Takahashi Laboratory

# Exploring Solutions to Agricultural Challenges and Implementing a Super Smart Society Through Engineering Knowledge!

Assoc. Prof. Takahashi

Laboratory Webpage

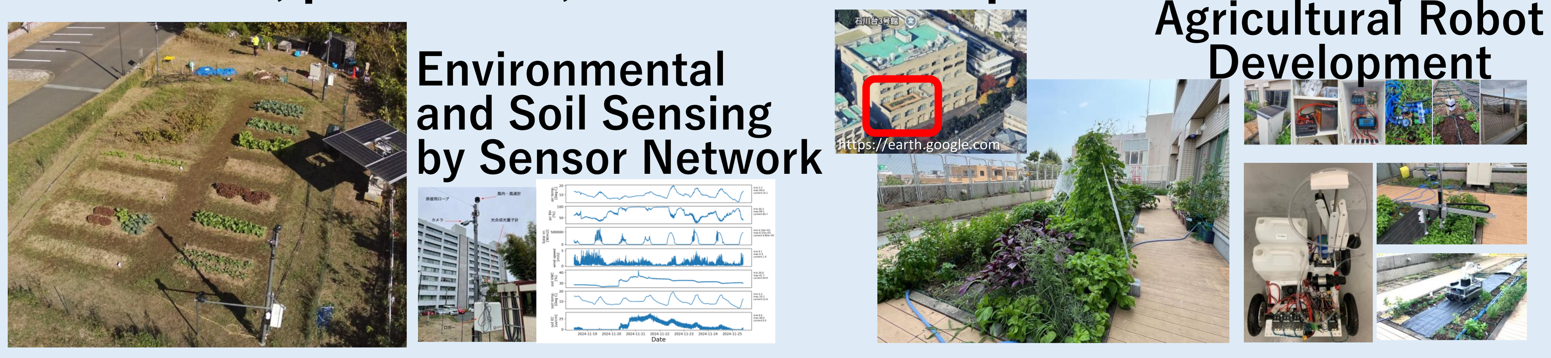
## Research Outline

Our laboratory promotes **Smart Agriculture** through a comprehensive framework integrating **mechanical systems**, **robotics**, **sensing**, and **AI**:

- **Off-grid Energy & Communication**: Providing stable power, water supply, and telecommunications to remote agricultural sites.
- **Sensing**: Monitoring temperature, humidity, light intensity, pH, plant growth, and other key variables.
- **Actuation**: Automating soil and crop management (e.g., pruning and harvesting), including **automated robotic systems for tomato lower-leaf processing** and **wildlife-damage prevention device** development.
- **Ecosystem-based Organic Agriculture**: Advancing sustainable, organic farming that leverages biodiversity.

**Digital Twin**: The core platform integrating these technologies—visualizing field data from robots, sensor networks, and **smart agricultural boots** for environmental mapping—and delivering real-time predictions for optimal cultivation strategies.

Through integrated **research and education**, we shape the future of socially implemented, inclusive agriculture and help realize a **sustainable, productive, and inclusive Super Smart Society**.



