

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

**KAWASE Yoshiyuki  
Institute of Agricultural Machinery, NARO**

- 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

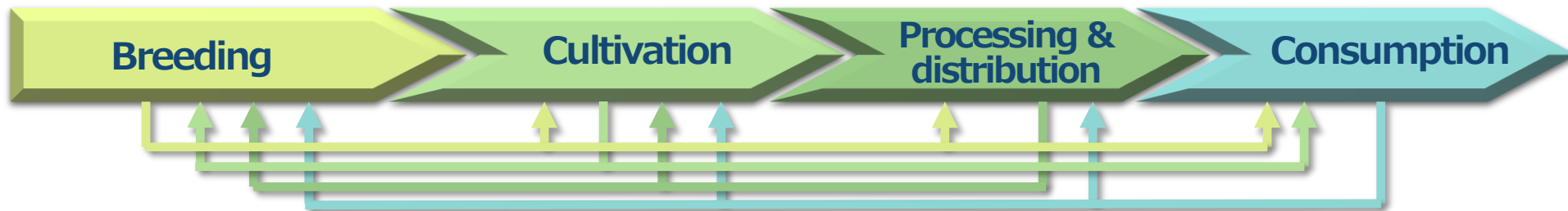
@Kawasaki, Kanagawa

## Institute of Agricultural Machinery

@Saitama, Saitama

## Smart Food Value Chain

- 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.



Smart Breeding

Smart Production

Smart Processing  
Smart Distribution

Smart Selling  
Smart Export

**Objectives**

Speeding up crop breeding

**Objectives**

Optimizing productivity to cope with labor shortages

**Objectives**

Controlling fluctuations of supply and price

**Objectives**

Increasing demand  
Promotion of exports

Feedback analyzed data



Data collection, AI analysis

**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.

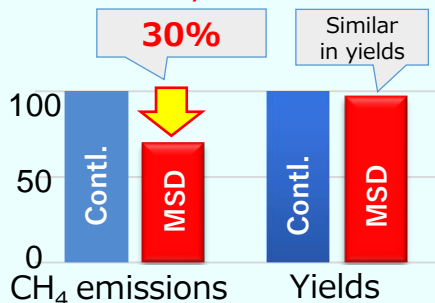
## To reduce GHG emissions

### Water Control in Rice Paddy

- Prolonged midsummer drainage (MSD) of paddy reduced  $\text{CH}_4$  emissions by 30%

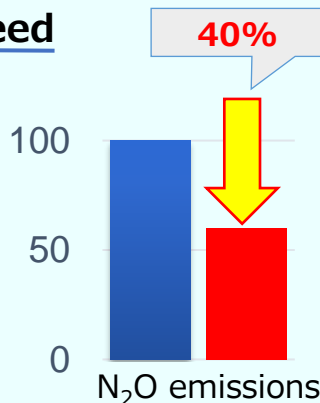


Midsummer drainage



### Amino Acid Balanced Feed

- The feed reduced  $\text{N}_2\text{O}$  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



Pest control by laser irradiation

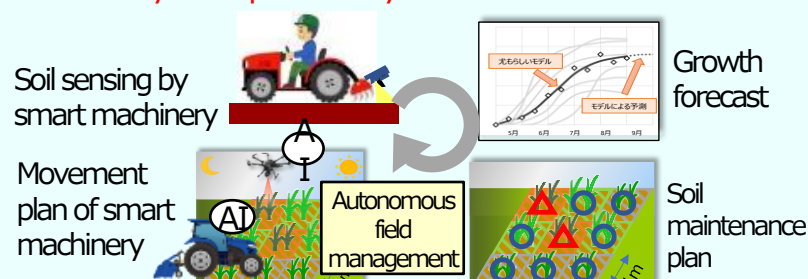
Materials supporting natural enemies, next-generation bunker materials



