence (AI) technology, and the Innovative Optical and Wireless Network (IOWN)* (Fig. 1). Our lineup of services and technologies encompasses greenhouse farming (sunlight type and artificial-light type), open-field cultivation, raising livestock, shared weather information, maps and distribution, sales, and food and food-loss reduc-

tion, which contribute to the United Nations’ Sustainable Development Goals (SDGs). By combining these services and technologies, for example, large-scale and distributed farmland and facilities (greenhouses) can be integrated as one virtual farm, and farming can be simulated (by Digital Twin Computing) in a manner that makes it possible to centrally manage and coordinate various types of digital data about the environment and soil, growth status, weather information, etc. Based on the simulation results, an optimal cultivation plan is drawn up for each item (vegetable, animal, etc.), and farming is efficiently carried out according to that plan while remotely controlling robotics such as agricultural machines, drones, mowers, and harvesters. The results of these research laboratories and group-company initiatives are strategically disseminated through various exhibitions and external lectures (Fig. 2).

* IOWN: A next-generation communication infrastructure that NTT is promoting toward practical application around 2030.



Fig. 2. Exhibition booth of the NTT Group.

3. Specific initiatives with leading partners

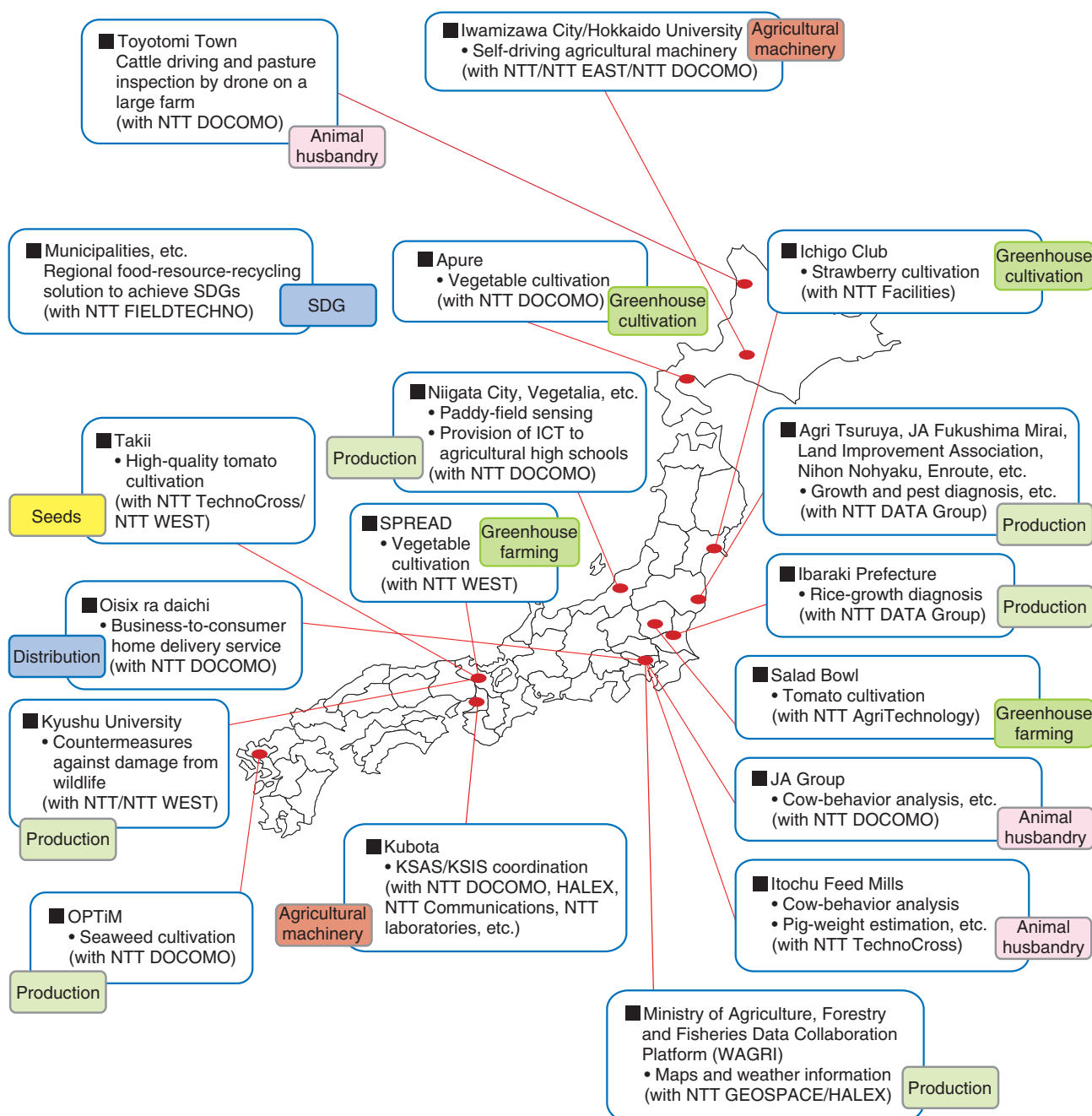
The NTT Group has a short history of participating in the agricultural business, so it lacks specialized knowledge and know-how. Therefore, we are strategically promoting collaboration with leading partners in industry, government, and academia (**Fig. 3**). For example, NTT Group, Hokkaido University, and Iwamizawa City in Hokkaido have concluded an industry-government-academia collaboration agreement and initiated a joint study to apply innovative technologies to agriculture. We are aiming to (i) create and implement world-class smart agriculture by using self-driving robotics technology (including cutting-edge agricultural machinery), high-precision location information, fifth-generation mobile communication system (5G), and data-analysis technology such as AI; (ii) develop models for sustainable regional revitalization and smart-city solutions centered on smart agriculture; and (iii) study the application of future innovative technologies, including IOWN, to smart agriculture.

