



2025.10.23

International Seminar on Smart Agriculture
@Suncheon National University, Korea

Experiments on Internet Environment Improvement in Mountainous Farmland Using Starlink and Mesh-net Wi-Fi Technology

Masaru Mizoguchi

Professor emeritus/Project professor
Graduate School of Agricultural and Life Science
The University of Tokyo



I visited SNU 3 times (?) before

- Oct. 30, 2006 韓・日 u-農業共同 workshop
- May 11, 2009 The 2nd Korea Japan u-agriculture Workshop
- June 21, 2016 AFITA

Oct. 30, 2006

韓・日 u-農業共同 workshop
@Sunchon National University, Korea

Current Status and Prospect for Real-time Soil Information Monitoring by Field Server



Masaru Mizoguchi

The University of Tokyo

SWIFT factory tour by Univ. COOP
December 22, 2008
Chiang Mai, Thailand

2009.5.11
The 2nd Korea Japan u-agriculture Workshop
Sunchon National University, Korea

Spinach Field Monitoring for bridging Thai Producer and Japanese Consumer using Field Sever

Masaru Mizoguchi^{1*}

Shoichi Mitsuishi, Tetsu Ito², Ayumi Arakawa², Yuki Kojima²

Kiyoshi Honda³, Aadit Shrestha³, Rassarin³, Apchon³

1 Interfaculty Initiative in information Studies, The University of Tokyo

2 Department of Global Agricultural Science, The University of Tokyo

3 School of Engineering and Technology, Asian Institute of Technology

Contact: amizo@mail.ecc.u-tokyo.ac.jp

SWIFT factory tour by Univ. COOP
December 22, 2008
Chiang Mai, Thailand

2009.5.11
The 2nd Korea Japan u-agriculture Workshop
Sunchon National University, Korea

Farm to Table Experiment with
Information and Communication
Technology
@University of Tokyo
Co-op Cafeteria

Ayumi Arakawa¹ , Masaru Mizoguchi²

1 Graduate School of Agriculture and Life Sciences

2 Graduate School of Interfaculty Initiative in information Studies,
The University of Tokyo

Before
Today's topic



Made in Fukushima like a phoenix



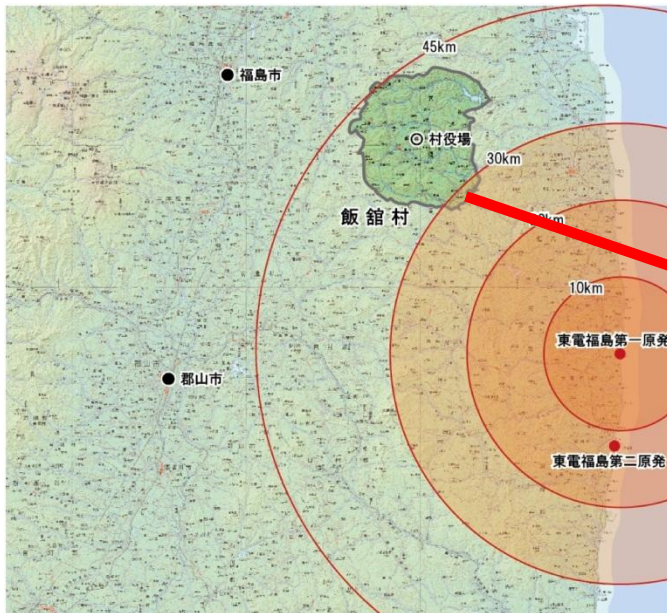
Masaru **Mizo**guchi
The University of Tokyo
Email: mizo@g.ecc.u-tokyo.ac.jp



Dr. Doroemon



Iitate Village in Fukushima Prefecture

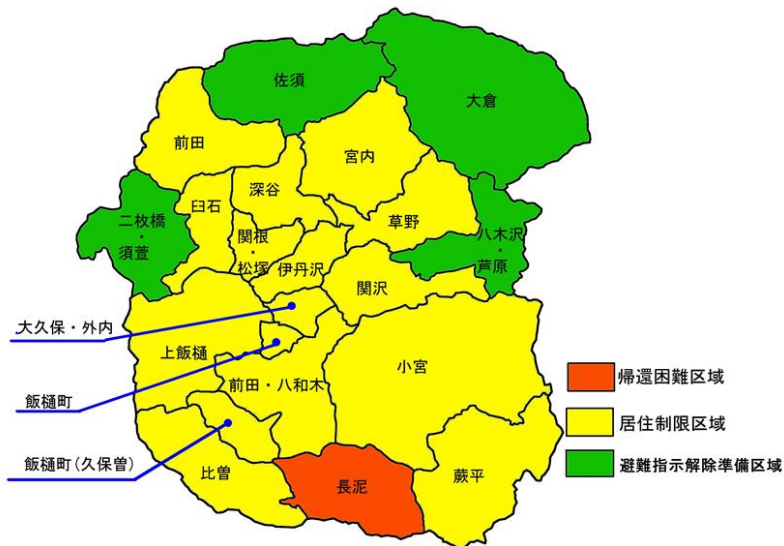
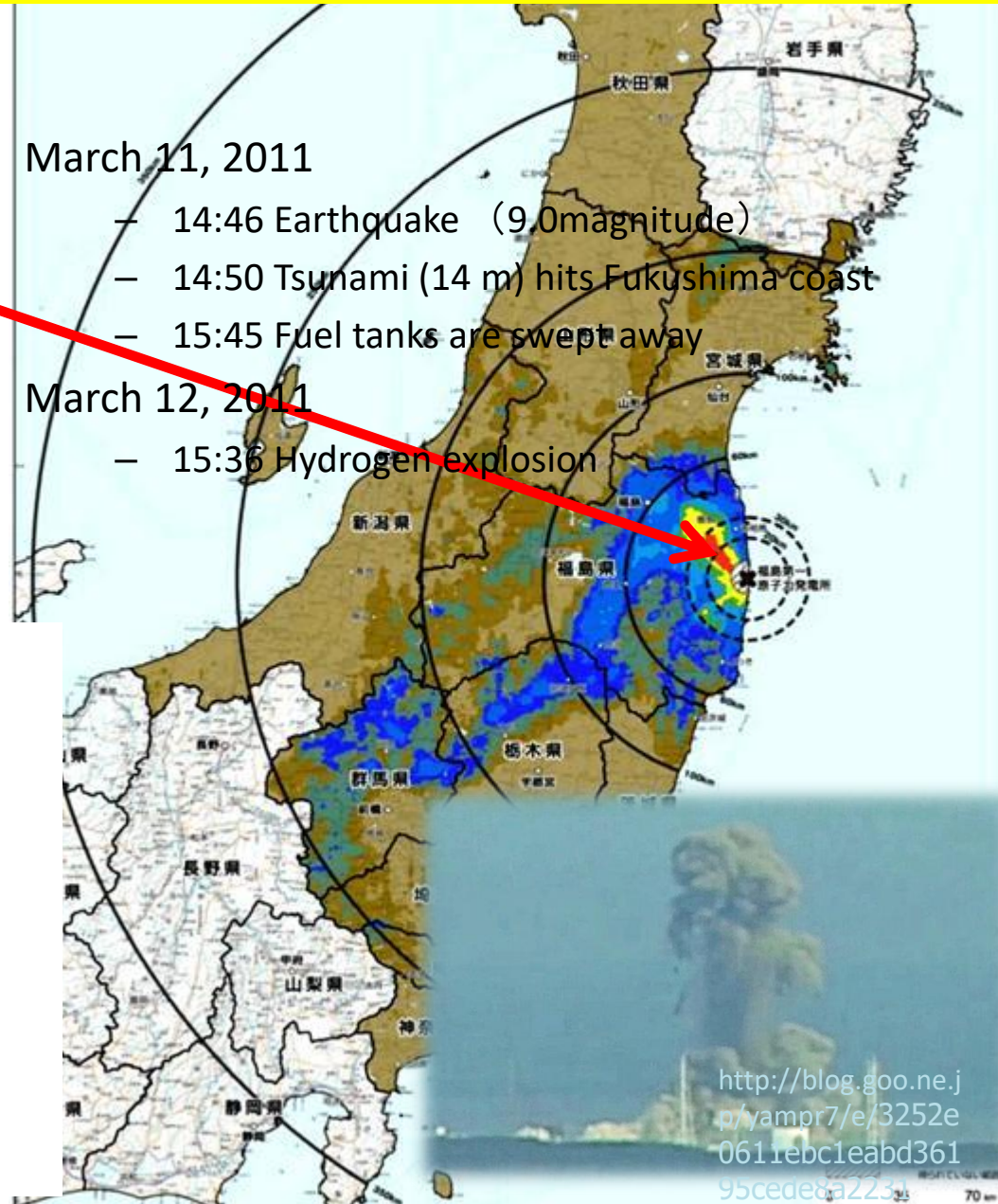


