Japan's work on activities related to improving nutrient use and manure management towards sustainable and resilient agricultural systems

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JIRCAS

Outline

1. Japan’s experience I. Technical activities for improved fertilizer use efficiency and increased productivity
2. Challenges and expectation to the Koronivia joint work on agriculture and UNFCCC constituted bodies
3. Japan’s experience II. Social awareness raising

1. Technical activities

General background

i. AFOLU activities accounts for 82% of nitrous oxide emissions from human activities (2007-2016). IPCC Special Report on Climate Change and Land, 2019

ii. Nutrient use and manure management and associated greenhouse gasses are related with many elements (e.g. crop yield and quality, N and C dynamics in soil)

iii. Improved nitrogen use efficiency is often related to multiple benefits (e.g. reduced cost/yield, reduced leaching, possibly also with biodiversity)

1. Technical activities

Examples of research

- Model-based visualization tool for agricultural soil carbon sequestration and GHG emissions
- Biological nitrification inhibition (BNI)
- Promotion of Smart Agriculture

Possible trade off：Management practice to increase soil carbon may increase emissions of other GHGs

Need to evaluate the total Global Warming Potential (GWP)

e.g. Mitigation option: “Increase C inputs to soils”

Soil C increase (CO_2 decrease)

Trade-off

CH_4 and N_2O increase

Total GWP?

Source: Dr. Shirato, NARO, Agriculture is the solution! workshop, May 2019, Shiga

Web-based visualization tool for agricultural soil carbon sequestration and GHGs emission