We are currently in the demonstration phase of fully self-driving (unmanned) agricultural machinery (level 3) with the world's first "cooperative-work" system using multiple agricultural machines and remote monitoring. To achieve the next stage (commercialization), it is necessary to (i) acquire accurate positioning information and automatically generate

farm-work plans based on understanding and forecasting of the states of agricultural machinery, weather, and crop growth and (ii) transmit video information from cameras mounted on agricultural machinery to monitoring sites while ensuring low delay and reliability. To satisfy these needs, 5G and local 5G will be used and IOWN will be used in the future. For example, a large number of agricultural machines, drones, robot mowers, and others are monitored and controlled over a wide area of a farm from a remote location such as a monitoring center in Iwamizawa City by a member of Japan Agricultural Cooperatives (JA) or a contractor of agricultural work. Therefore, we aim to create a world that enables technological innovation and the accompanying industrialization of agriculture in cooperation with universities, local governments, JA, manufacturers of agricultural machinery, and others. It is said that like Japan, emerging countries are becoming more urbanized and the population of farmers is decreasing. For this reason, to contribute to alleviating global food shortage through automation and boosting efficiency of agriculture, we will model and systematize our smart agriculture technology and solutions and expand them globally (**Fig. 4**).

4. Future directions

The NTT Group has been expanding its activities



KSAS: Kubota Smart-Agri System
KSIS: Kubota Smart Infrastructure System

WAGRI: A data sharing and provision platform for creating environments in which people working in agriculture can improve productivity and management by using data.

Fig. 3. Collaborations with partners.

into the so-called smart food chain, which is a larger market covering agricultural production to distribution, processing, sales, food, and exports. For example, through a mechanism called “digital food value chain,” which connects producers and customers/

consumers with digital data, and market-in agriculture, which produces crops on demand from consumers, we aim to ensure planned and stable production and procurement and implement a system that enables people involved in food and agriculture to

