ISSN 2759-5846 (Online)

Annual Report 2024 (Apr. 2024–Mar. 2025)

JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

JIRCAS

Japan International Research Center for Agricultural Sciences

Annual Report 2024

(April 2024-March 2025)

Japan International Research Center for Agricultural Sciences
1-1 Ohwashi, Tsukuba, Ibaraki 305-8686
JAPAN

Editorial Board

Telephone +81-29-838-6313
Facsimile +81-29-838-6316
Homepage https://www.jircas.go.jp

CONTENTS

JIRCAS Annual Report 2024

Message from the President

President
Osamu Koyama
(FY2021-)

Pushing ahead towards sustainable agri-food system transformation

The Japan International Research Center for Agricultural Sciences (JIRCAS), including its predecessor organization, has been conducting international joint research with local research institutes and universities in the tropics and subtropics as well as in developing regions for over 50 years. It is a unique Japanese national research and development agency that contributes to the improvement of agriculture, forestry, and fisheries technologies overseas, and eventually to the development of the world's agriculture, forestry, and fisheries industries.

The situation surrounding the world's agriculture, forestry, and fisheries has changed significantly with the times. Expectations for novel technology development in each era, such as the era of large production increases led by the Green Revolution, the era of export competition between developed countries, the era of deepening awareness of global environmental problems, and the era of volatile food prices due to the economic crisis, have also changed. In particular, in the tropics/subtropics and developing regions targeted by our Center, the need for new technologies is changing drastically due to economic globalization, urbanization, and rapid economic growth.

As global issues such as climate change intensify, many activities are being developed to achieve the Sustainable Development Goals (SDGs), which are shared goals of the international community. In 2021, the United Nations Food Systems Summit was held, confirming that a series of activities related to food production, processing, transportation, and consumption will be transformed into a sustainable system. Japan also declared its goal of achieving carbon neutrality by 2050, and so in May 2021, it issued a policy called the "Strategy for Sustainable Food Systems, MIDORI." This strategy aims to both enhance productivity potentials and ensure the sustainability of agriculture, forestry, fisheries, and food industries through innovation. The government has taken action and has been promoting initiatives to achieve these objectives. Furthermore, in FY 2024, the Basic Law on Food, Agriculture, and Rural Areas, which is often called the constitution of Japan's agricultural policy, was revised for the first time in 25 years, and a new Basic Plan was determined by the Cabinet. This updated plan clearly outlines key priorities such as "ensuring food security" and "establishing a food system in harmony with the environment," reflecting growing expectations not only for domestic research but also for international collaborative research to address global-scale issues.

In parallel with the above, JIRCAS has maintained a solid and long-term corporate philosophy (JIRCAS Vision). It has consistently endeavored to solve food and environmental problems through research and development and made international contributions through science and technology. In April 2021, JIRCAS started the 5th Medium to Long-Term Plan based on the 5th Medium to Long-Term Target as instructed by the government, redefining the important mission of JIRCAS. JIRCAS is mandated to improve agriculture, forestry, and fisheries technologies around the world, including Japan, toward the realization of government policies, and to represent Japan as a core national institute in the field of international agriculture, forestry, and fisheries research.

For the five years of the 5th term, we have set up a system that enables efficient and effective business operations by arranging four business segments: Planning, Environment, Food, and Information. We are also working to improve the matrix system, a unique research promotion method of JIRCAS, in which research staff from different academic disciplines and belonging to specialized divisions participate in multiple research projects set in the research activity segments and engage in interdisciplinary research activities that solve complex problems. In addition, we have assigned the Information and Public Relations Office directly under my supervision so it can promote institution-wide public relations and collaborative works. With this new administrative system, we have started activities to achieve our medium to long-term goals.

Following a challenging first two years in the implementation of the Fifth Medium to Long-Term Plan, which was heavily impacted by the Covid-19 pandemic, research activities at local sites overseas mostly recovered in the third and fourth years. However, the global food and agriculture situation remained uncertain due to climate change events and conflicts in Ukraine and other regions. Under these circumstances, global food security concerns were raised in various international fora. As an institution representing Japan, which depends on the international market for about 60% of its food on a calorie basis, JIRCAS had its role defined, and its mission of making an international contribution through science and technology innovation was highlighted further.

In FY2024, the fourth year of the medium to-long term plan, JIRCAS continued to showcase its outstanding research findings—such as BNI (Biological Nitrification Inhibition) wheat—at global events, contributing to international discussions on global food security and the establishment of sustainable agricultural and food systems. Furthermore, the “Green Asia” project, which aims to realize the MIDORI Strategy, is now in its third year. In the targeted Asian monsoon region, the project added many scalable technologies developed in Japan to its catalog and continued to demonstrate promising technologies that combine productivity and sustainability. Moreover, the technologies listed in the catalog were incorporated into local policy guidelines, and specific methods for reducing methane emissions from rice paddies through water management were adopted as a bilateral carbon credit methodology, enabling JIRCAS to participate in international rule-making. Outstanding research results derived from JIRCAS’s long-standing collaborative research have also led to social implementation in many research settings.

With a rich history of international joint research spanning more than 50 years, our strength lies in our working method where we tackle global food and environmental problems—which are sometimes in conflict with each other—with an interdisciplinary approach and present solutions with local partners hand in hand. JIRCAS will remain dedicated to its mission as a public institution that provides global public goods, and we will create new value common to all humankind, “together for our food and planetary health.” We hope that you will read this Annual Report, which introduces a part of our activities over the past year, and that you will continue to understand, support, and cooperate with the activities of JIRCAS. We also welcome your candid advice and questions.

August 2025
Osamu Koyama, President

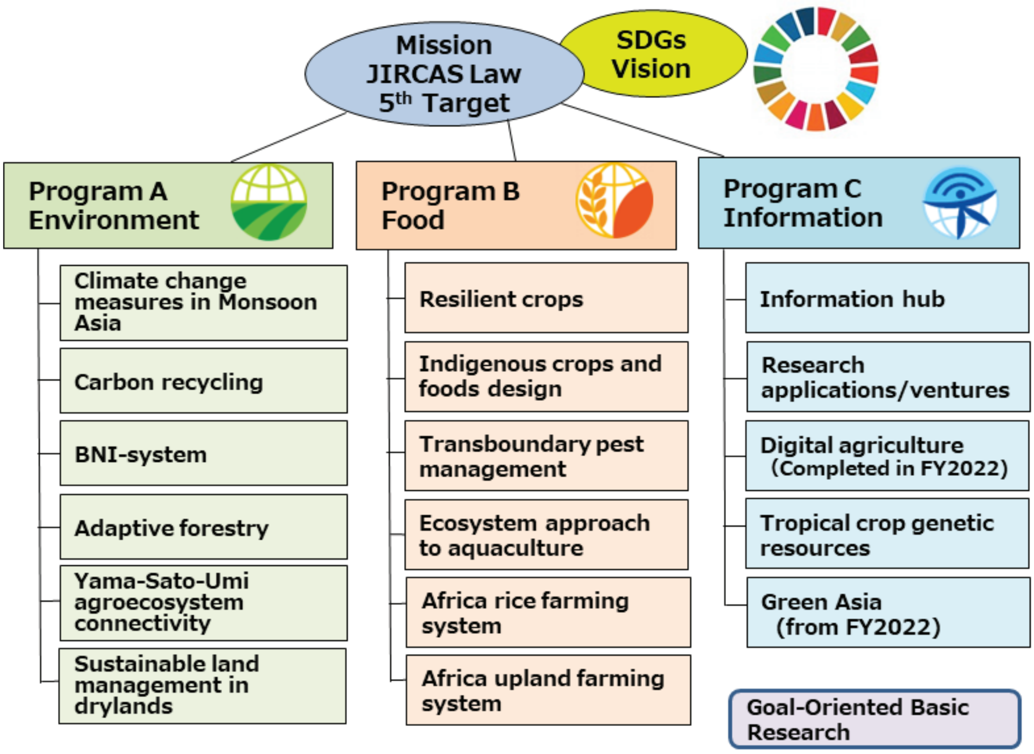


Fig. 1. Program-Project Research Framework (FY2021-2025)

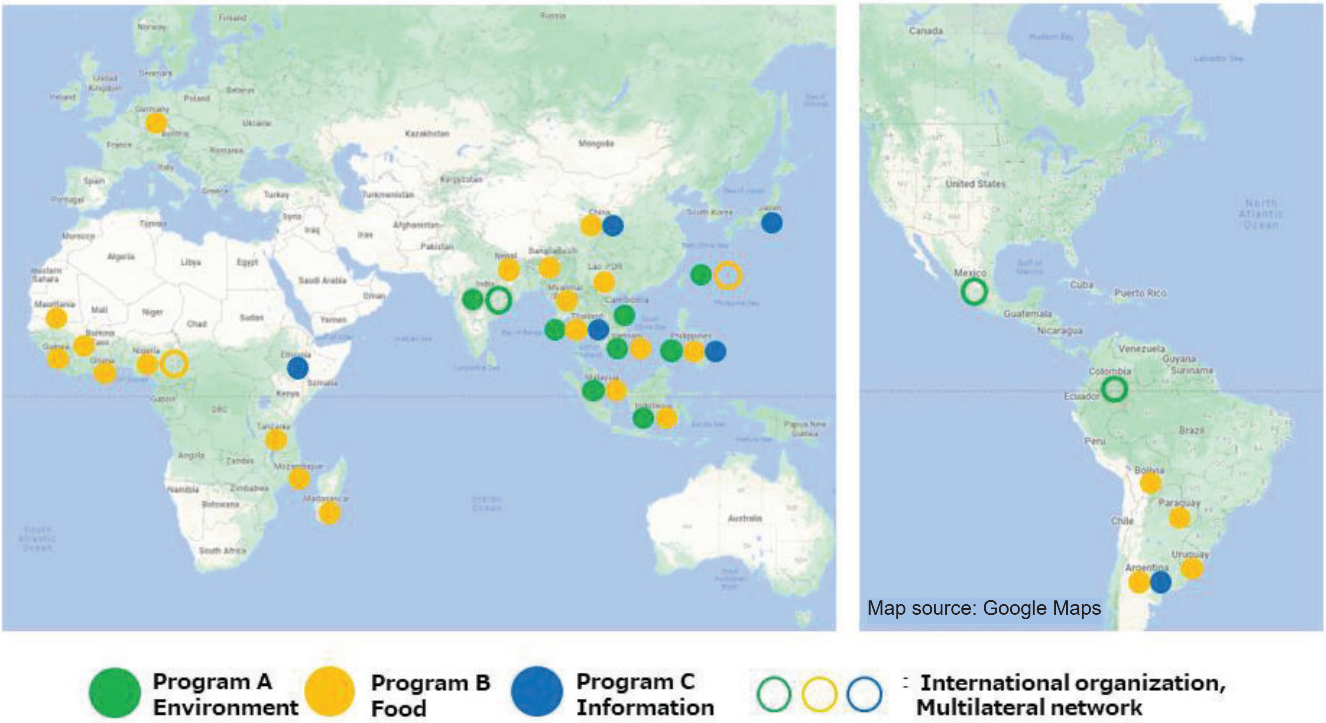


Fig. 2. Locations of activities in the 5th Medium to Long-Term Plan

Highlights from 2024

JIRCAS International Symposium 2024 Report

The JIRCAS International Symposium 2024, titled "Resilient Genetic Resources for Food Security in the Era of Global Boiling – Opportunities and Challenges for Conservation and Utilization," was held on Friday, November 22, 2024, at the U Thant Conference Hall of the United Nations University in Shibuya-ku, Tokyo. Supported by the Ministry of Agriculture, Forestry and Fisheries (MAFF) and the National Agriculture and Food Research Organization (NARO), the symposium was conducted in a hybrid format, with simultaneous interpretation in Japanese and English. A total of 180 participants joined the event—81 onsite and 99 online—highlighting widespread interest in this pressing global topic.

In his opening remarks, Mr. Osamu Koyama, President of JIRCAS, stressed the urgent need to conserve and utilize genetic resources to develop sustainable and resilient crops, especially as climate change intensifies and global food security becomes increasingly threatened. In a welcoming address, Mr. Teruya Sakaida, Director-General of the Agriculture, Forestry and Fisheries Research Council Secretariat at MAFF, introduced key government initiatives, including the "Green Food System Strategy" and the revised "Basic Law on Food, Agriculture and Rural Areas" enacted in May. He emphasized the importance of transforming food systems to be both resilient and sustainable.

The keynote session featured Dr. Sarada Krishnan, Director of Programs at the Global Crop Diversity Trust, who delivered a presentation titled "Historical Perspectives on the Role of Crop Diversity in Achieving Food and Nutrition Security," highlighting the central role of genetic resource conservation. She was followed by Dr. Toshihiro Hasegawa, Executive Scientist at the Institute for Agro-Environmental Sciences, NARO, who presented "Adapting Food Systems to a Changing Climate," outlining strategies to strengthen agricultural adaptation and resilience in response to climate change.

In Session 1, "Potentials of Genetic Resource Diversity for Resilient and Nutritious Food Systems," based on research results for underutilized crops, Dr. Yukari Nagatoshi, Project Leader at JIRCAS; Dr. Hiroshi Ehara, Professor in the Graduate School of Bioagricultural Sciences at Nagoya University; and Dr. Prakit Somta, Associate Professor in the Faculty of Agriculture at Kasetsart University, gave presentations on quinoa, sago palm, and mung bean, respectively.

In Session 2, "Opportunities of Utilizing Genetic Resources to Build Resilient Food Systems," based on research results for major and other crops, Dr. Venuprasad Ramaiah, Research Unit Leader at the International Rice Research Institute; Dr. Yoshihiro Matsuoka, Professor in the Graduate School of Agricultural Science at Kobe University; and Dr. Shinsuke Yamanaka, Director of Tropical Agriculture Research Front (TARF) and Project Leader at JIRCAS, made presentations on rice, wheat, and TARF initiatives, respectively.

The event concluded with a panel discussion moderated by Dr. Yasunari Fujita, Program Director (Food), JIRCAS. Eight panelists—including the keynote speakers and session presenters—engaged in a wide-ranging dialogue (key points summarized below) on the conservation and utilization of genetic resources to build resilient food systems in the face of climate and food security challenges.

1: What is needed to unlock the potential of resilient non-major crops?

The moderator initiated the discussion by asking the panelists how to unlock the full potential of resilient but underutilized crops. Dr. Krishnan emphasized the importance of global initiatives for the conservation and utilization of genetic resources, citing the U.S. Department of State's VACS initiative as a notable example. Dr. Nagatoshi highlighted the potential of quinoa, a highly nutritious and climate-resilient crop. She noted that quinoa research could not only serve as a model for the development of other underutilized crops but also contribute to enhancing the stress tolerance of major crops through the transfer of adaptive traits. Dr. Ehara stressed the need for supportive policy frameworks alongside technological innovations, such as improving starch extraction efficiency and the valorization of processing residues, to realize the full potential of sago palm. Dr. Somta underscored the importance of interdisciplinary collaboration, particularly between breeders and molecular biologists, and the need to harness molecular tools and genomic resources derived from genetically diverse materials. Collectively, the panel concluded that unlocking the potential of resilient non-major crops will require a coordinated approach—one that combines policy support, advanced research, and cross-disciplinary collaboration to accelerate their development and integration into resilient food systems.

2: Strengthening the resilience of major crops

In addressing the theme of "Strengthening the Resilience of Major Crops," the moderator invited panelists to share insights on strategies for ensuring food system stability in the face of climate change. Dr. Hasegawa emphasized the urgent need for genetic improvement and cutting-edge research on major crops to enhance their adaptability. He stressed that a holistic approach is essential—one that combines sustainable agricultural practices, effective resource management, and robust infrastructure. Dr. Matsuoka underscored the importance of breeding efforts that incorporate beneficial alleles from wheat wild relatives, which hold untapped potential for enhancing stress tolerance. Dr. Ramaiah pointed to several key factors for maximizing the use of gene banks: the importance of understanding user needs, developing methods to regenerate wild species, ensuring data availability, and facilitating timely access to seeds. Dr. Yamanaka highlighted that the strategic value of existing genetic resources is expected to grow, particularly as access and use are increasingly governed by international frameworks such as the Convention on Biological Diversity. Collectively, the panel called for a comprehensive strategy that integrates genetic innovation with conservation efforts, promotes the use of wild and underutilized species, and enhances the effective deployment of gene banks to build more resilient staple crops in a changing climate.

3: Questions from the audience and summary

During the Q&A session, the panelists emphasized several key priorities for addressing the escalating challenges of climate change. They highlighted the urgent need to swiftly transfer newly developed agricultural technologies to farmers, leverage functional gene banks, and accelerate forward-looking breeding programs aimed at enhancing crop resilience. In her closing remarks, keynote speaker Dr. Krishnan underscored the critical importance of securing sustainable funding for gene banks, recognizing their central role in preserving crop diversity for future generations. Dr. Hasegawa added that, looking toward the coming decades, international collaboration must promote genetic resources research that ensures equitable access to technologies for smallholder farmers and meaningful engagement with local communities. He concluded with a powerful message: "We must never give up the fight against climate change." In summary, the discussion reaffirmed the urgent need to strengthen international and interdisciplinary research cooperation, with a particular focus on farmers and local communities, to effectively conserve and utilize resilient genetic resources in the era of global warming.

In his closing address, Dr. Seiji Yanagihara, Vice-President of JIRCAS, reaffirmed the critical role of international collaborative research in safeguarding and utilizing genetic resources to build robust and resilient food systems. He thanked all speakers, participants, and especially MAFF and NARO for their steadfast support. Special appreciation was extended to both onsite and online participants, and the organizing team for their dedication.

To those unable to attend the event, videos have been posted on the JIRCAS YouTube channel. (In the original language only; no Japanese-English interpretation provided.)

Commemorative photo

The 2024 Japan International Award for Young Agricultural Researchers (The 18th Japan Award) and Commendation Ceremony

About the Japan Award

The Japan International Award for Young Agricultural Researchers (Japan Award), which began in 2007, is organized and presented by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan to honor young foreign researchers whose outstanding achievements promote research and development of agricultural, forestry, fishery and other related industries in developing regions.

Up to three young researchers under age 40 (as of January 1st, award year) who have shown (1) outstanding performance in research and development in agriculture, forestry, fisheries, or related industries in developing regions and (2) outstanding achievements in research and development that will lead to future technological innovation in agriculture, forestry, fisheries, or related industries in developing regions are invited yearly to Japan to receive certificates of commendation from the Chairman of the Agriculture, Forestry and Fisheries Research Council.

The 2024 (The 18th) Japan Award Ceremony Report

The 2024 (The 18th) Japan Award commendation ceremony was held on November 22 (Friday) in a hybrid format (in-person and online) at the U Thant International Conference Hall of the United Nations University in Tokyo.

On behalf of the organizers, Mr. Kazuyoshi Honkawa, Chairman of the Agriculture, Forestry and Fisheries Research Council (AFFRC) of the Ministry of Agriculture, Forestry and Fisheries, delivered the opening remarks. Dr. Daisuke Kawakami, Deputy Director General for Science, Technology and Innovation of the Cabinet Office of Japan, and Mr. Hiroyuki Yamaguchi, Vice President of the Japan International Cooperation Agency (JICA), gave congratulatory speeches. They were followed by Dr. Mutsuo Iwamoto, Chairperson of the Selection Committee, who provided an overview of the screening process. The certificates of commendation (Chairman's Award) were presented by AFFRC Chairman Honkawa, while the cash incentives (MOTAI-JIRCAS Award) were awarded by Mr. Osamu Koyama, President of JIRCAS.

A brief photo session took place after the ceremony, followed by commemorative lectures highlighting the research achievements of the 2024 award recipients and a welcome luncheon to celebrate the occasion.

Commemorative photo

The 2024 (The 18th) Japan Award Winners (*Ages are as of January 1, 2024.)

Elliott Ronald DOSSOU-YOVO
(37 years old, Male, Beninese)
Professional Affiliation: Africa Rice Center

Research Achievement: Water management innovations to enhance smallholder farmers' resilience to climate change in rice-based systems in sub-Saharan Africa

Reason for the Award:

The awardee conducted research on water management to enhance the resilience of small-scale farmers against climate change. This research study has been evaluated for its practical and field-based approach that improves productivity through precise cultivation management, its ability to disseminate research results through extension activities, and its future potential to make a significant contribution to rice cultivation in Africa through the development of technologies for water management and no-till rice straw management.

Andrés Javier CORTÉS VERA
(34 years old, Male, Colombian)
Professional Affiliation: Colombian Agricultural Research Corporation (AGROSAVIA)

Research Achievement: Research on the use of native genetic resources for the molecular hybrid breeding of common bean as a nature-based solution for the deployment of economic, sustainable and peaceful development in marginal communities across Colombia

Reason for the Award:

The awardee conducted research on molecular breeding using local indigenous genetic resources to develop new bean varieties adapted to global warming, and on genetic selection of locally adapted bean varieties through participatory breeding. This study has been evaluated for its energetic approach from both molecular and cultivation characteristics perspectives, which is expected to lead to the development of varieties adapted to climate change, and for its future potential to contribute to sustainable economic growth in remote rural communities.

Jutamat KLINSODA
(36 years old, Female, Thai)
Professional Affiliation: Institute of Food Research and Product Development, Kasetsart University

Research Achievement: Enhancement safety and nutrition along the chain of feeds, foods, and agricultural products by 16S rRNA gene sequencing microbiome innovation

Reason for the Award:

The awardee conducted research on food safety assurance through bacterial flora analysis utilizing 16S rRNA gene sequencing and developed the first bacterial flora database on the relationship between hand infection of organs and carcass handlers of food-producing pigs. This study has been evaluated as an important and practical research for ensuring food safety. It analyzes the impact of safe feed on pigs' intestinal health through a multi-omics approach and examines the transmission pathways of pig infections to humans from a broad perspective, ranging from basic research to food chain tracking.

NEW RESEARCH COLLABORATION

JIRCAS promotes its research network with international as well as national agricultural research institutions, extension systems, universities, and the private sector through information and personnel exchange programs. Memorandums of Understanding (MOUs) have been signed between JIRCAS and its research partners, both domestic and abroad, to implement long-term research collaborations.

As of March 2025, the number of active MOUs stood at 149. Based on the work plans elaborated in the respective MOUs, JIRCAS carried out joint research projects with 94 research institutions in 31 countries.

Together with domestic partners, JIRCAS carried out 158 joint research activities in total: 14 with national research and development agencies under the Ministry of Agriculture, Forestry and Fisheries, 11 with independent entities, 9 with public research institutions, 86 with universities, 32 with private companies, and 6 with other research collaborators. Some of the private companies contributed to the financing of research activities undertaken by JIRCAS, totaling 4 million JPY.

TROPICAL AGRICULTURE RESEARCH FRONT

The Tropical Agriculture Research Front (TARF), a substation of JIRCAS, is located at the southwestern edge of Ryukyu Archipelago in Ishigaki, Okinawa, Japan. Geographically, TARF is closer to Taiwan (280 km to the west) than to Tokyo (2,000 km to the northeast). The climate is subtropical, with an average temperature of 24.3°C and annual rainfall of 2,107 mm. TARF's facilities include 21 hectares of experimental fields, several types of greenhouses, and lysimeters. With its geographical advantages and facilities, TARF implements basic and fundamental research and creates improved agricultural technologies that can be applied in developing and/or island countries of the tropics and subtropics.

Research and development of agricultural production technologies

The following projects and related research activities have been implemented at TARF since FY 2021 under the 5th Medium to Long-Term Plan: (1) Island agriculture with environmental conservation, (2) Collection, evaluation, and utilization of tropical crop genetic resources, and (3) Development of a year-round vegetable production system for the Asia-Monsoon region.

The "Yama-Sato-Umi agroecosystem connectivity" project is designed to develop and evaluate environmental conservation technologies for tropical islands through an approach emphasizing Ridge-to-Reef (Yama-Sato-Umi) agroecosystem connectivity. This project aims to establish healthy material cycles among the connected ecosystems through the development of technologies to reduce environmental loads in the areas and resource circulation targeting the Philippines and Ishigaki, Okinawa, Japan. For this purpose, we are conducting research under the following themes:

- Development of technologies for reducing environmental loads and circulating natural resources based at TARF
- Elucidation of soil and nutrient loads from river basins and the conditions for implementing developed technologies in tropical islands

At TARF, we obtained the following results: Assuming sloped land use in a semi-mountainous area with a combination of fast-growing trees, fruit trees, and log mushroom cultivation, soil runoff in sloped test plots showed an approximately 80% reduction compared to no vegetation. The growth of the soil briquette method using sugar processing residue for tree seedling showed better growth than that using plastic pots. Land coverage was halved from 100% to 47.9% after thinning, but recovered to over 80% within six months through sprouting, thus maintaining the soil conservation effect. Pipe tests with crop plants conducted in a glasshouse at TARF confirmed the effect of biochar application on nitrate nitrogen (NO_3-N) leaching and crop growth (Photo 1). Cattle manure and sugar processing residues were applied during land preparation, and the use of chemical fertilizer was reduced by 30% for the new planting and ratoon cultivation of sugarcane. Consequently, sugarcane yields for both new planting and ratoon cultivation increased compared to plots that received 100% chemical fertilizer without organic amendments.

In the Philippines, the optimized subsurface irrigation system (OPSIS) showed higher yields with a minimum amount of irrigation water that is equal to the amount of water consumption by sugarcane. In addition, we started other experiments—originally conducted at TARF—in the Philippines to demonstrate and disseminate the developed technologies.

The "Tropical crop genetic resources" project is designed to strategically develop and promote research on tropical crops based on domestic and international issues and research needs for each crop, taking advantage of such diverse and abundant tropical crop genetic resources and geographical location in TARF. Furthermore, by sharing and providing this information and technology, we aim to strengthen collaboration that will lead to the formation of networks with domestic and overseas research institutions for the advancement of tropical crop genetic resource utilization. For this purpose, we are conducting research under the following themes across several crops such as rice, sugarcane, and tropical fruits:

- Information and networking of genetic resources
- Evaluation of genetic resources and development tools
- Utilization of genetic resources for new breeding materials and cultivation technologies
- Domestic research collaboration through utilization of

genetic resources

In rice research, we continued the collection and characterization of genetic resources for rice improvement, with a particular focus on tropical regions. These efforts led to the accumulation of valuable data that will serve as a foundation for future breeding programs aimed at enhancing productivity under suboptimal conditions. We also advanced the development of breeding materials through DNA marker-assisted selection, with a focus on flowering time. The resulting breeding lines were provided for field trials in Madagascar. In addition, we organized a workshop at the Japan Breeding Science Society to promote the exchange of knowledge and genetic resources, and to strengthen research networks. Collaborative research with international partners—including Bangladesh, the Philippines, Vietnam, Indonesia, Cambodia, and Laos—continued throughout the year, contributing to the effective utilization of genetic resources. Furthermore, we made progress in the functional analysis of genes using genome editing technologies, aiming to introduce precise genetic modifications for the improvement of rice and other crop traits.