March 11, 2011

- 14:46 Earthquake (9.0 magnitude)
- 14:50 Tsunami (14 m) hits Fukushima coast
- 15:45 Fuel tanks are swept away

March 12, 2011

- 15:36 Hydrogen explosion



<http://blog.goo.ne.jp/yampr7/e/3252e0611ebc1eabd36195cede8a2231>

Agriculture and Rural Area

Agricultural Infrastructure

public works

Soil, Water, Rural Areas, Information



Supporting agricultural production

A behind-the-scenes role

March 2011

Nuclear power plant accident 9



Radiation dose measured on a slope in Iitate Village (2011.6.25)



2.5 $\mu\text{Sv/h}$

3.5 $\mu\text{Sv/h}$

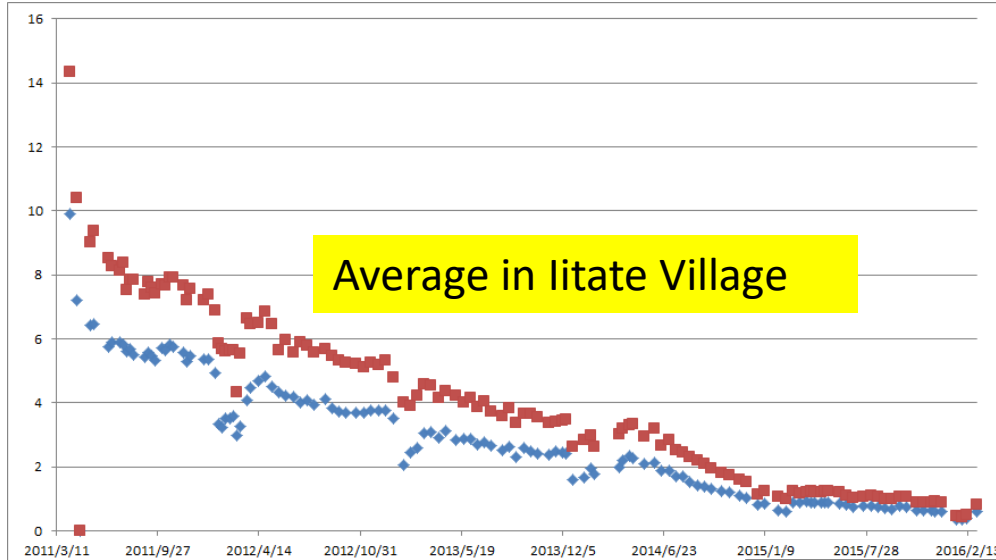
7.0 $\mu\text{Sv/h}$



飯舘村が東大と連携協定

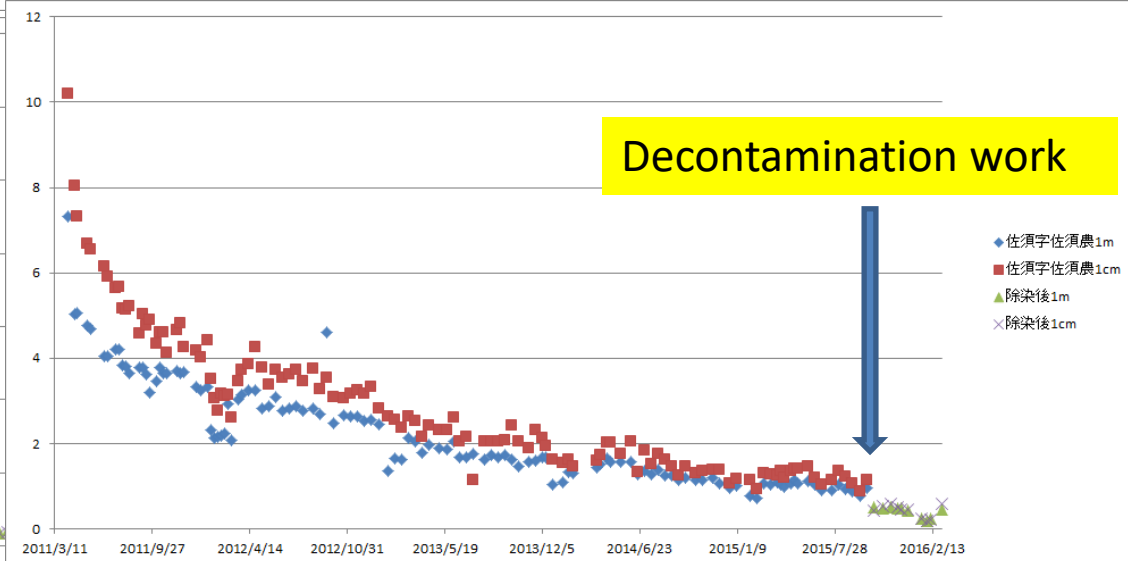
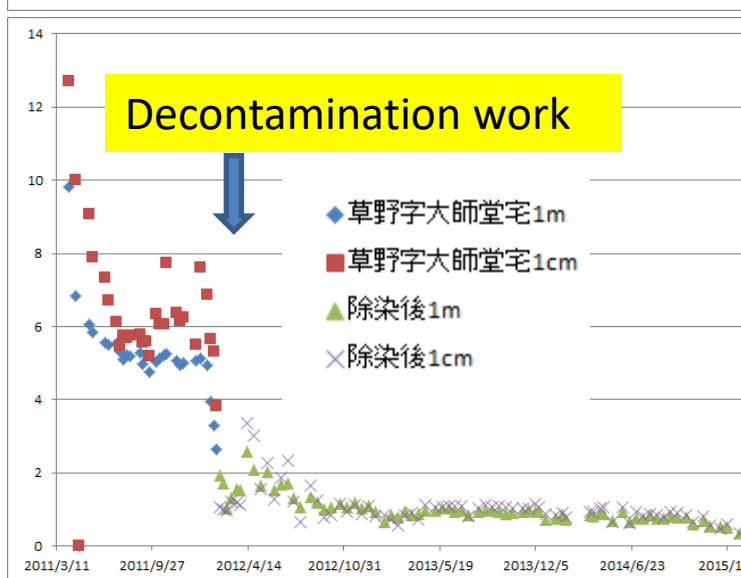


