An Overview of Japan's Efforts for Smart Agriculture

- Social implementation of robot and automated farm machine

"The 4th EU-Japan Public and Private GNSS Roundtable Meeting"

Date : 14 March, 2019
Venue: Mita Coference Hall
2-1-8, Mita, Minato-ku, Tokyo 108-0073, JAPAN

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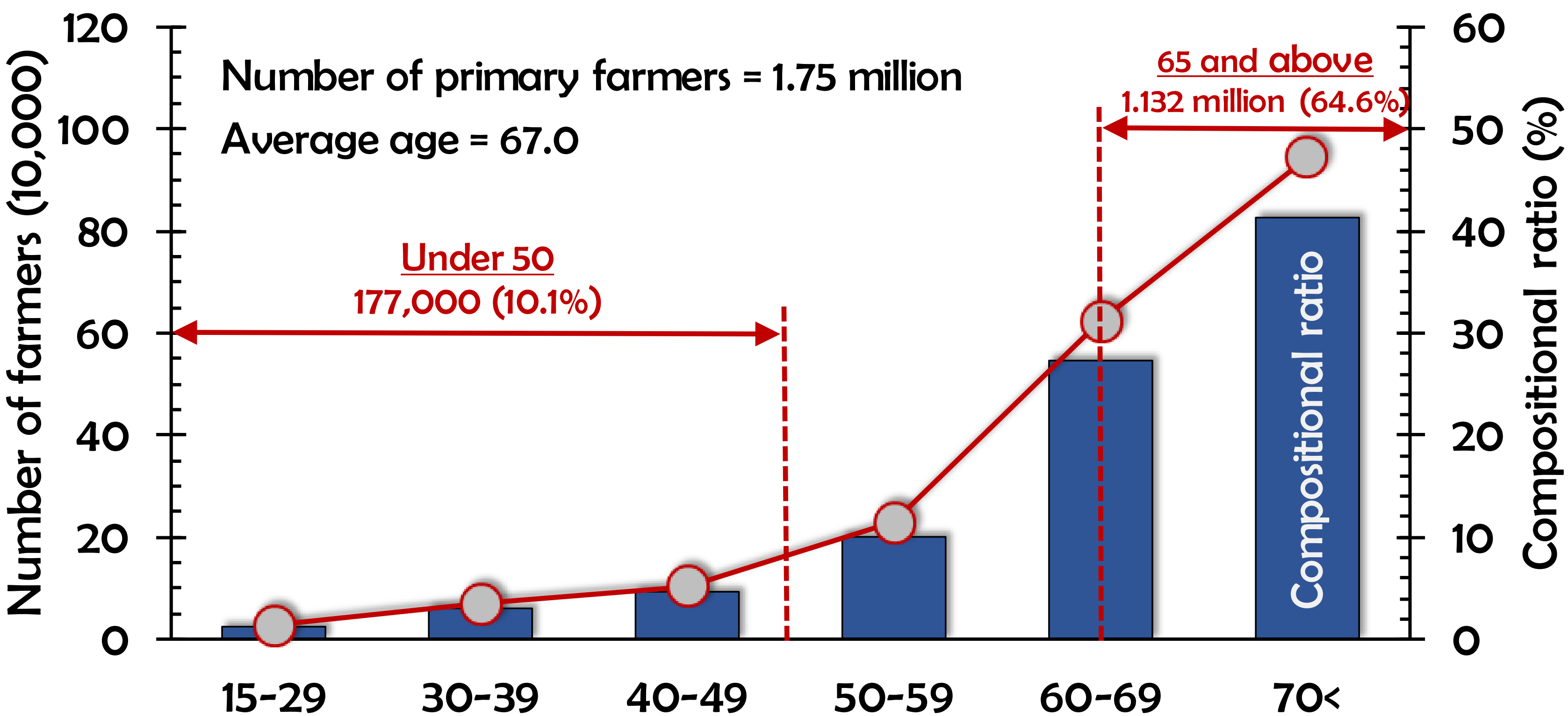
Current State of Agriculture in Japan

1. Diminishing number and overall aging of farmers
2. Decentralization and aggregation of field management, despite acquisition of abandoned farmlands
3. Loss of experience and intuitive knowledge due to retirement of veteran farmers
4. Free trade due to general agreement under TPP