Sugarcane research at TARF enables the establishment of essential information and technologies for the effective use of sugarcane-related wild genetic resources in breeding to improve sugarcane's productivity and adaptability to adverse environments and reduce its environmental load. We are focusing on wild sugarcane (*Saccharum spontaneum*) and *Erianthus* as important genetic resources for sugarcane improvement. A database consisting of 299 accessions of *S. spontaneum* genetic resources native to Thailand was developed (https://www.jircas.go.jp/ja/database/s_spontaneum), and agronomic data were collected from the third ratoon crops of about 500 accessions of Japanese *S. spontaneum* for database development. We also found that *E. arundinaceus* showed high water-use efficiency under drought conditions (Photo 2). It had fewer stomata on the underside of its leaves and accumulated high levels of betaine and γ-aminobutyric acid (GABA) in its leaves, both of which are involved in stomatal closure and stress responses. These characteristics are expected to be used as biomarkers for the selection of drought-tolerant clones using intergeneric hybridization between sugarcane and *Erianthus*. In Thailand, we are selecting new breeding materials developed using *Erianthus* with superior growth under severe drought conditions at Khon Kaen Field Crops Research Center.

Tropical fruit research for the utilization of genetic resources is being conducted to contribute to the promotion of tropical fruit production and sharing of information through research networking in Japan and main production areas in Southeast Asia. Tropical fruits are gaining attention as alternative crops that can be grown to cope with climate change in Japan. Moreover, the introduction of various tropical fruit species will contribute to the diversification of food and nutrient sources. In this project, we focus mainly on mango and passion fruit research, with the aim of achieving effective flowering and fruit setting for stable production through evaluation of genetic resources and development of new breeding materials and cultural technologies. Regarding measures for the warming climate in mango production, a method for evaluating high temperature stress tolerance of leaf cell membranes by measuring electrolyte leakage among 100 mango varieties was established. As a core member of the DFNet III project led by the Food and Fertilizer Technology Center (FFTC), we participated in the workshop to promote adaptive strategies and best practices aimed at mitigating the potential risks of climate change and enhancing the resilience of tropical fruit production systems in Asia.

Building on previous TARF research on a plant factory for tomato and strawberry production since 2016, we are conducting research on the development of strawberry cultivation technology in hot and humid tropical and subtropical regions. Additionally, we are carrying out comparative experiments to identify cultivars suitable for hot and humid environments and to examine cultivation methods that prevent water drainage. We are also researching the possibility of strawberry cultivation under high-temperature conditions by partially cooling the greenhouse. We also conducted related research to improve water use efficiency in greenhouse tomato cultivation for arid regions.

Contribution to domestic agriculture

TARF contributes to domestic agriculture through the following activities:

1) *Generation advancement*
Early generations of rice populations from NARO breeding stations all over Japan are grown twice a year.

2) *Conservation of genetic resources*
Through the NARO Genebank project, TARF, as a sub-bank for tropical and subtropical crop genetic resources, maintains 570 accessions of sugarcane and its relatives, 150 of tropical fruit trees, and 125 of pineapple vegetatively in fields and greenhouses.

3) *Development of varieties for Nansei Islands*
TARF-JIRCAS contributes to domestic sugarcane breeding by taking advantage of the optimum environmental conditions for sugarcane crossing in Ishigaki Island. In collaboration with NARO and the Okinawa Prefectural Agricultural Research Center (OPARC), 220 crossing fuzz with 116 combinations were obtained and provided to the domestic breeding program. Furthermore, promising clones showing vigorous ratooning ability and root growth were selected from the backcrossing populations of intergeneric hybrids between sugarcane and *Erianthus*, and provided to the 3rd and 4th selections in the domestic sugarcane breeding programs of NARO and OPARC.

Photo 1. Pipe tests for measuring NO_3-N leaching at TARF

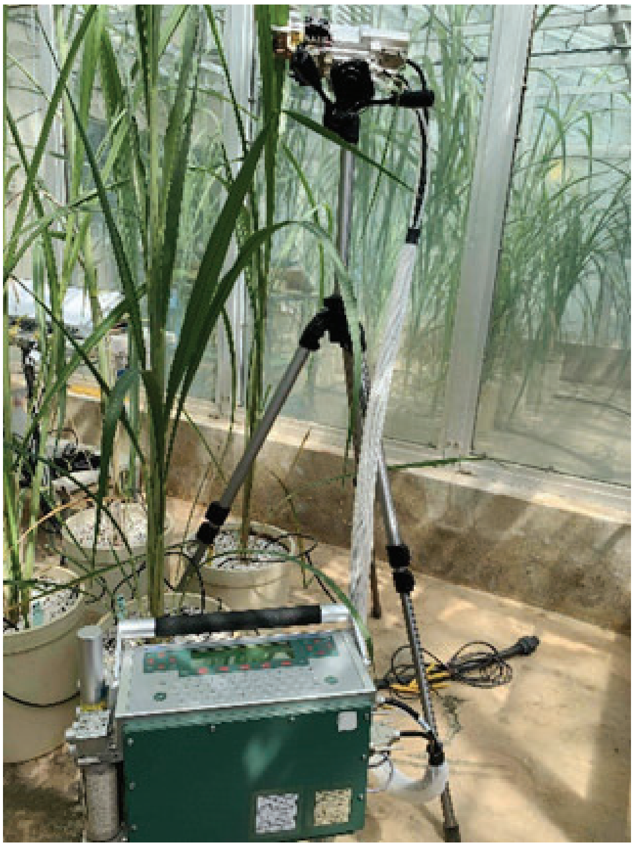


Photo 2. Photosynthesis measurements of sugarcane and wild germplasm at TARF

Academic Prizes and Awards

Senior Researcher Kazuhiro Sasaki and Colleagues Win Best Paper Award from the Crop Science Society of Japan

Dr. Kazuhiro Sasaki (Senior Researcher, Biological Resources and Post-harvest Division) and his co-authors received the 21st Crop Science Society of Japan (CSSJ) Best Paper Award for their research article, titled “Effect of drought stress on flowering characteristics in rice (*Oryza sativa* L.): a study using genotypes contrasting in drought tolerance and flower opening time,” at the 257th Meeting of the CSSJ held at Mie University on March 28–29, 2024.

Climate change is predicted to alter precipitation patterns, making it crucial to ensure crop production under conditions of water scarcity and drought stress. In fields experiencing drought stress, plant transpiration is limited, leading to increased temperatures in the panicles. This paper reveals that IR64+ *qEMF3* can flower in the early morning hours even under drought stress conditions, maintaining lower panicle temperatures compared to IR64. Among the rice lines developed by the International Rice Research Institute for drought stress tolerance, some are susceptible to high temperatures, indicating that early morning flowering trait may complement breeding efforts for drought stress tolerance.

Award Information (In Japanese)
CSSJ Best Paper Award

Awarded Paper
Tsutomu Ishimaru, Kazuhiro Sasaki, Patrick D. Lumanglas, Carlo Leo U. Cabral, Changrong Ye, Mayumi Yoshimoto, Arvind Kumar & Amelia Henry (2022) Effect of drought stress on flowering characteristics in rice (*Oryza sativa* L.): a study using genotypes contrasting in drought tolerance and flower opening time, *Plant Production Science*, 25:3, 359–370, DOI: 10.1080/1343943X.2022.2085589

Pick Up Article
572. Using Rice Early-Morning Flowering Trait to Reduce Sterility Due to High Temperature

Dr. Kazuhiro Sasaki with his award certificate

Dr. Sasaki observing the rice plants

Forestry Division Researcher Kiyosada Kawai Receives the 12th (2024) Young Scholar Award (Suzuki Award) from the Ecological Society of Japan

Dr. Kiyosada Kawai of the Forestry Division was honored with the 12th (2024) Young Scholar Award of the Ecological Society of Japan (ESJ Suzuki Award) at the 71st Annual Meeting of ESJ held at Yokohama National University on March 16–21, 2024.

The ESJ Suzuki Award recognizes young researchers who are expected to develop outstanding research within four years after obtaining their degrees.

Dr. Kawai has been investigating the functional significance of tissue traits in tree leaves and xylem using a combination of anatomical methods and physiological measurements. He examined the relationship between xylem traits and water passage and storage functions in tropical and subtropical trees, and the relationship between soft tissue traits and drought tolerance strategies in arid areas. For his outstanding achievements in the field of evaluating vascular plant functional traits, he was chosen to receive the ESJ Suzuki Award, and is expected to continue to make further contributions in this important field in the future.

Recipients of The Young Scholar Award of the Ecological Society of Japan (ESJ Suzuki Award)
https://www.esj.ne.jp/esj/English/Awards/Suzuki/list.html

Reason for selection (In Japanese)
https://www.esj.ne.jp/esj/award/shorei/12.html

Dr. Kiyosada Kawai delivering his lecture

Dr. Kawai receiving his award

Senior Researcher Katsumi Hasada Receives the Japan Society of Regional and Agricultural Development (JASRAD) Encouragement Award for Food Security Research in Laos

On June 29, 2024, Dr. Katsumi Hasada (Senior Researcher, Rural Development Division) received the Japan Society of Regional and Agricultural Development (JASRAD) Encouragement Award at the Society's 2024 Spring Meeting.

https://www.jasrad.jp/prize.html (In Japanese)

This award recognizes JASRAD members who have conducted outstanding research activities within the Society, and Dr. Hasada has consistently promoted research on food security in Laos using statistical data and field survey data.

The award-winning research includes findings from meticulous field studies that revealed issues such as rice production and regional supply shortages, access to animal protein including wild animals, and preferences for traditional fermented fish products in Laos. These findings have been highly valued for their contribution to achieving a stable food supply and improved nutrition in Laos.

Some of these research findings, along with results from collaborative researchers, have been summarized in an animated video and a wildlife database app and made public.

Related Papers

1. Regional Rice Food Security Disparities and Regional Rice Deficits in Lao PDR (*Development Studies,* February 2023, Vol. 33, No. 2, pp. 31–38)
2. Regional Characteristics Affecting Animal Protein Intake in Rural Villages of Lao PDR (*Development Studies,* July 2022, Vol. 33, No. 1, pp. 1–17)
3. Evaluating Purchase Behavior and Customer Satisfaction for *Padaek* in Vientiane, Lao PDR (*Development Studies,* December 2021, Vol. 32, No. 2, pp. 1–9)
4. Current Situation and Issues of Fermented Freshwater Fish Paste Product "Padaek" Distribution in Vientiane, Lao PDR (*Development Studies,* July 2019, Vol. 30, No. 1, pp. 65–74)

Related Pages

- JIRCAS Reports: Animation Video "Protein intake of Rural People in Lao PDR and Sustainable Measures to Address Protein Deficiency" in JIRCAS Channel (2022-03-16)
- Database: Database App of Wildlife Consumed in the Hilly and Mountainous Areas in Central Laos
- JIRCAS Research Highlights: "Initial salinity adjustment effectively prevents histamine accumulation in *padaek*, a Laotian salt-fermented freshwater fish paste"

Dr. Katsumi Hasada with his award certificate

Animation video titled "Protein Intake of Rural People in Lao PDR and Sustainable Measures to Address Protein Deficiency"

Database App of Wildlife Consumed in the Hilly and Mountainous Areas in Central Laos（LaoBushmeat）

Dr. MSH Mandal, JSPS Postdoctoral Fellow at JIRCAS, Receives the 28th Kira Award (Outstanding Young Researcher Category) from the Japanese Society of Tropical Ecology

On June 29, 2024, Dr. Mohammad Shamim Hasan Mandal, a JSPS Postdoctoral Fellow in the Forestry Division, received the 28th Kira Award (Outstanding Young Researcher Category) at the 34th Annual Meeting of the Japanese Society of Tropical Ecology (JASTE34) held in Fukui. The research that earned the award is titled "Habitat suitability mapping for a high-value non-timber forest product: A case study of *Rauvolfia serpentina*."

Dr. Mandal has been conducting research focused on quantifying the distribution of plant species in tropical regions using remote sensing technology and applying statistical methods for ecological interpretation. The award-winning research employs spatial modeling techniques, including Maxent species distribution modeling, to evaluate the habitat suitability of *Rauvolfia serpentina*, taking future climate change impacts into account. This research not only contributes to the conservation and sustainable management of *Rauvolfia serpentina* but also offers potential applications to conservation studies of other species using similar methods. Currently, Dr. Mandal is engaged in research using remote sensing technology to study mangrove ecosystems and is expected to advance research on ecosystem conservation and management in tropical and subtropical regions under climate change.

For more information about JASTE and the "Kira Award," please visit: https://www.jaste.website/gakkai

Link to the award-winning paper: https://doi.org/10.3759/tropics.SINT04

Dr. M.S.H. Mandal speaking at the award ceremony


Dr. Mandal with his award certificate

Dr. Guntur Venkata Subbarao Receives the 8th Niigata International Food Award Grand Prize

On November 20, 2024, Dr. Guntur Venkata Subbarao, Senior Researcher in the Crop, Livestock and Environment Division, accepted the 8th Niigata International Food Award Grand Prize and delivered a commemorative lecture during the ceremony held at the Toki Messe Niigata Convention Center.

The Niigata International Food Award was established to honor individuals or activities that have significantly contributed to improving the quantity and quality of food worldwide and to promoting health, welfare, and peace through food. The Grand Prize is awarded to research or activities that are highly regarded globally and significantly contribute to solving the world's food issues.

Dr. Subbarao observed that many nitrogen fertilizers, which are essential for modern agriculture, were being leached out by the nitrifying bacteria in the soil, causing environmental and ecological problems. He discovered that plants possess a mechanism called 'Biological Nitrification Inhibition (BNI),' wherein their roots release specific substances that suppress nitrifying bacteria. The discovery and introduction of this function from wild wheat led to the successful development of BNI-enabled wheat. This achievement earned the prestigious Grand Prize in recognition of its global impact on reducing the environmental footprint of wheat production.

Dr. Guntur Venkata Subbarao with the 8th Niigata International Food Award Grand Prize trophy

Senior Researcher Tomohiro Nishigaki of the Crop, Livestock and Environment Division Wins the 43rd Japanese Society of Soil Science and Plant Nutrition (JSSSPN) Encouragement Award

Dr. Tomohiro Nishigaki (Senior Researcher, Crop, Livestock and Environment Division) has been selected as a recipient of the 43rd Japanese Society of Soil Science and Plant Nutrition (JSSSPN) Encouragement Award.

The JSSSPN Encouragement Award is given to young researchers who have made outstanding contributions to advancing research in soil, fertilizer, plant nutrition, and related environmental sciences. The awardees are recognized for their excellent achievements and are expected to continue to excel in the future.

The research topic for which Dr. Nishigaki is receiving the award is "Studies on Fertilizer Management Contributing to Soil Conservation and Improvement of Crop Productivity in Sub-Saharan Africa." His work has been highly praised for quantitatively analyzing material dynamics through soil and developing efficient fertilizer management to enhance crop yields, thereby addressing issues such as low soil fertility and land degradation due to inappropriate agricultural activities in Sub-Saharan Africa.

The award ceremony is scheduled to take place at the 2025 Annual Meeting of the JSSSPN in Niigata in September 2025.

Please visit the JSSSPN website for more details about the awards.
https://jssspn.jp/info/secretariat/post-271.html
(In Japanese)

Dr. Tomohiro Nishigaki at the survey site, a valley in northwestern Madagascar

TARF Researcher Hiroo Takaragawa and Senior Researcher Hiroshi Matsuda Receive the 22nd Japan Crop Science Society Paper Award

Dr. Hiroo Takaragawa (Researcher) and Dr. Hiroshi Matsuda (Senior Researcher) of the Tropical Agriculture Research Front (TARF) received the 22nd Japan Crop Science Society Paper Award for their research paper titled “Rapid Photosynthesis Measurement Using a Closed System in Sugarcane.”

Photosynthesis is the most fundamental process for plant growth, and improving CO_2 assimilation capacity (photosynthetic rate) has been considered to lead to better plant growth. However, measuring this process traditionally required an open system, which is time-consuming and susceptible to environmental factors (time of measurement, weather, etc.), making it less compatible with genetic breeding research that requires multiple measurements. Additionally, in Okinawa, high temperatures and intense sunlight, combined with the large size of sugarcane plants, necessitated less labor-intensive methods for measuring photosynthesis.

In their award-winning research, Drs. Takaragawa and Matsuda demonstrated that the recently commercialized closed-type rapid photosynthesis measuring system, used for small C_3 photosynthetic crops such as rice and soybeans in temperate regions, can also be applied with high accuracy to measure the genetic resources of large C_4 photosynthetic crops like sugarcane in subtropical regions. As a result, the measurement time, which previously required about 5–7 minutes per point using conventional devices, was reduced to less than 1 minute per point with this system.

Moving forward, it is expected that this system will be applied to rapid measurements targeting multiple points in hybrid and genetic resource populations, utilizing numerous genetic resources. This will enable efficient genetic analysis, including the identification of genetic regions that control photosynthetic capacity.

Takaragawa, H. & Matsuda, H. (2023). Rapid evaluation of leaf photosynthesis using a closed-chamber system in a C_4 plant, sugarcane, *Plant Production Science*, 26(2), 174–186.
https://doi.org/10.1080/1343943X.2023.2210766

Drs. Hiroshi Matsuda (left) and Hiroo Takaragawa (right)

Project Leader Youichi Kobori Wins International IPM Award of Excellence at the 11th International Integrated Pest Management (IPM) Symposium

Dr. Youichi Kobori, a project leader in the Crop, Livestock and Environment Division, received the prestigious International IPM Award of Excellence during the 11th International Integrated Pest Management (IPM) Symposium held in San Diego, California, USA, from March 3 to 6, 2025.

The symposium aimed to share the latest knowledge in IPM across fields such as agriculture, public health, and forest conservation while fostering networks and training experts. The International IPM Award of Excellence honors individuals and teams who have achieved significant results in IPM development, implementation, and organizational building.

Dr. Kobori has conducted over 15 years of research on IPM in Southeast Asia, including evaluating the dispersal abilities of vector insects responsible for citrus greening disease in Vietnam and modeling disease spread dynamics. His work has significantly contributed to controlling pest and disease outbreaks locally and improving farmers’ productivity. This award recognizes these impactful achievements.

For more details, visit the symposium’s official website: https://ipmsymposium.org/2025/

Dr. Youichi Kobori with his award plaque

Research Overview

Overview of JIRCAS's Research Structure

1. History

The Japan International Research Center for Agricultural Sciences (JIRCAS) was first established in 1970 as the Tropical Agriculture Research Center (TARC), one of the research institutes of the Ministry of Agriculture and Forestry of Japan. TARC was reorganized into JIRCAS in 1993.

On April 1, 2001, JIRCAS became an Incorporated Administrative Agency (IAA) under the jurisdiction of the Ministry of Agriculture, Forestry and Fisheries (MAFF), in accordance with the administrative reforms of the Government of Japan to facilitate the reorganization of national government-affiliated research organizations.

2. Mission

Through research and development (R&D) and dissemination of information related to agriculture, forestry and fisheries in developing regions, JIRCAS contributes to the improvement of the international presence of Japan and towards a secure and stable supply of food worldwide including Japan.

3. The IAA System

An IAA is an organization responsible for key public services that the government is not required to provide, but which the private sector is likely to neglect for various reasons. The IAA system was introduced in 2001, as part of central government reforms based on the scheme that the planning sectors and the implementing sectors should be separated. Under the IAA system, MAFF defined JIRCAS's Fifth Medium to Long-Term Goals in FY 2021, including that JIRCAS will focus on research areas that address growing expectations for the development of technologies in the agriculture, forestry, and fisheries sectors to achieve the Sustainable Development Goals (SDGs). Based on the Fifth Medium to Long-Term Goals, JIRCAS drafted and began to implement a detailed five-year plan, the Fifth Medium to Long-Term Plan (FY 2021 - FY 2025).

4. Evaluation

The performance and budgeting management of research activities conducted by JIRCAS undergo regular evaluation by the National Research and Development Agency Council established within MAFF. As for the activities of each fiscal year, the Council investigates and analyzes the progress towards achieving the Medium to Long-Term Plan, and the results of this evaluation shall be applied as deemed necessary to the modifications of the operational and financing systems for subsequent fiscal years. To meet the requirements of the general guideline concerning the evaluation of national research and development (a decision of the Prime Minister in 2016), JIRCAS conducted an internal assessment in FY 2024 as follows:

1) Research activities for each Research Project were reported in January 2025.
2) Summary reports of research activities for each Research Program were prepared, as well as summary reports on the management of research and development activities. These reports were collectively assessed by the President, Vice-President, Auditor, and Program Directors at the Internal Self-Assessment Meeting held in mid-February 2025.
3) A meeting to promote international research collaboration in agriculture, forestry, and fisheries was held in late February 2025. JIRCAS reported its research activities to government officials from MAFF, specialists from affiliated research institutes under MAFF, and representatives from the Japan International Cooperation Agency. The meeting also provided an opportunity to exchange ideas on how to promote cooperation with JIRCAS.
4) The JIRCAS External Evaluation Committee performed a comprehensive evaluation of all JIRCAS activities, including administrative operations, in a meeting held in March 2025.

The members of the JIRCAS Evaluation Committee are listed in the Appendix. The results of the self-assessment and a summary of all activities were submitted to MAFF in June 2025.

5. Medium to Long-Term Plan

JIRCAS implements three programs for research activities under the Medium to Long-Term Plan. Each program consists of several projects. Major accomplishments and research highlights of the programs in FY 2024 are described in the following sections. The contents of the Medium to Long-Term Plan are also described in the Appendix.

Table 1. Number of Projects in the Fifth Medium to Long-Term Plan (FY 2021 - FY 2025)

Program	Projects
A (Environment)	6
B (Food)	6
C (Information)	4

Fifth Medium to Long-Term Plan (FY 2021 - FY 2025)

Program A

Development of agricultural technologies for climate change, resource recycling and environmental conservation

Projects:

1. Development of comprehensive agricultural technologies for climate change mitigation and adaptation in Monsoon Asia
2. Development of carbon recycling technologies to address global issues caused by agricultural waste
3. Development of planet-friendly agricultural production systems using biological nitrification inhibition (BNI) technology
4. Evaluation of genetic resources for strengthening productivity and adaptability of tropical forests
5. Development and evaluation of environmental conservation technologies for tropical islands through an approach emphasizing Yama-Sato-Umi (Ridge-to-reef agroecosystem) connectivity
6. Development of sustainable land management technologies under extreme weather conditions in drylands

Program B

Technology development towards building a new food system with improved productivity, sustainability and resilience

Projects:

1. Development of resilient crops and production technologies
2. Design of crop breeding and food processing of indigenous resources to create new and diversified demands
3. Development of environment-friendly management systems against transboundary plant pests based on ecological characteristics
4. Development and dissemination of sustainable aquaculture technologies in the tropical area based on the eco-system approach
5. Development of sustainable rice cultivation and food production systems in Africa
6. Development of soil and crop management technologies to stabilize upland farming systems of African smallholder farmers

Program C

Strengthening function as an international hub for providing strategic information on agriculture, forestry and fisheries, and mobilizing new research partnerships

Projects:

1. Strategic information hub for international agricultural research
2. Practical application of global research results and establishment of a model platform for promoting private-sector research collaboration and creating new business ventures
3. Towards the development of digital agriculture technologies in Sub-Saharan Africa (Completed in FY2022)
4. Advancement of tropical crop genetic resources utilization through the development of database, technologies and research networking
5. Accelerating application of agricultural technologies which enhance production potentials and ensure sustainable food systems in the Asia-Monsoon region

6. Collaborative Research

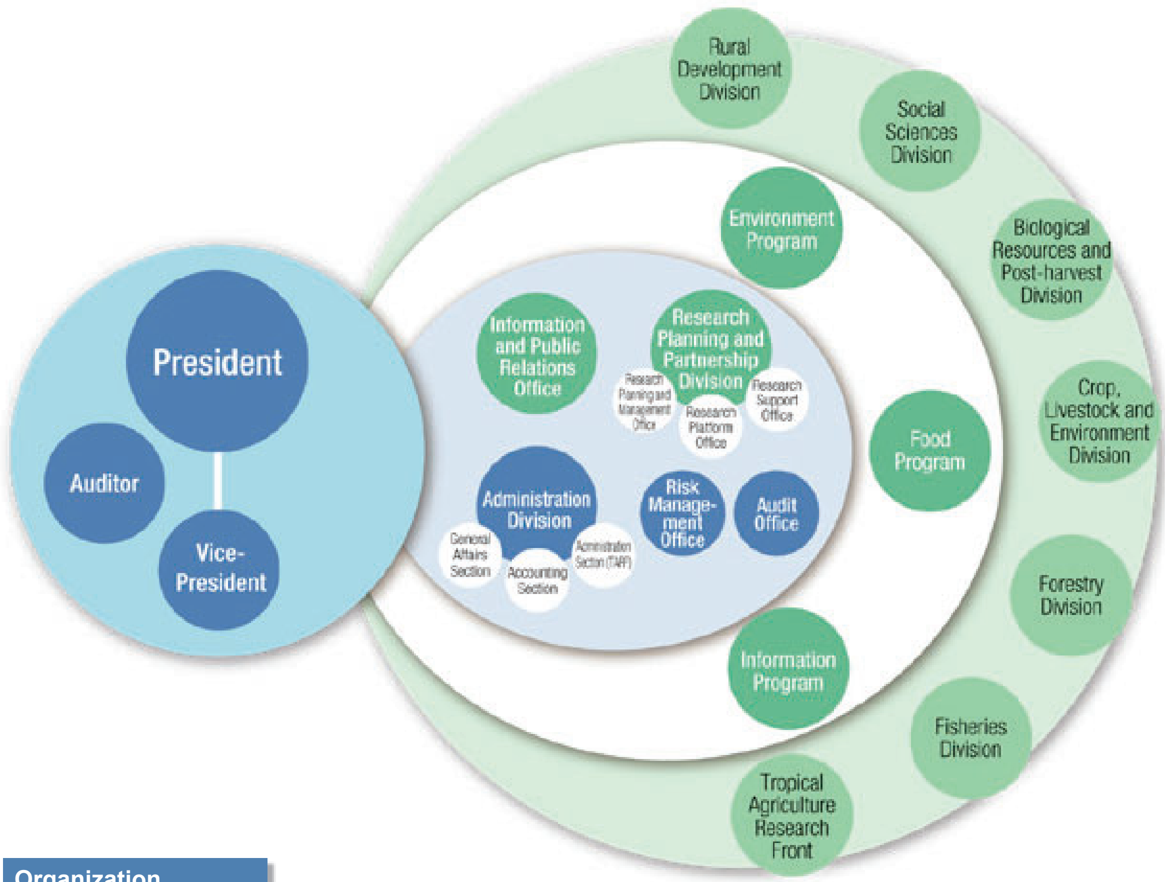
JIRCAS is required to cover a wide range of research fields. Human resources at JIRCAS, however, are limited. This makes collaborative research with other institutes or universities necessary towards achieving JIRCAS's project objectives. Whenever JIRCAS and its collaborators reach an agreement on the commencement of collaborative research after exchanging ideas and opinions, a Memorandum of Understanding (MOU) or a Joint Research Agreement (JRA) is usually concluded. JIRCAS developed the concept of JRAs in 2006. A JRA is a contract for collaborative research with a particular research subject and with a fixed term. A total of 149 MOUs and JRAs remained in force at the end of FY 2024.

In 2004, JIRCAS was given a Certificate of Recognition by CGIAR as a key partner and as the CGIAR focal point institution in Japan. JIRCAS has been playing an important role in promoting mutual understanding and collaboration between CGIAR and the Japanese government. It has also been intensively implementing collaborative research with several CGIAR research centers.

JIRCAS has been regularly dispatching researchers and research managers to promote research in the developing regions. Likewise, we have been inviting researchers from other institutes and universities to promote the effective implementation of JIRCAS's projects with the cooperation of such organizations. JIRCAS has also implemented several invitation programs for overseas researchers and administrators at counterpart organizations. These programs facilitate not only the promotion of international collaborative research but also related exchanges of information and opinions.