Change of Radiation dose in Iitate Village

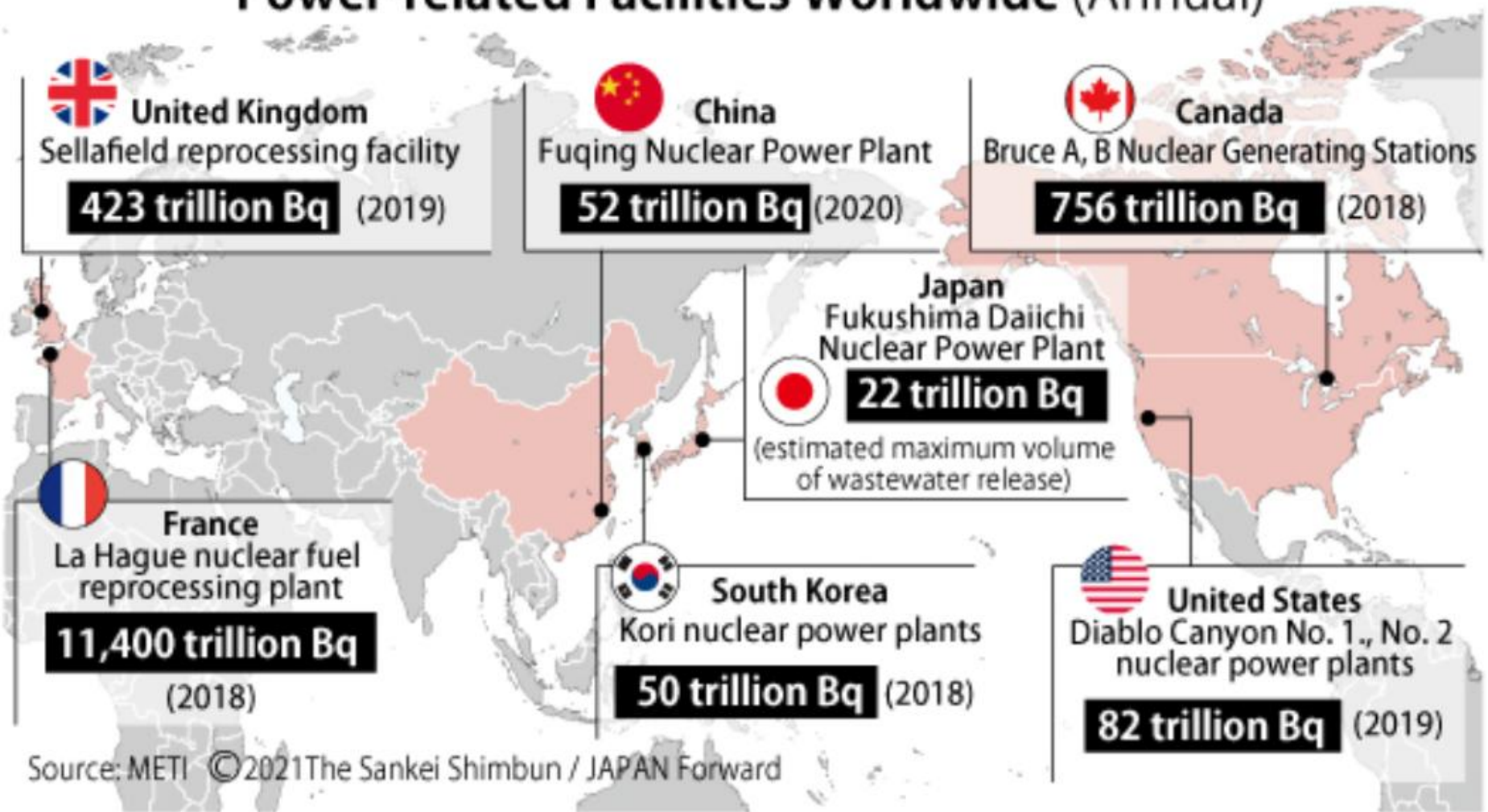


Source:

<http://www.fukushima-saisei.jp/mon/trendiitate/#00>



Volume of Tritium Discharge in Liquid Form for Major Nuclear Power-related Facilities Worldwide (Annual)



<https://japan-forward.com/china-and-south-korea-too-release-nuclear-plant-wastewater-into-the-oceans/>

I visited Kori (古里) nuclear power plant two years ago



2023.7.22 Kori nuclear power plant (古里)

Development of decontamination method farmers can do by themselves in paddy contaminated by radiocaesium in Fukushima



Prof. Masaru *Mizoguchi*

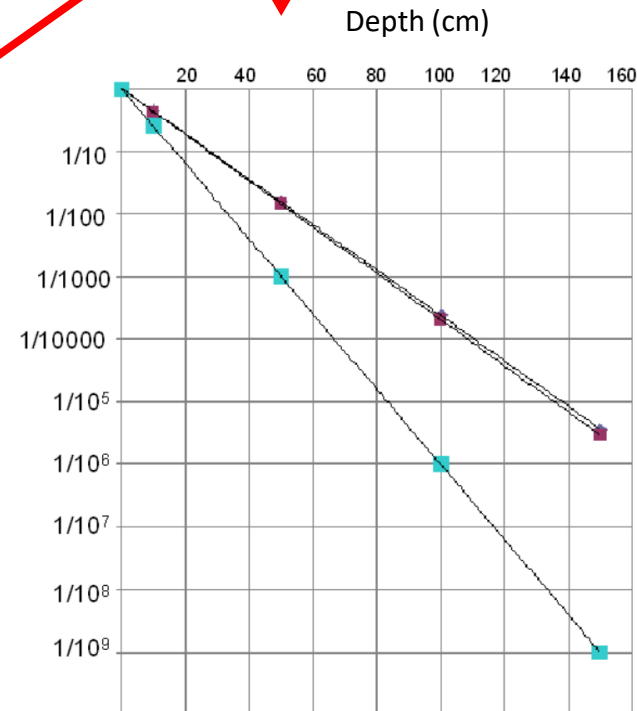
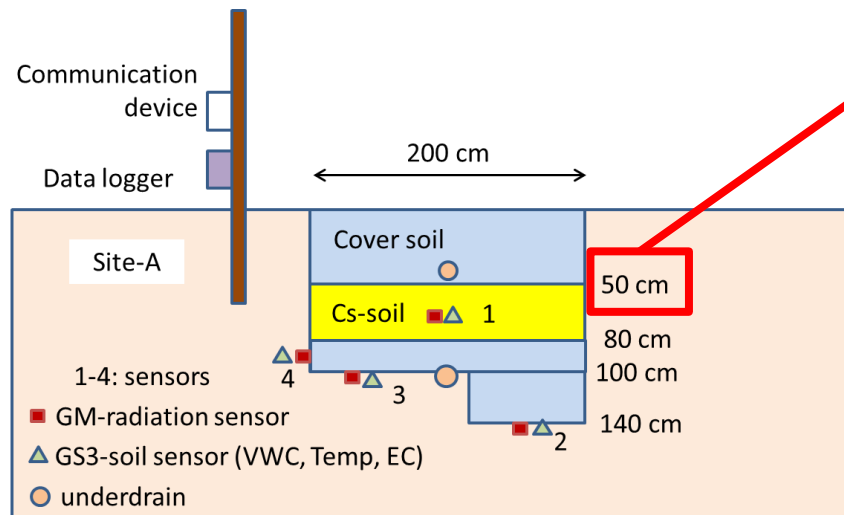
Dept. of Global Agricultural Science

Univ. of Tokyo

Contaminated soil should be buried in the bare hole!

Because

1. Cs is fixed to clay minerals such as weathered mica in soil
2. Radiation dose is 1/100 to 1/1000 just bury 50cm deep!



Measurement of soil radiation

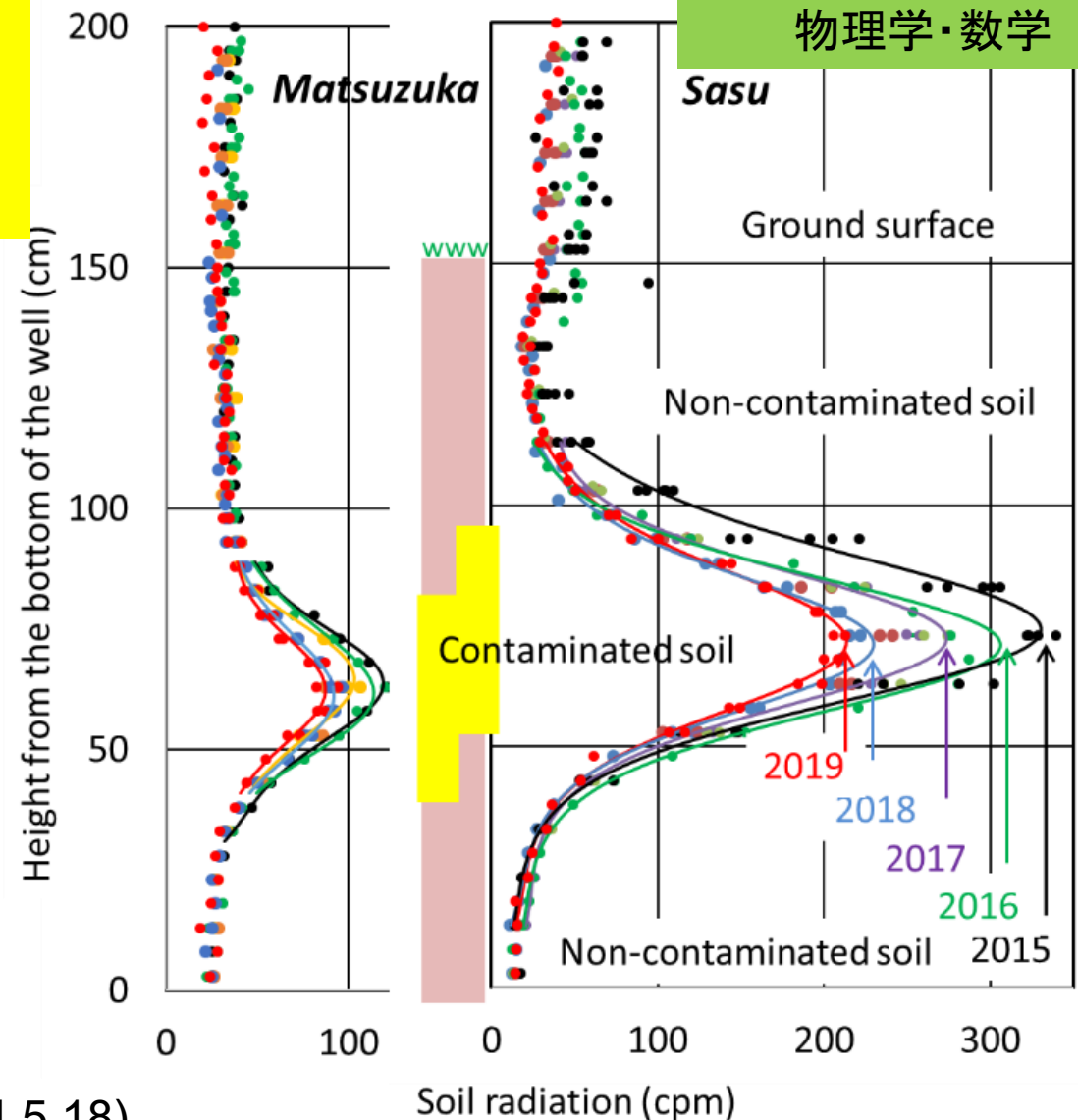
- Instrument “Choshaku-kun”
- Easy to measure soil radiation in a well
- 1 m long, 3 cm in diameter
- with 10 pieces of GM tube arranged at 10cm intervals
- 3-5 min to measure