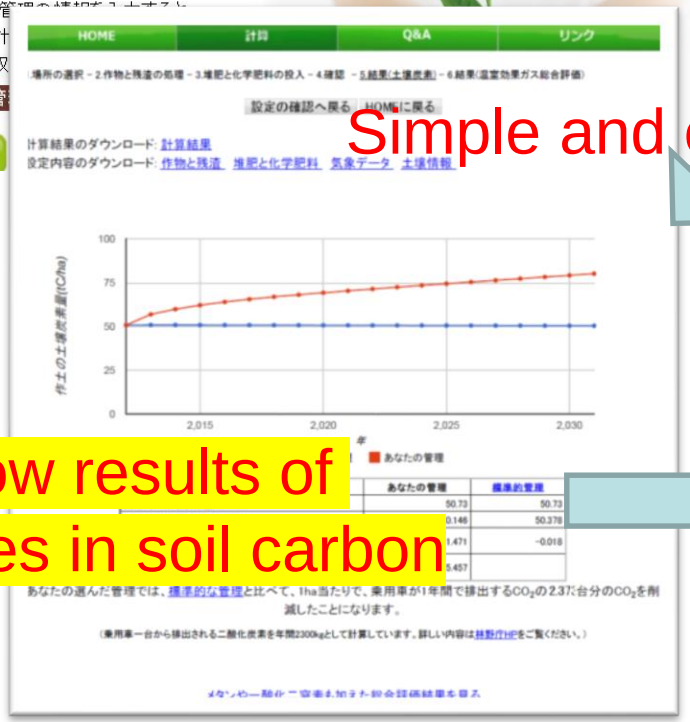
What's New

土壌のCO$_2$吸収量を
簡単に計算できます。

本サイトでは、場所や管理の情報を入力すると
土壌のCO$_2$吸収量を計
あなたの畑のCO$_2$吸収

調べたい場所 + 管

▸くわしくはこちら



Click on map ➔ get weather and soil data

Select crop and management

Simple and easy interface

➔ Show results of changes in soil carbon

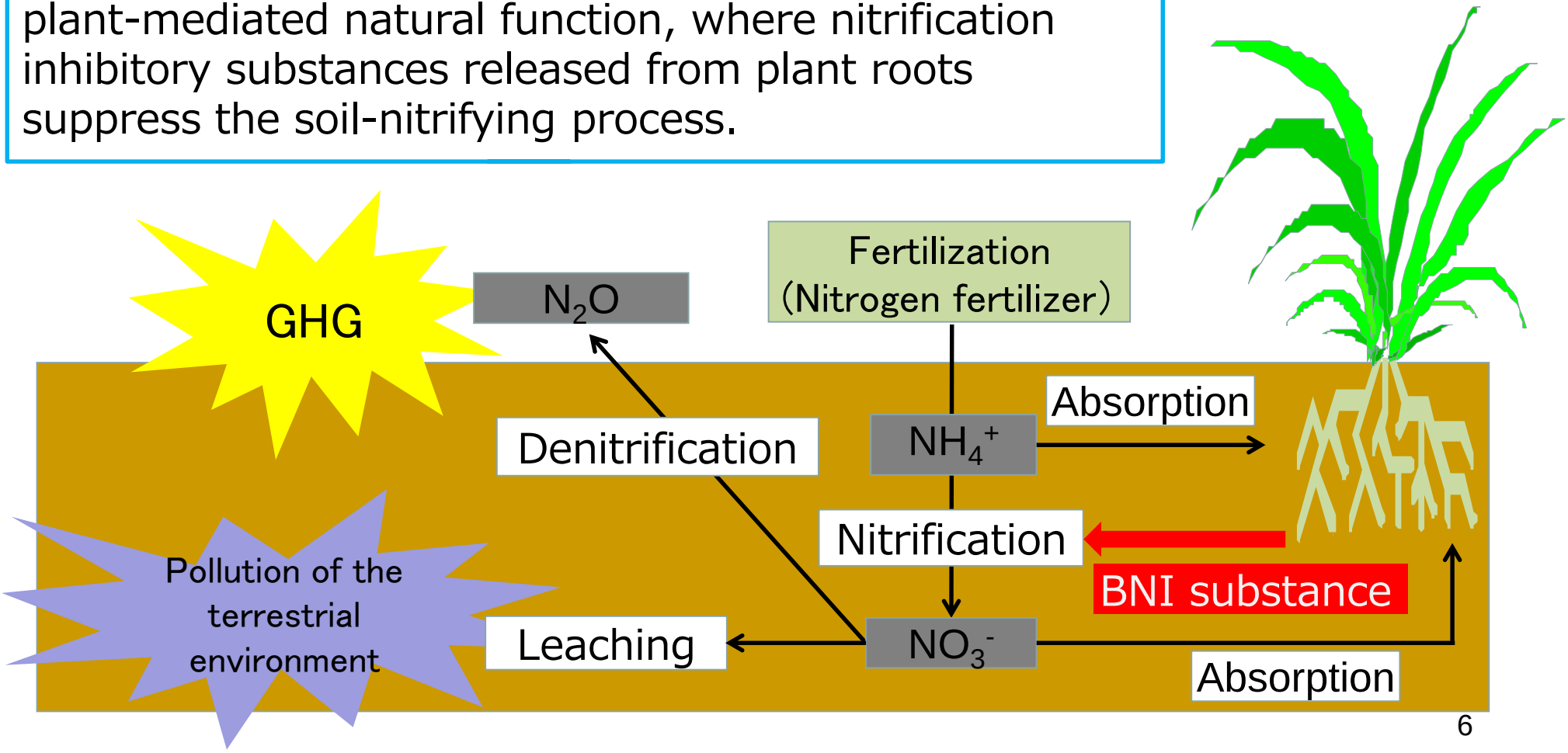
	あなたの管理	標準的管理
土壌炭素の増減によるCO$_2$(tCO$_2$/ha/年) (プラスが排出。マイナスが吸収)	-3.34	0.5
メタン(g-CH$_4$/m^2/年)	10.00	10.00
CO$_2$換算(tCO$_2$/ha/年)	3.40	3.40
N$_2$O(kg-N$_2$O/10a)	0.13	0.07
CO$_2$換算(tCO$_2$		0.20
うち化学肥料由		0.02
CO$_2$換算(tCO		0.05
うち堆肥由来(k		0.01
CO$_2$換算(tCO		0.03
うち作物残渣由	0.04	0.04
CO$_2$換算(tCO	0.11	0.11
化石燃料由来のCO$_2$(tCO$_2$/ha/年)	2.02	2.02
合計(tCO$_2$/ha/yr) (プラスが排出。マイナスが吸収)	2.47	6.12