7. Organization of JIRCAS

The organizational structure of JIRCAS for the Fifth Medium to Long-Term Plan period is summarized in the figure that follows:



Organization

Three Program Directors are responsible for the implementation of individual programs during the Fifth Medium to Long-Term Plan period.

The directors of divisions and the Tropical Agriculture Research Front (TARF) are responsible for managing staff and enhancing the capabilities of researchers.

TARF (formerly the Okinawa Subtropical Station), located in Ishigaki Island in the southernmost part of Japan, is JIRCAS's sole substation. It focuses on agricultural, forestry, and fisheries research being carried out in overseas regions with highly similar climatic and geographic conditions as Okinawa, taking full advantage of its subtropical weather and geographic location.

Main Research Programs

Program A
Environment

“Development of agricultural technologies for climate change, resource recycling and environmental conservation”

A significant rise in greenhouse gas (GHG) emissions through crop cultivation, livestock production, and extractive forest resource use has amplified the burden on people’s lives and the environment. The ‘Environment Program’ aims to ensure sustainability in the agriculture, forestry, and fisheries sectors and establish appropriate resource management by maximizing resource use efficiency, especially in developing countries and regions that are vulnerable to the adverse impacts of climate change.

[Climate change measures in Monsoon Asia]

Field trials demonstrated that intermittent irrigation can be applied even under large-scale plot-to-plot irrigation systems commonly used in Cambodia, achieving both methane emission reductions and yield increases. Simulation modeling demonstrated that introducing ratoon rice cropping to a reservoir-irrigated area mitigates water shortage risk and enhances water productivity. Based on long-term field experiments over 45 years, the soil carbon sequestration rate was estimated, and the effects of chemical fertilizers and organic matter application on upland soils in tropical regions were clarified. In sandy soils, soil carbon sequestration was observed down to a depth of one meter, and its positive impact on crop yield was demonstrated. A platform was coordinated to promote the Joint Crediting Mechanism (JCM) in the agricultural sector. Technical advice was provided, as an expert member of the JCM Agriculture Expert Committee organized by the Asian Development Bank (ADB), for the development of a methodology to reduce methane emissions from paddy fields using intermittent irrigation in the Philippines. Furthermore, representing the expert committee, the draft methodology was submitted to the Japan–Philippines JCM Joint Committee and was formally approved, thereby paving the way for the social implementation of the technology. A demonstration-scale feeding trial using Vietnamese cattle was conducted with cashew nut shell liquid (CNSL). It was confirmed that CNSL feeding during the fattening period had no effect on body weight or dry matter intake, and that the technology is acceptable for cattle farmers. Scientific evidence was presented supporting its feasibility for practical application. A large-scale production technology for a non-conventional yeast was developed in collaboration with an animal feed company, with the aim of utilizing the fermented cassava pulp as an alternative animal feed.

[Carbon recycling]

The novel properties of the saccharifying bacterium *Paenibacillus macerans* (a patented strain), which simultaneously saccharifies protein and xylan, were identified. The effects of the saccharifying bacterium on crop growth were evaluated. Cultivation conditions for the methane-oxidizing bacterium *Methylosinus* sp. N4-5-1 were investigated. The amounts of CH_4 absorption and CH_4/N_2O emissions from palm plantation soils were quantified and compared with soils from neighboring tropical rainforest. A special seminar was held within the framework of the International Symposium on Biopolymers 2024, where information on the achievements of SATREPS was disseminated to stakeholders in Malaysia through collaboration with Universiti Sains Malaysia and participating Japanese companies. The social implementation of pellet manufacturing technology, based on the raw material multi-treatment process from the SATREPS project, was carried out in a pellet manufacturing plant in Sarawak State by a Japanese company. Among the microbial saccharification technologies developed to utilize various agricultural and food wastes generated from agricultural production in Southeast Asia including Thailand, a saccharification technology for brewery residues was demonstrated at a proof-of-concept plant constructed in Japan. The project was selected as a feasibility study task under the BRIDGE program, funded by the Cabinet Office of Japan, to identify the sustainability of the developed technologies as a business. As a result of the evaluation, it was officially approved as a BRIDGE project starting in fiscal year 2025. Based on the results of the SATREPS project, a JICA project was launched in Malaysia aiming to develop technologies contributing to food production and food security through the integrated utilization of palm biomass.

[BNI-system]

Field trials of the BNI-enabled wheat prototypes, BNI-Munal and BNI-Borlaug 100, were conducted across three states in India. These trials confirmed the nitrogen reduction and yield improvement effects of BNI trait introduction in the Indo-Gangetic Plains under diverse production systems. The BNI trait was introduced into eight mega-wheat varieties—each cultivated on more than one million hectares in India—and promising lines were obtained through backcrossing. Additionally, backcrossing was carried out to introduce BNI trait into domestic wheat lines with the aim of reducing chemical fertilizer use in domestic wheat production. The effectiveness of the BNI trait has been confirmed in some of these lines. In CIMMYT maize lines (CMLs), the levels of the hydrophobic BNI trait and MBOA secretion were compared through hydroponic and field trials. This led to the identification of high- and low-BNI parent lines, as well as the formation of genetic populations (Double Haploid Lines, DHLs) for the development of molecular markers. A BNI compound was isolated and purified from finger millet, a major millet traditionally grown under low-nitrogen conditions in East Africa and India. Root box experiments confirmed differences in BNI capacity among three *Brachiaria*

(*Urochloa*) grass varieties. Taking India—a country where sorghum is produced as a staple food—as a model, we evaluated the environmental and economic benefits of possible BNI-enabled sorghum. The results showed that introducing it could reduce nitrogen application, GHG emissions, and government fertilizer subsidies, while also increasing farmer profits. The 5th BNI International Consortium Meeting was held in Tsukuba, and was attended by national research institutes, universities, government agencies, and international organizations from both the Global South and the Global North. This resulted in the creation of a global momentum to discuss the utilization of BNI-enabled crops. Furthermore, in response to the "International Initiative for Research on Millets and Other Ancient Grains," which was launched at the 12th G20 Meeting of Agricultural Chief Scientists (MACS-G20), a proposal on BNI research in millets was submitted and selected under the FY2024 Strategic International Collaborative Research Promotion Programme (joint research with India), thereby initiating a new international collaborative research effort with India. BNI-enabled wheat was explicitly mentioned as a technology for sustainable food systems in the revised 2024 edition of the "Grand Design and Implementation Plan for New Capitalism," which was approved by the Cabinet on June 21, FY2024. Additionally, the 8th Niigata International Food Award Grand-Prix was awarded by the Niigata International Food Award Foundation for BNI-enabled wheat development. These efforts contributed to the formation and launching of CropSustaiN, a large-scale international research project led by CIMMYT that aims to make the BNI trait a standard feature of global wheat breeding, and to further deepen international collaborative research with CIMMYT.

[Adaptive forestry]

A soil desiccation experiment was conducted on seedlings of eight Dipterocarpaceae species, and leaf traits relevant to species' drought tolerance were identified. Comprehensive gene expression analysis of temperature-treated mangrove saplings revealed the possibility of predicting growth variations under future temperature conditions. In teak plantations, SPAD (Soil Plant Analysis Development) values of leaves, which can be easily measured, were identified as a promising indicator of teak growth rate. Genotype data were obtained from valuable tree species selected through consultation among partner institutions in three countries (Indonesia, Malaysia, and Thailand), and genomic regions associated with climate were detected for a tree species. Growth prediction for dipterocarp trees was made through improvements of a new spatially explicit individual-based Dynamic Global Vegetation Model (SEIB-DGVM), and a workshop was held for participants to learn how to use the developed model. The chronosequence of mangrove biomass and soil carbon accumulation was clarified in Malaysia. A method for measuring CH_4 emissions from mangrove trunks and soil was developed. Soil CO_2/CH_4 flux measurements were conducted through a portable chamber system to evaluate the impact of clear-cutting in tropical rainforests. Hands-on training programs were conducted on forest genetic resource management techniques using DNA analysis technology developed through research under the fourth medium- to long-term research plan. These efforts contributed to the establishment of sustainable tree production systems in Indonesia and Thailand through appropriate seedling supply.

[Yama-Sato-Umi agroecosystem connectivity]

River and spring water samples were collected over a two-year period from 16 locations in Ishigaki Island, and the concentration and isotope ratios of nitrate ions were analyzed. It became possible to estimate annual pollutant loads in Ishigaki's rivers. Using the SWAT+ hydrological and water quality model, the fertilizer reduction effect of sugarcane cultivation was assessed. The nitrogen footprint of food consumption, developed specifically for Ishigaki Island, was applied to its 2022 food system to estimate both local and external nitrogen loads. A joint field trial with the Philippine Sugar Regulatory Administration (SRA) and a Japanese company was conducted on three 1-hectare farmer plots to evaluate deep-planting sugarcane cultivation. The technique proved effective for stable sugarcane production under severe drought conditions caused by El Niño. An international sugarcane conference was co-hosted with SRA for domestic and international sugar producers, affiliated companies, research institutions, and the Philippine government. Research findings, including deep-planting sugarcane cultivation, were shared with local stakeholders such as administrative agencies and farmer cooperatives through keynote presentations and special sessions. During Farmers' Day held by SRA, the effectiveness of deep-planting sugarcane cultivation was explained to the acting Minister of Agriculture of the Philippines, and a proposal document outlining sugarcane production improvement technologies was handed over. Scientific evidence was shown from field trials by a collaboration with a Japanese company for application of deep-planting cultivation technology in the Philippines. Recognizing its potential to benefit domestic sugarcane production, a demonstration trial was jointly conducted with Ishigaki City Office to introduce the technology to producers, farmer groups, and related stakeholders. Additionally, scientific findings on the deep-planting technology were presented at the Ministry of the Environment's FY2024 Sugarcane Yield Increase Plan Follow-Up Meeting.

[Sustainable land management in drylands]

Changes in soil moisture were observed over a two-year period at a lysimeter in India, and an appropriate depth of sub-surface irrigation of 20 cm was confirmed. In the Hisar region of India, where soil salinization is serious, the effectiveness of shallow sub-surface drainage with a Cut-soiler was verified, and an improvement of drainage function and a reduction in soil salinity was confirmed. In addition, seasonal fluctuations of groundwater levels, which are a cause of salinization, were observed, and it was estimated that the most effective time to construct a Cut-soiler is before the rainy season when the groundwater level is low. The Cut-soiler was constructed in an actual farmland, and it was confirmed that yields were highest after two years of construction. By analyzing the relationship between EC_e and $EC_{1:2}$, which are evaluation indicators of soil salinity, it was confirmed that seasonal variations occur depending on the soil's Exchangeable

Sodium Percentage (ESP). Efforts were made to publish research findings jointly with local counterparts, resulting in the publication of nine peer-reviewed articles in international journals. To promote the social implementation of the Cut-soiler in India, an initial stakeholder meeting was held in collaboration with the public and private sectors, led by the Japan International Research Institute for Agricultural Sciences (JIRCAS), the Indian Council of Agricultural Research (ICAR), and the Central Soil Salinity Research Institute (CSSRI).

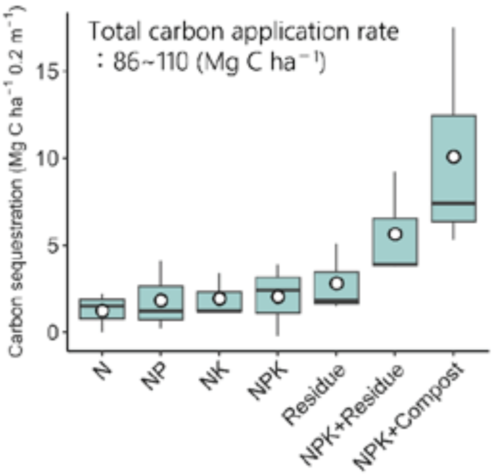
Carbon sequestration and soil fertility management in sandy and clayey soils revealed by over four decades of long-term field experiments in Thailand

Since soil is the largest terrestrial carbon (C) reservoir, even small changes in soil C storage can significantly impact the global C cycle. To better understand soil C dynamics in agricultural soils, it is essential to conduct long-term field experiments on the effects of various land management practices on the same farmland. However, long-term field experiments in tropical regions are limited, making it difficult to assess the impact of agricultural management on soil C sequestration accurately. JIRCAS, in collaboration with the Department of Agriculture (DOA) of Thailand, has analyzed data from over 45 years of long-term field experiments involving the continuous application of chemical fertilizer and organic matter (OM) on cropland.

The data from three long-term field experiments (hereafter referred to as Khon Kaen, Nakhon Ratchasima, and Rayong) were analyzed. Compared to the control without any amendment, soil C sequestration was 2.0 ± 2.1 and 2.8 ± 2.0 Mg C ha^{-1} 0.2 m^{-1} for chemical fertilizer and crop residue incorporation, respectively. The largest soil C sequestration occurred when chemical fertilizers were combined with OM applications. Specifically, when chemical fertilizer was combined with crop residue incorporation or compost application, soil C sequestration reached 5.6 ± 3.1 and 10.1 ± 6.5 Mg C ha^{-1} 0.2 m^{-1}, respectively (Fig. 1). Furthermore, the trend of C sequestration varied depending on soil type. In clayey soils (Nakhon Ratchasima), C was concentrated in the surface layer, whereas in sandy soils (Khon Kaen), the effect was significant across all layers up to a depth of 1.0 m (Fig. 2). Structural equation modeling indicated that the increase in soil C in sandy soils significantly improved basal soil fertility, such as soil pH, available phosphorus, and exchangeable potassium, resulting in higher cassava yields (Fig. 3). In contrast, no significant relationship was found between soil C content and cassava yield in clayey soils.

These results are expected to contribute to the establishment of a soil C dynamics model optimized for tropical regions by providing reliable estimates of soil carbon sequestration rates in low-latitude regions, where studies have been limited. Furthermore, the Intergovernmental Panel on Climate Change (IPCC) sets the standard for soil carbon sequestration assessment at a depth of 0.3 m (or tillage depth) from the surface. The results of this study indicate that in sandy soils, it is necessary to evaluate even deeper layers.

Authors: Iwasaki S., Watanabe, T., Matsumoto N. [JIRCAS], Tancharoen, S., Luanmanee, S., Nobuntou, W., Amonpon, W., Chumsuwan, N., Paisancharoen, K., Bumrung, S. [DOA]



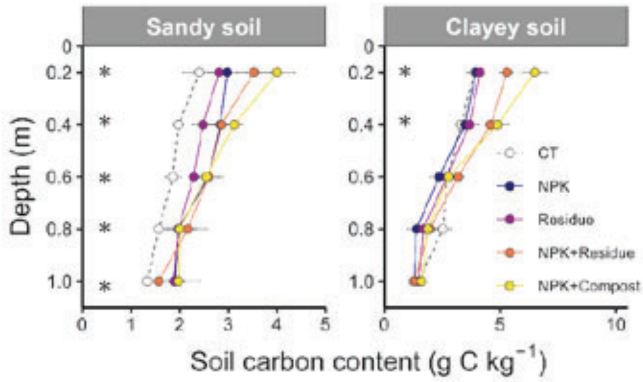


Fig. 1. Soil carbon sequestration rate

Calculated from long-term field experiments in Khon Kaen, Nakhon Ratchasima, and Rayong. Soil carbon sequestration is expressed as the difference from the control plot without any application. In the residue and NPK + residue treatments, cassava stems and leaves were returned to the field after harvest. The box plot represents the maximum, third quartile, median, first quartile, and minimum values. The ○ symbol indicates the mean value.

Fig. 2. Soil carbon content at five different depths

Soil samples were collected from five depth intervals (0–0.2 m, 0.2–0.4 m, 0.4–0.6 m, 0.6–0.8 m, and 0.8–1.0 m) in 2021. Values are presented as the mean ± standard error. The asterisk (*) indicates a significant difference between treatments at $p < 0.05$. Results from Khon Kaen represent sandy soil, while those from Nakhon Ratchasima represent clayey soil.

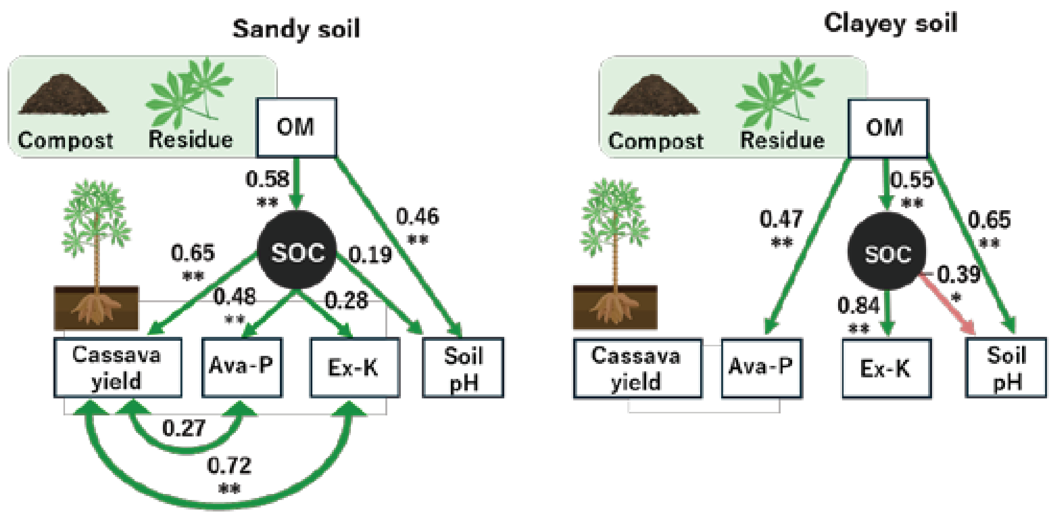


Fig. 3. Structural equation modeling of cassava yield

The relationships among organic matter application (OM), soil carbon concentration (SOC), available phosphorus (Ava-P), exchangeable potassium (Ex-K), soil pH, and cassava yield were analyzed using a structural equation model. Unidirectional arrows indicate causal relationships, while bidirectional arrows represent correlations. The numbers indicate the contribution coefficient. * and ** represent statistical significance at $p < 0.05$ and $p < 0.01$, respectively.

Reference: Tancharoen et al. (2024) *Land Degradation & Development* 35: 5488–5503.

The application of filter cakes improves the physicochemical and biological properties of soils with low pH in tropical regions

The application of organic matter is recommended for carbon sequestration and fertility improvement in agricultural soils. Sugarcane is widely cultivated in tropical regions, and a large amount of filter cake (FC) is produced as a by-product in the sugar industry. Earthworms (Oligochaeta) can improve soil functions such as nutrient cycling and water retention by promoting organic matter decomposition and modifying soil structure through their feeding and casting activities. Organic matter application is known to increase earthworm density and biomass. Also, soil pH can influence earthworm species composition, density, and biomass. However, the effects of organic amendments on these characteristics of earthworms at different soil pH values have not been fully understood, especially in tropical agricultural fields.

We conducted a field survey to evaluate the effects of a single application of FC on soil physicochemical properties and earthworm species, density, and biomass in sugarcane fields with two different soil pHs (low pH soil : <5.2, moderate pH soil : >6.0) on Ishigaki Island, Okinawa Prefecture, Japan. FC application decreased soil bulk density and hardness, and water content increased in the low pH soil. In addition, available P content and Ca^{2+}, K^{+}, and Mg^{2+} contents increased about 2-fold, and cation exchange capacity also increased (Table 1). In the moderate pH soil, FC application did not improve physical properties, although the available P increased 2.5-fold, and soil pH and Ca^{2+} and K^{+} contents decreased. Regardless of soil pH and FC application, *Pontoscolex corethrurus* (Müller, 1856) was dominant (Fig. 1) and accounted for approximately 30% to 100% of the density in each treatment. In addition to *P. corethrurus*, *Polypheretima elongata* (Perrier, 1872) was observed in the low pH soil with FC application. Earthworm biomass increased about 3-fold in the low pH soil but decreased by about 80% in the moderate pH soil with FC application (Fig. 2). Therefore, FC application to low pH soils can improve both physicochemical and biological properties of the soil.

Our results suggest that the application of FC, an underutilized organic resource, is expected to improve soil functions such as nutrient cycling and water retention in low pH soils through enhanced biological properties. Since this conclusion is based on data from a single application of FC, the effects of continuous application of FC and the effects of application of organic materials with different chemical properties from FC on soil physical and chemical properties need to be investigated. Additionally, future evaluations should include yield assessments.

Authors: Arai, M., Ikazaki, K., Terajima, Y., Anzai, T. [JIRCAS],
Minamiya, Y. [Tochigi Pref. Museum]

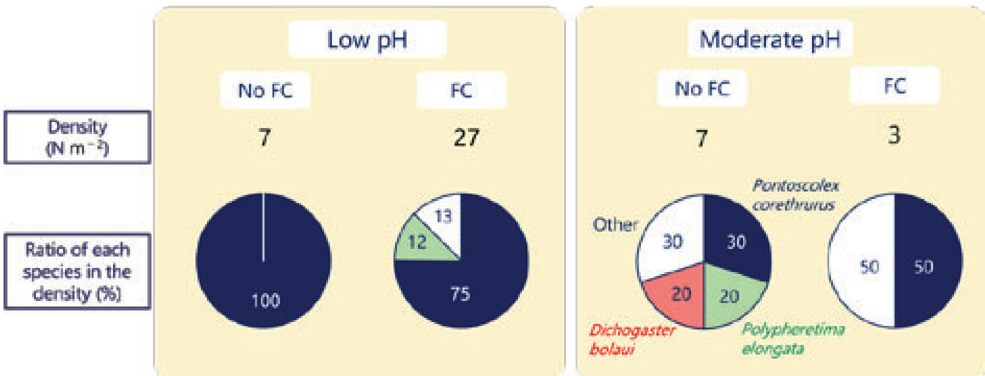
Table 1. Effect of filter cake application on physicochemical properties of soils at low pH and moderate pH

Soil pH	FC	pH (H_2O)	EC	Bulk density	Water content	Hardness	TC	C:N ratio	Available P	Ca^{2+}	K^+	Mg^{2+}	CEC
			$mS\ m^{-1}$	$Mg\ m^{-3}$	$m^3\ m^{-3}$	mm	$g\ kg^{-1}$		$\mu g\ kg^{-1}$	cmolc kg^{-1}	cmolc kg^{-1}	cmolc kg^{-1}	cmol(+) kg^{-1}
Low	No	4.74 (0.21)	6.35 (0.90)	1.22 (0.11)	0.21 (0.01)	12.32 (1.75)	9.69 (2.07)	9.89 (0.63)	115.6 (31.1)	1.74 (0.92)	0.27 (0.02)	0.42 (0.15)	13.22 (0.46)
	Yes	4.98 (0.38)	9.40 (2.33)	1.15 (0.14)	0.25 (0.02)	8.63 (0.98)	9.48 (1.55)	9.46 (0.41)	209.7 (21.1)	3.80 (1.39)	0.53 (0.19)	0.78 (0.14)	13.71 (2.65)
	p value		***	**	**	*		*	***	***	***	***	***
Moderate	No	6.50 (0.27)	6.76 (1.12)	1.20 (0.02)	0.22 (0.04)	7.40 (1.51)	9.19 (2.33)	9.82 (0.42)	125.7 (19.9)	10.25 (2.55)	0.61 (0.19)	1.33 (0.34)	16.60 (4.06)
	Yes	5.54 (0.20)	7.98 (1.27)	1.25 (0.16)	0.24 (0.03)	9.99 (3.13)	11.33 (2.17)	9.88 (0.29)	316.2 (67.6)	5.29 (1.27)	0.46 (0.06)	1.10 (0.13)	15.71 (2.93)
	p value	***							***	**	***		

Three pairs of adjacent sugarcane fields with and without filter cake application were selected in each of the low (< 5.2) and moderate (> 6.0) pH soils. FC: filter cake; EC: electrical conductivity; TC: total carbon content; C:N ratio: ratio of total carbon to total nitrogen. All cations are exchangeable. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. Values represent the mean (standard error) of three experimental plots.

Fig. 1. Density of earthworms and proportion of each species in the density

The numbers at the top of the pie chart indicate the density (N m^{-2}), and the numbers within the pie chart indicate the proportion of each species in the density (%). Blue: *Pontoscolex corethrurus* (Müller, 1856), Green: *Polypheretima elongata* (Perrier, 1872), Red: *Dichogaster bolaui* (Michaelsen, 1891), White/Other: represents individuals for which species identification was not possible due to fragments. Earthworms were collected by hand sorting soil at 0–10 cm depth corresponding to Table 1 and by mustard solution at a depth deeper than 10 cm.



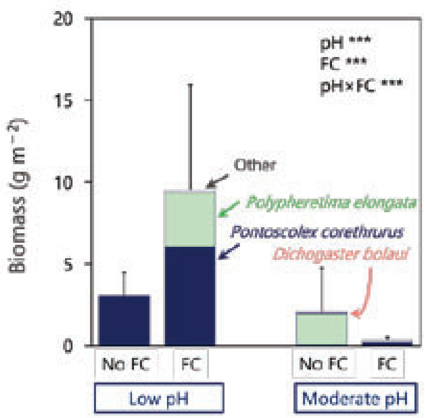


Fig. 2. Effect of filter cake application on earthworm biomass in each pH soil

Earthworm biomass for each species (g m^{-2}), corresponding to Figure 1 data. Error bars represent standard errors of total earthworm biomass in the three sugarcane fields. ***$p < 0.05$.

Reference: Arai et al. (2024) *European Journal of Soil Biology* 122: 103645.

Stabilization of soil organic matter by reactive aluminum phases in agricultural fields under volcanic influence

Increasing soil organic matter (SOM) storage in agricultural soils is needed to mitigate climate change and improve soil fertility. Particularly in humid tropical regions, high temperatures and high soil moisture can reduce SOM content. Understanding the factors that control SOM storage is a key step towards effective soil management for sustainable crop production. While clay + silt content is known to be an important factor in the stabilization of soil organic carbon (SOC)*, recent studies have shown that oxalate-extracted Al (reactive Al) is of greater importance. Reactive Al roughly corresponds to organo-Al complexes and amorphous clay**, and is formed through weathering of volcanic debris. However, in the tropics, most studies have been conducted on weathered soils with low reactive Al content, and the relationship between reactive Al and SOC content in different land uses has not been fully understood. This study aimed to clarify the factors regulating SOM content in agricultural fields compared to secondary forests or home gardens in Negros Occidental, Philippines. Sugarcane fields have been continuously cultivated for more than 70 years in the study site (Fig. 1).

SOC showed significant positive correlations with reactive Al content, but not with clay + silt content (Fig. 2). The slope of the regression line between SOC and reactive Al was not significantly different between sugarcane and the other two land uses, while the intercept was significantly lower in sugarcane sites (Fig. 3). These results suggest that land use conversion from forest to sugarcane decreases the SOC fraction (particulate organic matter***) that is relatively easily decomposed by soil microorganisms but does not decrease the SOC fraction stabilized by reactive Al.

Even in humid tropical regions where SOM is easily depleted, it is possible to achieve soil carbon sequestration in agricultural fields by developing technologies to increase the SOC fraction stabilized by reactive Al under volcanic influence. To develop such technologies, it would be necessary to evaluate the effects of factors (e.g., reactive Al content, SOC saturation level, quality and quantity of organic materials applied to fields) on the amount of change in SOC stabilized by reactive Al.