Profiles of soil radiation level



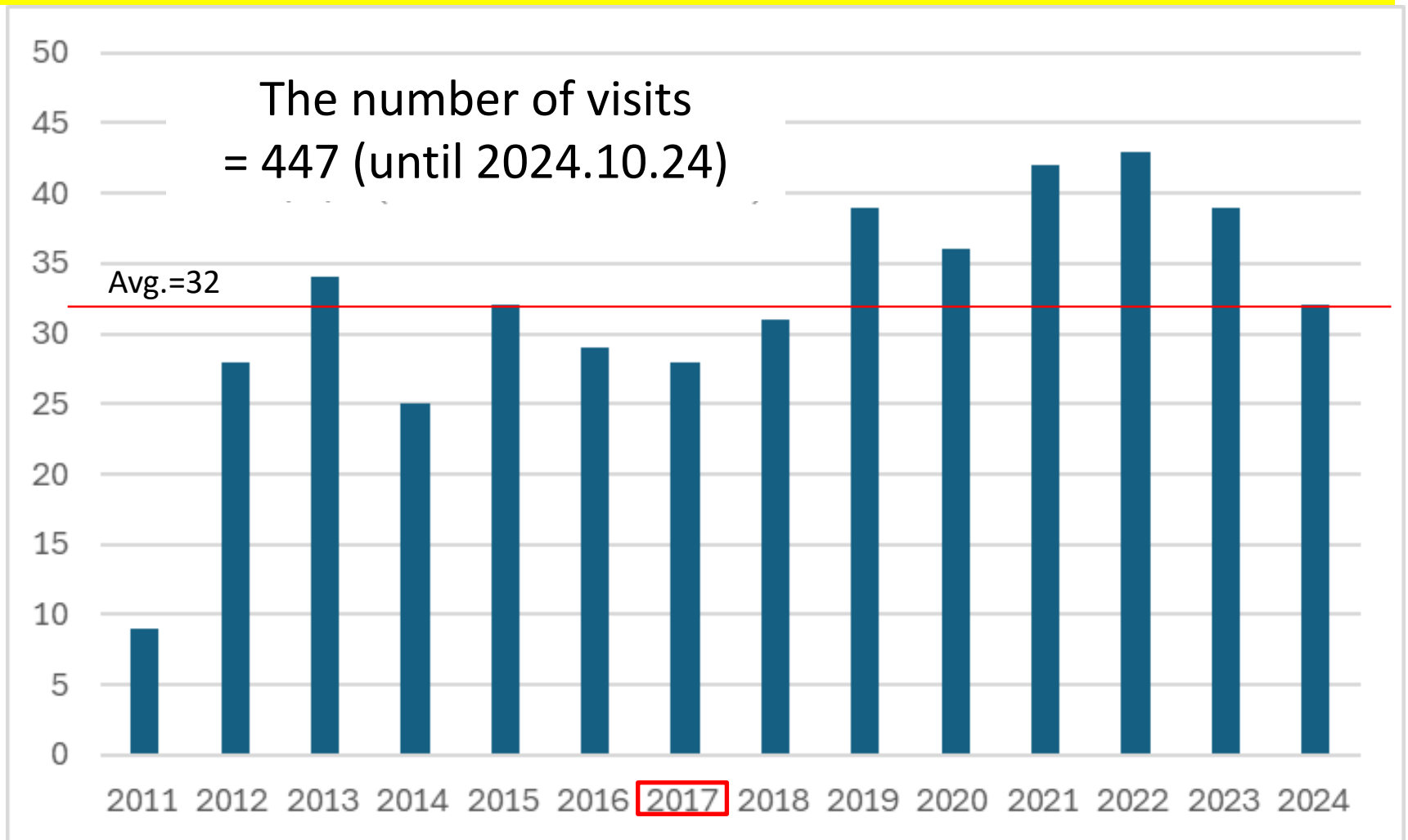
Burial of contaminated soil(2014.5.18)



- The peak depth of soil radiation has not changed
- The maximum of soil radiation levels are decaying naturally

What I found from the 14 years of activities in litate Village

The number of visits has increased after the
2017 declaration of return to the village!

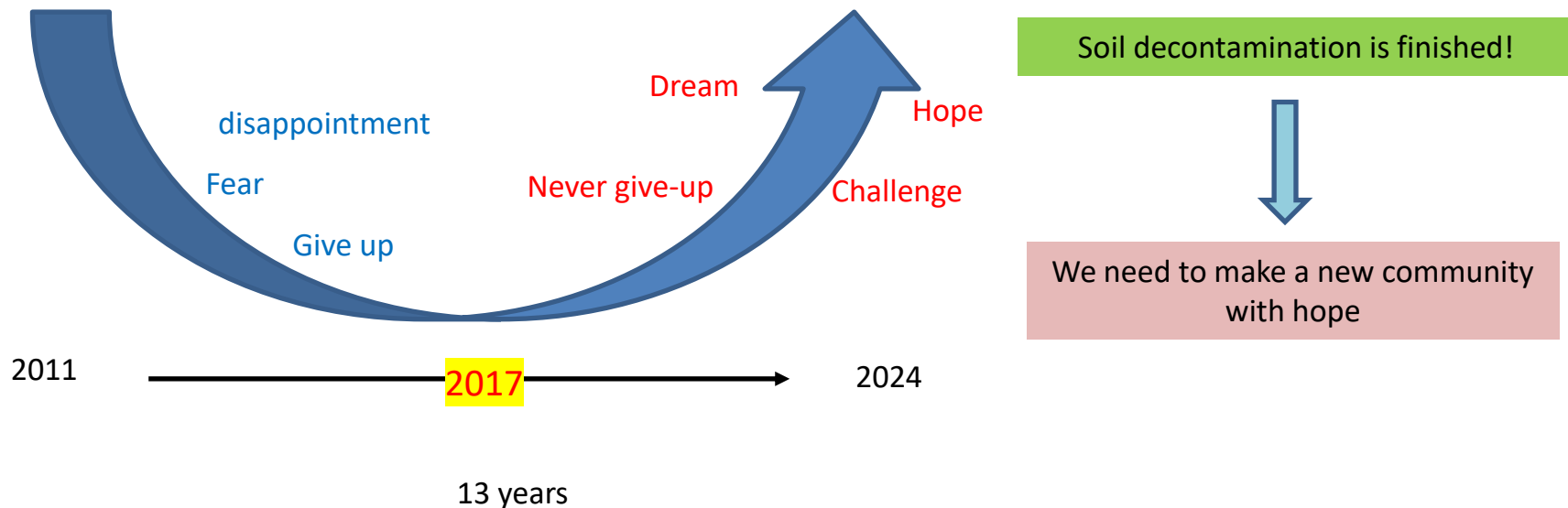


WHAT IS RESILIENCE AGRICULTURAL SCIENCES

-NEW AGRICULTURAL SCIENCE

- Resilience: the ability to be **happy, successful, etc.** again after something difficult or bad has happened (Cambridge Dictionary)

Reconstruction → Resilience



New challenge in Iitate Village

- Revitalizing Agriculture
- Rural regeneration
 - using ICT/IoT
- Youth education
 - through field tour



Revitalizing Agriculture in Fukushima

Conquer the world with litate sake

虎捕山の麓から 飯館再生のために
スマート農業のテクノロジーで育てた酒米から純米酒が誕生しました

Sake without heat



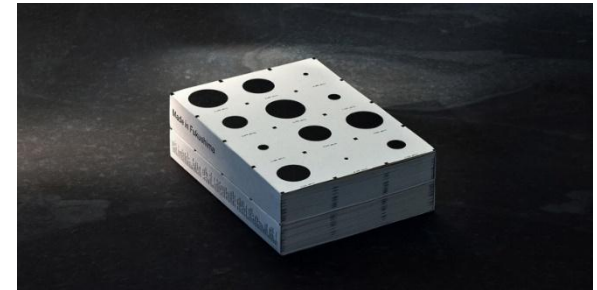
Sake with heat



フィールド WiFi カメラによる酒米水田の監視



Cannes



<https://www.madeinfukushima.com/>

2019/6/19



You can buy it at Takasakiya in front of the Faculty of Agriculture, UTokyo!