Overview of Smart Domestic Agriculture
: in the case of land-based farming

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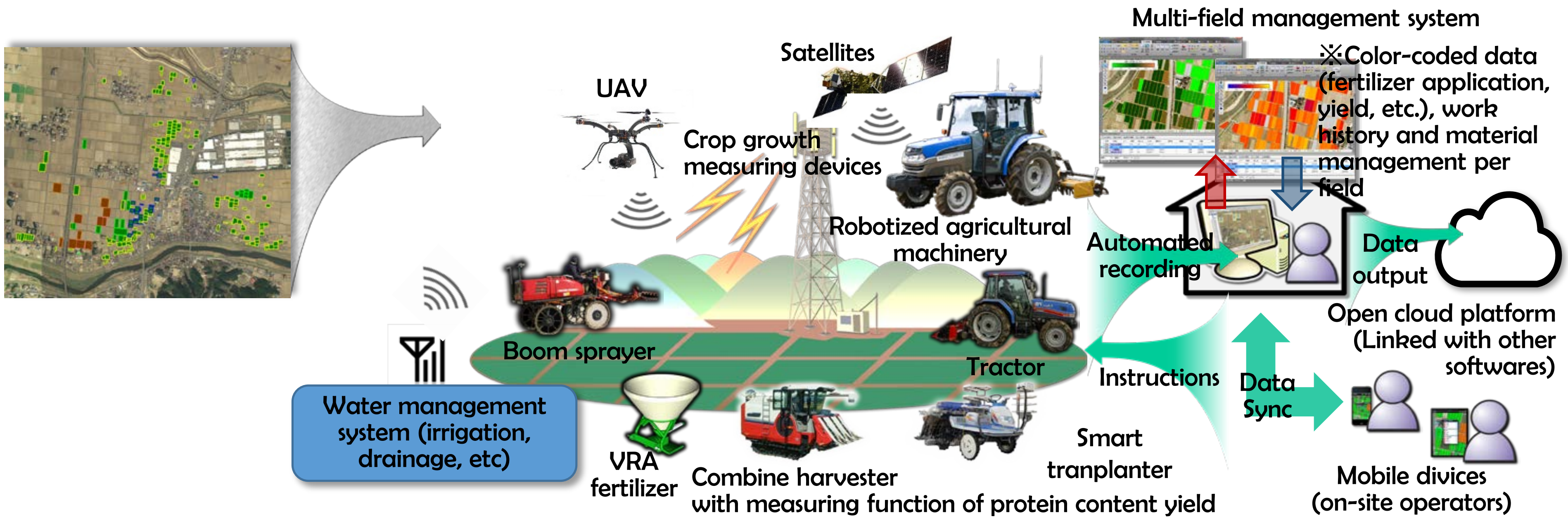
Mechanization of paddy and land farming, adaptation for larger-scale operations

- **Challenges:** ① rapid decentralization of fields due to aggregation of farms, ② limitations to improvement in efficiency and labor-saving under current technologies, ③ increased area per machine, ④ simple upgrade in size and performance of machines are costly
- **Needs:** ① further improvement in productivity, reduced cost, ② accommodate for climate change and decentralization of fields