*Stabilization of SOM: resistance to decomposition by soil microorganisms

**Amorphous clay: general term for clay with low crystallinity

***Particulate organic matter: Coarse SOM derived from fallen leaves, dead roots, and dead soil animals

Authors: Arai, M., Ikazaki, K., Anzai T. [JIRCAS],
Celestial, P.V., Tumbay, V.J., Santillana, S.I. [SRA], Wagai, R. [NARO]

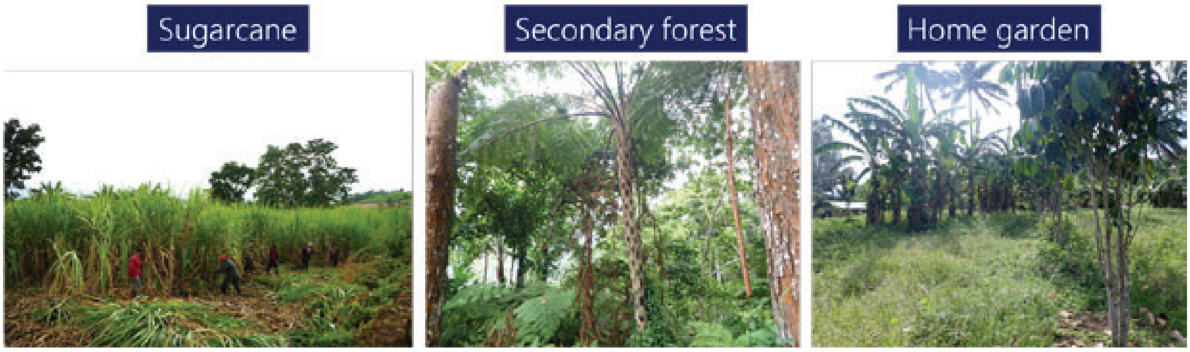


Fig. 1. Sampling points for each land use type

Sugarcane fields, secondary forests, and home gardens in Negros Occidental, Philippines

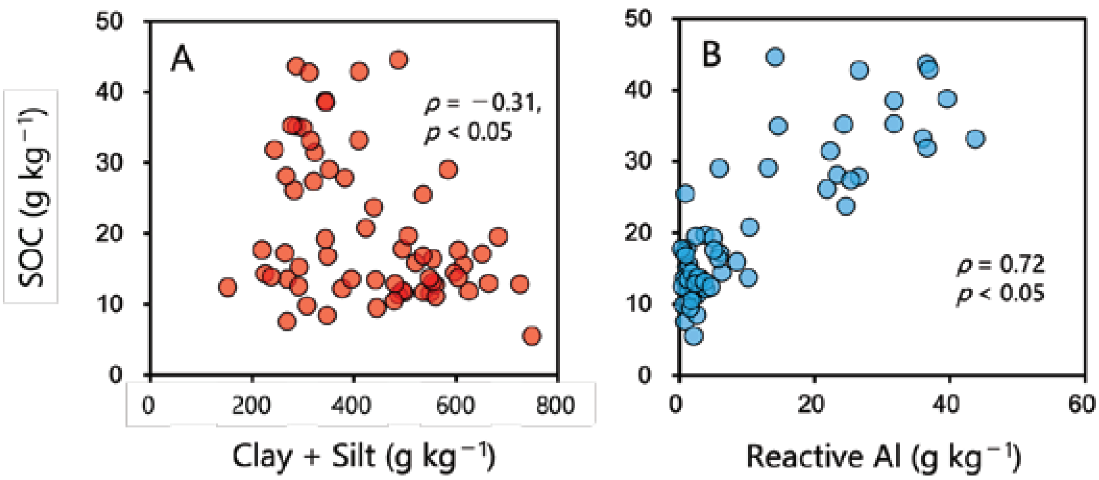


Fig. 2. Relationships between soil organic carbon (SOC) and clay + silt content (A) and reactive Al content (B)

Spearman's rank correlation coefficient (ρ) and *p* value are shown. Soils were collected at 0–10 cm depth from sugarcane fields (n = 33), secondary forests (n = 10), and home gardens (n = 23) in Negros Occidental, Philippines.

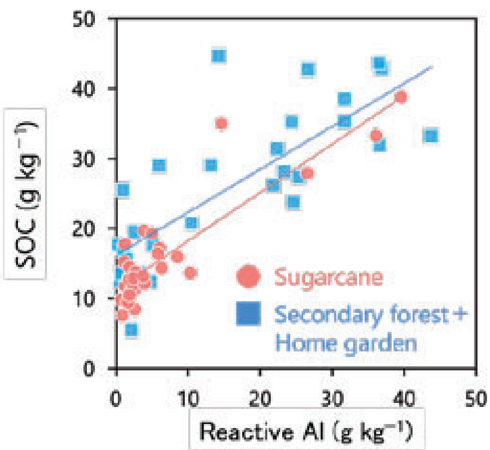


Fig. 3. Relationship between reactive Al content and SOC content by land use

Regression lines are shown for sugarcane fields (red; n = 33; y = 0.69x + 11.27, R^2 = 0.78, $p < 0.05$), which were highly anthropogenically disturbed, and other land uses (secondary forests + home gardens) (blue; n = 33; y = 0.61x + 16.16, R^2 = 0.78, $p < 0.05$), which were less disturbed. Analysis of covariance showed no significant difference in the slopes of the two regression lines ($p > 0.05$), but a significant difference in the intercepts ($p < 0.05$). This indicated that there was no difference in the SOC fraction stabilized by reactive Al between land uses.

Reference: Arai et al. (2025) *Soil Science and Plant Nutrition* 71: 27–37.

Enhancing reservoir water management through ratoon rice double cropping in tropical monsoon regions

Ratoon rice double cropping (RR) offers a resource-efficient alternative to conventional rice double cropping (DR) by eliminating the need for seedling preparation, puddling, and transplanting while also shortening the growth period. In irrigated areas under tropical monsoon climates, its adoption could contribute to stable water resource management. However, its impact on reservoir operations at the irrigation district level remains unverified. This study evaluates the effects of introducing RR on reservoir operations in the Yezin irrigation area of Myanmar, where dry-season water use is restricted due to hydrological variability, and wet-season cropping is prioritized.

This report estimates evapotranspiration for ratoon rice cropping using newly defined crop coefficients. Using 23 years of hydrological data, the reservoir water balance simulation was performed under different cropping patterns, including single, double, and triple cropping scenarios. Key indicators such as water shortage, reliability index (RAI), and water productivity (WP) were assessed. Additionally, rice yields were predicted using a machine learning model developed from 10 cropping trials, with input features such as harvest dates, meteorological data, and cutting heights. WP was calculated using simulated irrigation supply data (Fig. 1). For single rice cropping (3,600 ha in the wet season), early-season planting in early June avoids water shortages while maintaining WP of over 1.5 kg m^{-3} (Fig. 2). In DR, limiting the dry-season cultivation area to 1,400 ha (total annual cropping area, 5,000 ha) ensures an RAI above 0.8, a threshold for sustainable reservoir operations. In RR, planting in the dry season leads to water shortages that prevent crop continuation. However, when RR begins in the early wet season, an RAI above 0.8 is maintained. Compared to DR, WP improves by 60–87%, enabling more efficient reservoir management. However, for the triple rice-ratoon-ratoon cropping to maintain an RAI above 0.8, planting must be delayed with a cropping area of less than 4,400 ha, resulting in a reduction in WP to 0.45–0.48 kg m^{-3} (Fig. 3).

The proposed simulation framework enables comprehensive assessment of water shortage risks and WP in irrigated paddy rice under tropical climates. It facilitates the formulation of sustainable cropping and irrigation plans as an adaptation strategy to climate variability. For effective ratoon double cropping, strategies must be implemented to optimize harvesting schedules, avoiding rainfall-induced delays and mitigating yield losses from mechanical harvesting-related stubble compression.

Authors: Shiraki, S. [JIRCAS], Kywae, Nwe, N., Thin, M.C., Aung, K.T. [DAR]

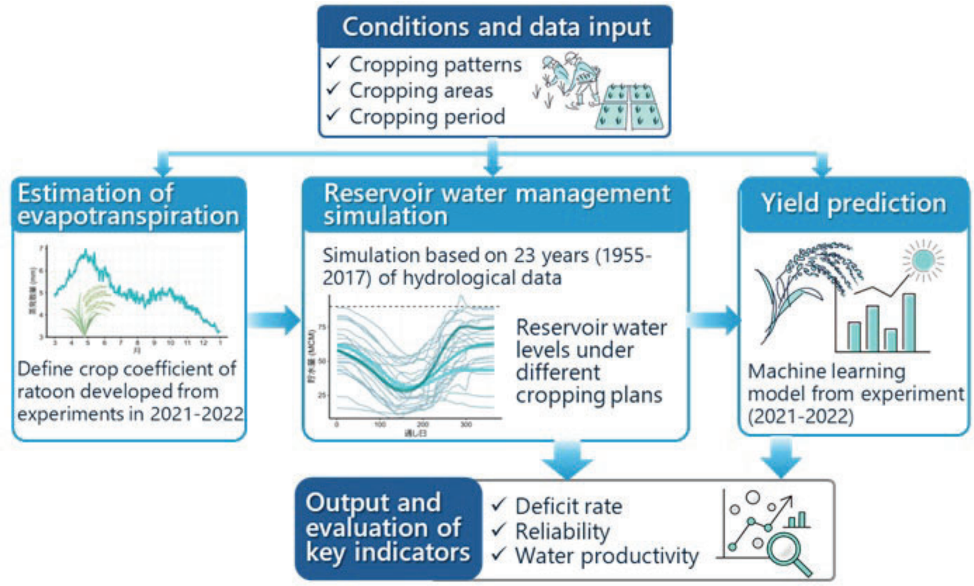


Fig. 1. Assessment of reservoir operations under different rice cropping patterns

In the study area, wet-season rice cropping (maximum area: 3600 ha) is prioritized, and dry-season cropping is adjusted based on early dry-season reservoir water levels.

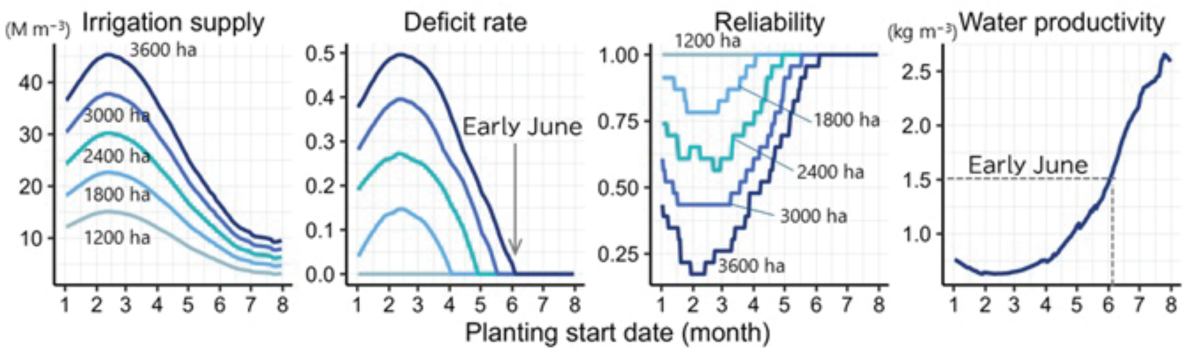


Fig. 2. Analysis of the impact of planting areas and timings on irrigation supply, deficit rate, reliability, and water productivity in single rice cropping

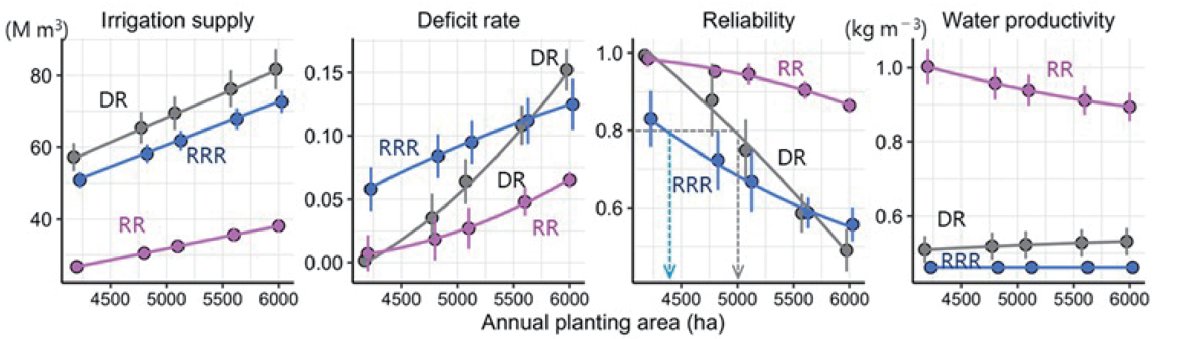


Fig. 3. Assessment of different planting areas on irrigation supply, storage deficit, deficit rate, and reliability in DR, RR, and RRR

DR, double rice-rice cropping; RR, double rice-ratoon cropping; RRR, triple rice-ratoon-ratoon cropping. Vertical bars across lines represent standard deviations.

Reference: Shiraki et al. (2025) *Agricultural Water Management* 307: 109251.

BNI-enabled sorghum reduces fertilizer application in India

Fertilizer consumption in India increased after the 'Green Revolution' and was the second highest in the world in 2018; furthermore, it has been strengthened by fertilization subsidies. Excessive subsidies, especially for urea, have distorted the balanced application of fertilizers, degraded the environment, and increased stress on national finances.

Biological nitrification inhibition (BNI) from plant root systems effectively curtails nitrogen (N) loss and enhances N utilization efficiency. BNI is increasingly important as a technology for mitigating greenhouse gas (GHG) emissions and water pollution, especially in countries where N fertilizer is overdosed.

This study aims to show the potential impacts of BNI-enabled sorghum varieties with a 30% soil nitrification inhibition rate on N fertilizer use, yield, life cycle GHG (LC-GHG) emissions, farmers' benefit, and government expenditure on subsidy under two scenarios: N fertilizer consumption is reduced (Scenario 1) or maintained (Scenario 2). We analyzed the farm survey data collected in Maharashtra, India, a major sorghum-growing state, for Rabi (in 2020–2021, n = 250) and Kharif sorghum (in 2022, n = 209). LC-GHG emissions were calculated using the life cycle assessment method (Fig.1).

Under Scenario 1 (Fig. 2, left), compared with conventional sorghum, the introduction of BNI-enabled sorghum reduced N fertilizer application in the Rabi and Kharif seasons by 8.0% and 7.4%, respectively. It also decreased area-scaled/yield-scaled LC-GHG emissions by 15.6% in the Rabi season and 11.2% in the Kharif season, while slightly increasing farmers' benefits. These changes could decrease the government's expenditure on urea fertilizer subsidies by 9.1%. However, many farmers indicated that they would not change the N fertilizer application even if the yield per N fertilizer application increased. Even under these circumstances (Scenario 2, Fig. 2, right), compared with conventional sorghum, area-scaled/yield-scaled LC-GHG emissions were decreased by 11.3% and 13.5% in the Rabi season and 8.1% and 10.2% in the Kharif season, respectively. Yield and farmers' benefits would increase by 2.5% and 4.9% in the Rabi season and by 2.4% and 6.5% in the Kharif season, respectively, but the government's expenditure on fertilizer would remain unchanged.

These results indicate that BNI-enabled sorghum can be used in two ways: reduced N fertilizer consumption (Fig. 2, left) or maintained consumption (Fig. 2, right). Some countries cannot apply enough N fertilizer to meet plant requirements, leading to low yields and exhaustion of soil fertility. BNI-enabled sorghum can be introduced in countries with low N fertilizer use to increase yield while maintaining fertilizer consumption, and in countries with high N fertilizer use to maintain yield while reducing fertilizer consumption.

Authors: Leon, A. [JIRCAS], Nedumaran, S. [ICRISAT]

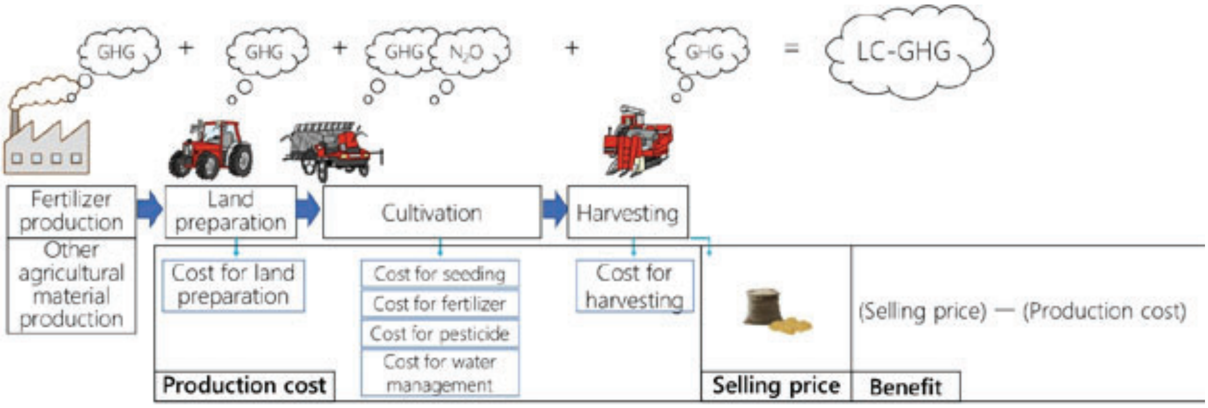


Fig. 1. Life cycle greenhouse gas (LC-GHG) emissions and benefits
LC-GHG is the sum of emissions from agricultural material production to harvesting.

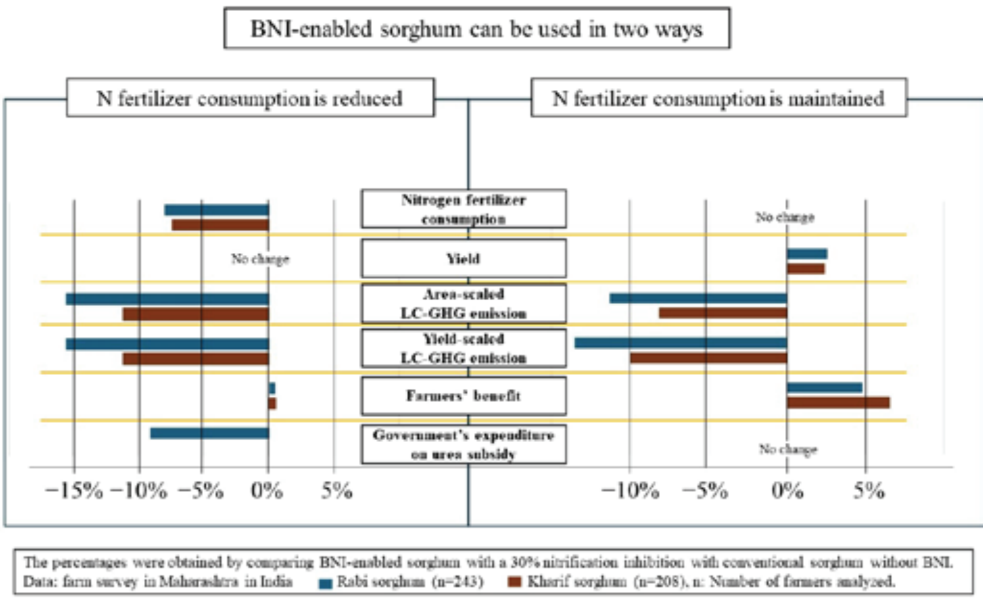


Fig. 2. The impact of BNI-enabled sorghum on nitrogen fertilizer consumption, yield, area-scaled/yield-scaled LC-GHG emissions, farmers' benefits, and the government's expenditure on urea subsidy when N is reduced (left) and maintained (right)
BNI-enabled sorghum could be a potential technology for establishing a sustainable agricultural system with the same yields (left) or higher yields (right) with lower GHG emissions and higher farmers' benefits.

Reference: Leon and Nedumaran (2024) *Science of the Total Environment 957*: 177385.

Leaf chlorophyll content is an indicator of growth rate of tropical teak tree

Teak (*Tectona grandis*) is an important timber resource in tropical forests and has a high market value, so a stable supply is required. However, there are large differences in growth rates between individual trees even within the same teak plantation. This difference limits accurate prediction of future timber yields. Various leaf traits such as leaf size, nutrient, and pigment contents affect photosynthesis; thus, they are likely to be related to the tree growth rate. For example, chlorophyll is a pigment that absorbs the energy of sunlight for photosynthesis, and if it is lacking, the photosynthetic rate decreases and growth becomes restricted. If the difference in growth rates between individuals can be easily estimated from leaf traits, it will lead to improved accuracy in predicting yields and rapid identification of areas of poor growth. This study examines the relationship between growth rate and leaf traits related to photosynthesis in teak trees.

We measured the height and diameter of teak trees in four plantation forests aged 14 to 46 years old in Malaysia and found a large variation in diameter and height within plantations (Fig. 1). Canopy leaves were collected and compared for leaf area, chlorophyll content indexed by SPAD value (hereafter referred to as chlorophyll content), nitrogen content, and leaf mass per area. Leaf traits vary greatly among individuals even within the same plantation, and they also differ in appearance (Fig. 2). Leaf chlorophyll content positively correlates with diameter and height growth rates, suggesting that individuals with high chlorophyll content also have high growth rates (Fig. 3). In contrast, there is no correlation between other leaf traits and tree growth (Table 1).

Using leaf chlorophyll content as an indicator of growth, this approach can be used to improve the accuracy of timber production across large plantation areas using remote sensing technology such as drones and satellites, and also contribute to identifying areas of poor growth in the plantation. Although these results were obtained from teak plantations in Malaysia, confirming whether similar results can be obtained from teak plantations in other regions with significantly different climates and soil traits, as well as to teak varieties that differ genetically, could make these findings useful for forest tree breeding.

Authors: Tanaka, K. [JIRCAS], Yoneda, R., [FFPRI], Azani, M.A. [Univ. Malaysia Putra]

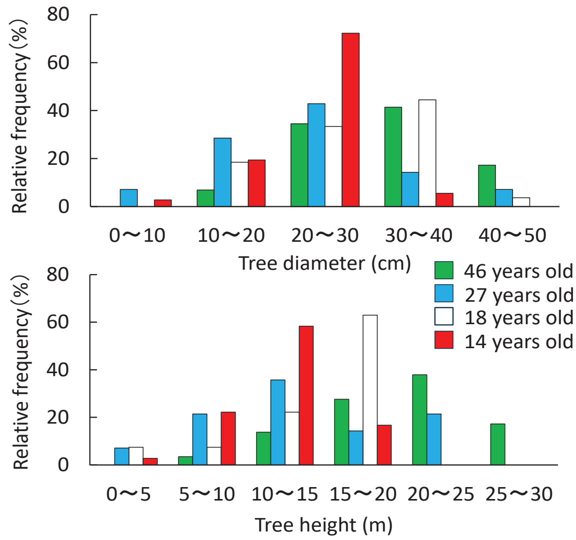


Fig. 1. Frequency distribution of tree height and diameter

Bar colors indicate plantation age.

Fig. 2. Leaves taken from same plantation

Each leaf is from a different individual. Dark green leaves contain a high amount of chlorophyll.

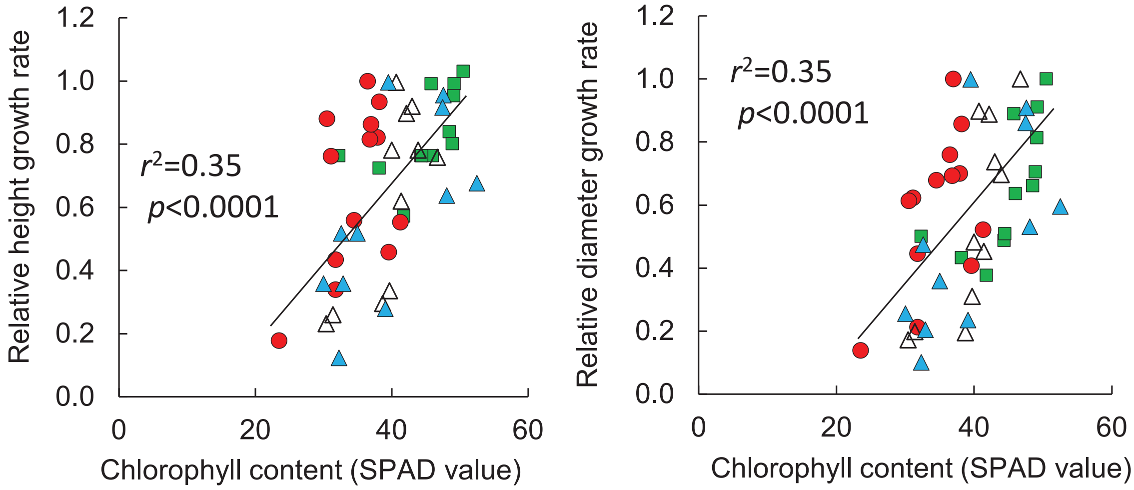


Fig. 3. Relationship between chlorophyll content and tree height (left) and diameter (right) growth

The symbol colors indicate stand age as in Fig.1, and the solid line represents the regression line.

Table 1. Results of multiple regression analysis of leaf traits and height and diameter growth rates in teak trees

Explanatory variables for growth rate	Relative height growth rate	Relative diameter growth rate
Nitrogen content	0.177	0.184
Chlorophyll content (SPAD value)	0.475**	0.561**
Leaf area	0.249	0.174
Leaf mass per area	−0.044	−0.001
Stand age	0.057	−0.153

The values are standardized coefficients, and ** indicates a significance level of p<0.01.

Predicting responses to soil desiccation from leaf traits in potted saplings among Dipterocarpaceae species

Ever-wet tropical forests of Southeast Asia account for a large fraction of forestry production in the world, but there are increasing concerns that this productivity will decline due to increased intensity and frequency of droughts associated with climate change. Hence, there is an urgent need to implement climate change adaptation measures by improving the drought tolerance of plantation trees. The Dipterocarpaceae, an important timber resource in this region, consists of >470 species, and there are potentially useful species with high drought tolerance. However, the drought tolerance of individual species and its indicators are unknown, which poses a challenge in implementing climate change adaptation through conversion of planting species.

This study aims to evaluate interspecific differences in drought responses and to identify traits which predict species' drought response through soil desiccation experiments on potted saplings of eight dipterocarp species, which differ in their distributions and morphological characteristics.

We artificially dried the soil of pots by stopping irrigation in a growth chamber with controlled environments and monitored the changes in physiological and morphological traits related to drought survival (leaf photosynthesis and degree of wilting) to quantify the drought response of each species (Fig. 1). We found that, regardless of species, stomatal conductance decreased at the earliest stage of soil desiccation, followed by a decrease in electron transport rate. The decline in maximum quantum efficiency and leaf wilting occurred at approximately the same time under severely dehydrated soils (Table 1). There were interspecific differences in the response of stomatal conductance, electron transport rate, and wilting progression to soil desiccation (Table 1). These species' drought responses were significantly associated with leaf-level drought-avoidance capacity, such that species with drought-avoidant leaves can maintain photosynthetic metabolism and avoid wilting under strongly desiccated soils (Fig. 2).

Overall, leaf drought-avoidance capacity is a convenient indicator of drought response in potted saplings of dipterocarps species and can be used to efficiently search for species with high drought tolerance. However, it should be noted that the above results were obtained from young potted saplings under controlled temperature, humidity, and light conditions and need to be validated in plantations and mature trees, where these environmental conditions vary over time and space.