Total evaluation of 3 greenhouse gases (CO_2, CH_4, N_2O)

Source: Dr. Shirato, NARO, Agriculture is the solution! workshop, May 2019, Shiga

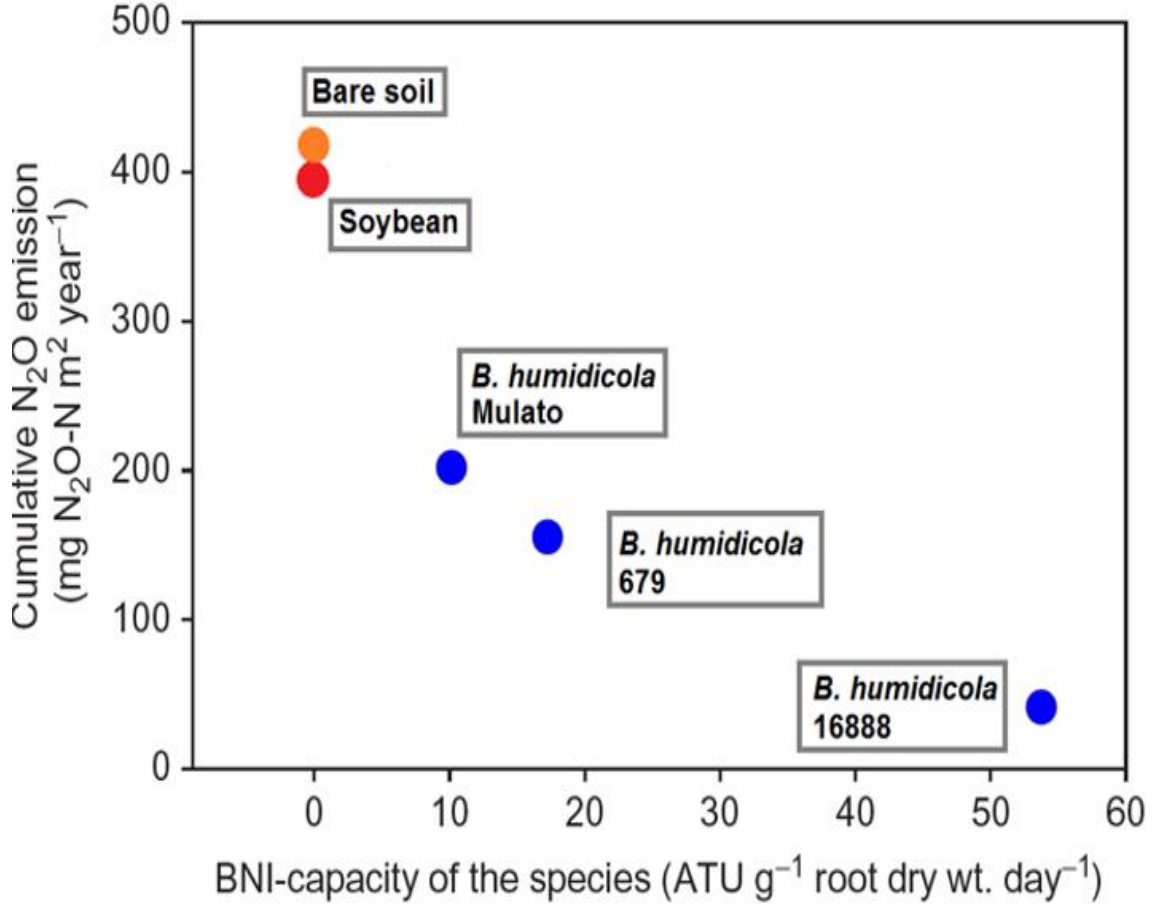
The concept and function of Biological Nitrification Inhibition (BNI)