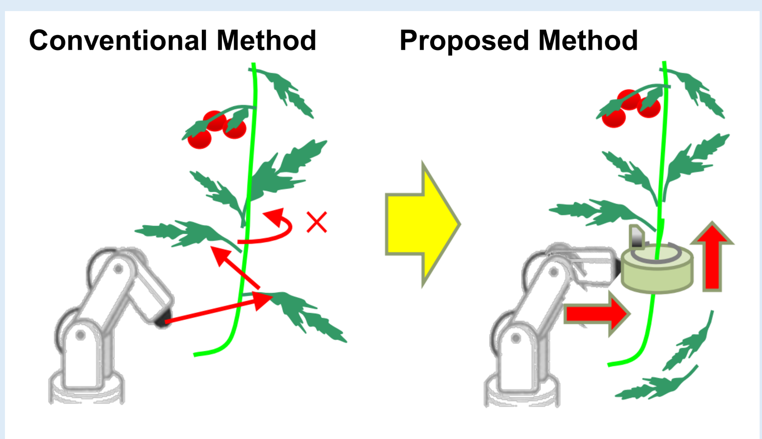

Smart Agriculture Research & Education Field @ Suzukakedai Campus

Urban Rooftop Farm @ Ookayama Campus

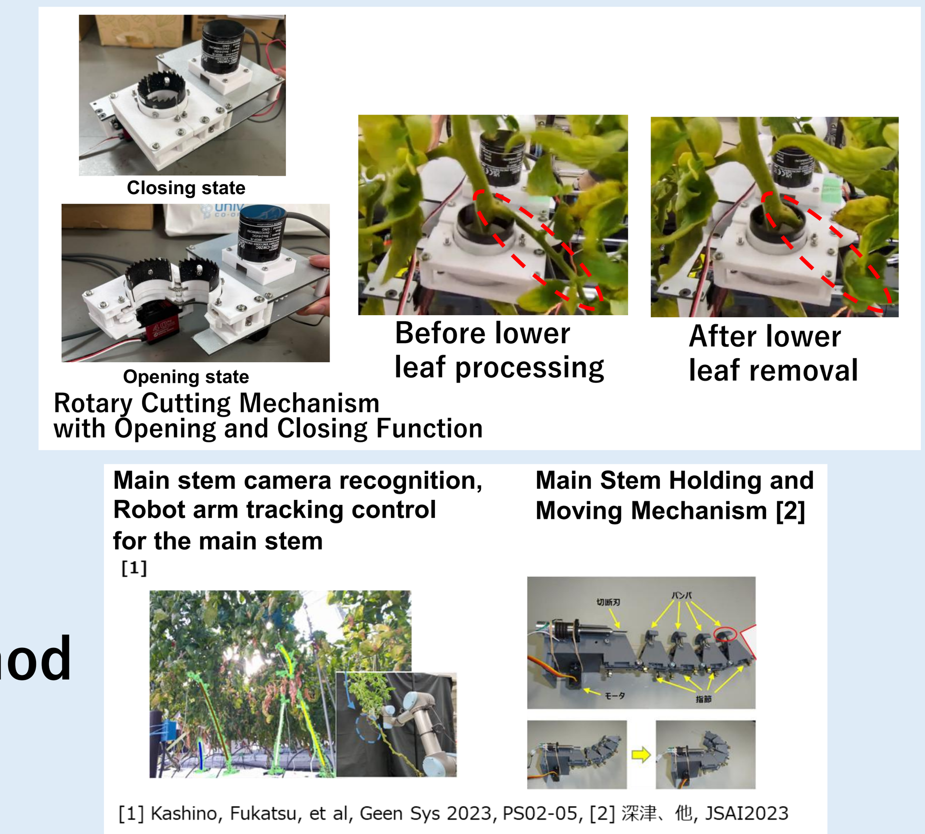

Research Theme Overview (Takahashi Laboratory)

## Development of an Automated Robot System for Lower Leaf Processing Operations

- We are collaborating with Fukatsu et al. at the National Agriculture and Food Research Organization (NARO) to develop a robotic system that automates lower leaf removal - a task requiring significant labor after harvesting in tomato cultivation.
- 2025–2027 Grant-in-Aid for Scientific Research (B) "Realization of a Cultivation Support Robot System Capable of Handling Work Targets Obstructed by Branches and Leaves" (Collaborator).



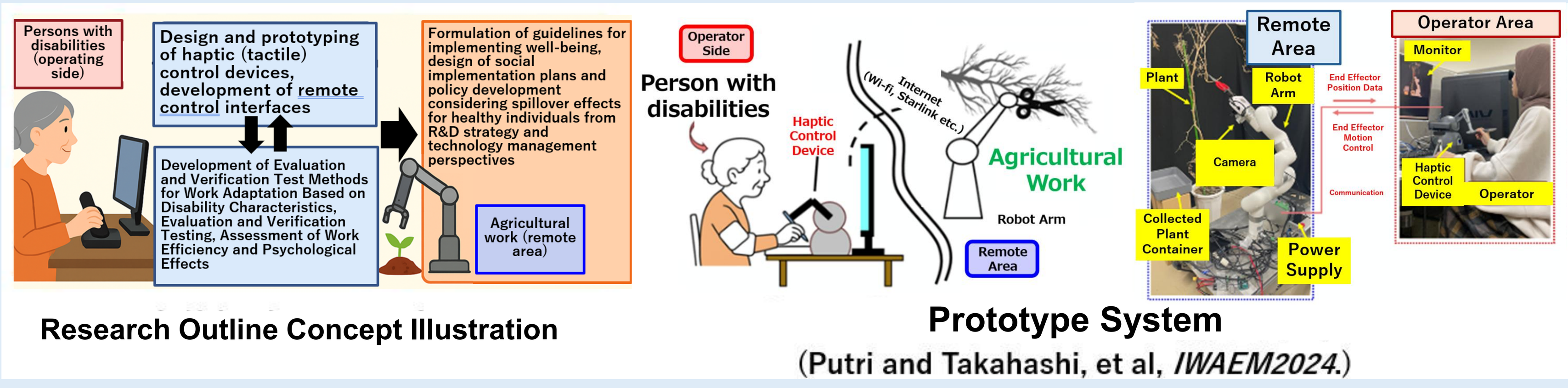

Overview of the Proposed Lower Leaf Processing Method




Technology under development

## Creating New Value with Remote Agricultural Support Systems

- Focusing on the "severe labor shortage" in Japan's agriculture and the "potential workforce of people with disabilities who face physical barriers to participation." This initiative leverages agricultural activities themselves as rehabilitative training, reconstructing a new relationship between people with disabilities and farm work.
- A novel approach to enhance the well-being of people with disabilities—specifically their physical and mental health, social participation, and self-actualization—through tactile feedback-based remote agricultural support.
- Funded by the University's Basic Research Organization New Research Development Grant, this collaborative project is underway (2025–) between the Medical and Dental Sciences Program, Aging Control Science Course (Tohara, Yamaguchi et al.) and the School of Environment and Society, Innovation Science Division / Professional Degree Program in Technology Management (Kimura et al.).