Authors: Kawai, K. [JIRCAS], Ng, K.K.S., Lee, S.L. [Forest Research Institute Malaysia (FRIM)]

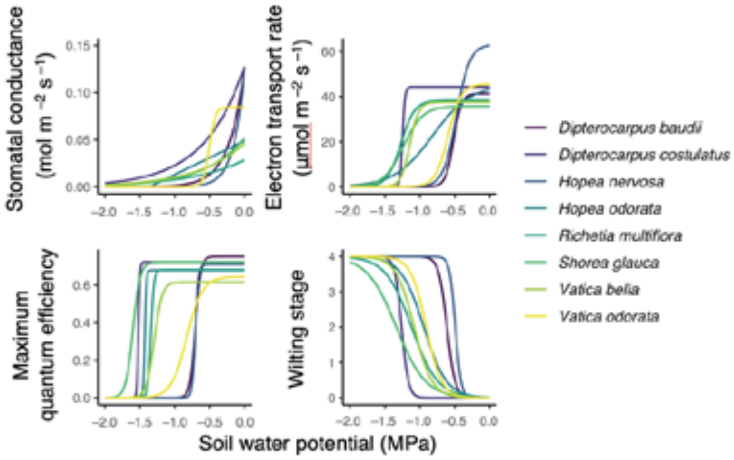


Fig. 1. Decline of photosynthesis and progression of wilting against soil desiccation
Higher absolute values in soil water potential indicate higher drought stress. Higher stomatal conductance and electron transport rate indicate higher photosynthetic rate. Lower maximum quantum efficiency indicates that more photosynthetic apparatus is damaged. Higher wilting stages indicate that wilting is more progressed. Different colors indicate different species.

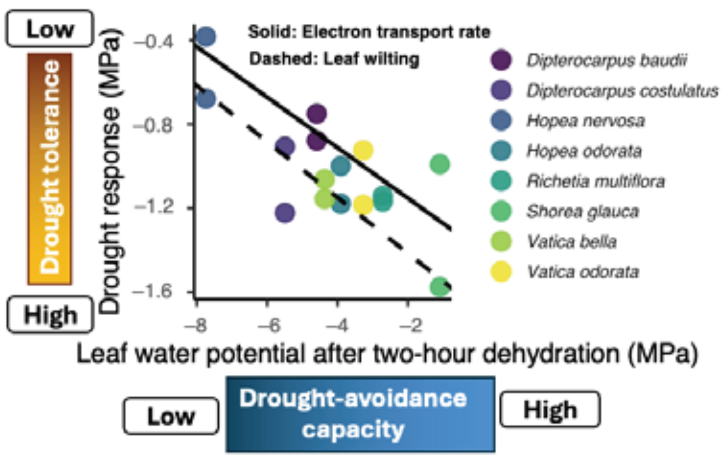


Fig. 2. Relationship between drought response and drought avoidance capacity at the leaf level
Higher absolute values in drought response show that changes against soil desiccation are small and indicate high drought tolerance. Lower absolute values in leaf water potential after two-hour dehydration indicate lower drought stress experienced under desiccating conditions and higher drought-avoidance capacity. Solid and dashed lines indicate trends of electron transport rate and leaf wilting, respectively.

Table 1. Responses of leaf photosynthetic paraments and wilting stage to soil desiccation

Species	Leaf characteristics			
	Stomatal conductance	Electron transport rate	Maximum quantum efficiency	Leaf wilting
Dipterocarpus baudii	−0.21a	−0.75ab	−0.95	−0.88ab
Dipterocarpus costulatus	−0.38ab	−0.91ab	−1.32	−1.22ab
Hopea nervosa	−0.22ab	−0.38a	−0.84	−0.68a
Hopea odorata	−0.67ab	−1.00ab	−1.34	−1.18ab
Richetia multiflora	−0.26ab	−1.14b	−1.34	−1.17ab
Shorea glauca	−0.25ab	−0.99ab	−1.54	−1.58b
Vatica bella	−0.37ab	−1.06b	−1.26	−1.16ab
Vatica odorata	−0.70b	−0.92ab	−1.04	−1.18ab
Average	−0.38A	−0.75B	−0.95C	−0.88C

Units: MPa. Higher absolute values show that changes against soil desiccation are small and indicate high drought tolerance. Differences in lowercase alphabets show significant differences among species, whereas differences in uppercase show differences among leaf characteristics (p < 0.05, Tukey test).

Reference: Kawai et al. (2025) *Kanto Shinrin Kenkyu* 76(1): 81–84.

Biochar application to soil surface layer effectively reduces nitrogen leaching under crop-present conditions

The Haber–Bosch process enables humanity to produce nitrogen fertilizer, allowing the population to grow by increasing food production. However, nitrogen applied as fertilizer often leaches from farmland in nitrate form, moving into water bodies such as groundwater and rivers and polluting the surrounding environment. Therefore, mitigating nitrogen leaching is urgently required. Biochar has been applied to farmlands to mitigate leaching while storing carbon. The effect of biochar application differs depending on the application depth; however, the effect of the application depth has not been evaluated under crop-present conditions. This study aimed to evaluate the effects of different biochar application depths on nitrogen leaching under crop-present conditions.

We conducted a pipe experiment with a plant (NERICA4) using bagasse biochar (800°C) with four treatments (Fig. 1): no biochar application (control), surface application (0–5 cm), plow layer application (0–30 cm), and subsurface application (25–30 cm). The experiment was conducted in a glass room. The amount of applied biochar was the same among the treatments (10 t ha^{-1}). Surface irrigation was conducted every two or three days, and powdered fertilizer was applied monthly. We measured the amount of nitrate and ammonium leaching during the experiment. Nitrate leaching was reduced by 12.3% by surface application ($p<0.05$), whereas nitrate and ammonium leaching were increased by 6.4% ($p<0.05$) and 164.1% ($p<0.01$) by plow layer application (Fig. 2). The subsurface application did not alter the leaching. We estimated the soil's dry condition and found that it was weaker at a depth of 10 cm under surface application, whereas it was stronger under plow layer application (Fig. 3, left). The root length density was increased at all depths under surface application, while it was smaller at the soil surface layer under plow layer application compared to the control (Fig. 3, right). The estimated amount of adsorbed inorganic nitrogen indicated that 75% of nitrogen existed at depths of 0–30 cm under surface application, whereas more than half of it existed at depths of 30–95 cm under plow layer application (Table 1).

Our study indicated that surface application reduced nitrate leaching; the reduction in soil's dry condition and the increase in adsorbed inorganic nitrogen might explain these differences. Choosing a proper biochar application depth could contribute to mitigating nitrate leaching and possibly reducing nitrogen fertilizer use.

Authors: Hamada, K., Nakamura, S., Kuniyoshi, D. [JIRCAS]

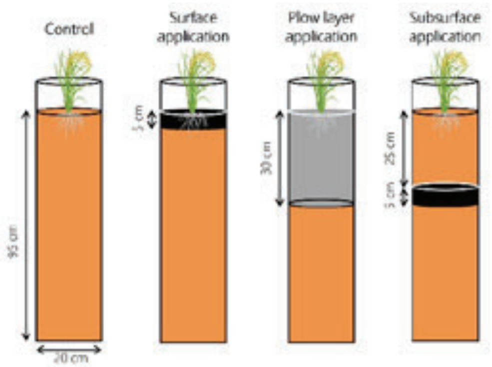


Fig. 1. Schematic of the experimental pipes
We applied four treatments with five replicates. The amount of applied biochar was the same among the treatments, but its content rate was different. Black and grey indicate high and low biochar content, respectively.

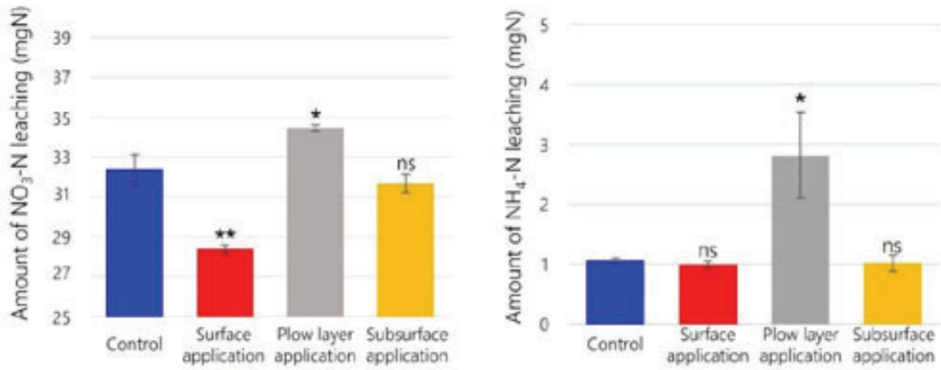


Fig. 2. Cumulative leaching amount of nitrate (left) and ammonium (right)
** and * indicate significant differences (p<0.01 and p<0.05), while ns indicates a non-significant difference compared with the control. Error bars represent the standard error.

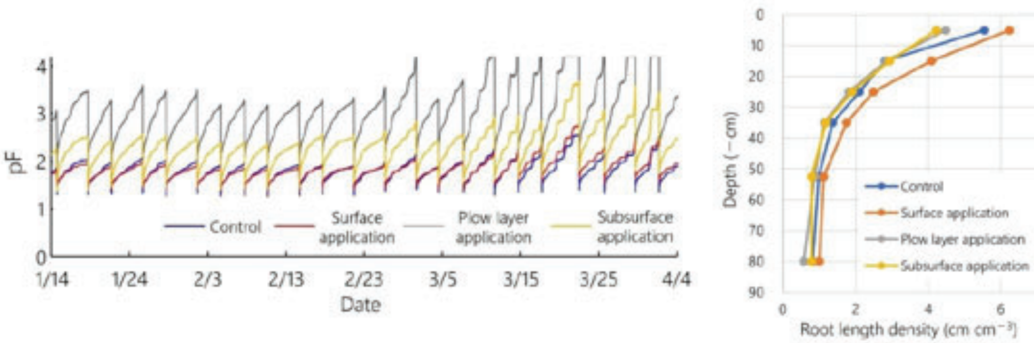


Fig. 3. Temporal change in pF (left) and distribution of root length density (right)
At pF>3, soil dryness increases, and water and nutrient absorption by roots decreases.

Table 1. Nutrient budget of inorganic nitrogen

	Control	Surface application	Plow layer application	Subsurface application
Inorganic nitrogen in soil (mg)				
0–30 cm depth				
Total	87	161	126	116
NO_3–N	17	31	12	19
NH_4–N	70	131	114	97
30–95 cm depth				
Total	27	25	38	25
NO_3–N	17	9	18	13
NH_4–N	10	16	20	12

Reference: Hamada et al. (2024) *Scientific Reports* 14: 22823.

Improving airborne LiDAR-based mangrove aboveground biomass estimation in the Philippines

Monitoring mangrove biomass is crucial for evaluating carbon storage, understanding carbon cycles, and studying climate change. Traditional estimation methods often underestimate biomass due to regional variations in species composition and tree height. LiDAR technology, which measures distances and shapes using laser light, allows for non-destructive, extensive biomass estimation. The study aimed to develop a biomass estimation formula for old-growth mangrove forests in the Philippines using national-level airborne LiDAR data and focused on improving the accuracy of biomass estimation models.

The Lorey's mean canopy height (H_m) and LiDAR relative height (RH) metrics were calculated for the old-growth mangrove forest in the Katunggan It Ibajay Ecopark (KII Ecopark) on Panay Island, Philippines (Fig. 1). The RH metrics were used to estimate H_m and above-ground biomass. Using the RH metrics, aboveground biomass was estimated in two ways: (i) Conventional method: Using the optimal RH, H_m was estimated, and then aboveground biomass was estimated using an existing formula (Suwa et al. 2021), and (ii) Developed equation: The newly developed equation directly estimates aboveground biomass using the optimal RH metrics. The relationship between H_m and the RH was verified, and then the conventional formula (above-ground biomass = $2.25H_m^{1.81}$ (Eq. 3) was applied to estimate above-ground biomass. The relative height at the 95th percentile (RH_{95}) corresponded best with H_m (R^2 = 0.79). When RH_{95} was applied to Eq. 3, above-ground biomass was underestimated in plots with high canopy height (R^2 = 0.46) (Fig. 2, left). The formula for estimating above-ground biomass using RH_{95} showed relatively high accuracy (Fig. 2, right: above-ground biomass = $0.02*RH_{95}^{3.56}$ (Eq. 4), R^2 = 0.58). The above-ground biomass map of the old-growth mangrove forest in KII Ecopark can be obtained using the developed Formula 4 (Fig. 3).

The newly developed equation is expected to enhance biomass measurement in old-growth mangrove forests, enabling extensive and correct assessments using airborne LiDAR data. This can contribute to measurement, reporting, and verification (MRV) processes, although incorporating additional variables, such as tree diameter, could further improve accuracy. The study highlights the importance of advanced methods for better understanding and management of mangrove ecosystems in the context of carbon storage and climate change.

Authors: Mandal, M.S.H., Suwa, R. [JIRCAS], Rollon, R.N., Albano, G.M.G., Cruz, A.A.A. [Univ. of the Philippines], Ono, K. [FFPRI], Primavera-Triol, Y.H. [Aklan State Univ.], Blanco, A.C. [Univ. of the Philippines], Nadaoka, K. [Tokyo Tech.; Kajima Tech. Res. Inst.]

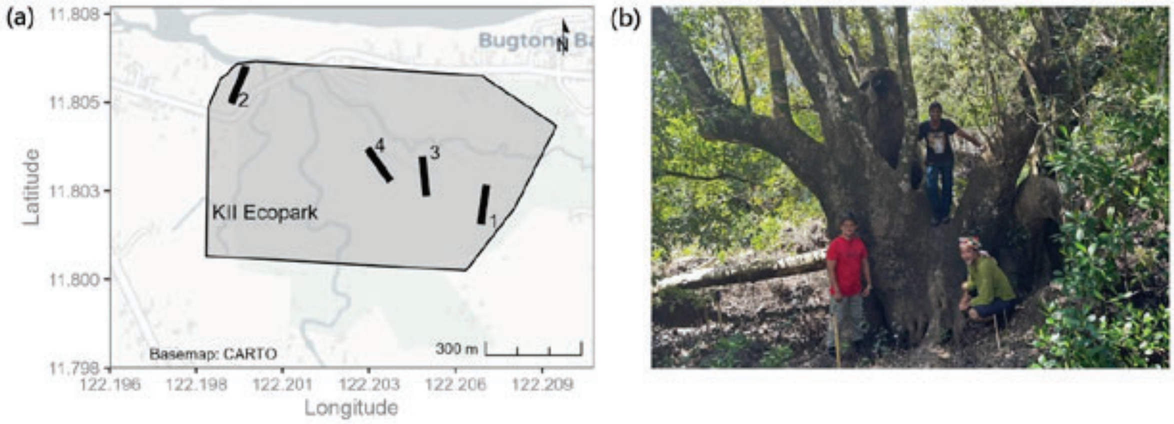


Figure 1. Katunggan It Ibajay Ecopark (KII Ecopark) on Panay Island, Philippines
(a) The location of the survey area and the transect plots (▮), with the numbers indicating the survey transect ID. (b) A very old *Avicennia rumphiana* tree in the survey area

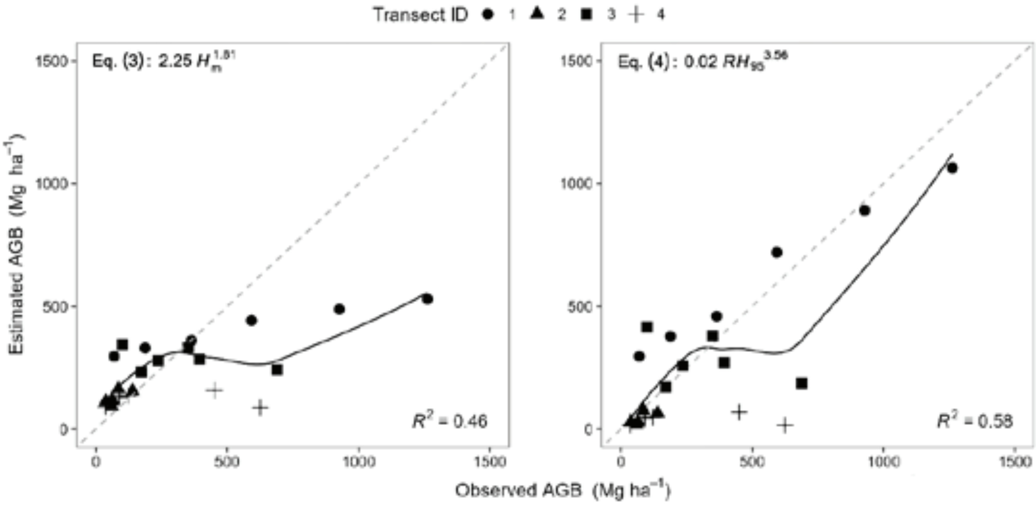


Figure 2. Relationship between observed aboveground biomass (AGB) and estimated aboveground biomass (AGB) using Eq. (3) (left) and Eq. (4) (right)
The dashed line indicates a 1:1 ratio. The solid line indicates a trend based on the Loess method.

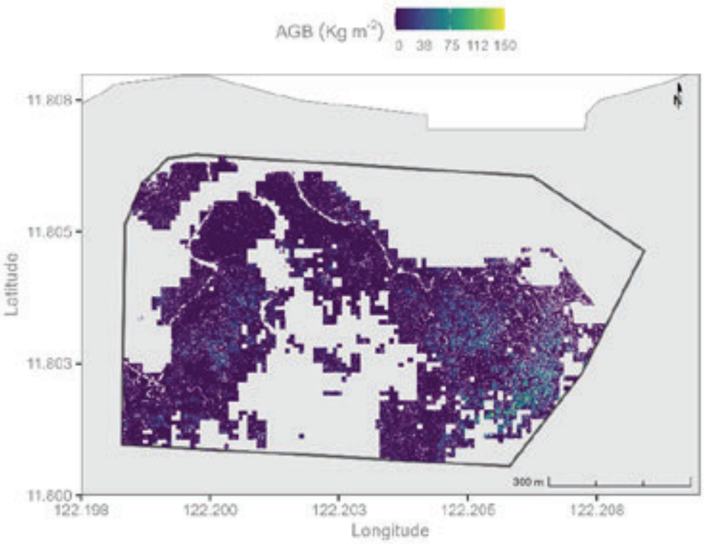


Figure 3. Aboveground biomass (AGB, kg m^{-2}) map in the KII Ecopark

Reference: Mandal et al. (2024) *Ecological Research* 40: 120–132.

The effect of improving soil salinity and pH by Cut-soilers (shallow sub-surface drainage) is high at a construction spacing of 2.5 m

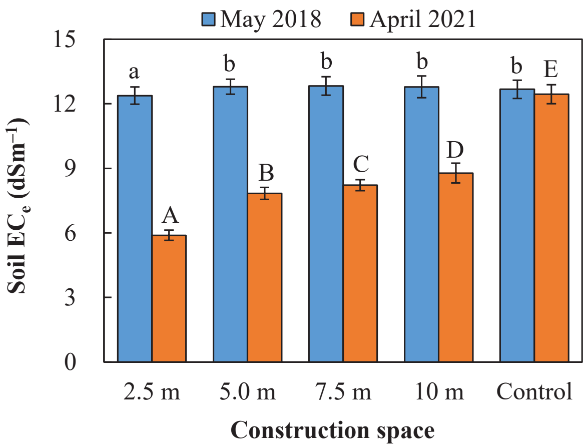
In the Indo-Gangetic Plain (IGP), salinization due to irrigation with highly saline groundwater and poor drainage in the field has been a serious problem. In addition, soil sodicity, which increases the proportion of sodium ions, is occurring. Specifically, poor drainage due to sub-surface soil sodicity is worsening. Constructing sub-surface drainage is effective in mitigating salinization, but it is difficult for farmers to implement due to substantial costs. The Cut-soiler, a tractor attachment developed in Japan, can construct shallow sub-surface drainage (40–60 cm depth) while burying crop residues and/or soil improvement agents simply by towing it with a tractor (Fig. 1) (2022 JIRCAS Research Highlights: Shallow sub-surface drainage constructed with "Cut-soiler" mitigates soil salinity). Therefore, this technology could be a sustainable countermeasure against salinization for farmers in developing countries because it is inexpensive and easy to use.

In this study, we investigated the optimal construction spacing (2.5, 5, 7.5, 10 m) that achieved the highest effectiveness with this shallow sub-surface drainage in the salinized area of the IGP. Additionally, we implemented an effective measure to address soil sodicity by applying gypsum ($CaSO_4$) at 10 t ha^{-1}. This treatment replaces the sodium ions with calcium ions, promoting the leaching of sodium. Simultaneously, we buried rice straw at 6 t ha^{-1} using this technology and verified the reduction effect in soil pH. Comparing the spacings, the reduction in soil salinity (EC_e) after 3 years of construction was highest at 2.5 m spacing (Fig. 2), and the yield of rainy season crops (pearl millet) was also highest at 2.5 m spacing (Fig. 3). On the other hand, comparing the soil pH, the reduction in soil pH after 2 years of construction was highest at the 2.5 m spacing (Fig. 4). Furthermore, the reduction in soil pH was higher the closer to the Cut-soiler construction line (Fig. 5).

This technology can be widely applied to similar salinized areas because it can be easily implemented using a tractor. To extend this method widely, a "Technical manual" focusing on shallow sub-surface drainage with Cut-soiler will be compiled. In India, this technology will be disseminated through the Indian Council of Agricultural Research (ICAR) and the Central Soil Salinity Research Institute (CSSRI). Since the construction method of shallow sub-surface drainage with Cut-soiler varies depending on the drainage situation around the field, it is necessary to check the drainage conditions in advance. The Cut-soiler is not equipped with wheels for transportation. The expected useful life of the Cut-soiler is approximately 7 years when constructing 30–50 ha per year. If there is no damage to the frame, it can be used continuously by replacing consumables.

Authors: Yadav, G., Yadav, R. K., Rai, A. K., Kumar, S., Neha [CSSRI],
Onishi, J., Kameoka, T., Matsui, K., Lee, G. [JIRCAS], Kitagawa, I. [NARO]

Fig. 1. (a) Cut-soiler, (b) Construction with Cut-soiler, and (c) Schematic diagram



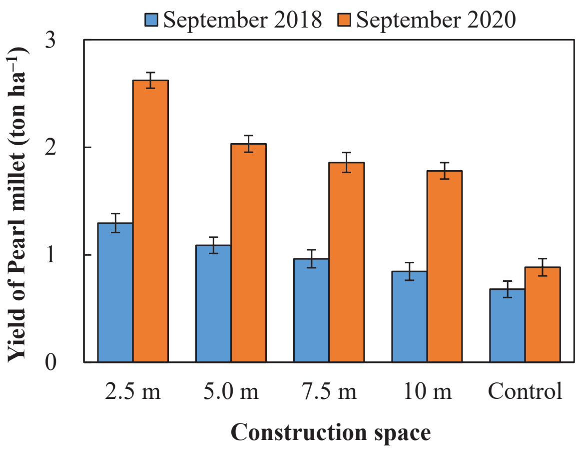
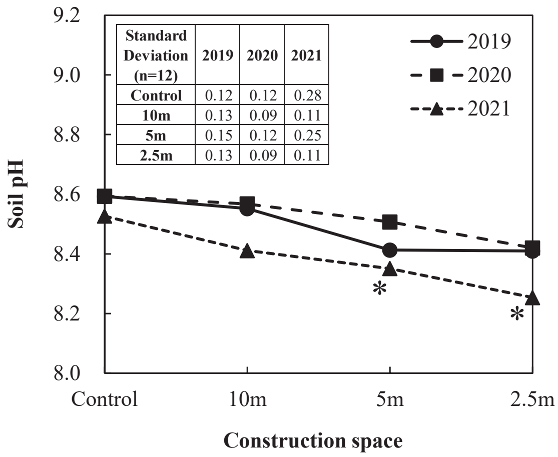


Fig. 2. Change in soil salinity

The sub-surface drainage was constructed with Cut-soiler in May 2018. There are significant differences (at the 1% level) between different symbols. Error bars are standard deviations (*n*=108).

Fig. 3. Yield of pearl millet

The sub-surface drainage was constructed with Cut-soiler in May 2018. There are significant differences (at the 1% level) between different symbols. Error bars are standard deviations (*n*=9).



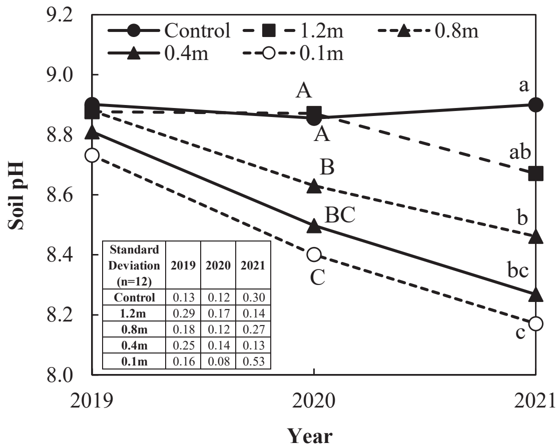


Fig. 4. Soil pH at each spacing

The sub-surface drainage was constructed with Cut-soiler in July 2019. * indicates significant difference (at the 5% level) from Control, 2019.

Fig. 5. Soil pH at each distance

The sub-surface drainage was constructed with Cut-soiler in July 2019. There are significant differences (at the 5% level) between different symbols.

References: Gajender, Y. et al. (2024) *Journal of Arid Land Studies* 34(S), 21–24;
Rajender, K.Y. et al. (2024) *Journal of Arid Land Studies* 34(S), 29–32.

Changes in location and structure of underground pipes enhance water vapor collection in plastic film tunnels

Agriculture is the largest water user, with 70% of the world's freshwater withdrawn for irrigation. Ishikawa et al. (1996) developed an "earth-air heat exchange water distillation system" that can produce freshwater by collecting water vapor in a plastic film tunnel as condensed water on the insides of the plastic film and underground pipes. Their system successfully collected 30% of the evaporated water. This study aimed to develop a simple water distillation system constructed from agricultural materials, suitable for installation in rural areas, while improving the earth-air heat exchange water distillation system to enhance water vapor collection.

Three plastic film tunnels (1.2 m wide, 0.6 m high, 8.0 m long) were built, and three types of underground pipes were embedded at 20 cm depth below ground: i) one PVC pipe with a diameter of 100 mm below the tunnel (control; Ishikawa model), ii) one PVC pipe with a diameter of 100 mm outside the tunnel (100 mm outer), and iii) four PVC pipes with diameters of 50 mm outside the tunnel (50 mm x 4 outer). Different underground pipes were selected for each tunnel and rotated for the next trials. Water tubs serving as evaporation pools were put in the tunnels, and the water in the pools was heated by solar radiation and evaporated. Hot and humid air was blown into the pipes by a fan with a solar panel, and water vapor was cooled by soil temperature around the underground pipes and condensed on the inside of the pipes. The water vapor in the tunnel was cooled by ambient air, and condensed water on the inside of the plastic film was collected by L-shaped aluminum frames placed under the plastic film on both sides of the tunnel. The collected freshwater was stored in tanks at the tail end of the tunnel (Figs. 1 and 2).

