

FARMING A HIGH-TECH NEW FIELD

By 2022, Japan hopes that robots and a cloud-based market for agricultural data **WILL HAVE REDUCED WORK HOURS BY 30% ON SOME FARMS.**

Roughly 60% of Japan's farmers are older than 65, and the country's agricultural sector expects to lose up to one-third of its workforce between 2015 to 2030. As a result, Japan has pioneered two large-scale projects involving satellite-controlled robotic farm machinery and data-driven production and distribution. It's at the forefront of a global 'smart' agriculture market expected to total US\$13.5 billion by 2023, with the local market predicted to reach 33 billion yen (US\$314 million) in the same year.

Cabbages in the cloud

In April 2019, the National Agriculture and Food Research Organization (NARO) commercially launched Agricultural Data Collaboration Platform (WAGRI), which connects information on everything from topography to soil types, with data pulled from the private sector and government institutes in a public cloud. "It's like a marketplace for different types of data on everything from weather to fertilizers. Users can process the data they need to their advantage," explains Hisatomi Harada, the director-general of NARO development strategy

centre. "We are shifting to more sustainable farming methods that are optimized with big data, where in the past, farmers relied on experience and intuition to assess their land and estimate when their harvest would be ready."

THIRD-GENERATION AUTOMATED MACHINERY WILL BE ABLE TO BE CONTROLLED REMOTELY THROUGH A COMPUTER OR SMARTPHONE

This year, for example, farmers used a prototype modelling system with data sourced from WAGRI to simulate the harvest cycle of cabbages and lettuces across 40 hectares of land in Hokkaido, a prefecture in northern Japan. They input planting dates, map and weather forecast data into a computer program to generate a model predicting when their harvest will be ready.

That foresight allowed farmers to make more strategic decisions. For instance, they could plan exactly how many

workers to hire in advance, and which field to start harvesting first, says Noboru Noguchi, a professor at the Research Faculty of Agriculture at Hokkaido University. Farmers reported that having such precise information on the harvesting times increased profits by 10%.

NARO is expanding WAGRI to include a system called the Smart Food Chain, which will collect data on everything from production, processing and distribution, to consumption and sales figures, by 2022. That will allow farmers to anticipate shifting market demands, and hope to further reduce applicable agricultural waste by 10% by 2022. "When farmers have access to data on consumer demands, they can avoid food loss by allocating their resources to produce crops that meet market needs," Noguchi explains.

Robotic farmers

Autonomous robot tractors will address the shortage of human agricultural workers. Japan is already at the forefront here, with three companies launching autonomous tractors in 2018, based on NARO research. These relied on research from Noguchi's

laboratory, which is developing tractor robots that perform everything from rice planting and fertilizing fields to weeding and heavy-lifting. "We want the robots to take over the repetitive tasks so that the farmer can focus on other aspects of the agricultural process," says Noguchi.

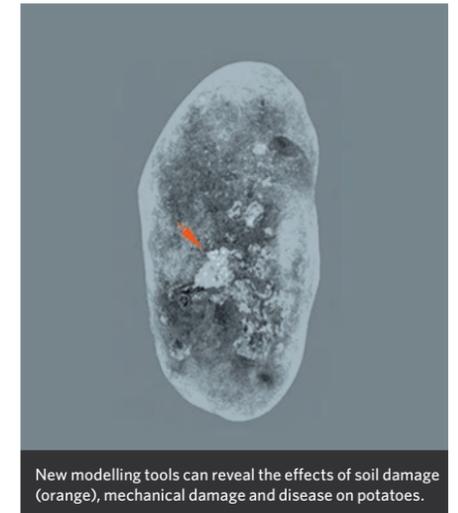
Japan pioneered 'second-generation automated machinery' comprised of robot tractors carrying out tasks while a farmer supervises nearby, and these have been successfully developed and commercialized by manufacturers. First-generation automated machinery consisted of an auto-guidance system, which is already used not only in Japan, but in the United States and Europe. Some of the first two tranches harness a Global Navigation Satellite System (GNSS) connected to Japan's new Quasi-Zenith Satellite System (QZSS), a system of four satellites established between 2010 and 2017. At least one satellite of the QZSS is visible at all times from locations in the Asia-Oceania region, ensuring stable, high-precision positioning and control of robots with an error margin of 5cm.

Noguchi is currently working on third-generation



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Japan is pioneering third-generation agricultural robots controlled remotely via smartphones and laptops.



New modelling tools can reveal the effects of soil damage (orange), mechanical damage and disease on potatoes.



Second-generation autonomous robots supervised by farmers nearby.

automated machinery that farmers will be able to control remotely through a computer or smartphone. In addition to remote-control capabilities, the third-generation automated machinery can autonomously move between fields using active roads. In order to ensure stable and safe operation on a road with traffic, these robots will incorporate machine vision, a laser technology known as 3D LiDAR

and artificial intelligence, as well as the GNSS based navigation systems.

Noguchi and Harada say that these production-boosting and labour-saving strategies will help farmers increase profits by reducing workloads, and this will also open up the profession to new workforces. And as countries converge to support the United Nation's 20 Agenda for Sustainable Development to eradicate

hunger, NARO also wants its smart farming technology to help build resilient agricultural systems globally, notes Harada. "Food security is a global issue and we would like these technologies to be used to boost productivity and meet food demands internationally."

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