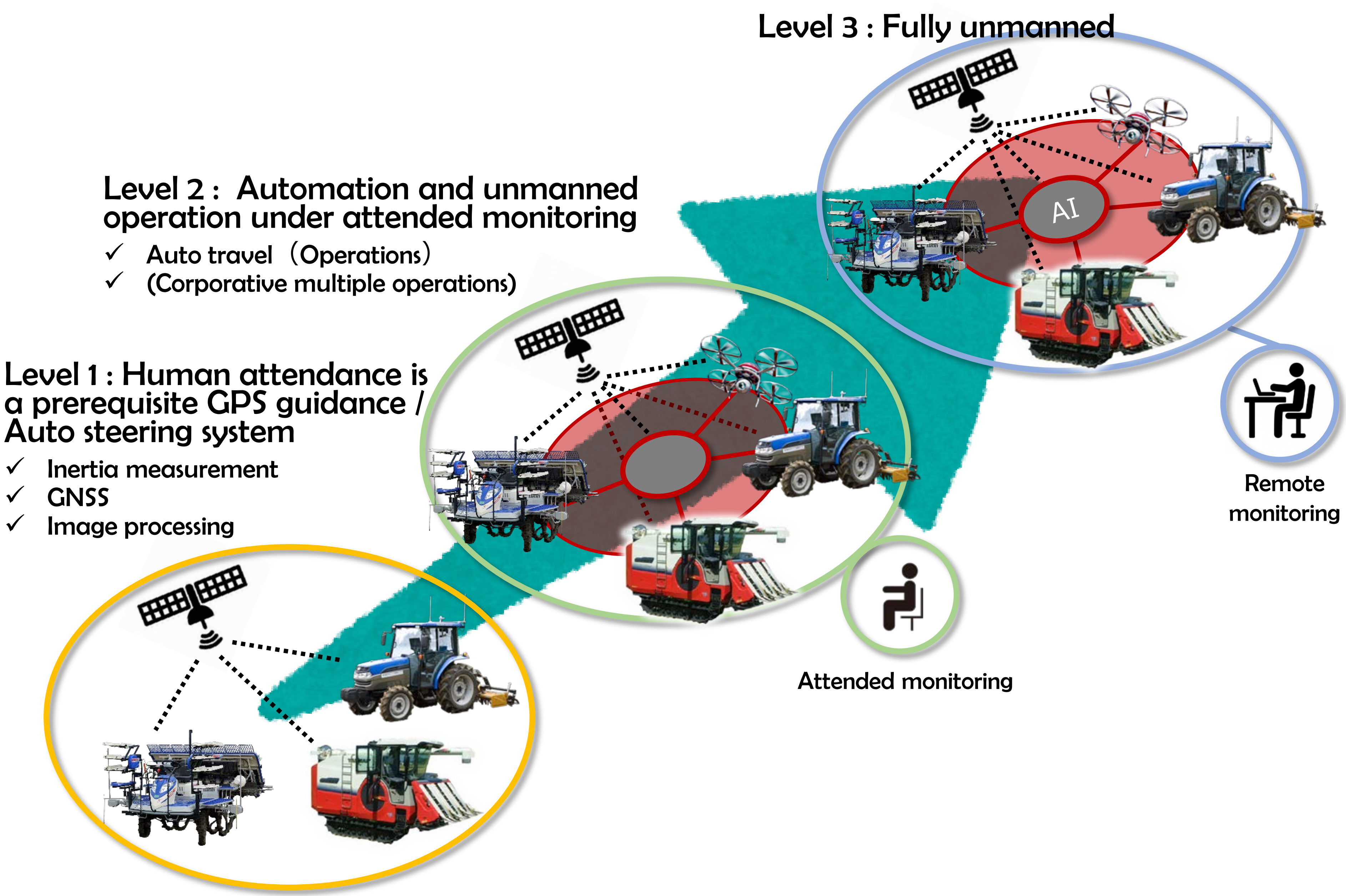
Improvement in efficiency of multi-field farm management



Establishment of Japanese and Asian Smart Agriculture Systems

① Collection, analysis, and utilization of crop, field, and weather data, ② big data analysis (including the use of AI), ③ provide optimized work plan and crop management data, ④ remote control, self-driving, and securement of safety for farm machines and water management systems through robotics, ⑤ crop and field data collection and system feedback by farm machines, ⑥ Standardization of communication protocols