Towards agricultural regeneration: the litate brand

- litate three bottles

- Sake: like a phoenix
- Wine
- Beer “Re : craft”



- litate speciality agricultural and livestock products

- **litate beef**
- litate speciality snacks
- traditional seasoning food



- International expansion and cooperation with consumers

- **Fukushima/litate brand**
- quality control (Global-GAP)
- Recipe development



Rural regeneration using ICT/IoT

Equation quiz

$$\text{IoT} - \text{I} = \text{oT}$$

(Internet of Things) - (Internet) = (only Things)



The IoT is only a trash if non-internet

Building new villages through ICT/IoT

Beautiful and Smart Conception

美賢村構想

- Creating a village that is 'beautiful' plus 'smart'.
- Use of optical leased line cables
 - Monitoring of the elderly
 - Unmanned vehicles
- Smart agriculture
 - Automatic water taps
 - Automatic Animal monitoring
 - Monkeys chasing robots
- Smart disaster prevention
 - Local weather forecasting
 - River monitoring (water levels)
- Others



Watching the front door of elderly people's homes



River monitoring



[Monkey monitoring](#) 2024.10.19

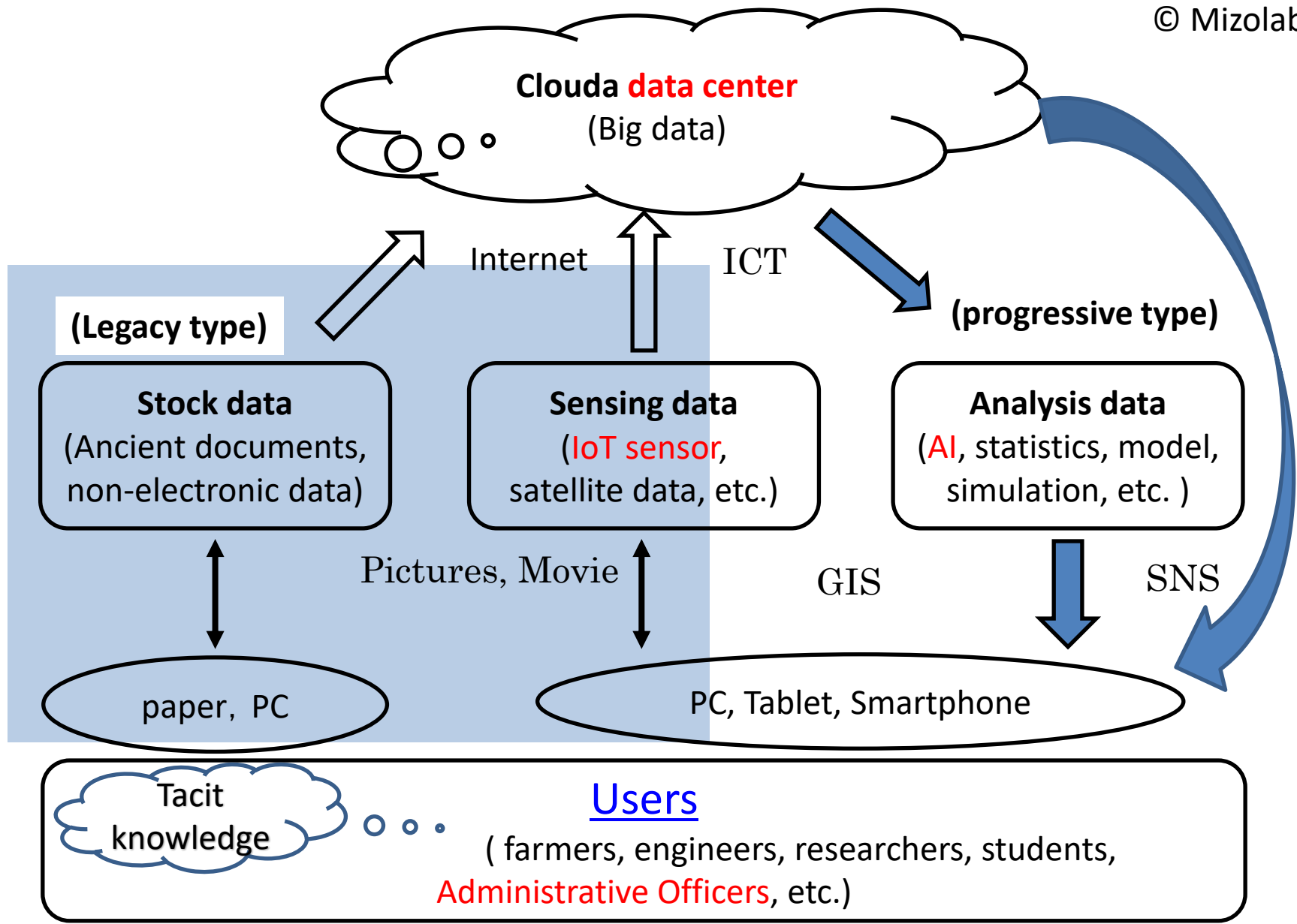
Agricultural science flourishes, but agriculture dies (T.Yokoi)



Using science & technology to revive agriculture (Mizo)

From Data to Information, and Local Wisdom

© Mizolab



2025.10.23

@ Suncheon National University

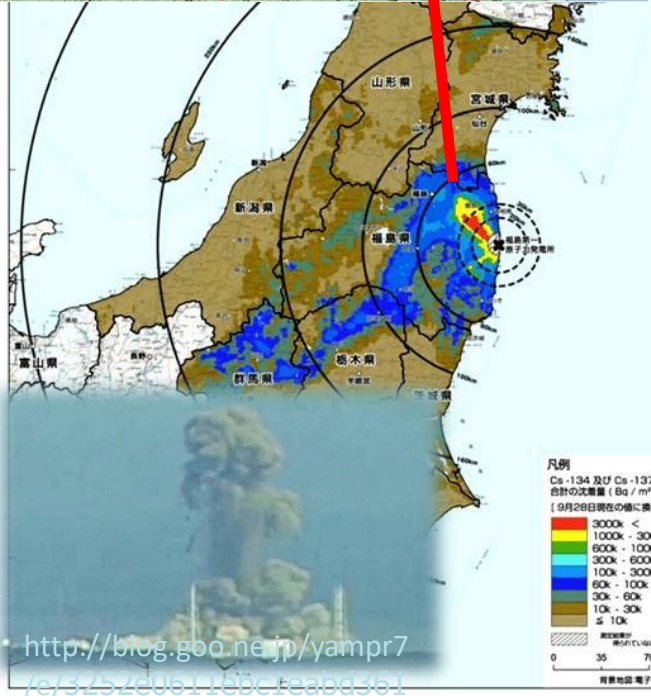
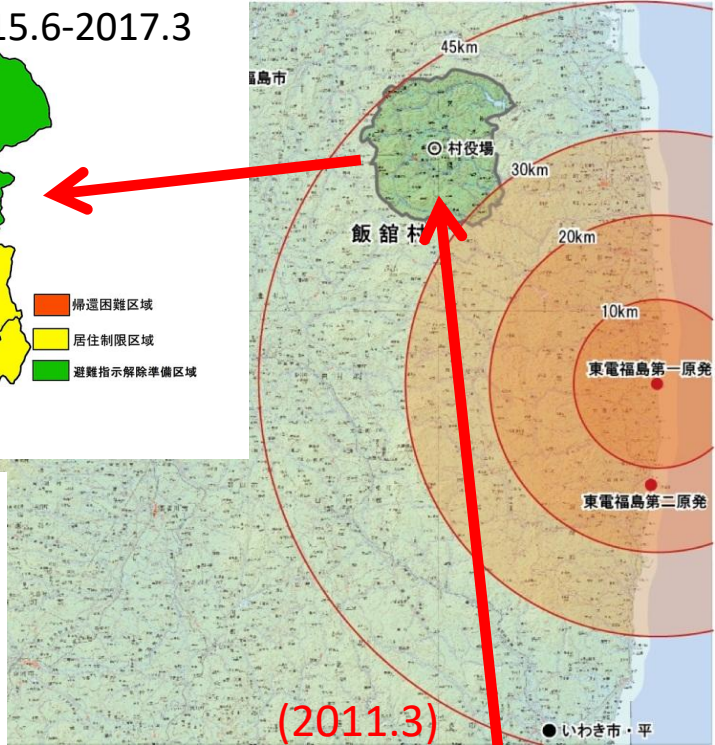
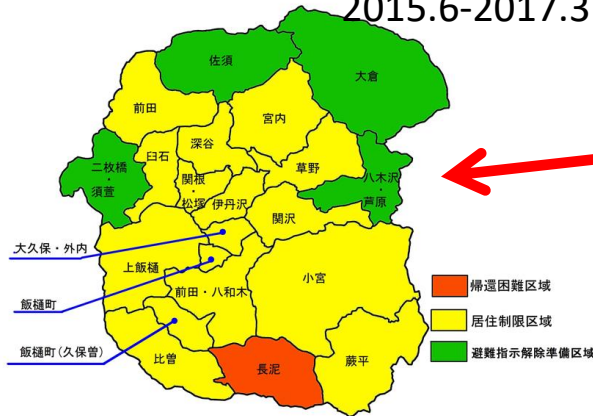
Experiments on Internet Environment Improvement in Mountainous Farmland Using Starlink and Mesh-net Wi-Fi Technology