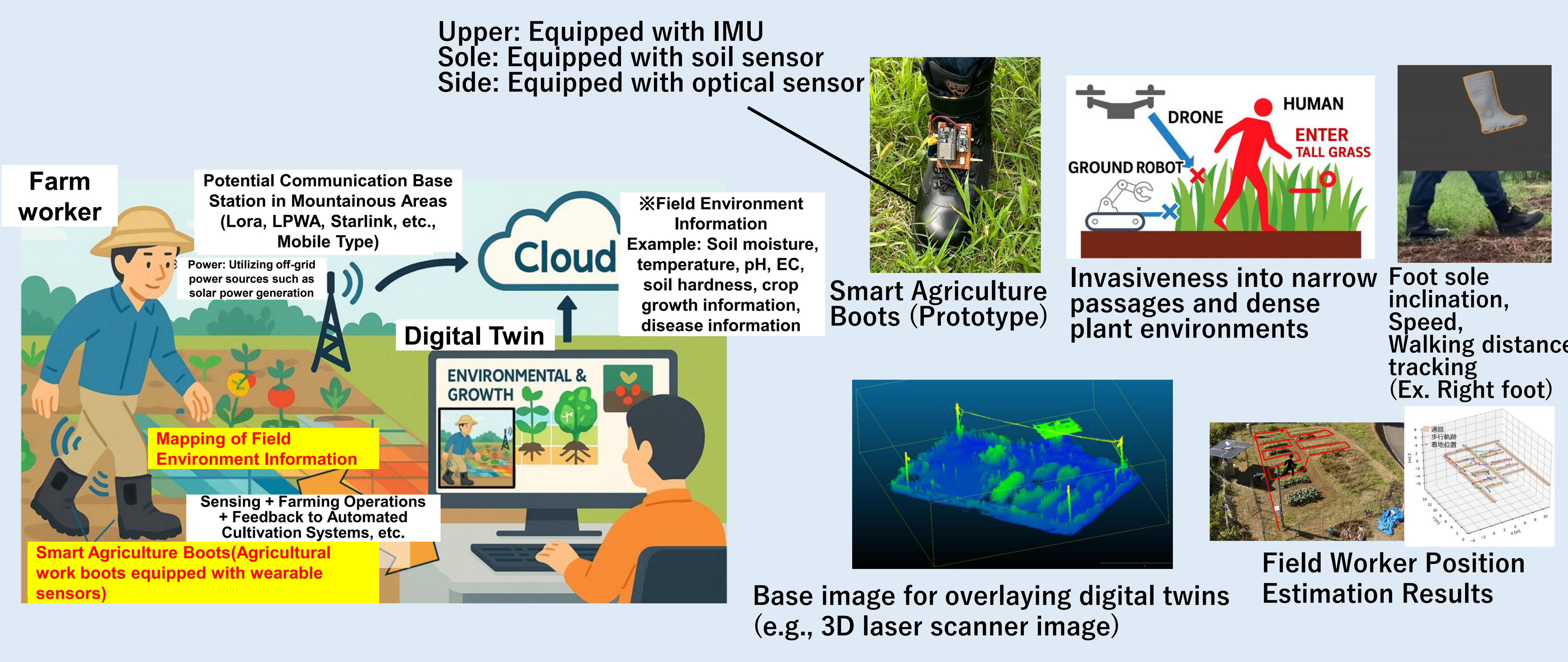



(Putri and Takahashi, et al, *IWAEM2024*.)

Development of a Remote Control System Utilizing Haptic Devices to Accelerate Agricultural Support for Persons with Disabilities and Its Implementation in a Well-being Society

## Smart Agriculture Boot Development and Digital Twin

- Using agricultural work boots equipped with wearable sensors (smart agriculture boots) to measure field environment data on the move, then integrating that data to build an agricultural digital twin with farm sensor network and other robots.
- Conceived an original approach: "Transforming the worker themselves into a sensor platform."
- Achieves high-resolution, time-series environmental information mapping that complements conventional fixed sensors and remote sensing with robots, enabling labor-saving and advanced agricultural production management.
- Collaboration with Univ. Virginia, Furukawa et al. ongoing (2025–).




Environmental Information Mapping Using Smart Farming Boots for Realizing Agricultural Digital Twins

## Research on Reducing Wildlife Damage

- Development of an animal detection device utilizing directional ultrasound and an ultrasonic field generator (intimidation device) that delivers aversive stimuli to animals.
- Demonstrated the potential for image detection and 3D object shape imaging, while confirming a certain level of intimidating effect on monkeys.
- 2024-2025 F-REI Agriculture, Forestry, and Fisheries Sector Commissioned Project Theme (3) "Construction and Demonstration of a Bird Damage Prevention System Utilizing Advanced Technologies" (Promotion of Agriculture, Forestry, and Fisheries Research at the Fukushima International Research and Education Organization). Collaborative project with Yamaguchi et al. at the National Agriculture and Food Research Organization (NARO), currently in progress.