- Simplified natural enemy control
- Dealing with various insects

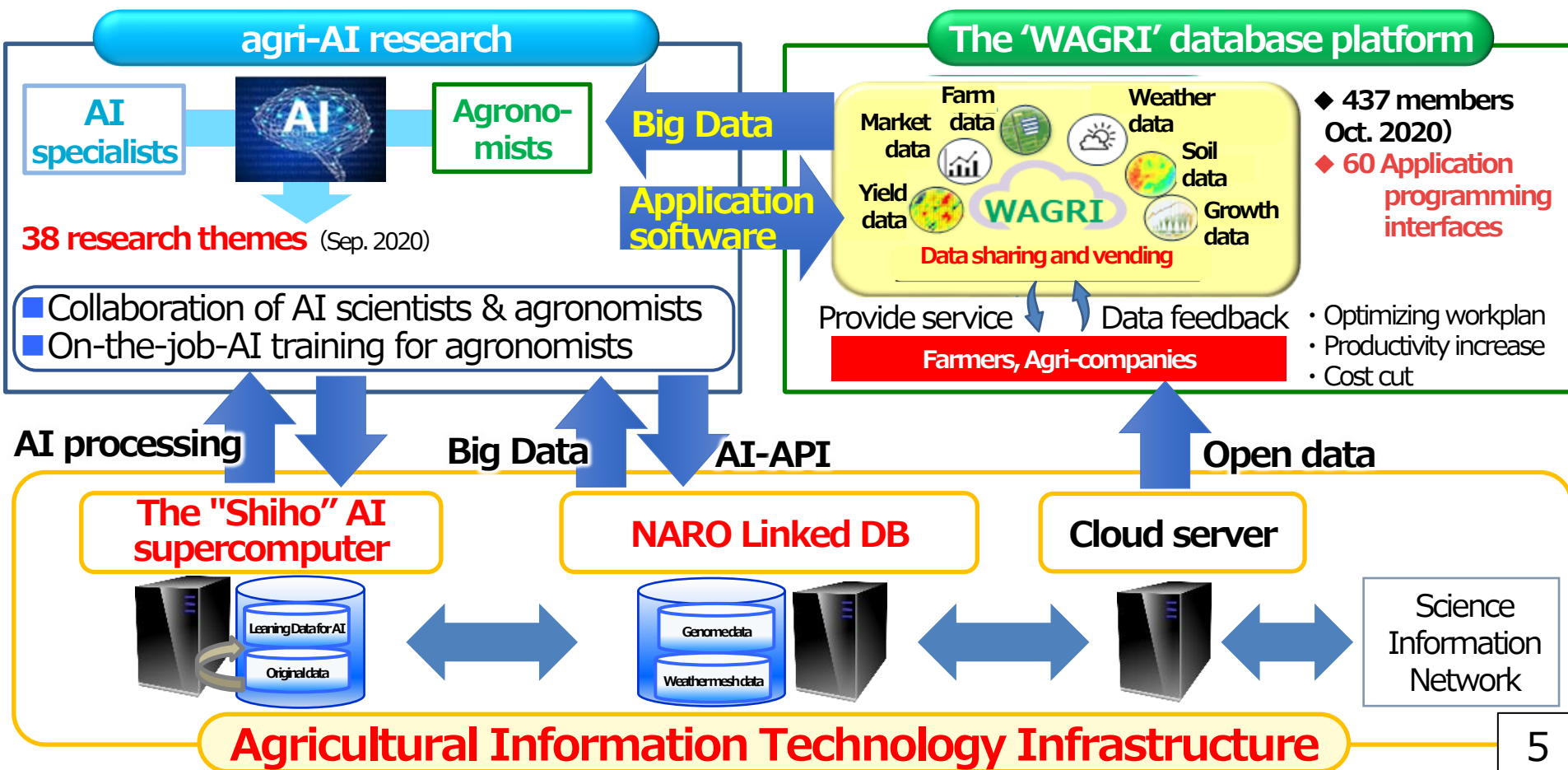
### Data-driven soil management

- Optimal soil maintenance by sensing soil fertility and possibility of GHG emissions