Soil temperature at the ground surface, pipe wall temperature, and air temperature in the pipes embedded outside the tunnel tended to be lower than those of the control. In particular, the pipe wall temperature of 50 mm x 4 outer was significantly lower than the control (Table 1). In the case of 50 mm x 4 outer, 12.4 L of freshwater was produced from one tunnel on a sunny day in March in Tsukuba, Ibaraki, Japan. The water vapor collection ratio, defined as the ratio of collected water volume to evaporated water volume, for the pipes of the control, 100 mm outer, and 50 mm x 4 outer was 4.3%, 11.3%, and 23.3%, respectively (shown as the orange color bar in Fig. 3). The water vapor collection ratios for the plastic films were 30.3% using the control, 27.2% using 100 mm outer, and 22.5% using 50 mm x 4 outer (shown as the blue color bar in Fig. 3). The total collection ratio for both the pipes and plastic film of 50 mm x 4 outer was 46%, which was 1.3- and 1.2-times higher compared to the control and 100 mm outer, respectively.

Authors: Ikeura, H. [JIRCAS], Fujimaki, H. [Tottori Univ.]

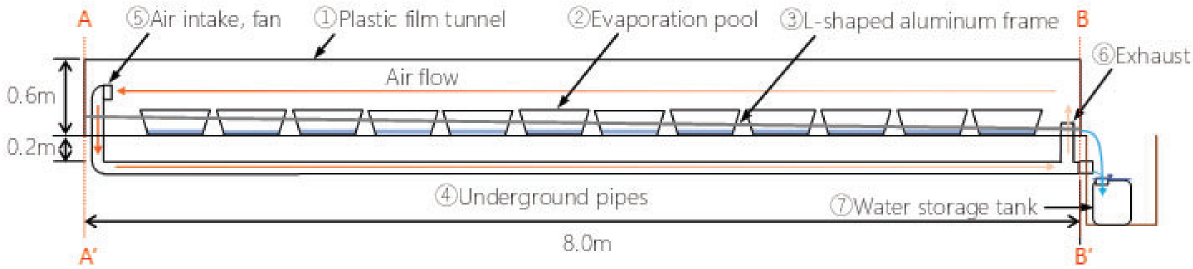


Fig. 1. Schematic of the improved earth-air heat exchange water distillation system

Sectional notations are shown as A-A′, B-B′, and the numbers ①-⑤ are common items with Fig. 2.

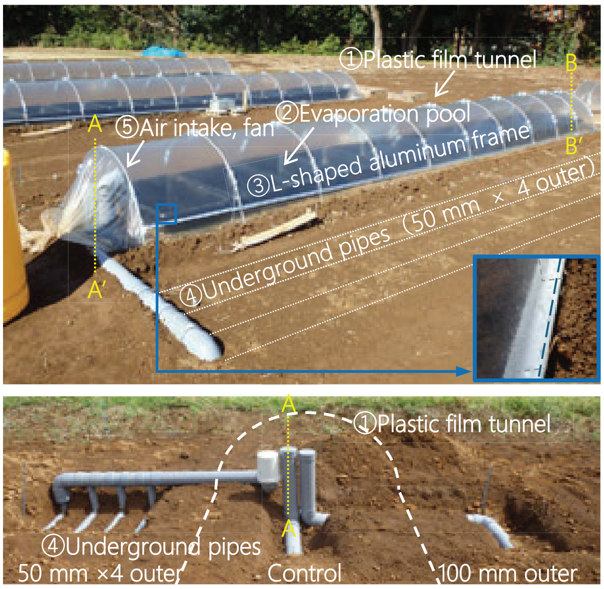


Fig. 2. Plastic film tunnel and underground pipes

Upper photo shows the structures above ground, with the blue line box showing an enlarged view of the L-shaped frame. The frame ridge, shown as a blue dashed line, is adhered to the inside of the plastic film. Lower photo shows the pipes buried underground.

Sectional notations shown as A-A′, B-B′ and the numbers ①-⑤ are common items with Fig. 1.

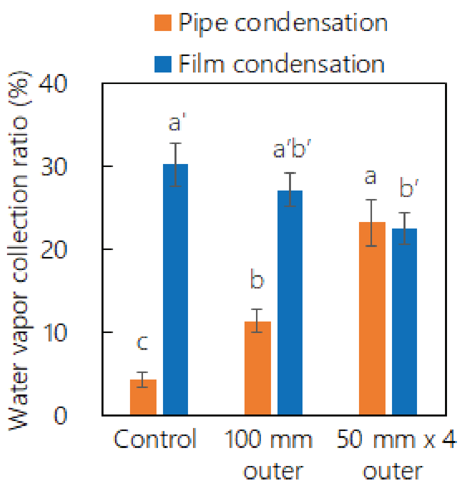


Fig. 3. Water vapor collection ratio by underground pipes and plastic film

Error bars show standard error (n=12). Significant differences were found among a-b-c and a′-b′ (p < 0.05, Tukey Kramer HSD test).

Water vapor collection ratio
= collected water volume
/ evaporated water volume.

Table 1. **Daily average temperatures of the air in the tunnel, soil, inner wall, and inner air of the underground pipes**

	Air temp. in the tunnel (°C)	Soil temp. at ground surface (°C)	Soil temp. at 10-cm depth (°C)	Pipe wall temp. at 20-cm depth (°C)	Air temp. in the pipes (°C)
Control	19.8	19.3^{a}	20.4^{a}	22.2^{a}	22.9^{a}
100 mm outer	19.5	12.6*	14.5^{b}	19.0^{ab}	19.9^{ab}
50 mm × 4 outer	19.2	11.9^{b}	14.6^{b}	18.3^{b}	19.1^{b}

n = 12 (*Lacking 4 ground surface data points for 100 mm outer.)

Significant differences were found between a and b (p < 0.05, Tukey-Kramer HSD test)

Reference: Ikeura and Fujimaki (2024) *Paddy* and *Water Environment* 23: 95–109.

Program B
Food

“Technology development towards building a new food system with improved productivity, sustainability and resilience”

Economic disparities within developing regions are widening, and needs are diversifying, including responses to increasingly complex food and nutrition issues. In the agriculture and fisheries sectors, solving food and nutritional deficiencies remains an important issue. At the same time, there are growing expectations for new initiatives, such as the qualitative improvement of nutrition, higher value-added products, and the transformation to a new food system utilizing information and communication technology (ICT) and the Internet of Things (IoT). In order to contribute to the stable production of food and improved nutrition to meet new needs in developing regions such as Asia and Africa while also taking domestic benefits into consideration, the ‘Food Program’ aims to develop crops and food processing technologies by utilizing the various characteristics of indigenous crops and advanced methods such as ICT and IoT. To maintain and strengthen the food production base, we are also working on control technologies for transboundary pests and diseases that are expanding beyond national borders, and revitalizing the fisheries industry through appropriate management of aquaculture and fishing grounds. Furthermore, for the African region, which is facing serious food and nutrition problems, we are contributing to rice production and the Coalition for African Rice Development (CARD), and developing technologies to improve agricultural productivity, sustainability, and resilience, including field crops and livestock production. To achieve our goals, we conduct the following six research projects.

[Resilient crops]

For the development of resilient crops and production technologies, we focused on the following research in FY 2024. Regarding rice, we detected loci related to the timing of glume opening. For soybean, we generated recurrently selected populations using male sterility to accumulate useful genes for multiple traits. We identified geographical differences in the pathogenicity of the soybean fungal pathogen, *Cercospora kikuchii*, in Argentina. For quinoa, using the virus-induced gene splicing (VIGS) method developed previously, we showed that epidermal bladder cells of quinoa are involved in leaf water retention. Furthermore, we obtained and published high-quality and accurate genome sequence information of quinoa line cultivated in the Andean highlands. In Bolivia, phenotypic and genomic data of local quinoa lines were obtained. We developed quinoa generation acceleration technology using viral vectors. From microorganisms isolated from quinoa, we selected a population of useful microorganisms that promote plant growth. In addition, we established a method for stabilizing, extracting, and transporting RNA from plants in the field without the use of liquid nitrogen.

[Indigenous crops and foods design]

For design-oriented crop breeding and food processing of indigenous resources to create new and diversified demands, we focused on the following research in FY 2024. We analyzed the sequences of key genes for flavonoid biosynthesis in black and white rice, which are representative of domestic and Lao rice. From the results, we suggested that functional rice breeding utilizing variation in these genes is effective for domestically produced white rice and some Laotian white rice varieties. To develop a method for producing lactic acid-fermented amazake that suppresses the growth of *Staphylococcus aureus*, a food-poisoning bacterium, and is suitable for the Southeast Asian environment, we used the heat-resistant lactic acid bacteria that we had discovered to ferment lactic acid at 45°C. Results confirmed that *S. aureus* was killed under these conditions. Ultraviolet (UV) radiation is stronger, and temperatures are lower in mountainous areas than in flatlands. We have revealed that genes involved in the accumulation of substances such as taxifolin respond to UVB and low temperatures. Furthermore, we found that it is possible to achieve both productivity and quality in black rice by optimizing phosphorus fertilizer management. In addition, with the cooperation of the Wakasa Bay Energy Research Center, which we started collaborating with in 2023, we became the first in the world to demonstrate that black rice grown in mountainous areas has a higher active oxygen scavenging ability than black rice grown in flatlands. Furthermore, as a result of evaluating the starch properties of Laotian rice genetic resources cultivated for three years in the Fukui Prefecture Agricultural Experimental Field, we found a strain that does not harden even when cooled and is less prone to senescence. These are used in domestic multipurpose rice breeding. We also developed a labor-saving, high-yield cultivation method for yam and clarified the effects of mixed cultivation with cowpea.

[Transboundary pest management]

For the development of an environment-friendly management system against transboundary plant pests based on ecological characteristics, we focused on the following research in FY 2024. In Mauritania, we discovered novel behaviors of desert locusts and implications for their management. Some females laid eggs during the extreme heat of the day, while males acted as “parasols,” playing a thermoregulatory role by helping to suppress the rise in body temperature. These mating pairs remained stationary for extended periods, suggesting that this timing could offer a valuable window for more effective pesticide application. We also found that molting occurs in inconspicuous locations such as bushes, and that the vulnerable period when the insects are immobile lasts only about 10 minutes. In north-central Vietnam, we studied rice planthoppers and their natural enemies. One key predatory bug, *Cyrtorhinus lividipennis*, was found to be highly susceptible to commonly used insecticides, limiting its use in combination with chemical control. In contrast, the wolf spider, *Pardosa pseudoannulata*, showed low susceptibility to multiple insecticides. This finding highlights the wolf spider’s potential as a component of integrated pest management (IPM) strategies, as it is likely to be compatible with insecticidal treatments. Additionally, a management analysis of rice farmers revealed that mixing multiple insecticides increases application costs without significantly improving yields, suggesting the need to develop pest control technologies using insecticides containing a single active ingredient. In the Indochina region, we assessed the pesticide susceptibility of three major natural enemies of the fall armyworm using simple methods developed in previous years. This allowed us to propose rational strategies for integrating natural enemies and insecticides. Furthermore, we investigated the extent of fall armyworm damage, government responses, and the conditions necessary for the adoption of IPM practices at the farm level.

[Ecosystem approach to aquaculture]

For the development and dissemination of sustainable aquaculture technologies in tropical areas based on the ecosystem approach, we focused on the following research in FY 2024. Flooding and the resulting mass mortality of cultured oysters are increasing in Malaysia during the rainy season. The continuous observation on both water temperature and salinity in the oyster farm using an ICT buoy and water quality sensors showed that salinity correlates well with water temperature. Using this relationship, we could predict the onset of fatal salinity conditions for the oysters through the surface water temperature at the oyster farm monitored by the ICT buoy via the internet. In addition, to improve survival rates and reduce labor for juvenile oysters, the juvenile oyster nursery tank for intermediate breeding was refined. It worked well and encouraged the growth of oysters in the tank. Since the structure of the refined nursery tank is drastically simplified from the original, it allows farmers to assemble their tanks at low cost and then operate and maintain them easily on-site. The suitability of *Hypnea* sp. (“Ibaranori”) as a potential seaweed for aquaculture was examined. Its growth rate was comparable to or greater than that of *Kappaphycus* and *Eucheuma* spp., which are currently the most widely cultivated seaweeds for carrageenan production in tropical countries. The carrageenan extracted from *Hypnea* sp. showed gel-forming properties, with different viscosity and gel strength properties than *Kappaphycus striatus*, indicating its potential as a novel aquaculture species in tropical regions through the development of suitable carrageenan products.

[Africa rice farming system]

For the development of sustainable rice cultivation and food production systems in Africa, we focused on the following research in FY 2024. In Tanzania, we showed that acrylic-resin coating improves the flow efficiency of a concrete irrigation canal by 40% over five years. The method is estimated to have an internal rate of return of 96%, assuming a five-year service life and 5 km construction length. A revised manual for water use efficiency improvement measures was published. We further improved a hydrological model to estimate both depth and duration of standing water covering 50 km^2 and refined an NDVI model to predict rice yields of rainfed lowland areas in northern Tanzania. We showed that Nerica19 carrying either the root length locus *qRL6.1* or the grain number locus *SPIKE* significantly increases rice yields under early drainage conditions at the grain filling stage. X265-*MP3*, which carries the panicle number-enhancing gene *MP3*, showed a significant increase of 19% in panicle number and 6% in grain yield compared to X265 in its first-year variety registration trial. Additionally, in Madagascar, a quantitative trait locus (QTL) derived from DJ123, known for its tolerance to excess iron stress, significantly improved the yield of IR64 in iron-toxic paddy fields. Repeated on-farm trials confirmed that dense planting enhances grain yield and profitability in low-yielding paddy fields of Sub-Saharan Africa. A randomized controlled trial (RCT) proved that a simple soil diagnostic information significantly increased both rice yields and income for lowland rice farmers in Madagascar. The application of farmyard manure (FYM) was particularly effective in phosphorus-deficient paddy soils, and its benefits were enhanced when used in combination with nitrogen fertilizers over multiple seasons. On-farm trials revealed that yield gain by P-dipping is maximized when paired with the shallow-rooting gene *qsor1*, as its roots cluster near the P-enriched hotspot at the soil surface. Cultivating *Stylosanthes guianensis* and incorporating its residues into the soil significantly increased the yield of subsequent upland rice compared to continuous upland rice cultivation. In nutrient-deficient fields in Nigeria, two wild legume accessions (TVu257 and TVu395) were found effective in improving the growth of subsequent upland rice. Analysis of panel data from Madagascar revealed that the impact of international fertilizer price spikes varied by household income level, with the most adverse effects observed among the middle-income group.

[Africa upland farming system]

For technology development to facilitate farmers’ decision-making and boost sustainable upland farming systems in Africa, we focused on the following research in FY 2024. In northern Ghana, we verified the applicability of yam variety identification technology to local varieties and conducted a workshop for technology dissemination. Through the fractionation of soil organic matter, it was found that stable mineral-associated organic carbon (MOC) accounted for 63% on average. We validated the Rothamsted Carbon model and demonstrated that carbon dynamics at the study sites can be predicted using this model. We established a mathematical optimization model for spatiotemporal optimization assuming crop rotation system. Furthermore, we developed an application compatible with smartphones to propose optimal cropping systems. We examined the formulation of total mixed rations (TMR) using available resources in northern Ghana and showed that mixing silage-prepared ingredients improved fermentation quality. For amaranth yields, it was confirmed that under chemical fertilizer application, yield did not change even when irrigation frequency was reduced. In Burkina Faso, various interventions were implemented for 1,024 farmers in 4 provinces to verify the effectiveness of the Fallow Band System (FBS) in farmers’ fields. Among those in the conditional cash transfer intervention group, 10% of farmers adopted FBS. A three-year topsoil removal trial revealed that soils with shallow effective depth (PT-pt.px) showed greater yield reduction with increasing cumulative soil erosion compared to soils with deep effective depth (Lx-fr). In addition, in PT-pt.px soils, sorghum showed a greater yield increase from fertilization than cowpea, indicating the potential for more effective soil erosion control and fertilizer management by considering soil type and crop species. We clarified that the yield stability of major upland crops in the Sudan Savanna changes depending on soil type and rainfall. The study revealed differences in the varietal effects of cowpea by rainfall and soil type, and identified the optimal cowpea varieties for each cultivation condition. We also identified the fertilizer response of major upland crops to different soil types and rainfall levels, selecting crops with high fertilizer use efficiency for each condition. Through the determination of nutritional content changes during the pod development of cowpea, the optimal harvest time for nutritional intake was identified. In addition, we created a high-resolution soil map for estimating the distribution of three dominant soil types at the farm level in the Sudan Savanna. In northern Ghana, we clarified the determinants influencing the adoption of Integrated Soil Fertility Management (ISFM) technologies by smallholder farmers. In Burkina Faso, we identified the factors contributing to the dissemination of the traditional soil conservation technology "Zaï."

Development of a cryogen-free extraction and preservation method for plant-derived RNA

Increasing the resilience of plants to environmental stress is crucial for improving crop yield. Understanding gene expression patterns provides insight into stress tolerance mechanisms and accelerates the development of high-performance crops. RNA used for gene expression analysis is unstable, and its analysis usually requires cryogens such as liquid nitrogen and dry ice. Thus, gene expression analysis in samples from developing countries with limited access to cryogens has been challenging. While companies have released RNA preservation reagents that maintain the quality of RNA in living organisms without cryogens, the effects of different sample storage conditions on overall gene expression patterns and the optimal storage conditions for maximizing RNA stability in plants have not been thoroughly investigated. In addition, the long-distance transport of extracted RNA without cryogens has also been a hurdle. Considering the application in developing countries, this study aimed to establish cryogen-free methods to transport 1) high-quality plant leaf specimens from the field to the laboratory for gene expression analysis, and 2) isolated RNA for genomics analysis.

In the newly developed "infiltration method," a commercial RNA preservation reagent is infiltrated into the apoplast (intercellular space) of a plant leaf using a syringe (Fig. 1). When comparing the expression patterns in rice leaf samples treated with the infiltration method to those simply immersed in the solution (both stored at 4°C for 5 days), the former better preserved the original RNA expression pattern obtained by freezing samples with liquid nitrogen (Fig. 2). The effectiveness of the developed infiltration method was validated in Madagascar by demonstrating that leaf samples from fields with poor plant growth exhibited significantly higher expression of phosphorus deficiency- or iron deficiency-inducible genes (Fig. 3). Thus, the use of the infiltration method allowed for detection of nutrient disorders even without the use of cryogens in a developing country. Additionally, it was found that the extracted RNA remained relatively stable (for 48 hours) when bound to a silica-based membrane compared to being in a solution (Fig. 4).

One limitation is that the infiltration method may bias salinity- or cold stress-related genes compared to freezing with liquid nitrogen, and caution should be taken when analyzing such stresses using the infiltration method. Nevertheless, the application of the infiltration method is expected to accelerate gene expression analyses in plant samples collected from fields in developing countries. The possibility of long-distance transport of RNA without cryogens offers the possibility to run genomics studies (e.g. RNA sequencing) using such samples.

Author: Ueda, Y. [JIRCAS]

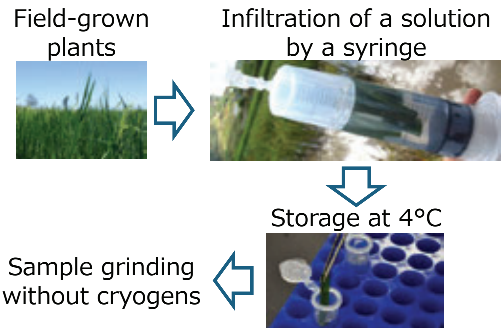


Fig. 1. Summary of the infiltration method

The leaf surface is washed briefly with a detergent solution and then infiltrated with a commercial RNA stabilization solution using a syringe. The samples are then stored at 4°C, allowing for RNA extraction without the need for cryogens.

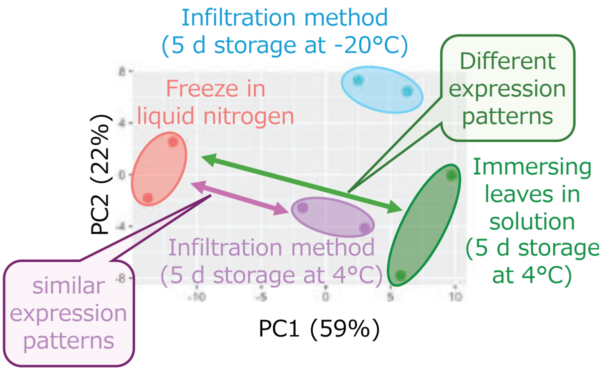


Fig. 2. Evaluation of the infiltration method through RNA sequencing

The results of principal component (PC) analysis using samples stored under different conditions are shown. Each dot represents a sample, with closely plotted samples indicating similar expression patterns. The data indicates that the infiltration method better preserves the original expression pattern compared to simply immersing leaves in the solution. In addition, the storage at 4°C is recommended over −20°C post-infiltration.

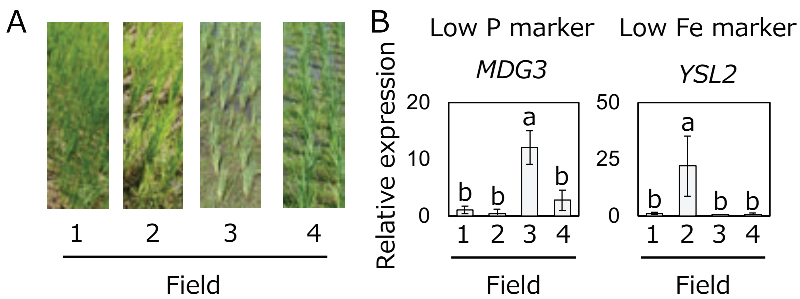


Fig. 3. Gene expression analysis using infiltration methods in Madagascar

A. The plants in 4 different fields from which leaves were harvested using the infiltration method. **B.** Expression of phosphorus (P) and iron (Fe) marker genes in the fields shown in A. Higher expression in each gene indicates that the plants suffer from a deficiency of each nutrient. Different letters indicate significant differences in expression (Tukey-Kramer post-hoc, $p < 0.05$). The data reveal that plants with pale-green leaves (field 2) and restricted tillering (field 3) suffer from P and Fe deficiencies, respectively.

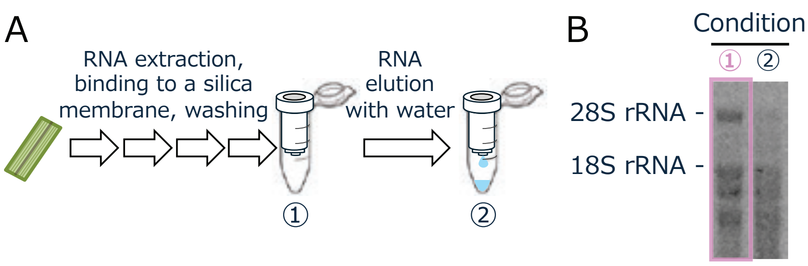


Fig. 4. Evaluation of different transportation methods for extracted RNA

A. The steps in RNA extraction. **B.** The results of electrophoresis using RNA samples bound on a silica membrane (①) and extracted with water (②) after a 48-hour transport from Madagascar to Japan on ice. Stronger bands of "28S" and "18S" rRNA, which indicate different sizes of ribosomal RNAs, suggest more intact RNA.

Reference: Ueda (2024) *Plant Methods* 20: 187.

Chromosome-level genome assemblies for highland quinoa cultivated in the Andean highlands

Quinoa is emerging as a key seed crop for global food security due to its ability to grow in marginal environments and its excellent nutritional properties. Our comprehensive genomic analyses revealed that the quinoa inbred lines can be categorized into three genetic sub-populations: the northern highland, southern highland, and lowland groups (2020 Research Highlights: Genetic and phenotypic variation of agronomic traits and salt tolerance among quinoa inbred lines). However, unlike lowland quinoa lines, no useful genomic information is available for highland quinoa lines. The high-quality genome assemblies obtained in this study will provide the basis for advancing functional genomics in quinoa to facilitate the development of climate-adapted highland quinoa breeding materials and contribute to a better understanding of the domestication process of quinoa, including its adaptation to harsh environments and its origin.

The whole genome sequences of J075 as a representative line of northern highland quinoa, and J100 as a representative line of southern highland quinoa were decoded using PacBio high-fidelity (HiFi) sequencing. Furthermore, we obtained their chromosome-level genome assemblies by integrating the HiFi sequencing reads and aligning them using the linkage map generated by dpMig-Seq. The assembled genomes of J075 and J100, each comprising 18 pseudochromosomes, exhibited sizes of 1.29 Gb and 1.32 Gb, with contig N50 values of 66.3 Mb and 12.6 Mb and scaffold N50 values of 71.2 Mb and 70.6 Mb, respectively, and were predicted to harbor 65,303 and 64,945 genes. As an example of comparative analysis of genome structure and diversity among quinoa genotypes, we selected genes homologous to the reported betalain biosynthetic gene sequences from each line and assessed genomic structural variation. Regions on chromosomes containing clusters of betalain synthesis genes *CqDODA1* and *CqCYP76AD1* were less conserved in genome structure compared to adjacent regions in each line, suggesting their association with the phenotypic differences between the dark-red highland and the light-colored lowland quinoa.

Detailed comparative analysis of genomes among representative quinoa genotypes is expected to facilitate the selection of crop design materials for developing quinoa varieties with enhanced stress tolerance, yield stability, and high nutritional value, which are critical for food security. These genomic data are publicly available via the Kazusa DNA Research Institute's "Plant GARDEN" portal.

Authors: Kobayashi, Y., Fujita, Y., Nagatoshi, Y., Fujii, K. [JIRCAS], Hirakawa, H., Shirasawa, K. [Kazusa DNA Res. Inst.], Nishimura, K. [Okayama Univ.], Oros, R. [PROINPA], Almanza, G.R. [Universidad Mayor de San Andres], Yasui, Y. [Kyoto Univ.]

Table 1. Genome assembly statistics of Northern and Southern highland quinoa lines

	Northern highland J075	Southern highland J100
Genome size (Gb)	1.29	1.32
Number of Genes	65,303	64,945
N50 (Mb) *	71.2	70.6
BUSCO (%)†	99.2	99.1
LAI score‡	17.40	17.75

*The N50 value is a statistical measure that reflects the contiguity and overall quality of an assembly. The higher the N50, the longer the average contiguous sequences in the assembly.

†The BUSCO measures genome assembly completeness by checking for the presence of essential, single-copy genes from the embryophyta dataset.

‡The LAI measures how effectively a genome assembly reconstructs LTR retrotransposons—higher scores reflect more complete and continuous assemblies of these repetitive regions.

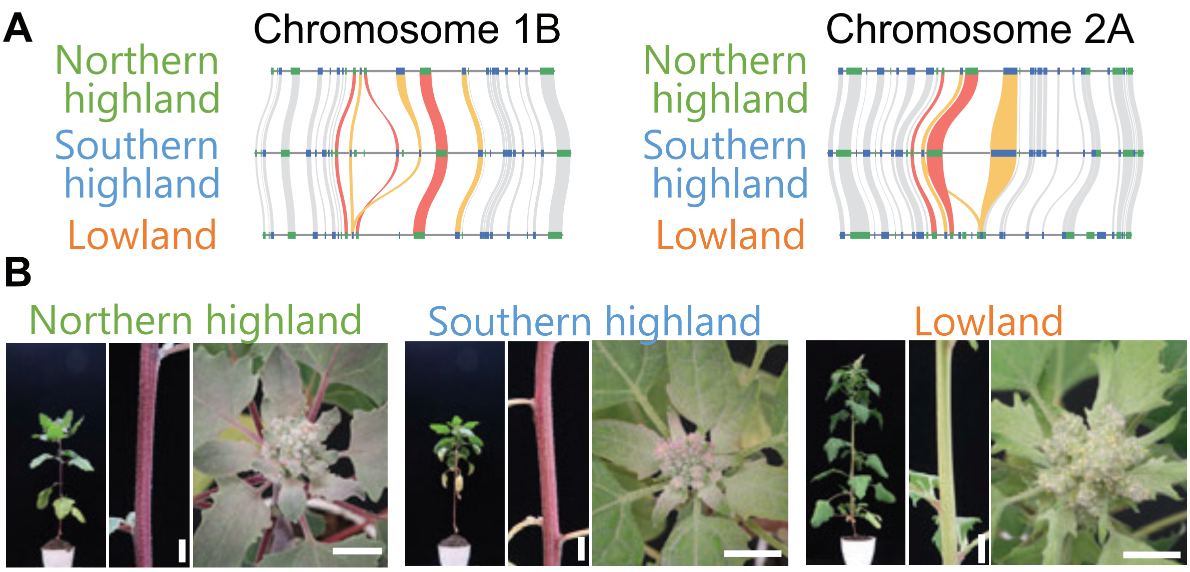


Fig. 1. Genomic structure of betalain biosynthesis gene clusters and plant color phenotypes in representative quinoa lines

(A) Structural conservation of the regions encompassing the betacyanin biosynthesis gene cluster on chromosomes 1B and 2A. The betalain biosynthesis genes, *CqDODA1* and *CqCYP76AD1*, are connected by red and orange lines, respectively, across quinoa genotypes.