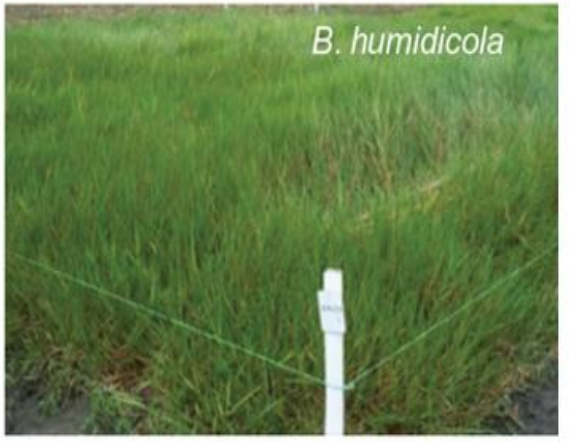
Rapid nitrification results in inefficient N-use by crops, leading to environmental pollution. **BNI** is an active plant-mediated natural function, where nitrification inhibitory substances released from plant roots suppress the soil-nitrifying process.



Evidence of benefits (Environment)

N_2O emission negatively correlates with the activity of BNI secretion from the species planted (adapted from Subbarao et al., 2012).

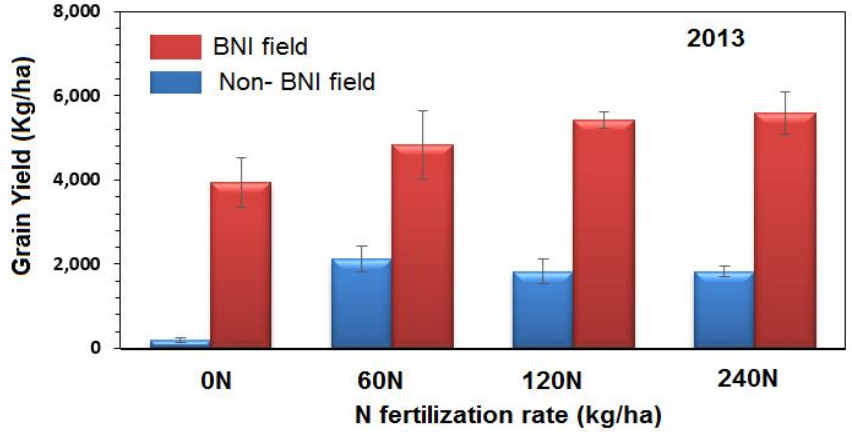


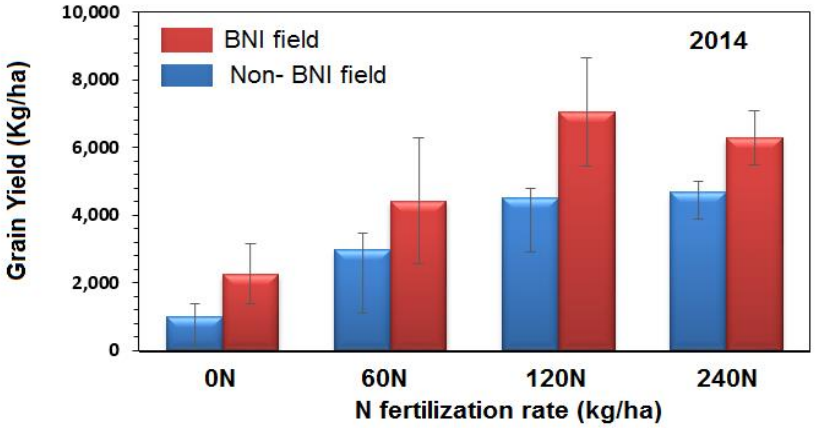


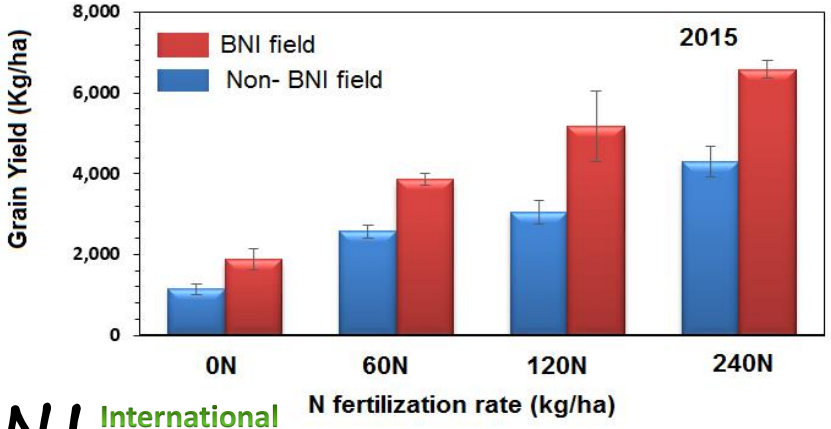
BNI International Consortium
Biological Nitrification Inhibition

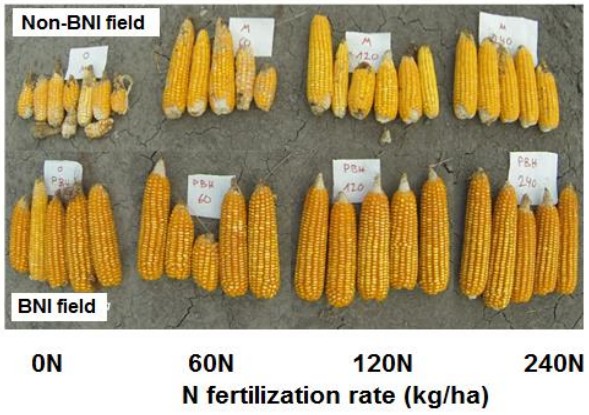
Evidence of benefits (Agriculture)

Corn grain yield in fields with previous land use of Brachiaria (BNI field) and crops (non- BNI field). Data and image are provided by Dr. Jacobo Arango, CIAT, Colombia.