# Research Center for Agricultural Information Technology (RCAIT)

- 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)



# Technologies for smart agriculture by SIP

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



the cross-ministerial Strategic Innovation Promotion Program



Plowing and Puddling

Robot tractors



Transplanting

Robotic transplanter



Robot combine harvester

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

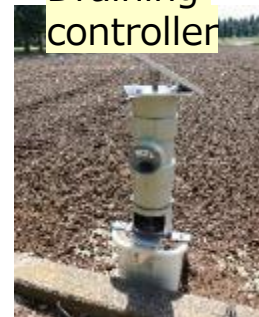
\* Combined use of these four ICT agri-machines resulted in a **45% increase in one farmer's income through farm-size expansion.**<sup>†</sup>

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

Water supply controller



Draining controller



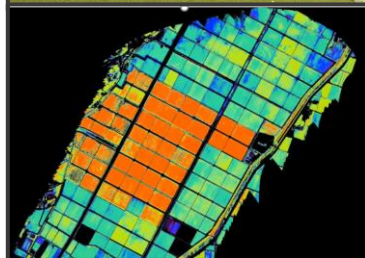
Automatic & remote water management system

<sup>†</sup> 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



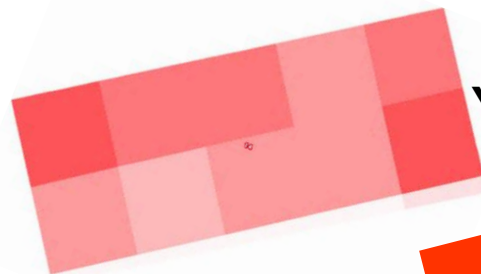
Plant growth mapping



Map-based variable rate fertilization according to growth



Combine harvester with yield monitoring



Yield mapping



Map-based variable rate fertilization according to yield



- 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.



# Automated agri-machinery test

◆ In Japan, various automated agri-machines have been put on the market and are being introduced into agricultural fields gradually.

Autonomous Tractor



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

Autonomous Tea Harvester



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

Auto-steering Combine



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

Auto-steering Transplanter



Cited from ISEKI & CO.,LTD. Auto-steering transplanter NP-80D  
<https://www.iseki.co.jp/products/taueki/taue-np80dz/>

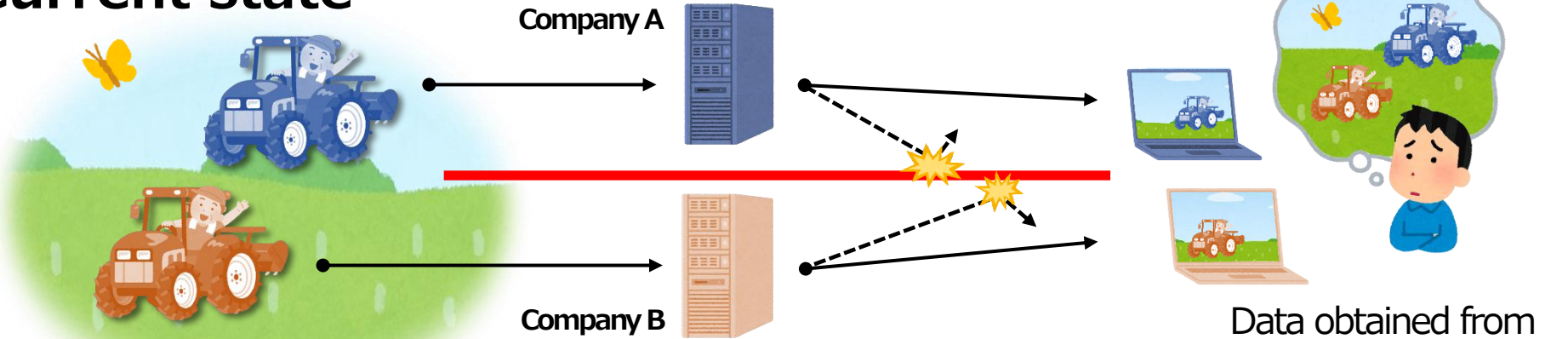
- ◆ Publication of Certified Machines (as of Dec. 2021)
  - Auto-steering agri-machinery test :  
38 types for 3 kinds of machines
  - Autonomous agri-machinery test :  
3 types for 2 kinds of machines
  - If the machine passes the optional test, the machine will be able to indicate “Two Stars”.