Masaru Mizoguchi

Graduate School of Agricultural and Life Science
The University of Tokyo



Introduction

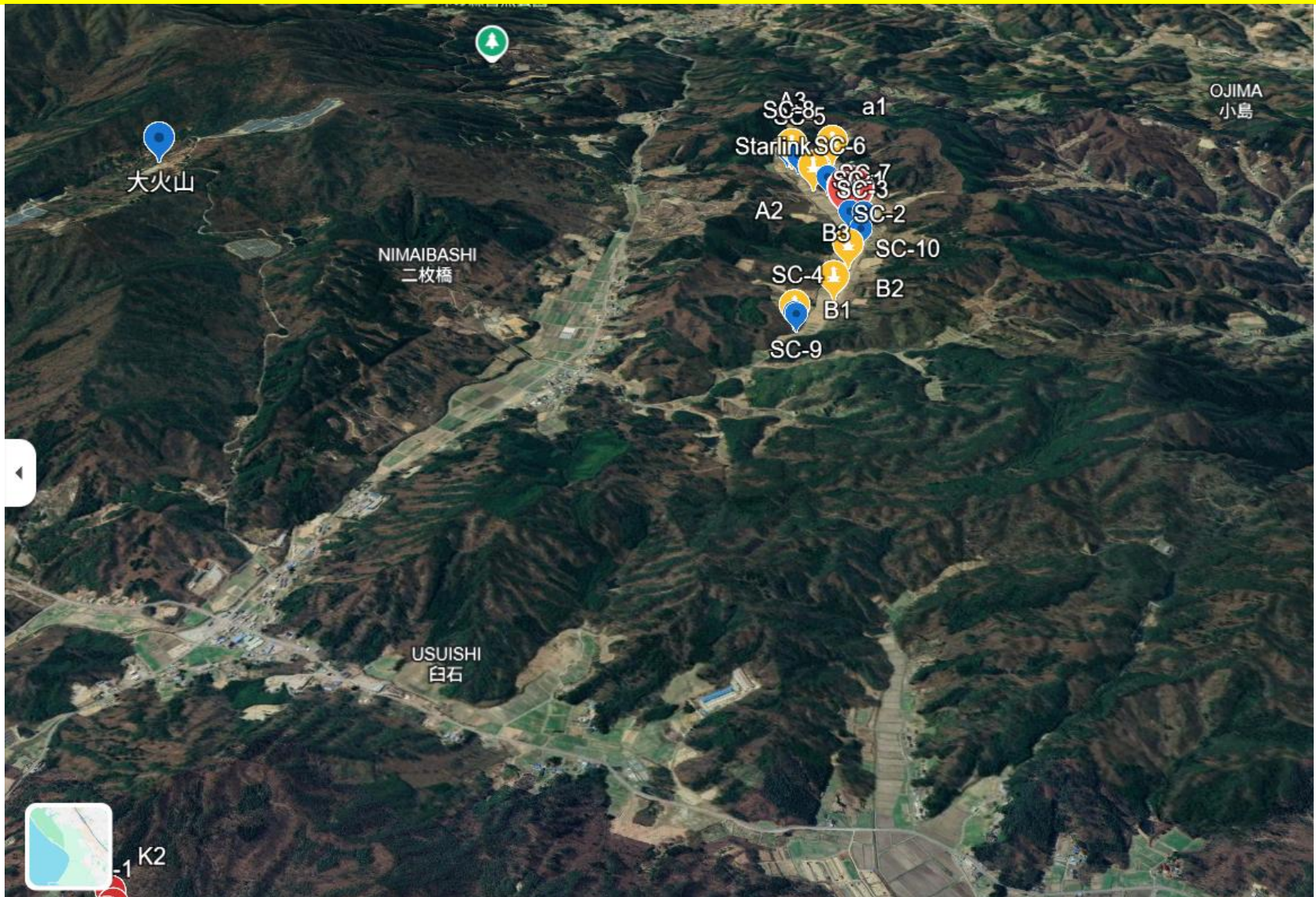


- Fourteen and a half years after the 2011 nuclear accident, Iitate Village in Fukushima Prefecture is still struggling with population return.
- The planned evacuation order lasted from April 22, 2011 to March 31, 2017.
- Few farmers have returned, and farmland consolidation is progressing faster than in any other municipality in Japan.
- Currently, the Iitate Village Promotion Corporation (Agriculture Department) manages most of the farmland.
- About 75% of the village area is mountainous forest, and many fields lack mobile signal coverage.
- Smart farm machinery functions cannot be used under these conditions.

<http://blog.goo.ne.jp/yampr7>

/e/3252e0611ebc1eabd361

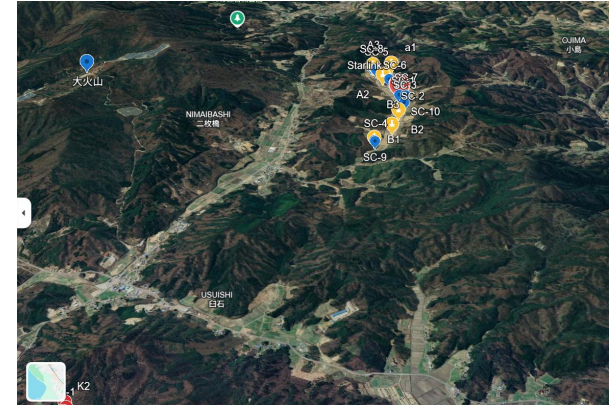
Farmlands are located between mountains



Trends in Smart Agriculture in Japan

- In June 2024, the Law on the Promotion of Smart Agricultural Technology was enacted and came into effect in October (MAFF, 2024).
- Since FY2020, the Ministry of Agriculture, Forestry and Fisheries (MAFF) has implemented projects to improve ICT infrastructure for smart agriculture and rural revitalization, and issued the Guidelines for Developing ICT Environments in Agricultural and Rural Areas (MAFF, 2024).