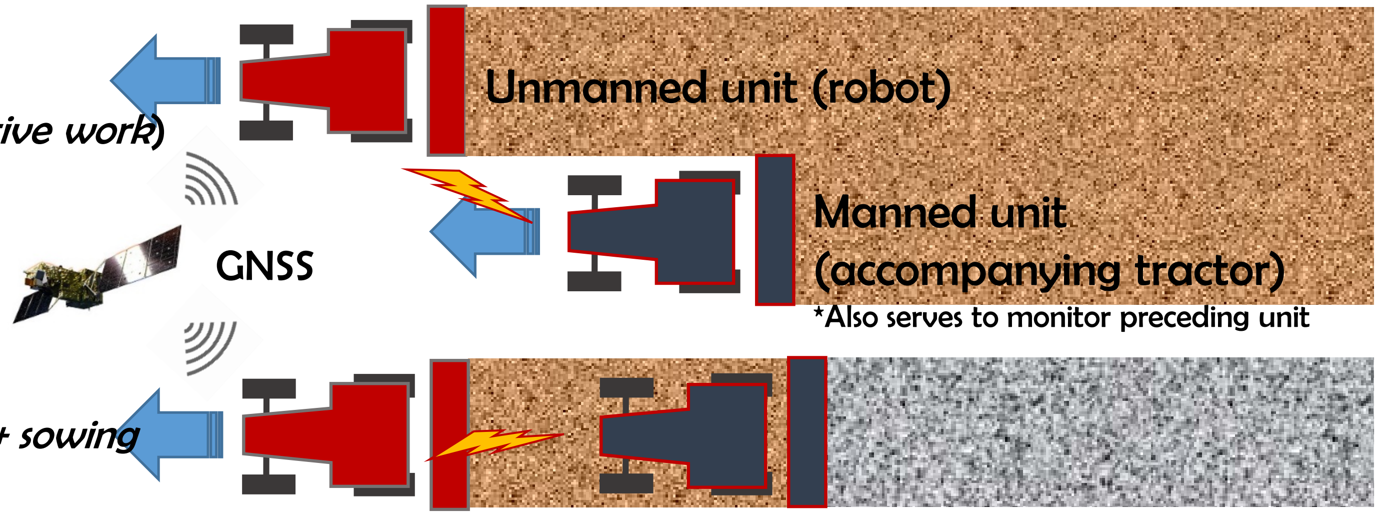
Social implementation of robot and automated farm machine



Social Implementation of Robots -01

☛ Practical use of "manned-unmanned cooperative work system" in 2018

Case 1: Double width tilling
(Multiple-machine cooperative work)



Case 2: Tilling + fertilization + sowing
(Simultaneous work)

☛ "Unattended systems via remote monitoring" including interfield movement by 2020

Based on ISO 18497 for highly automated farm machines and the guideline (Ministry of Agriculture, Forestry and Fisheries (MAFF)' "Guideline for securing the safety of automatic traveling of farm machines" revised in Mar. 2018) in Japan;

☛ Aug. 2018 - Established the system for safety function evaluation test for robot and automated farm machines（Inspection performing institution: Institute of Agricultural Machinery, NARO）

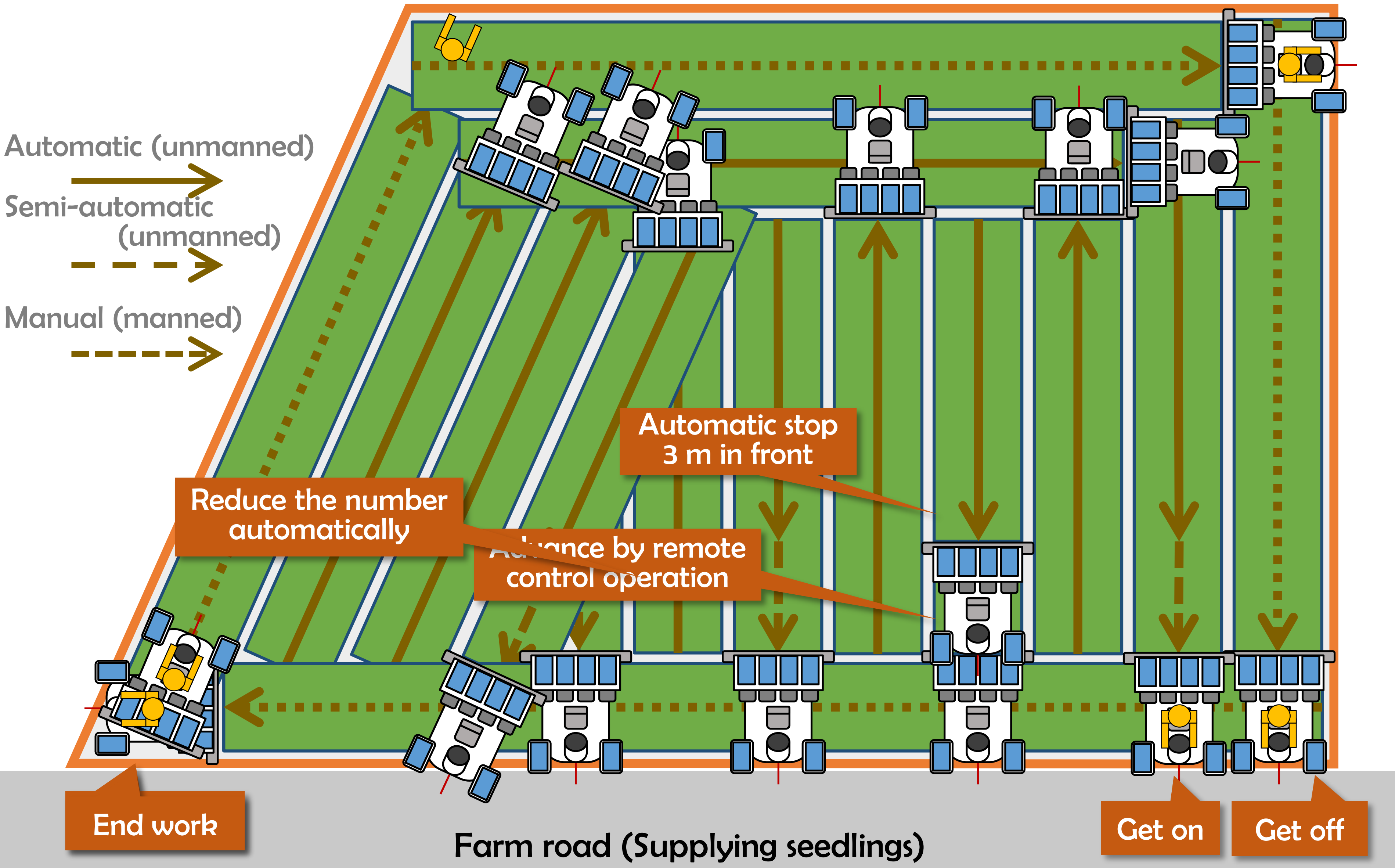
☛ Dec. 2018 - Announcement of the validated equipment for automated farm machine inspection (first approved equipment)