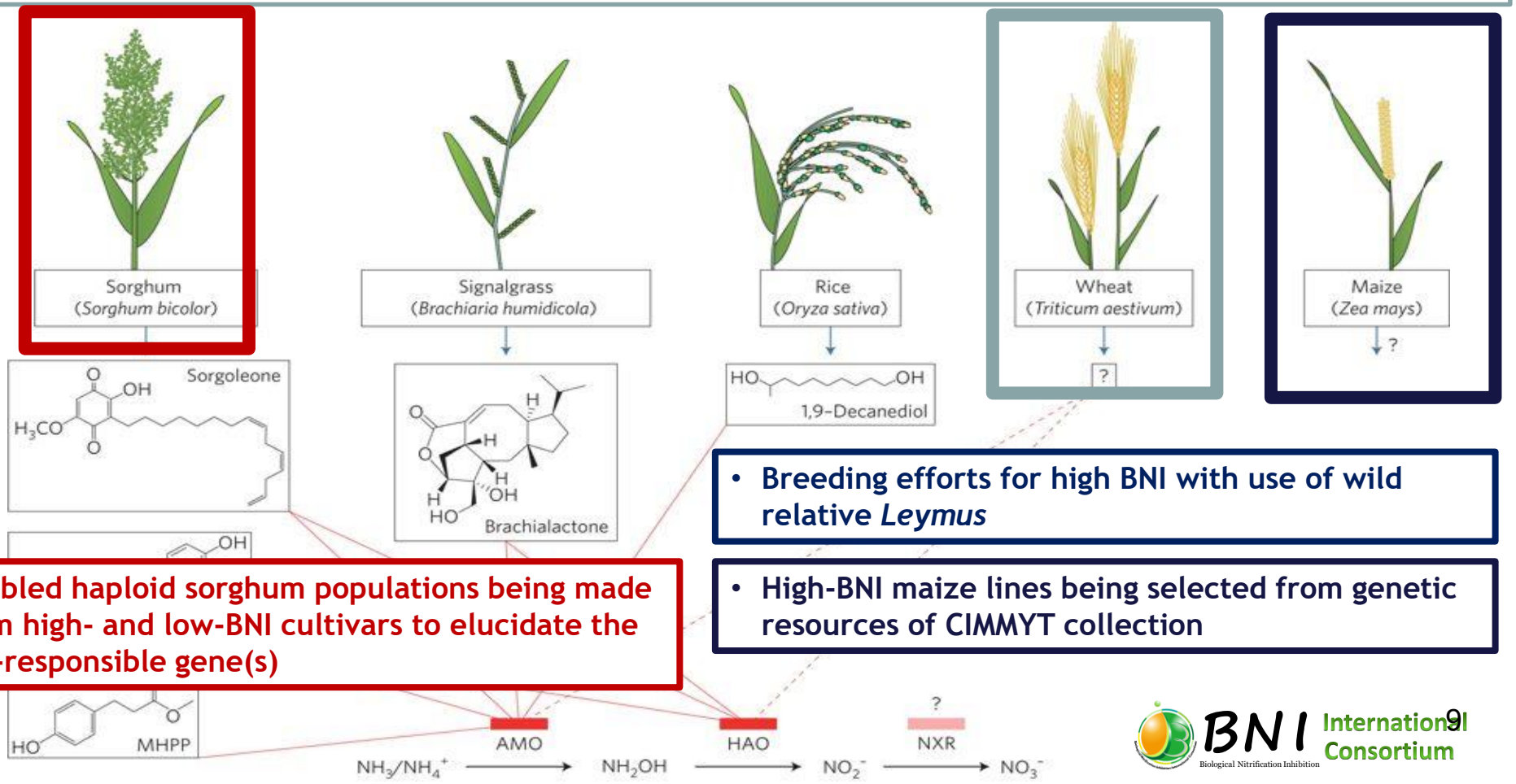


BNI International Consortium
Biological Nitrification Inhibition

The BNI technology

- **Primarily discovered the phenomenon by Japanese scientists in Latin America.**
- **A lot of efforts have been paid by JIRCAS and collaborators for the scientific recognition of the existence and significance of BNI.**

Modified from Coskun et al., 2017



- **Doubled haploid sorghum populations being made from high- and low-BNI cultivars to elucidate the BNI-responsible gene(s)**

- **Breeding efforts for high BNI with use of wild relative *Leymus***
- **High-BNI maize lines being selected from genetic resources of CIMMYT collection**

BNI International Consortium
Biological Nitrification Inhibition

Development of cultivation management system to reduce greenhouse gas derived from agriculture

MAFF-CIAT project, 2018-

Introduce to
degraded pasture

Monitoring and analysis of environment, on-farm management and growth

AI and IoT technology

management based on data

- Increased productivity on degraded pasture
- Reduced N_2O emission

High-BNI capacity pasture

Smart Agriculture

Advantage of agriculture of Japan

- Expert skills corresponding to local characteristics such as climate and soil
- Delicious breeds and brands with wide variety reflecting local characteristics around Japan
- Safe and secure agriculture products matching with consumers' needs

advanced technologies

Robot tractor

40% reduction of working time

Assist suit

Only a half of the usual power is required in lifting operation

Drone

Optimized **manuring and pest control** based on **sensing data** of the whole field

"Agriculture Technology" × "Advanced Technology"

Smart Agriculture

Effects of Smart Agriculture

- Automation of operation by advanced technologies such as robot tractors and water-management system operated by smartphones enables scale-up of business.
- ICT technologies enables succession of agricultural skills of expert farmers to young farmers.
- Highly managed agriculture will be realized by accurate prediction of growth and diseases to utilize and analyze sensing data, etc.