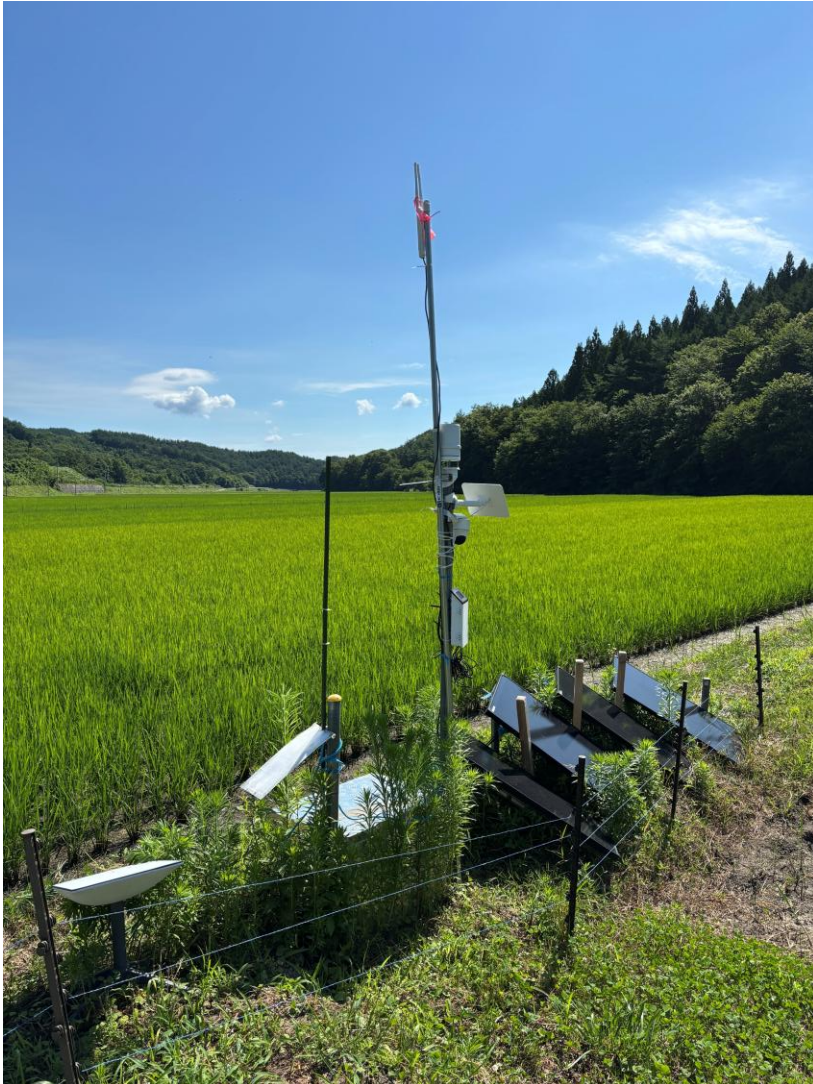
Objective



- To develop a communication network in farmland lacking power supply and mobile signal coverage, using:
 - Starlink satellite internet
 - Mesh-net Wi-Fi repeaters
 - Remote monitoring of agricultural water gates via Wi-Fi cameras



Starlink Satellite Internet



- Starlink provides broadband internet using low-earth-orbit satellites developed by SpaceX.
- It enables communication even in mountainous and offshore areas where conventional infrastructure is unavailable.
- A standard Starlink base station was installed between rice paddies, powered by four 100-W solar panels.
- Power is supplied via a PoE-compatible LAN cable to an outdoor access point (AP) mounted on a 3-m-high pole.

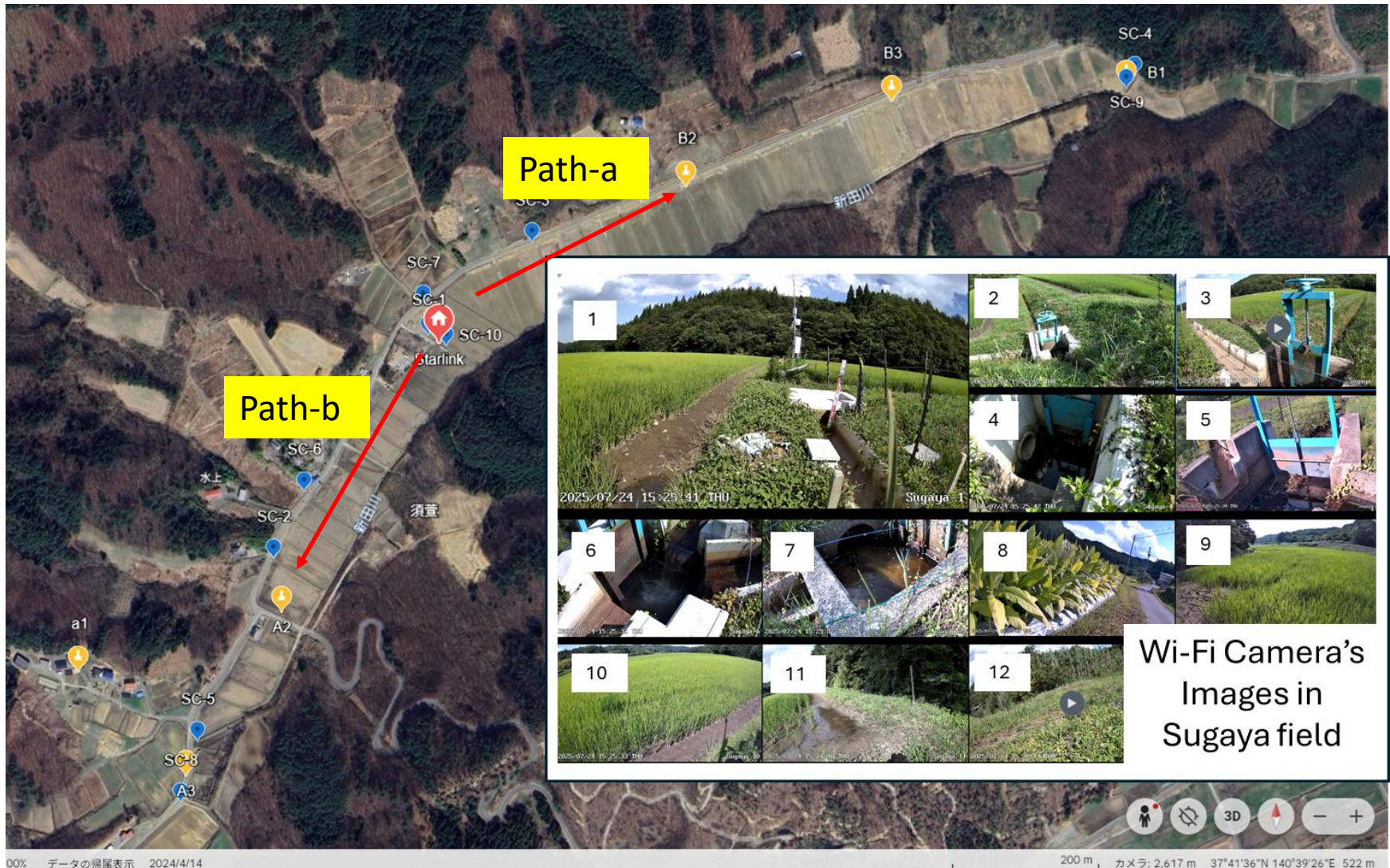
Mesh-Net Wi-Fi Repeater

- Six Wi-Fi repeaters were deployed in two systems originating from the base station.
- Each repeater consists of an access point, a lithium-ion battery, and a 50-W solar panel (approx. 10 kg total).
- They are easy to relocate and set up between rice paddies using a single pole and antenna prop.



Layout of Wi-Fi communication network

Two systems internet from base station



Distance between APs vs. Signal strength

Path-a	S0	<421>	a2	<250>	a3	<211>	a1
Signal Strength		-76		-68		-72	
Path-b	S0	<396>	b2				
Signal Strength		-71					
Path-c	S0	<700>	b3	<325>	b1		
Signal Strength		-80		-75			

<number> indicates distance between APs (m). Signal strength (dBm) may vary by ± 2 dB depending on weather conditions.