Social Implementation of Robots -03

"Unattended systems via remote monitoring“ including interfield movement by 2020

Autopilot Transplanter :

Social Implementation of Robots -05



Social Implementation of Robots -06

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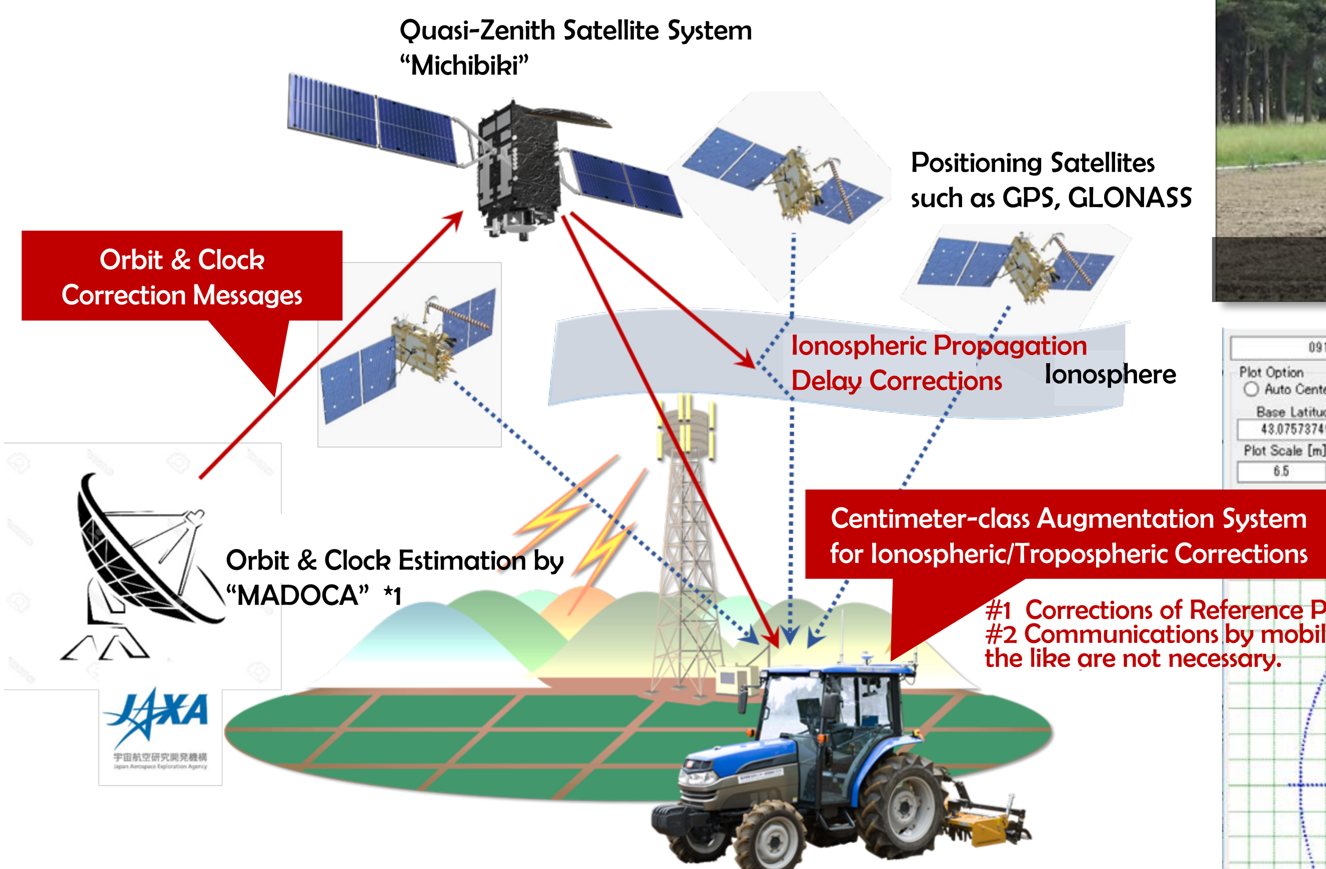
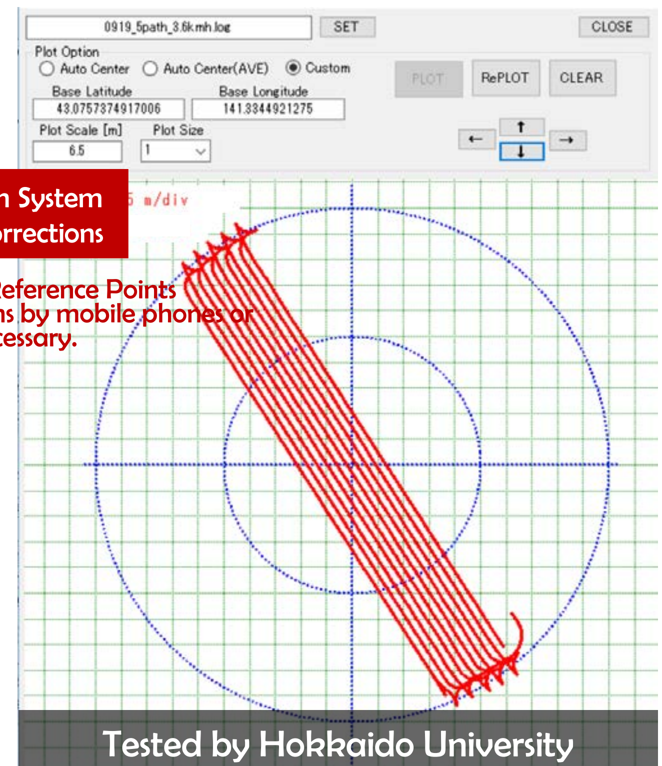
Low-cost and High-Accuracy Quasi-Zenith Satellite Positioning System





* 1 : MADOCA（Multi-GNSS Advanced Demonstration tool for Orbit and Clock Analysis）

Quasi-Zenith Satellite System “Michibiki” will enter operation.

☛ **The service will be started from November 1 of 2018.**

(By National Space Policy Secretariat, Cabinet office, March 2, 2018)

Social Implementation of Robots -07

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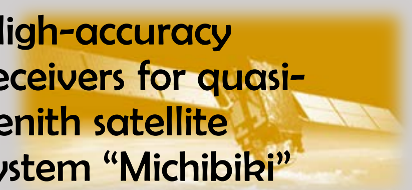
Outcomes	Descriptions and Effects	The timing of practical application
Robot Tractor (single) 	・Automated operations via remote monitoring accompanied by manned tractor.	To be implemented in FY 2018
Multi-robot Tractor System for Farm Work 	・Automated operations by two tractors via remote monitoring. ・Operation efficiency is 160% and over.	At an early stage after FY 2018
Autopilot Transplanter 	・Automated operations via remote monitoring (visual observation). ・Enabled transplanting operations together with seedling feeding by one person. ・The same accuracy as skilled persons.	At an early stage after FY 2018
Robot Combine (riding type) 	・Automated operations by two combines via remote monitoring. ・Operation efficiency is 170%.	At an early stage after FY 2018
High-accuracy receivers for quasi-zenith satellite system "Michibiki" 	・They do not require base stations and enhanced positioning performance by centimeter-class augmentation. ・Reduced costs (JPY 300,000).	To be implemented in FY 2019
Water Management System for Paddy Fields 	・Automatic controls for hydrant/waste plugs. ・80% reduction in water management labors.	Started advance sales from March 2018