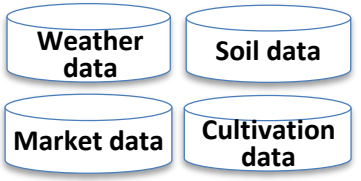
Development of Agriculture by Making Full Use of the Data - Agricultural Data Collaboration Platform "WAGRI" -

For everyone involved in agriculture to be able make a good use of data for better productivity and management, ICT vendors, agricultural machinery manufacturers, and research institutes start to use "**The agricultural data collaboration platform (WAGRI)**".

Current status and tasks

Agricultural ICT services in Japan

Most of public data is scattered and not suitable for ICT use



the agricultural data collaboration platform "WAGRI"

Functions

Coordination

It will enable different vendors and manufacturers to share data on various ICTs, agricultural machinery, and sensors.

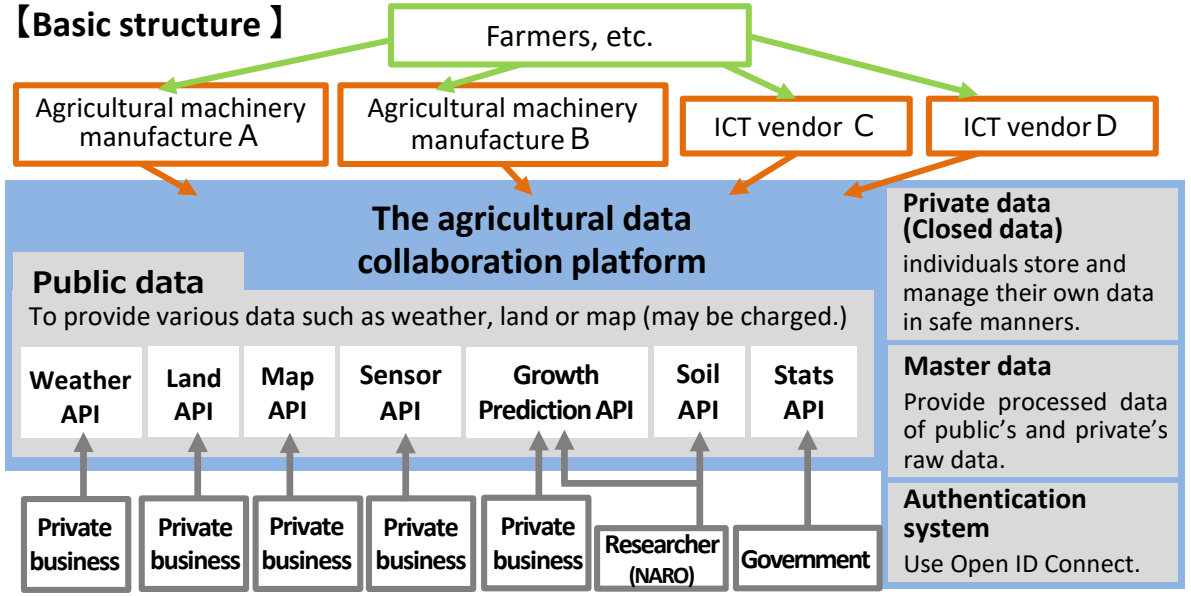
Sharing

Data sharing will create new services that will lead to data comparison and better productivity.

Providing

It enables to provide useful data for farmers such as soil, weather and market.