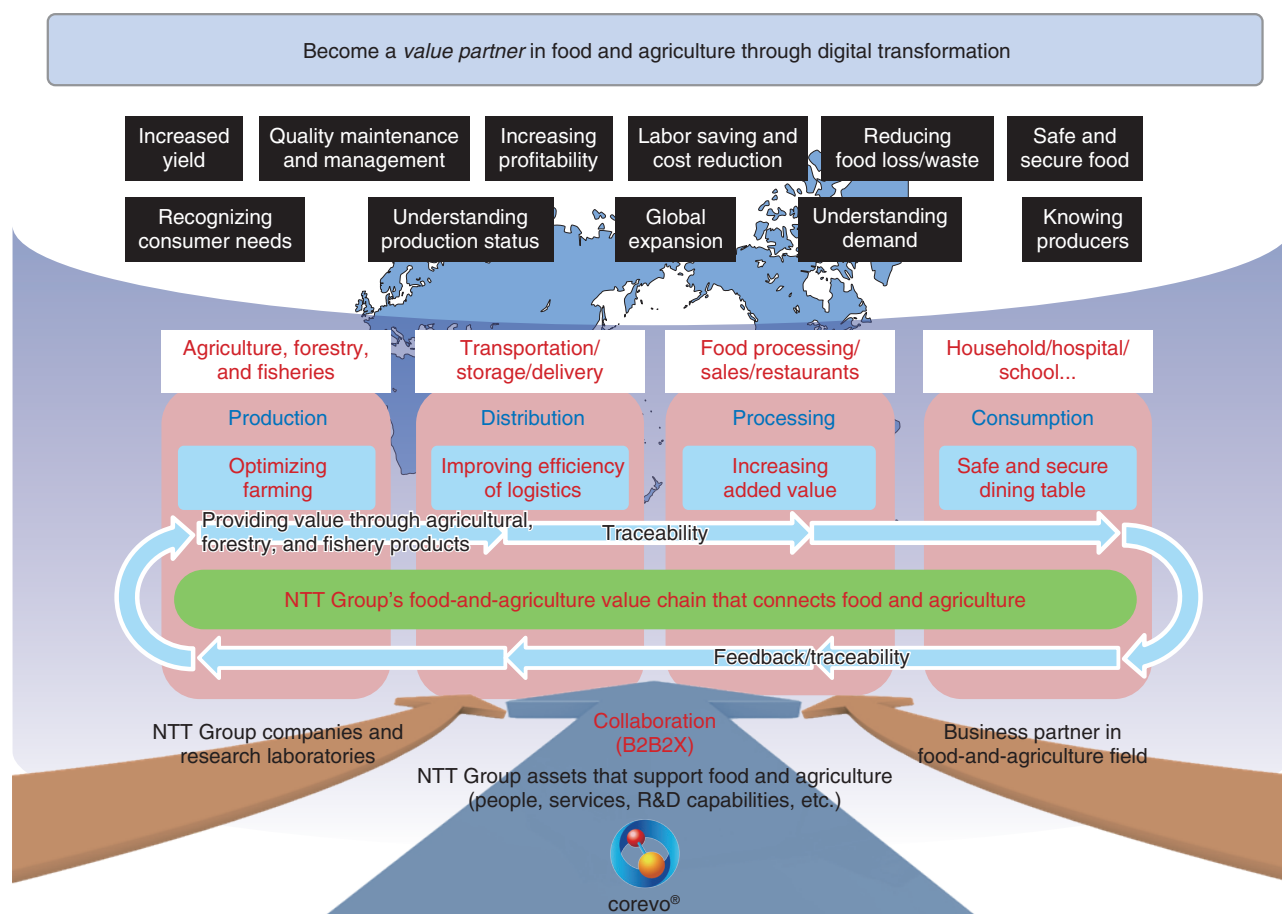
World-class smart agriculture with agricultural robot technology and ICT



Fig. 4. Collaboration with Hokkaido University and Iwamizawa City.

enjoy benefits of such value chain without waste. We will also strive to address SDGs by reducing food waste/loss through improved distribution efficiency while expanding the scope of our efforts to global agriculture. We first plan to promote our initiatives in Southeast Asia, the Middle East, and Africa, where growth is expected, as well as in Europe, which is an

advanced agricultural region, through specific projects with local companies, organizations, and universities. We then plan to expand our efforts to forestry and cooperate with partners necessary for that expansion at an early stage. To become a value partner of choice, we will continue to contribute to the development of primary industries as a whole (**Fig. 5**).



B2B2X: business-to-business-to-X

Fig. 5. Vision.

References

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