(Results and Discussion)

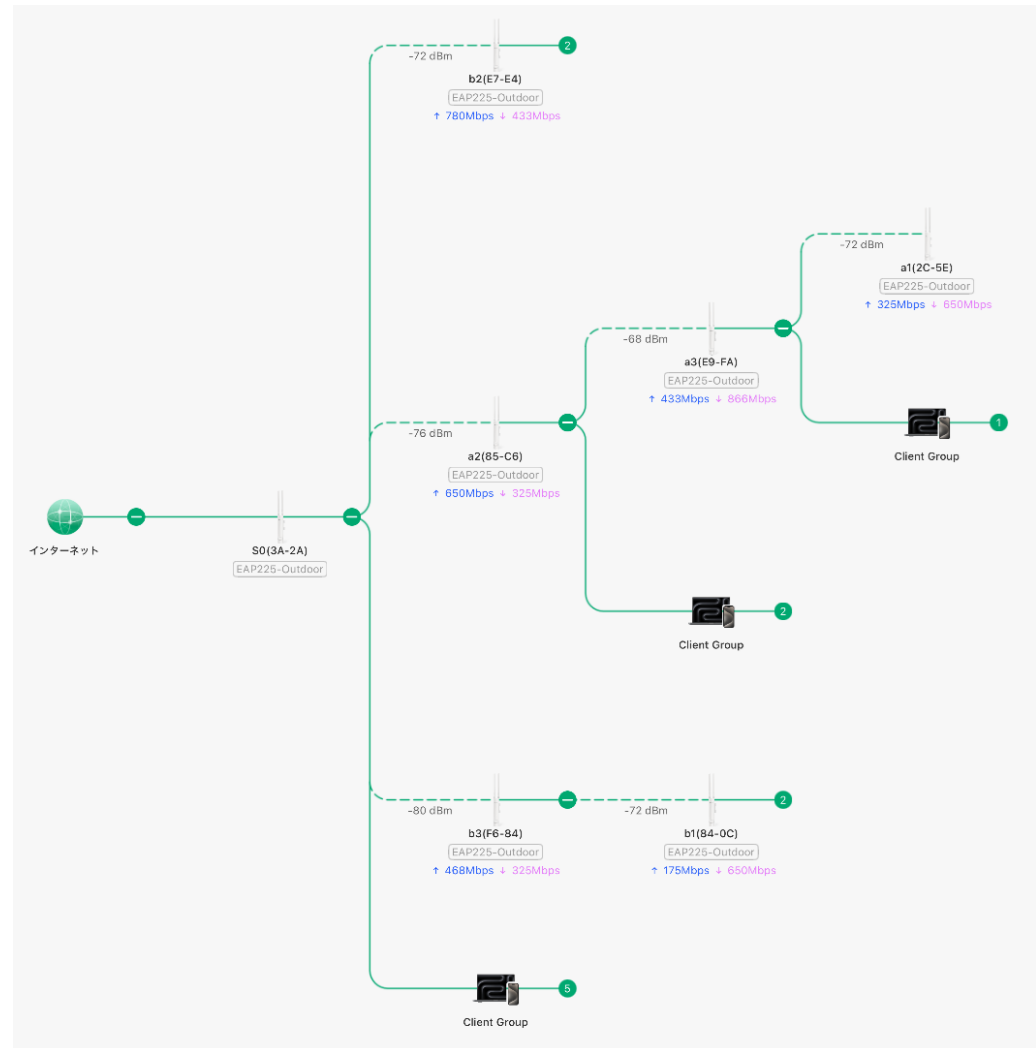
Starlink base station

- Starlink consumes approximately 50–75 W of power continuously, day and night.
 - Four solar panels were insufficient for 24-hour operation.
 - A timer was used to power the system from 6 a.m. to 7 p.m., depending on battery level.
- Field staff comment:
 - “We want to monitor the paddies even at night during heavy rain.”
 - → Plan: Increase solar capacity or enable remote on-demand activation during rainfall.

(Results and Discussion)

Mesh-net Wi-Fi communication

- Connection status was easily confirmed using the Omada Cloud Controller smartphone app.
- The topology map displayed repeater and camera connections, as well as worker smartphone statuses in real time.



(Results and Discussion)

Wi-Fi Camera

- Real-time monitoring of paddy fields and sluice gates was possible via smartphones or PCs.
- Field staff comment:
 - “It’s convenient to check the water level from home.”
 - Future goal: automatic operation of spindle-type sluice gates via LoRa-connected base stations, depending on budget.



Sugaya-6

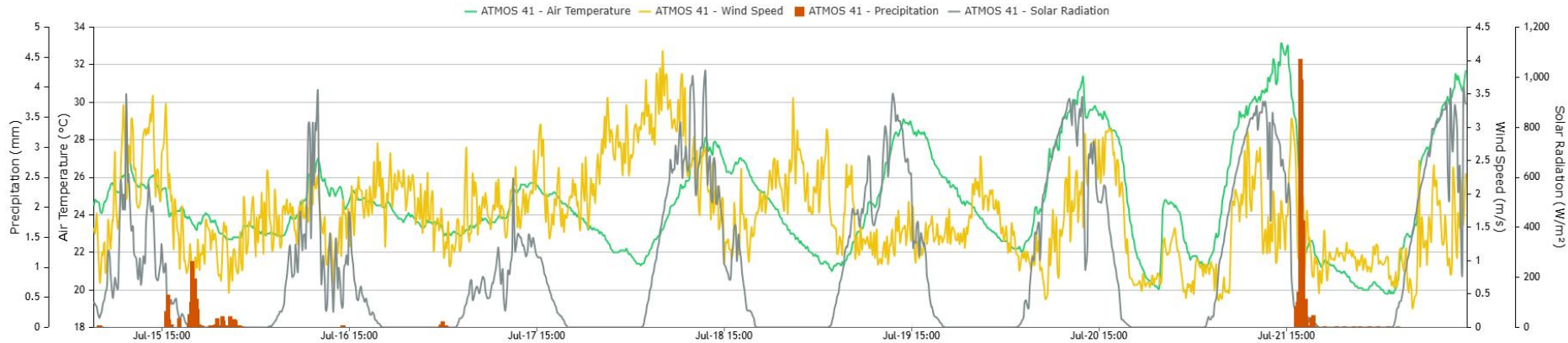


Sugaya-5



(Results and discussion)

Weather Data



- Weather conditions were measured using an ATMOS-41 sensor (METER), recording temperature, wind speed, precipitation, and solar radiation.
- Data were successfully transmitted via a Wi-Fi data logger (ZL6, METER) — even in areas with no cellular coverage (the world's first such case).
- Battery drain was severe due to transmission during off hours; limiting data sending to active periods can solve this.

Conclusion

- In this study, Starlink internet was introduced to farmland with no power supply or cellular signal, and extended over a 12-ha area using mesh-net Wi-Fi technology.
 - In District S, where farmland has been consolidated into a single large unit, both information and physical infrastructures were established, creating a leading-edge smart farming area.
- This approach **increases farmland value** and can serve as **a model for ICT-based agricultural development in mountainous regions across Japan.**

References

- Mizoguchi, M., & Itakura, Y. (2024). Field Wi-Fi expansion experiment in Iitate Village. J. Agricultural Reconstruction Science, 4(2), 8–13.
- Mizoguchi, M., & Itakura, Y. (2025). Experiments on Internet Environment Improvement in Mountainous Farmland Using Starlink and Mesh-Net Wi-Fi Technology. J. Agricultural Reconstruction Science, 5(2), 23–28.
- Mizoguchi, M., & Itakura, Y. (2024). Proceedings of the Japanese Society of Irrigation, Drainage and Rural Engineering, 135–136.

Youth education through field tour

Agricultural soil education for the general public



Soil Museum (2018.4.29)

Publication of
Dr. Doroemon
([Kindle版](#))



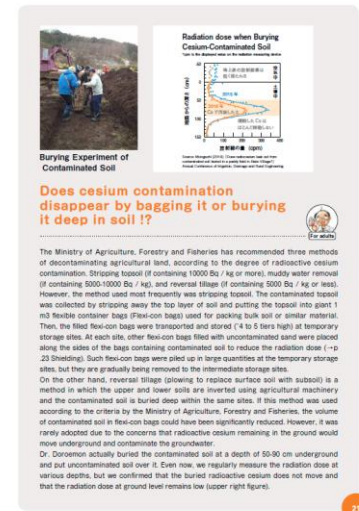
Japanese

English

Chinese



Tour for high school students
([2019.9.14-15](#))



English

Study Tour

Lecture on Fukushima Reconstruction Knowledge

(1) 2022.8.17-19 (2) 2022.11.19-21



Fukushima Daiichi Nuclear
Power Plant (11.19)



Agricultural Experience
@litate Village (11.20)



Cattle Barn Tour
@litate Village (11.20)



Dialogue with the Mayor
@litate Village (8.19)



Farmers Dialogue
@litate Village (11.20)



Rich beef bowl tasting
@litate Village (11.20)

Rice planting tour for US students

([2025.5.28@Iitate Village](#))



<https://x.com/msrmz/status/1927226205775745322>

Let's enjoy Fukushima
tour!



<http://madeiuniv.jp/phoenix/>



Thank you

감사합니다