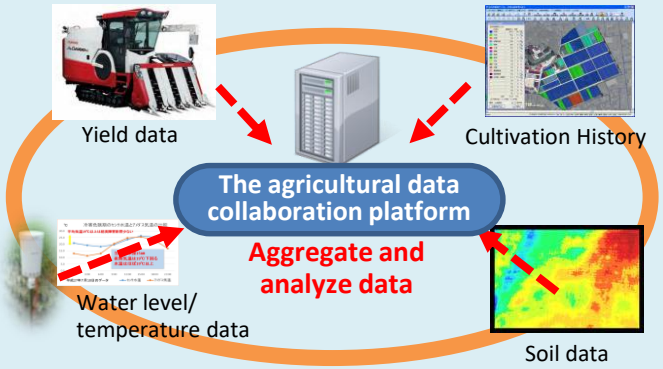
【Basic structure】



<Effects of "WAGRI">

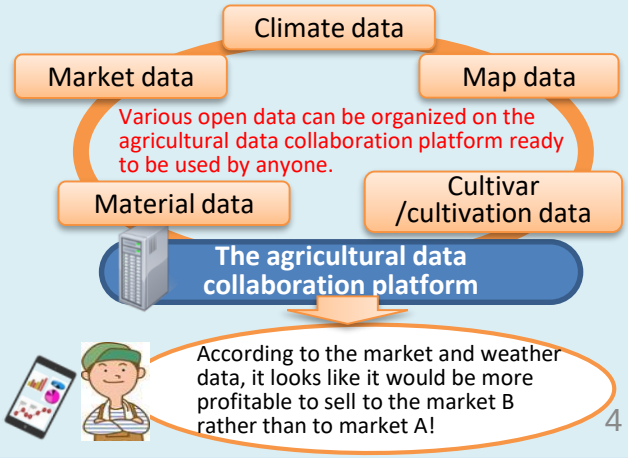
【An effect of data collaboration】

It increases yield and quality of products, by data aggregation and analysis.



【An effect of open data utilization】

Various open data will be provided on the agricultural data collaboration platform, which will help farmers make strategic management decisions.



2. Challenges and how KJWA and the UNFCCC Constituted bodies can help

1. Implementation of best practices, innovations and technologies in **farmers' fields**
2. Inter-disciplinary collaboration
3. Communicating science to users and beneficiaries of the technologies (e.g. farmers, consumers, national and local policy makers)

KJWA and UNFCCC bodies can advance work by connecting science to the broader community and national tools

3. Social awareness activities

International symposiums held in Japan (2019)

- Agriculture is the Solution! for Climate Change
- Scaling up and out climate-smart technologies and practices for sustainable agriculture “Climate change and agriculture business”

Agriculture is the Solution! for climate change

International symposium, May 2019 in Shiga, Japan

All participants highlighted the **extreme vulnerability of agriculture to climate change** and the **urgency of accelerating action** before it is too late.

Key messages

1. **Multi-stakeholders exchanges** are fundamental for inclusive decision making and successful uptake of actions on the ground.
2. **Farmers are at the center of addressing climate change** and are key to scaling up proven solutions.
3. Consumers, governments and all stakeholders in this common challenge must recognize the valuable role of farmers.

The symposium was organized by MAFF with support from Shiga Prefecture, the Food and Agriculture Organization, the World Bank and the 4per1000 initiative.

Opening by H.E. Minister Takamori Yoshikawa

Field trip

Program and presentations available at
http://www.maff.go.jp/e/policies/env/agsol.html

Climate Change and Agriculture Business

International symposium, November 5, Tokyo

MAFF Japan also organized a symposium for **scaling up and out climate-smart technologies and practices**, as part of the follow-up international workshop of G20 Meeting of Agriculture Chief Scientists (April 2019, Tokyo).

← Website of the symposium (http://www.maff.go.jp/j/kanbo/kankyo/seisaku/kikouhendou/symposium/cs.html)

Panel discussion “Let’s discuss seriously for our future”

International symposium, November 5, Tokyo

Research community

farmers

Private sector

Farmers’ voices

- We feel the crisis – plant diseases, extreme weather events, etc…
- Farmers care about climate change, but didn’t know what was happening at global scale. Even if they intend to do good thing, they might burden the environment, because sometimes they don’t have scientific knowledge.
- Farmers bear the operational risk when installing new equipment and machinery to introduce new practice.