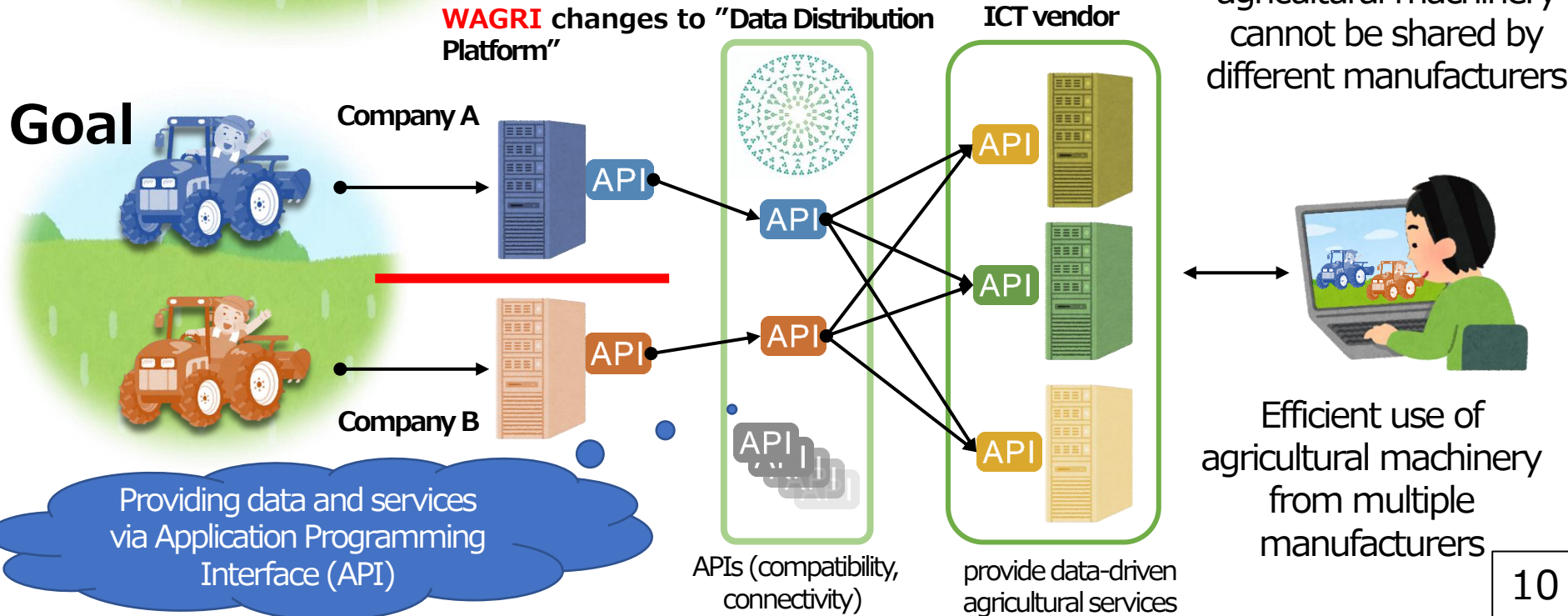
- ◆ IAM will continue to revise the test based on the results of the MAFF's trial project for introducing automated agri-machinery.

# "Open API" is required in Japan

## Current state



## Goal





Thank you for your attention!