(B) Phenotypes of stem and shoot apex colors in northern and southern highland and lowland inbred lines after 56 days of growth. Bars indicate 1 cm.

Reference: Kobayashi et al. (2024) *Frontiers in Plant Science* 15: 1434388. © The Author(s) 2024

The table and figure are modified from Kobayashi et al. (2024).

Enhancing yam yield through strategic planting: a climate-resilient approach

White Guinea yam (hereafter referred to as yam) is a major crop widely cultivated in the Guinea savanna region of West Africa, requiring 8 to 10 months from planting to harvest. The timing of the rainy season's onset and end is crucial for shoot growth and tuber enlargement. However, climate change is expected to shorten the rainy season in this region, potentially reducing yam yields by 33% by 2050. Adjusting the planting time of yam seed tubers has been proposed as a promising adaptation strategy, but its effectiveness remains unclear. Typically, yam is planted about one month after the rainy season starts to avoid drought stress during early growth. If climate change delays the onset of rainfall, postponing the planting period may cause the crop's late growth stages to coincide with the dry season, exposing it to drought stress and reducing yields. While *Dioscorea alata* (water yam) initiates tuber bulking based on photoperiod rather than planting date, little is known about the photoperiodic response of White Guinea yam. This study evaluates the impact of planting time on yam yield through on-farm trials in Nigeria, the world's largest yam-producing country.

Field trials examined three planting dates: early planting (at the beginning of the rainy season), normal planting (one month later), and late planting (two months later). The results showed that early planting led to harvest occurring about 90 days earlier than normal planting, with a 21% yield increase (Fig. 1). Tuber enlargement was determined by the number of days after planting rather than by calendar date, with minimal influence from photoperiod. Earlier planting advanced tuber bulking, allowing completion within the rainy season when soil moisture was sufficient (Fig. 2). The relatively low rainfall at the beginning of the rainy season had little effect on shoot growth or yield. In contrast, delayed planting caused tuber bulking to overlap with the dry season, significantly reducing yield due to drought stress. These findings highlight the risks associated with late planting under shifting rainfall patterns.

This study provides essential insights for optimizing yam cultivation systems under future climate conditions. Early planting can increase yield and mitigate the negative effects of rainfall variability, but some varieties exhibit unstable sprouting, necessitating the development of improved varieties and cultivation techniques. Additionally, extremely low rainfall at the beginning of the rainy season may delay shoot growth, increasing production risks. Further research is needed to refine planting strategies that ensure stable yields in response to changing climatic conditions.

Authors: Iseki, K. [JIRCAS], Olaleye, O., Matsumoto, R. [IITA]

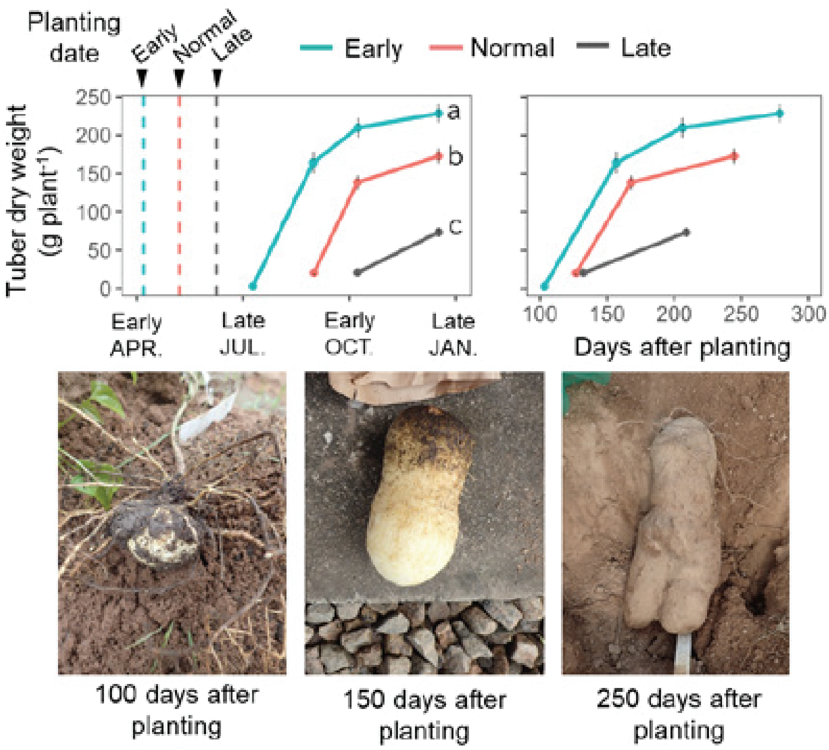


Fig. 1. Effect of planting time on tuber bulking growth

Data represent the average results from a two-year cultivation trial (2019–2020) conducted at the experimental field of the International Institute of Tropical Agriculture (IITA) in Nigeria, using two yam genotypes. Each sampling included four plants with three replications. Vertical bars indicate standard errors (n=48). The vertical lines in the figure represent planting dates. Different letters indicate significant differences in tuber yield at harvest (p < 0.01). The photos show representative tubers under normal planting conditions.

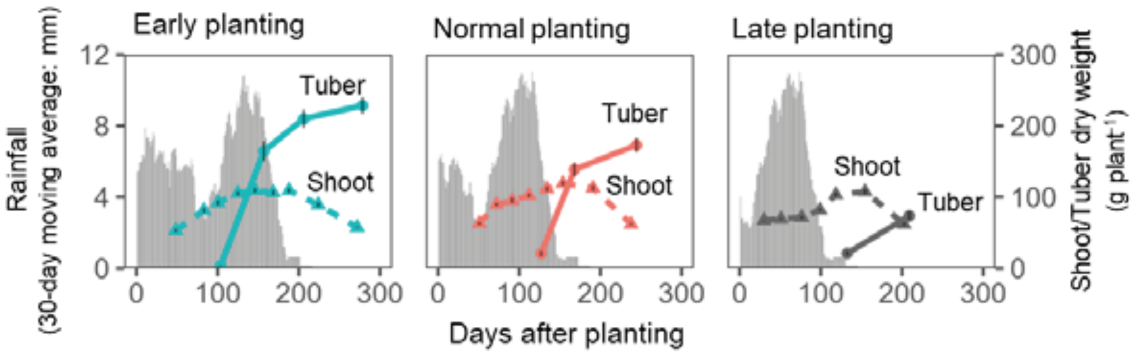


Fig. 2. Rainfall differences by planting time

The gray bars represent the 30-day moving average of rainfall over 300 days after planting, averaged over two years. The dashed line indicates changes in shoot dry weight, while the solid line represents changes in tuber dry weight (mean ± standard error, n=48). Early-season planting allows tuber bulking to be mostly completed within the rainy season. As planting is delayed, the amount of rainfall at the onset of tuber bulking decreases, leading to reduced tuber growth and a significant decline in yield.

Reference: Iseki et al. (2024) *Plant Production Science* 27: 212-220.

Organization and cost requirements of government-recommended fall armyworm control measures in Indochina countries

The fall armyworm (FAW), *Spodoptera frugiperda*, a polyphagous pest native to the Americas and known for causing significant damage to maize crops, was first detected in West Africa in 2016 and was reported in Southeast Asia by 2019. However, there is still room for a systematic organization of information on the FAW management strategies of ASEAN governments, including their feasibility for adoption at the farm level. This study categorizes FAW control measures recommended by governments and assesses their alignment with practices adopted by farmers in the Indochina region, including Myanmar, Thailand, Laos, Cambodia, and Vietnam. The findings aim to provide critical insights to support the development and dissemination of integrated pest management (IPM)-oriented FAW control technologies.

FAW control measures promoted by governments for farmers include brochures, websites, and social media in local languages. While many countries recommended chemical pesticides such as emamectin benzoate, concerns about resistance have led to the promotion of resistance management and biological controls, including microbial agents and natural enemies (Table 1). A survey of 127 feed maize farmers in Thailand in September 2021 revealed that foliar application of chemical pesticides was the dominant FAW control method, with no farmers reporting the use of seed treatments or natural enemies. From October 2022 to March 2023, interviews with 14 feed maize farmers in the Indochina region were conducted to analyze production costs for individual operations. Across various countries, pest prevention and control costs, including application and opportunity costs, accounted for less than 5% of total production costs for most farmers (Fig. 1). The foliar application of emamectin benzoate was prevalent, with material costs averaging $9/ha and application costs $5/ha, indicating relatively low expenses.

To encourage the adoption of chemical insecticide alternatives recommended by national governments, their costs must not become significantly higher than those of foliar applications of emamectin benzoate. According to our survey results and prior studies, seed treatments and the release of natural enemies show potential as cost-effective measures, warranting further investigation. However, the limited sample size of farmer interviews in this study highlights the need for broader surveys to draw more generalizable conclusions, particularly regarding specific figures such as the cost of emamectin benzoate.

Authors: Kusano, E., Kobori, Y. [JIRCAS]

Table 1. FAW control measures recommended by three or more Indochina countries

Method	Description	Country
Sampling and monitoring		
Insect traps	Pheromone trap; light trap; sweet-sour bait trap	MTC
Chemical control		
Recommended active ingredients	Emamectin benzoate (MTLCV); indoxacarb (MTLCV); chlorantraniliprole (MTLC); flubendiamide (MTLC); spinetoram (TLV); methoxyfenozide + spinetoram (TL); chlorfenapyr (TL); lufenuron (TV)	MTLCV
Application		
- Seed treatment	Cyantraniliprole; cyantraniliprole + thiamethoxam	TLV
Insecticide resistance management (IRM)	Alternate use of insecticides with different active ingredients to avoid resistance evolution in pests; switch chemical groups every 30 days	MTLV
Biological control		
Insect natural enemies		
- Egg parasitoids	*Trichogramma* spp.	MTV
- Predators	Earwigs; predatory stink bugs; assassin bugs; ladybugs	TCV
Pathogens		
- Bacteria	*Bacillus thuringiensis* var. *aizawai* or *kurstaki*	MTLV
Conservative biological control	No tillage, retain crop residues, and perform crop rotation to encourage beneficial insects; restrict use of chemical pesticides	MTV
Cultural and interference methods		
Agronomic practices		
- Weeding	Eliminate grassy weeds	MCV
Other methods		
Hand picking	Twice a week when FAW oviposition is heavy, and after that at weekly or fortnightly intervals	MTV

Selected recommended techniques from the six categories of measures, including only those recommended by three or more countries. Country abbreviations: “M” = Myanmar, “T” = Thailand, “L” = Laos, “C” = Cambodia, “V” = Vietnam. In the chemical control category, the names of countries recommending each specific active ingredient are listed.

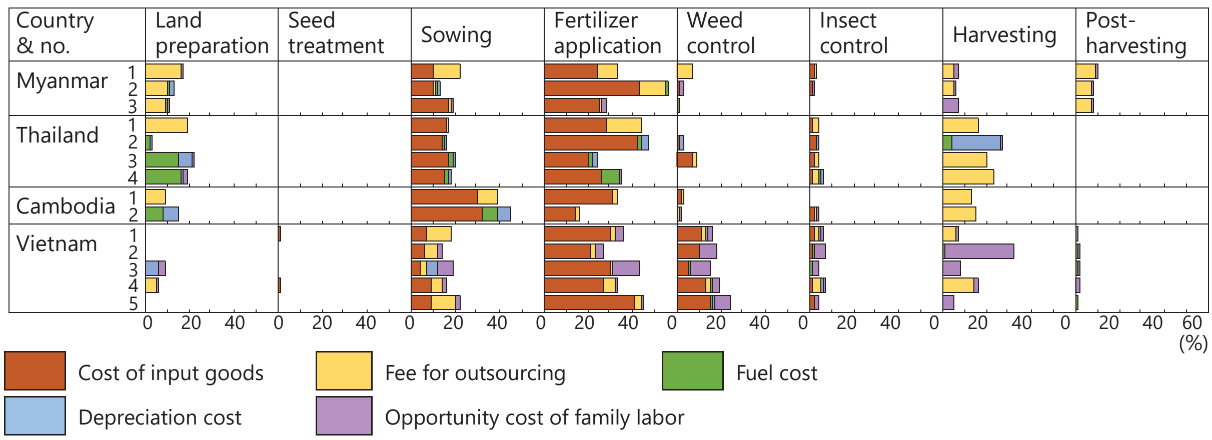


Fig. 1. Proportion of production costs for each maize production stage, wet season, 2022

The horizontal axis is labeled in 10% intervals, with all categories capped at a maximum of 60%. “Insect control” denotes foliar chemical insecticide treatment. “Post-harvesting” includes de-husking, threshing, drying, and transportation of seeds from the field to the market. “Disease prevention and curing” was not included due to zero responses in the survey. Interviews were also conducted in Laos; however, no valid responses were obtained.

Reference: Kusano et al. (2025) *Front Insect Sci* 4: 1455585.

Dense planting enhances grain yield and profitability in low-yielding paddy fields of Sub-Saharan Africa

Rice yields in Sub-Saharan Africa (SSA) average 2.1 t ha^{-1}, which is significantly lower than in other regions. Many smallholder farmers in SSA face economic constraints that limit their access to essential resources for improving yields, such as irrigation facilities, chemical fertilizers, and high-quality seeds. Optimizing planting density is a technique that smallholder farmers can implement on their own without these external inputs.

The effects of planting density have been extensively studied in irrigated rice fields with relatively high yield levels exceeding 5 t ha^{-1}. However, no experimental studies have systematically examined how variations in planting density impact rice yields in low-yielding paddy fields (<5 t ha^{-1}) commonly found in SSA.

This study was conducted in Madagascar, where low-yielding paddy fields are widespread. We examined the effects of two planting density treatments: the standard planting density of 25–26.7 hills m^{-2} (*Standard*) and a doubled density of 50–53.3 hills m^{-2} (*Dense*) using a common variety (X265) in a range of 38 environmental conditions. Additionally, based on household surveys of 356 farmers across 60 villages, we estimated the economic benefits of optimizing planting density by calculating the costs associated with seeds and labor, as well as the revenue gains from increased yields.

The results demonstrated that the dense planting had significantly and consistently higher yields than standard planting by 0.4 t ha^{-1} in the yield range of 1.8 and 4.6 t ha^{-1} while no advantage was detected when the yield was high at 5.5 t ha^{-1} or extremely low at < 1.3 t ha^{-1} (Fig. 1). In the yield range of 1.8 and 4.6 t ha^{-1}, dense planting boosted initial light interception (Fig. 2), and the cumulative light interception from transplanting to maturity was closely correlated with the grain yield (Fig. 3). A household survey identified that the added seed and labor costs for doubling transplanting density from *Standard* to *Dense* were 58,000–62,000 MGA ha^{-1} and 66,000–71,000 MGA ha^{-1}, respectively (Table 1). The additional benefit from the yield gain of 0.4 t ha^{-1} was estimated at 441,000 MGA ha^{-1}, which exceeded 3 times the sum of added seed and labor costs for doubling planting densities. The study provided a practical and impactful strategy for increasing rice yields of smallholder farmers in SSA.

Authors: Tsujimoto, Y., Ozaki, R. [JIRCAS], Andrianary, B.H., Rakotonindrina, H., Ramifehiarivo, N. [University of Antananarivo]

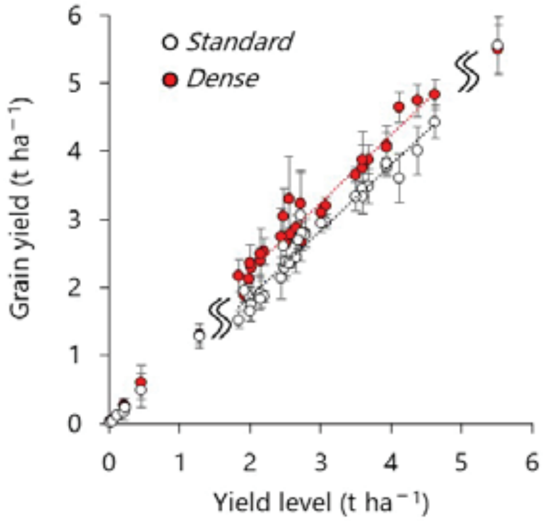


Fig. 1. Effect of transplanting density on grain yield under a range of yield levels

The yield level is the mean yield of two transplanting density treatments. The effect of transplanting density is significant with no interaction of environments in the yield range of 1.8 and 4.6 t ha^{-1} (n=30), but not significant in the other environments (n=8). Errors bars represent the standard error of the replicates.

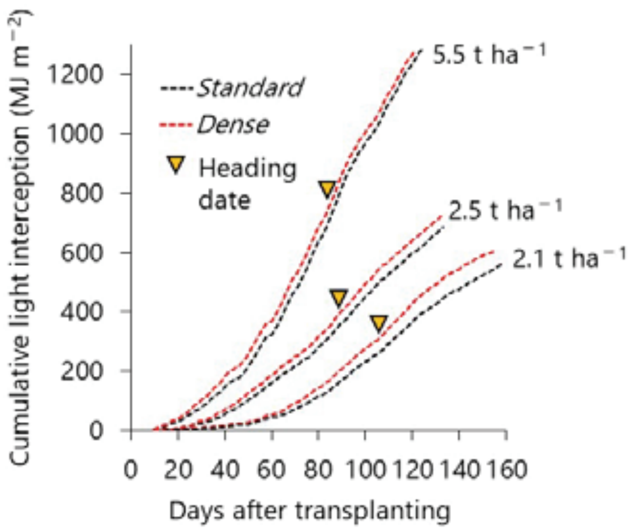


Fig. 2. Cumulative light interception at different yield levels

Cumulative light interception was determined by summing the daily intercepted radiation, which was calculated as the product of daily canopy coverage and solar radiation. The daily canopy coverage was estimated using weekly captured canopy images and the image analysis software ImageJ.

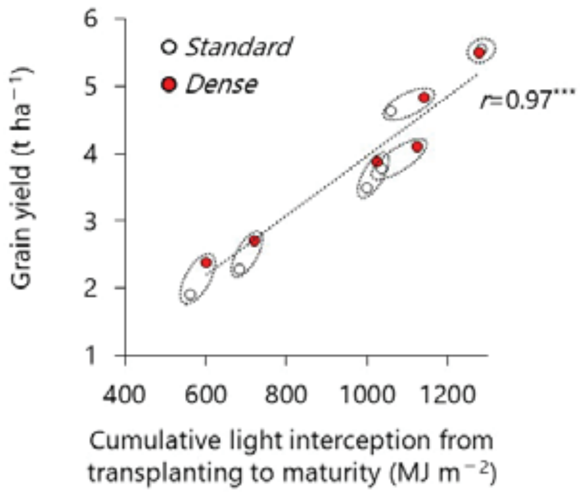


Fig. 3. Correlation between cumulative light interception and grain yield

*** Significant at p<0.001.

Table 1. Estimated costs of seeds and transplanting labor for the standard and dense planting treatments

	seed cost (10^3MGA ha^{-1})	labor cost for transplanting (10^3MGA ha^{-1})
Farmer*	106	120
Standard	58~62	66~71
Dense	116~124	132~142

*Mean of 356 farmers across 3 years. The costs of seeds and transplanting labor were estimated for the standard and dense planting treatments assuming that these costs increase or decrease in direct proportion to planting density. The average planting density of farmers was 45.2 hills m^{-2}.

Reference: Andrianary et al. (2024) *Field Crops Res.* 318: 109601.

Simple soil diagnostic information increases lowland rice yields and income of smallholder farmers in Madagascar

In sub-Saharan Africa, where farmers face low purchasing power and high spatial variability in soil fertility, targeting fertilizer application to responsive plots is crucial to improve agricultural productivity and income. However, the use of soil diagnostic information remains limited due to the complexity and high cost of generating such data, which involves assessing multiple soil characteristics. Few experimental studies have empirically evaluated the impact of providing soil diagnostic information on farmers' fertilizer use and income. This study focuses on the central highlands of Madagascar, where fertilizer use is low compared to other SSA countries and soil phosphorus deficiency is a major constraint on agricultural productivity. Through a socioeconomic experiment, this study examines the impact of providing smallholder farmers with simple diagnostic information based solely on soil phosphorus content on their fertilizer use, productivity, and income.

In our experiment, soil composites were collected from the focal lowland rice plots of randomly selected 70 households across 10 villages. Oxalate-extractable phosphorus content was analyzed to determine whether the effectiveness of nitrogen application would be high or low. Only 35 households in the treatment group received this binary information before the cultivation period began (Fig. 1). The treatment and control groups were randomly assigned, with no prior differences observed between them in terms of income, plot size, lowland rice yield, chemical fertilizer use, or the proportion of plots where nitrogen application effectiveness was classified as high (Table 1). The results demonstrated that, at the plot level, receiving information that nitrogen application effectiveness was high led to a higher nitrogen application rate and lowland rice yield by 34.1 kg ha^{-1} (76%) and 1.1 t ha^{-1} (24%), respectively, compared to the plots of control group households, where no diagnostic information was provided (Fig. 2). In terms of household-level impacts, the receipt of the binary diagnostic information led to a 0.6 t ha^{-1} (16%) higher rice yield and 434,000 MGA ha^{-1} (24%) higher income for households in the treatment group compared to those in the control group, while the nitrogen application rate did not show a significant difference (Fig. 3).

This study provided insights into policy design to promote efficient fertilizer management, thereby improving farm productivity and income, especially in regions where farmers' purchasing power is limited and soil fertility varies from field to field.

Authors: Ozaki, R., Tsujimoto, Y. [JIRCAS],
Andriamananjara, A., Rakotonindrina, H. [University of Antananarivo], Sakurai, T. [Tokyo Univ.],

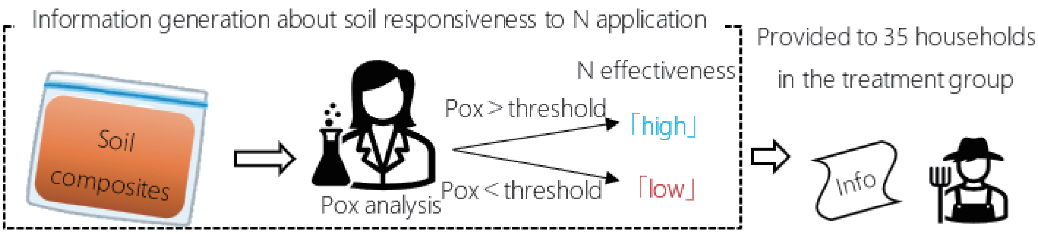


Fig. 1. Process of information generation and provision

Oxalate-extractable phosphorus (Pox) of surface soil was analyzed. Following Asai et al. (2020) *Plant Prod. Sci.* 24 (4): 481–489, N application effectiveness was considered "high" if Pox exceeded 100 ppm, and "low" otherwise. In villages where phosphorus absorption capacity was high due to volcanic ash soil, the threshold was 300 ppm. To prevent differences in conditions and the burden of procuring fertilizer from influencing the results, 5 kg of urea was provided.

Table 1. Situation of target farmers before intervention

	Treatment	Control
1. Household size	5.1	5.3
2. Years of education of household head	5.7	6.3
3. Household income (10^3 MGA)*	638.0	628.7
4. Total size of rice plot including upland rice (ha)	0.61	0.45
5. Size of rice plot subset to soil analysis (ha)	0.17	0.14
6. Yield of the rice plot in the previous year (t ha^{-1})	4.3	4.5
7. N application rate of the rice plot in the previous year (kg ha^{-1})	14.1	13.3
8. Percentage of "high" plots in nitrogen application effectiveness (%)	28.6	34.3

Differences between the two groups were tested using a *t*-test (1–7) and Fisher's exact test (variable 8). No significant differences were found. *Income was calculated as the value of household assets. N application rate was calculated based on the N content of the chemical fertilizer used. If no fertilizer was used, it was recoded as 0 if none was applied (same calculation for Fig. 2 and Fig. 3).

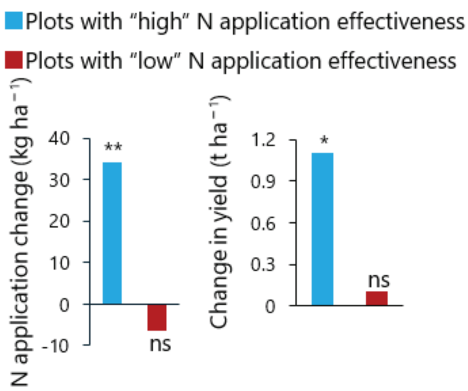


Fig. 2. Impacts of information on N application and yield of the target lowland rice plots

** and * denote p<0.05 and p<0.10, respectively. ns denotes no significance. Changes were estimated as regression coefficients comparing with target plots of the control group.

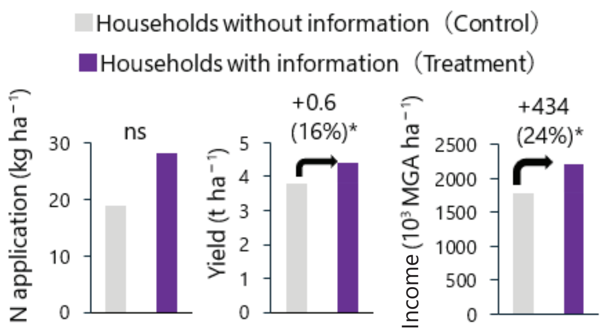


Fig. 3. Impacts of information on N application, yield, and income of the target plots

* and ns denote p<0.10 and no significance, respectively. Income was calculated by subtracting costs of seed, hired labor, fertilizers, and chemicals from the value of products, and converted to per hectare.

Reference: Ozaki et al. (2024) *Agriculture & Food Security* 13: 45.

A quantitative locus, *MP3*, which increases panicle number, enhances grain yield in Hokuriku 193, the highest-yielding rice cultivar for livestock in Japan

In recent years, agriculture and livestock in Japan have become increasingly challenging due to global warming as well as rising fertilizer and feed prices caused by changes in international situations. Under these circumstances, the use of highly productive rice is a possible strategy to stabilize farmers' production and profits. Previously, we identified a quantitative locus, *MP3*, whose Koshihikari allele increased panicle number in the genetic background of *indica* cultivars. A near-isogenic line (NIL) carrying the Koshihikari allele in the genetic background of the high-yielding *indica* cultivar Takanari increased panicle and spikelet number, and enhanced grain yield under an elevated atmospheric CO_2 environment. However, the NIL did not increase grain yield under an ambient CO_2 environment, probably due to its insufficient photosynthetic capacity. On the other hand, another Japanese *indica* cultivar Hokuriku 193, which recorded Japan's highest yield of 13 t ha^{-1}, may have the potential to enhance grain yield with *MP3* under ambient CO_2 environments because it may have surplus photosynthetic ability. The purpose of this study is to develop another NIL carrying *MP3* in the Hokuriku 193 genetic background, and elucidate whether *MP3* contributes to enhancing grain yield in the Hokuriku 193 genetic background under different nitrogen fertilizer applications.

