Toward the realization of “Digitalisation and Innovation” by developing smart agriculture based on the farm management information system, Japan

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Topics

- Introduction of NARO
- Society 5.0 & Smart Food Value Chain
- Cross-ministerial Strategic Innovation Promotion Program (SIP)
- Automated agri-machinery test, IAM/NARO
- Open API (Application Programming Interface)
Overview of NARO

- Conducts R&D for the development of Japanese agriculture and food industry.
- Established in 2001 by integrating the experimental research institutions of Ministry of Agriculture, Forestry and Fisheries (MAFF). ※ * Originated in 1893 (Meiji 26) as Agricultural Experiment Station.
- 3,300 employees (includes 1,830 research staff) (as of FY2020).

New organization - April 2021

Headquarters
- Core Technology Research Headquarters
- Priority Research Centers
- Research Support Centers

Central Region
- @Tsukuba, Ibaraki

Western Region
- @Fukuyama, Hiroshima

Kyushu Okinawa
- @Koshi, Kumamoto

Hokkaido
- @Sapporo, Hokkaido

Tohoku
- @Morioka, Iwate

Bio-oriented Technology Research Advancement Institution
- @Kawasaki, Kanagawa

Institute of Agricultural Machinery
- @Saitama, Saitama
The entire process in the food value chain is made ‘smart’ by utilizing AI and ‘WAGRI,’ the Agricultural Data Collaboration Platform.

Productivity optimization, total costs cut, food waste reduction, high value adding and technology matching are anticipated.

Society 5.0 in Agri-Food Industries:
Smart Food Value Chain

- **Breeding**
  - Objectives: Speeding up crop breeding

- **Cultivation**
  - Objectives: Optimizing productivity to cope with labor shortages

- **Processing & distribution**
  - Objectives: Controlling fluctuations of supply and price

- **Consumption**
  - Objectives: Increasing demand, Promotion of exports

Data collection, AI analysis
Feedback analyzed data

The ‘WAGRI’ AI and Agricultural Database Platform

Basic Research for Agriculture
- (plant/animal protection, GHG reduction, disaster prevention/mitigation, genetic resources)
Technology Innovations toward the Goals Set by the “MeaDRI”

*For example,* Contribute to the reduction of chemical pesticides by 50% and chemical fertilizers by 30% through the development and the implementation of technologies to reduce chemical pesticides and chemical fertilizers using biological resources by 2050.

**To reduce GHG emissions**

**Water Control in Rice Paddy**
- Prolonged midsummer drainage (MSD) of paddy reduced CH$_4$ emissions by 30%

**Amino Acid Balanced Feed**
- The feed reduced N$_2$O emissions by 40% from livestock feces

**To reduce chemical pesticides and fertilizers**

**Innovative pest control not depending on chemical pesticides**
- Reduction of the use of chemical pesticides by using biological resources such as advanced physical technology and natural enemies
- Materials supporting natural enemies, next-generation bunker materials
  - Simplified natural enemy control
  - Dealing with various insects

**Data-driven soil management**
- Optimal soil maintenance by sensing soil fertility and possibility of GHG emissions
- Soil sensing by smart machinery
- Movement plan of smart machinery
- Autonomous field management
- Growth forecast
- Soil maintenance plan
RCAIT was launched in October 2018 under the direct control of NARO’s President.

- Promoting application-oriented agricultural AI research
- Full-scale operation of the ‘WAGRI’ platform (started in April 2019)
- Infrastructure consisting of a supercomputer and a database for agri-AI research (started in 2020)

38 research themes (Sep. 2020)

- Collaboration of AI scientists & agronomists
- On-the-job-AI training for agronomists

The ‘WAGRI’ database platform

- 437 members (Oct. 2020)
- 60 Application programming interfaces

- Optimizing workplan
- Productivity increase
- Cost cut

The "Shiho" AI supercomputer

NARO Linked DB

Cloud server

Agricultural Information Technology Infrastructure

Science Information Network
SIP is a Cross-ministerial project which Minister of State for Science and Technology Policy and the Prime Minister takes leadership.

* Labor efficiency is 160% by use of two robot tractors.

* Combined use of these four ICT agri-machines resulted in a 45% increase in one farmer’s income through farm-size expansion. †

* Automatic & remote water management system reduces working hours by 80%.

† In the case of the field trials in Chiba.
An Example of Smart Agriculture in Paddy: Realization of Labor-saving by precision farming

Sensing by drone

Plant growth mapping

Combine harvester with yield monitoring

Map-based variable rate fertilization according to growth

Map-based variable rate fertilization resulted in the increase of productivity by 10% (400kg/ha) and the decrease of nitrogen applied per yield by 22% in one instance.
In Japan, various automated agri-machines have been put on the market and are being introduced into agricultural fields gradually.

Autonomous Tractor
Autonomous Tea Harvester
Auto-steering Combine
Auto-steering Transplanter

Cited from Yanmar Holdings Co., Ltd. Robot Tractor
https://www.yanmar.com/jp/technology/robotics.html

Cited from MATSUMOTO KIKO Co., Ltd. Robot Tea Harvester MCRT12VF
http://matsumotokiko.co.jp/custom.html

Cited from KUBOTA Corporation. Auto-steering Combine WRH1200A
https://agriculture.kubota.co.jp/product/combine/wrh1200a/

Cited from ISEKI & CO., LTD. Auto-steering transplanter NP-80D
https://www.iseki.co.jp/products/taueki/tau-e-np80dz/
Automated agri-machinery test

◆ Publication of Certified Machines (as of Dec. 2021)
  ▪ Auto-steering agri-machinery test: 38 types for 3 kinds of machines
  ▪ Autonomous agri-machinery test: 3 types for 2 kinds of machines
  ▪ If the machine passes the optional test, the machine will be able to indicate “Two Stars”.

◆ IAM will continue to revise the test based on the results of the MAFF’s trial project for introducing automated agri-machinery.
“Open API” is required in Japan

Current state

Data obtained from agricultural machinery cannot be shared by different manufacturers.

Goal

Efficient use of agricultural machinery from multiple manufacturers.

Providing data and services via Application Programming Interface (API)

WAGRI changes to “Data Distribution Platform”
Thank you for your attention!