The Future of the Robot Systems

Field to field traveling technology by integrating sensing technology

- **Background issue**

  The automated travel system by intelligent farm machines operated by one supervisor was developed. However, travel between farm fields is hindering savings in labor as attended driving is required.

- **Objective**

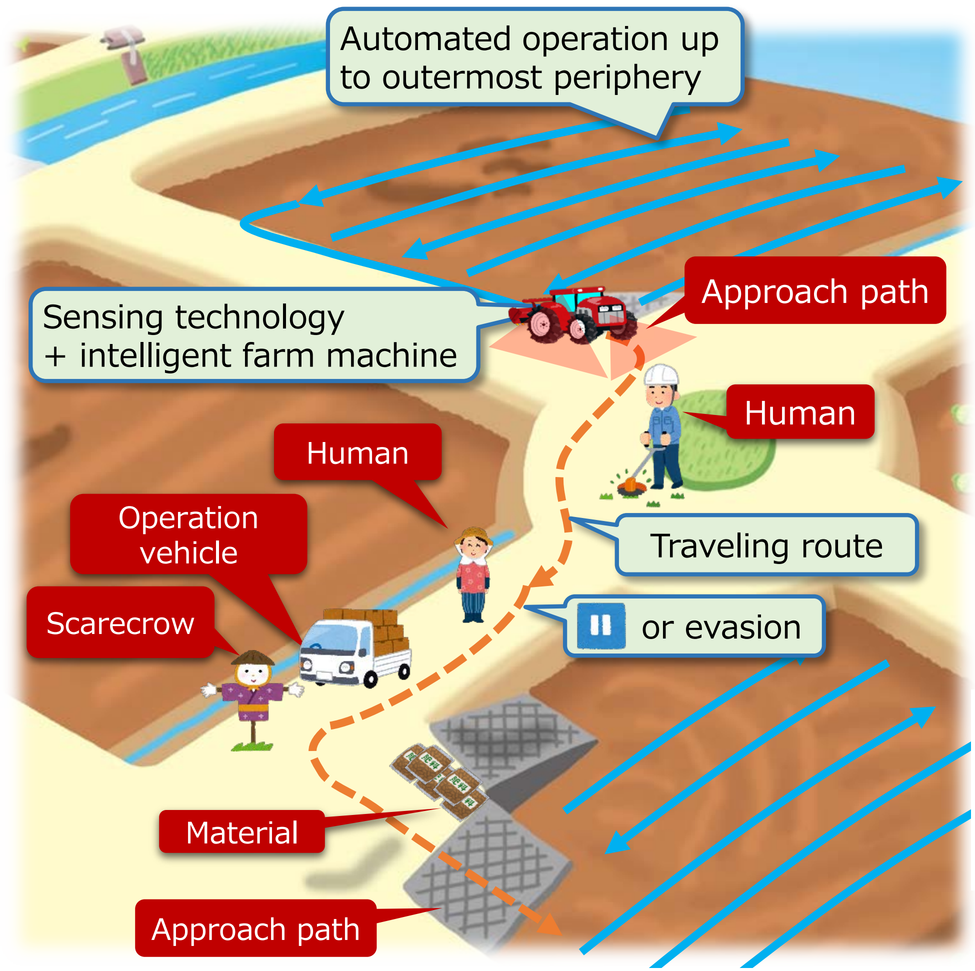
  To develop a technology where operation within a farm field including the outermost periphery is completed automatically and machines can travel automatically and safely to the next farm field.

- **Research description**

  Developing a technology for controlling vehicles properly by recognizing objects in the environment such as obstacles, humans, and farm road area by integrating GNSS, LiDAR, and Vision, and evaluating the recognition results.

- **Expected outcome**

  Development of a high-efficiency automated operation system that takes advantage of the intelligent farm machine.



Anticipated environment

Thank you
for your attention

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