We can see that Hokuriku 193-*MP3*, developed from multiple backcrossing of Koshihikari with Hokuriku 193 (Fig. 1A), shows more matured panicles compared to Hokuriku 193 (Fig. 1B). Hokuriku 193-*MP3* increases panicle number by 21–28% (Fig. 2A) and spikelet number by 22–23% (Fig. 2B) irrespective of nitrogen applications. Then, it enhances grain yield by 6%, from 9.7 t ha^{-1} to 10.3 t ha^{-1} with nitrogen application, and by 8%, from 7.7 t ha^{-1} to 8.4 t ha^{-1} without nitrogen application compared to Hokuriku 193 (Fig. 2C). Non-structural carbohydrate (NSC) content in stems is dramatically decreased in Hokuriku 193-*MP3* compared to Hokuriku 193 during the initial 2 weeks after heading (Fig. 3), suggesting that more NSC is translocated to panicles in Hokuriku 193-*MP3* for promoting the growth of endosperm cells. The percentage of empty spikelets (weighing 6 mg or less) in a panicle is 11% in both Hokuriku 193 and Hokuriku 193-*MP3* (Fig. 4), suggesting that Hokuriku 193-*MP3* has surplus photosynthetic and translocation abilities that can fill the *MP3*-increased spikelets.

Since Hokuriku 193-*MP3* enhances grain yield even with low nitrogen application, the use of Hokuriku 193-*MP3* is expected to contribute to stable rice production for farmers under rising fertilizer prices. Moreover, *MP3* is expected to further improve the yield potential of world *indica* cultivars with high photosynthetic ability equivalent to Hokuriku 193.

Authors: Takai, T., Oo A.Z. [JIRCAS], Nakano, H. [NARO]

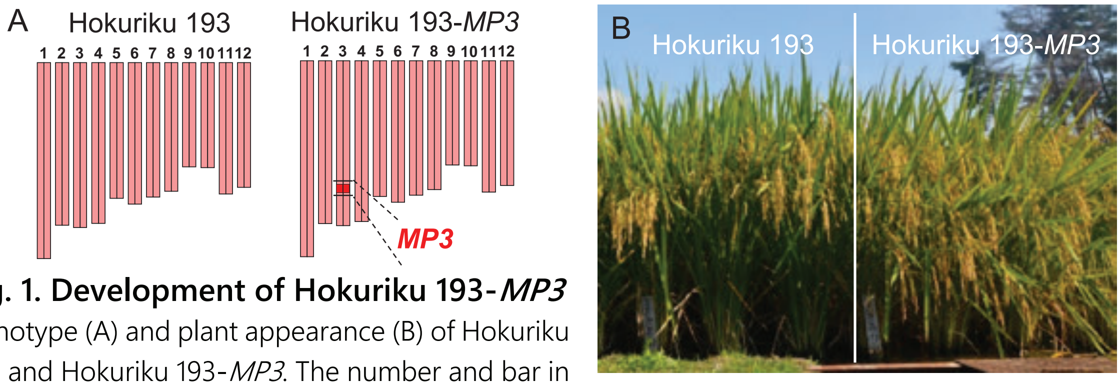


Fig. 1. Development of Hokuriku 193-*MP3*

Genotype (A) and plant appearance (B) of Hokuriku 193 and Hokuriku 193-*MP3*. The number and bar in (A) indicate chromosome number and length, respectively.

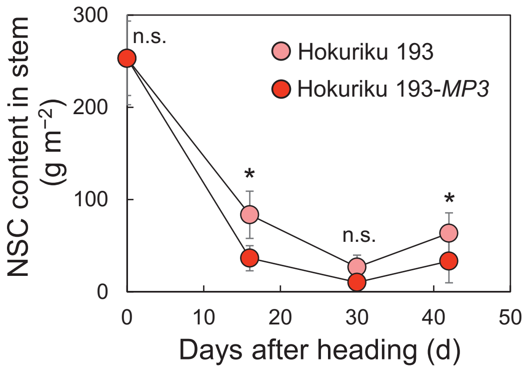


Fig. 3. Comparison of non-structural carbohydrate (NSC) content in stem after heading between Hokuriku 193 and Hokuriku 193-*MP3*

n.s. and * show non-significance and significance at 5% levels by ANOVA.

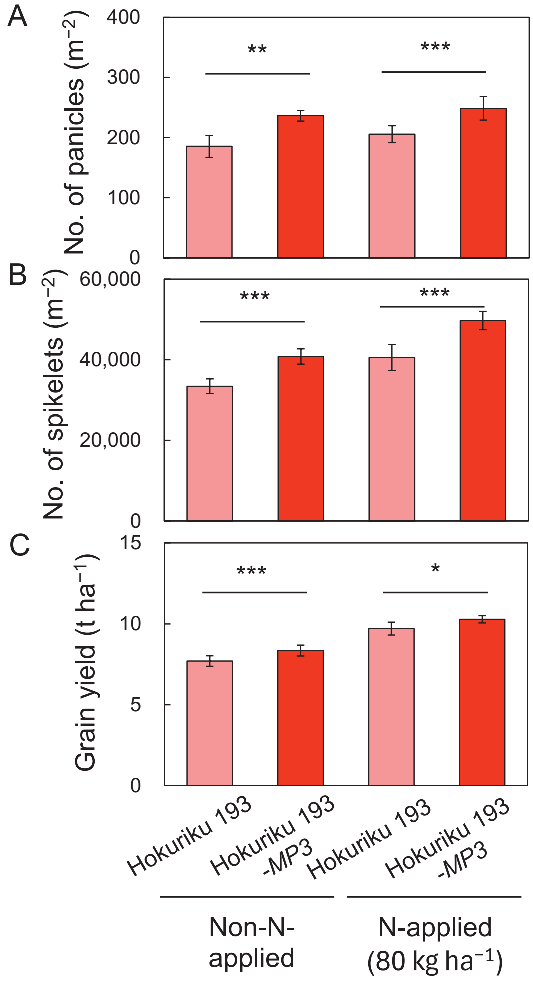


Fig. 2. Comparisons of panicle number (A), spikelet number (B), and grain yield (C) between Hokuriku 193 and Hokuriku 193-*MP3* with and without nitrogen (N) applications

*, **, and *** show significance at 5%, 1%, and 0.1% levels, respectively, by ANOVA.

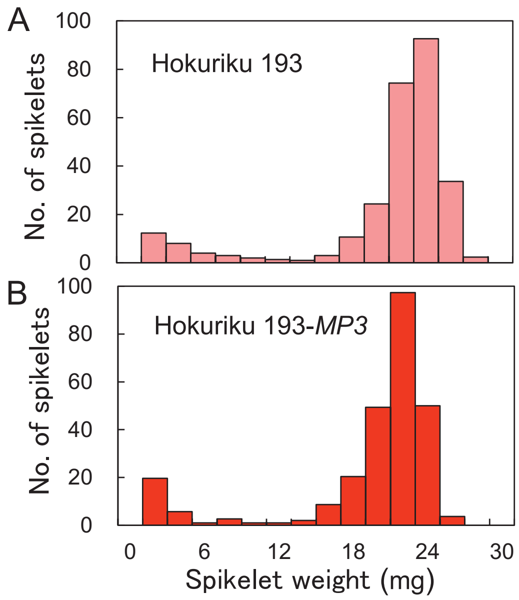


Fig. 4. Distribution of spikelet weight in a matured panicle for Hokuriku 193 and Hokuriku 193-*MP3*

Reference: Takai et al. (2024) *Field Crops Research* 318: 109566.

Enhancing leguminous crop production in semi-arid regions with low-grade phosphate rock as an affordable fertilizer alternative

Phosphorus deficiency in semi-arid tropical soils is a major limitation to food production, causing chronic poverty among smallholder farmers. Chemical fertilizers, which are essential to address this deficiency, are often too costly for farmers in many developing countries, and the recent rise in fertilizer prices has worsened this issue. Low-grade phosphate rocks (Fig. 1), which are rich in impurities and contain lower phosphorus content, are often underutilized. Ground low-grade phosphate rock (referred to as phosphate rock) can serve as a low-cost alternative to chemical phosphorus fertilizers. While phosphate rock's effectiveness has been proven in rice cultivation, its impact on dryland crops is less understood. Leguminous crops, with their ability to fix nitrogen symbiotically and release organic acids that acidify the soil, may be more efficient at utilizing the insoluble phosphorus in phosphate rock. This study aimed to determine the suitability of phosphate rock for five leguminous crops (cowpea, groundnut, bambara nut, soybean, and mung bean) grown in two dominant soil types (Lixisols and Plinthosols) in the Sudan savanna.

Under typical rainfall conditions in the West African dry savanna, applying low-grade phosphate rock from Burkina Faso resulted in similar effects to chemical phosphorus fertilizers for cowpea, groundnut, and soybean (Fig. 2). Among these, cowpea and groundnut showed the highest absolute yields, while soybean, although yielding less overall, exhibited the highest yield increase. The type of soil also affected the results. Lixisols, being more nutrient-rich, produced higher yields than Plinthosols. However, the higher moisture retention in Lixisols led to excessive moisture stress, which reduced the effectiveness of the fertilizer. As a result, the yield increase from phosphate rock application was higher in Plinthosols than in Lixisols.

These findings indicate that low-grade phosphate rock can be an effective and affordable substitute for chemical fertilizers, contributing to improved crop production in low-fertility soils of semi-arid regions. However, the solubility of phosphate rock varies by source, so using more soluble phosphate rocks may yield better results. Additionally, when phosphate rock is applied without nitrogen fertilizers, nitrogen may become the limiting factor, potentially reducing the yield improvement. Therefore, proper nitrogen management is crucial to maximize the benefits of phosphate rock application.

Authors: Iseki, K., Ikazaki, K., Nakamura, S. [JIRCAS], Sidibe, H. [INERA]

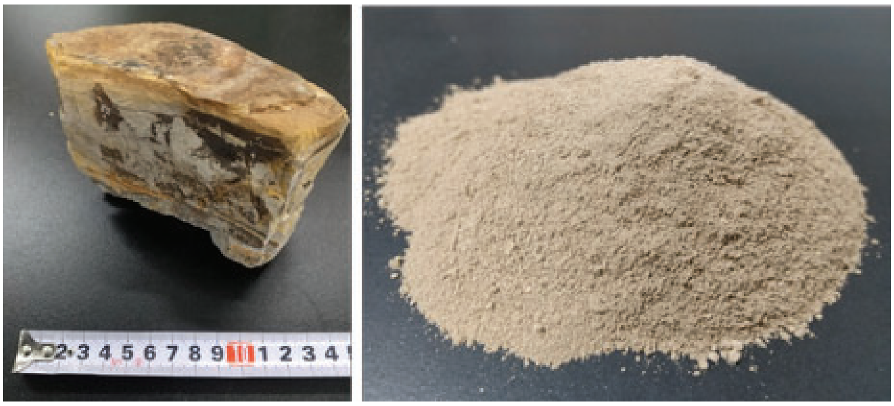


Fig. 1. Low-grade phosphate rock from Burkina Faso (left) and its ground sample (right)

In the field trial, the ground sample on the right was applied at a rate of 400 kg ha^{-1}, following the local recommended application amount.

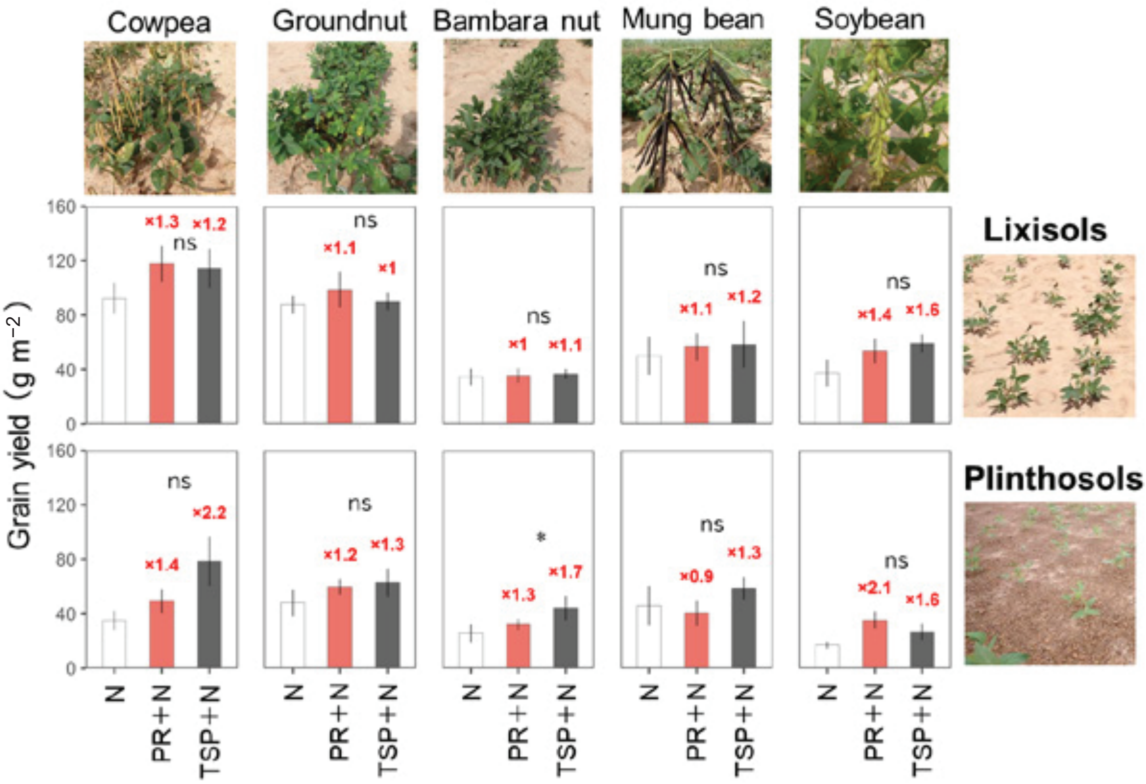


Fig. 2. Differences in the effects of low-grade phosphate rock (PR) and chemical phosphorus fertilizer (TSP) on five leguminous crops

This figure shows the mean ± SE (n=10) from two-year field trials, with five replicates. The control plot received only nitrogen (N) in the form of ammonium at 14 kg ha^{-1}. The treatment plot received chemical phosphorus fertilizer + N, applying a quantity of triple superphosphate (TSP) equivalent to the phosphorus content of the PR (4.6 kg P ha^{-1}). The red text indicates the relative increase in yield compared to the control (N only). "ns" indicates no significant difference in the increase rate between PR+N and TSP+N, while "*" denotes a significant difference at $p < 0.01$ in the increase rate.

Reference: Iseki et al. (2024) *Plant Production Science* 27: 272-282.

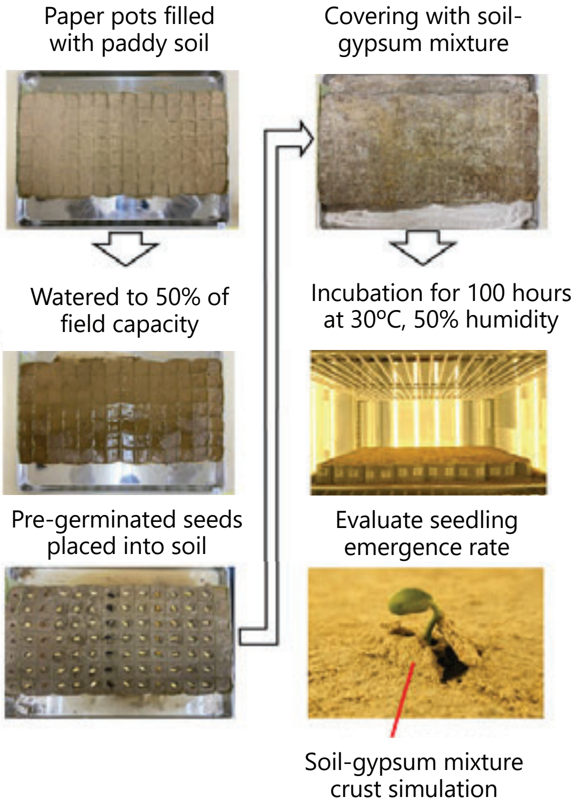
A simple evaluation method for seedling emergence ability using soil-gypsum mixed crust

Soil crust, a thin hard layer on the soil surface formed after rainfall, physically inhibits seedling emergence, reducing plant number, which results in cultivation concerns such as reduced yield per unit area and increased cultivation costs due to seed resowing. To cope with this problem, varieties with stable seedling emergence under crust conditions are needed, but testing these materials under crust conditions is difficult because crusts do not form uniformly under natural conditions. In previous research, to reproduce uniform crusts, an artificial rainfall simulator was used with soil from the desired environment. However, this method is not simple due to the labor required for soil collection and the high cost of the artificial rainfall device, making it unsuitable for evaluating a large number of materials at once such as genetic resources. Consequently, previous studies have not been able to evaluate enough number of materials, delaying variety breeding. In this study, we developed a method to evaluate seedling emergence against soil crust conditions using commercial gypsum mixed into soil to reproduce uniform crusts and tested this method on soybean genetic resources.

The method involves mixing commercial gypsum at a ratio of about 20–40% into the soil according to the desired hardness, following sowing of the seeds in paper pots evenly covered with the soil-gypsum mixture (Fig. 1). The paper pots were filled with high water-holding capacity soil (e.g. paddy soil) and the seeds were pre-germinated before sowing to enable highly reproducible evaluation under uniform conditions. Since the soil-gypsum mixture increases in hardness over time, the mixture ratio can be adjusted. We used a 20% mixture ratio since it reached a hardness close to that of the soils prevalent in West Africa (1.57 MPa) after 100 hours of the treatment under 30°C and 50% humidity (Fig. 2). Therefore, since no special equipment is required and the method can be performed at low cost, it is suitable for screening multiple lines with replications (Fig. 3).

This method can be applied to other crops besides soybean by using paper pots of an appropriate size for the seeds. If paper pots are not available, commercial trays can also be used instead. Although the crust hardening speed varies depending on the properties of the soil used and the temperature and humidity conditions after treatment begins, the drying time of the gypsum (set to 100 hours in this study) can be set arbitrarily depending on crop characteristics such as emergence speed and the desired crust hardness.

Authors: Nakagawa, A., Iseki, K., Ikazaki, K. [JIRCAS]



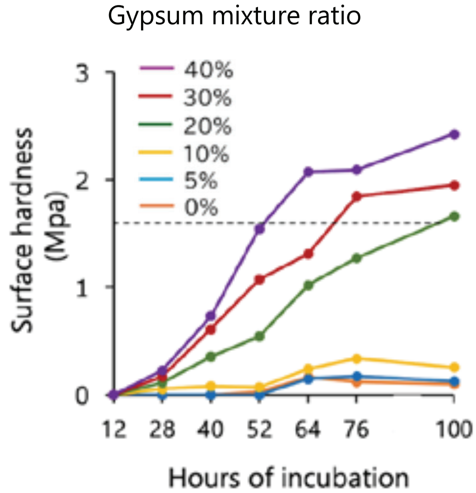


Fig. 2. Temporal changes in surface hardness of soil-gypsum mixture

Changes in surface hardness over time when gypsum was mixed with different ratios (0–40%) measured using a crust hardness meter. The dashed line represents the hardness of the predominant soil of West Africa, the target for this study.

Fig. 1. Evaluation of seedling emergence ability against soil crust

Pre-germinated seeds of soybean were sown in paper pots filled with moisturized paddy soil and covered with soil-gypsum mixture. The paper pots were incubated in a growth chamber at 30°C and 50% humidity and evaluated after 100 hours.

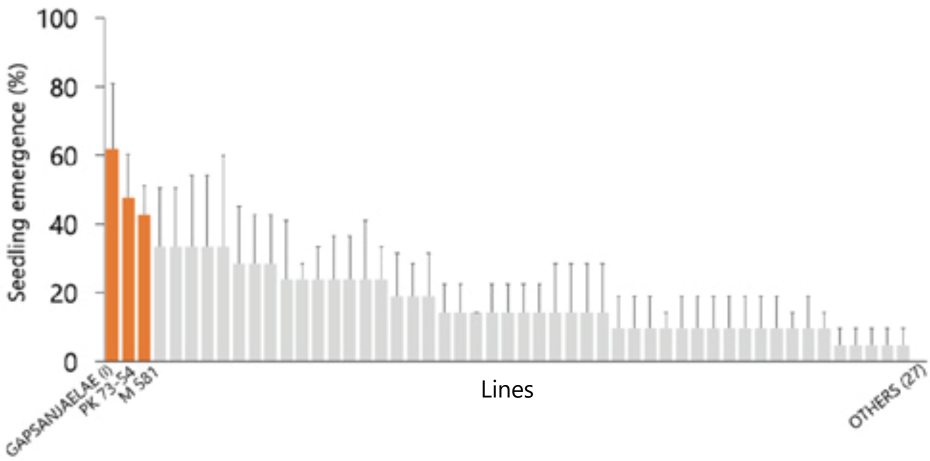


Fig. 3. Evaluation of soybean genetic resources seedling emergence ability using the developed method

Seedling emergence rates of 78 accessions from the World Soybean Core Collection and four tropical varieties. Bars and error bars represent averages and standard errors for three replications, respectively. Orange bars represent the three accessions with the highest emergence rates. Accessions for which seedling emergence rates were zero are shown as 'OTHERS' including 27 accessions.

Reference: Nakagawa et al. (2024) *Plant Production Science* 27(4): 265–271.

Program C
Information

“Strengthening function as an international hub for providing strategic information on agriculture, forestry and fisheries, and mobilizing new research partnerships”

Strengthening function as an international hub for providing strategic information on agriculture, forestry and fisheries is one of the pillars of the JIRCAS Fifth Medium to Long-Term Plan (FY 2021-2025) which began in April 2021. The ‘Information Program’ aims to collect data and analyze challenges affecting the agriculture, forestry, and fisheries sectors as well as global food systems in an increasingly complicated and multifaceted world, and provide strategic and evidence-based information on potential solutions.

[Information hub]

In recent years, the momentum for solving global issues has been accelerating, while the continuous progress of science and technology has brought about great changes in the world. We are now in an era where international competitiveness depends on the difference in strategies such as cooperation in different fields and the introduction of cutting-edge technologies. In order to promote the transition to a healthy and sustainable global food system for both the Earth and humankind, it is expected that comprehensive information linking socioeconomics, food nutrition, and technological development will be collected, analyzed, and disseminated. The “Information hub” project systematically organizes information on international agriculture, forestry, and fisheries, through the use of dashboards and the creation of original content, in an effort to establish our position as among Japan’s leading information centers on scientific topics related to global food security, climate change, and food systems.

In FY 2024, we organized several international events in addition to JIRCAS International Symposium 2024, which featured resilient genetic resources for food security in the era of global boiling. One event was a special seminar with the FAO Chief Economist, Dr. Máximo Torero, regarding global food security and nutrition and resilient food systems. Another was a symposium with the 2024 World Food Prize Laureate, Dr. Cary Fowler, on genetic diversity preservation and a new mission for Africa’s adapted crops and soils. Moreover, we organized an international symposium on the long-term impacts of climate change on global food supply and demand and food security.

We served as a nationally designated expert in intergovernmental panels such as the IPBES Nexus Assessment and the IPCC Scoping Meeting, contributing significantly to agenda setting—particularly in shaping the discourse around the role of food systems. Our original “Pick Up” articles sought to provide updates on the status of global food security, which is facing growing uncertainties over fuel, fertilizer, and food volatilities induced by the interlinked impacts of COVID-19, climate change, and conflicts. In addition to analyzing these trends, we are also working on the development of economic models that can evaluate the impacts of climate change and/or associated mitigation/adaptation policies on the global agriculture, forestry, and fisheries sectors. Examples include models that evaluate the environmental, nutritional, and other socio-economic impacts of agricultural technologies.

[Research applications/ventures]

In order to respond to the needs of society both domestically and internationally in an accurate and timely manner, and in accordance with the “Law on the Revitalization of Science, Technology and Innovation Creation” promulgated in FY 2019, JIRCAS has recognized that it is important to promote more actively the societal implementation of research results/technologies generated by JIRCAS researchers. This project is composed of three main pillars:

1) Commercial deployment of shrimp seed production/recirculating aquaculture technology developed by JIRCAS,
2) Promotion of JIRCAS’s Asian Monsoon Model Plant Factory System, and
3) Establishment of a platform to support and promote practical application/societal implementation of JIRCAS’s research results.

In FY 2024, regarding work relating to shrimp, JIRCAS continued research on the development of seed production technology suitable for commercial usage and methodology for achieving artificial maturation of female prawns under re-circulating rearing systems. In support of this work, JIRCAS has also received a government research grant from BRAIN (Bio-oriented Technology Research Advancement Institution) under the organization’s Research and Implementation Promotion Program through Open Innovation. JIRCAS is partnering with IMT Engineering Co., Ltd. on this grant which will run from FY 2024 to FY 2027. In addition, JIRCAS’s first institute-related business venture, ShrimpTech JIRCAS, Inc. (established February 2022), continues to be engaged in consulting activities related to re-circulating aquaculture of the Pacific whiteleg shrimp, *Litopenaeus vannamei*, and customized research.

Regarding plant factory-related research, staff researchers at JIRCAS’s Tropical Agriculture Research Front (TARF), located on Ishigaki Island, have published and disseminated a manual entitled “Manual for managing tomato cultivation in Asia Monsoon Plant Factory System (AMPFS)” (see URL: https://jircas.repo.nii.ac.jp/records/2000730). This technology was developed through joint research with the private sector and Japan’s National Agriculture and Food Research Organization (NARO) and has thus reached the level of actual application. In addition, building upon results obtained at TARF, research on strawberry cultivation was conducted in collaboration with Indonesia’s Universitas Padjadjaran, enabling year-round strawberry production using the AMPFS technology.

Regarding the establishment of our platform for promoting research results, multi-site trials aimed at the registration of soybean cultivars possessing resistance to rust disease were conducted in Argentina, Mexico, and Uruguay. Additionally, an application for the registration of another new variety was submitted to the relevant authorities in Paraguay. In Indonesia, we promoted new breeding lines of rice to which field resistance genes against blast disease had been introduced. In Bangladesh, trials for purposes of variety registration were conducted for rice lines with the aim of improving nitrogen use efficiency. In Laos, joint activities were implemented with the foundation WORLDS LINK in order to disseminate a method for suppressing histamine formation during the production process of *padaek*, a shelf-stable salt-fermented freshwater fish paste popularly used for seasoning various Laotian dishes. This project will help make low-histamine *padaek* readily available and thus support school meal programs.

[Tropical crop genetic resources]

JIRCAS maintains diverse genetic resources of sugarcane, indica rice, tropical fruits, and *Brachiaria* (tropical grass). These tropical crops play important roles as food, energy production, calorie and nutrient sources, cash crops, and fodder in the production areas, particularly in developing countries/regions. Amid concerns about global climate change, the sustainable and stable production of these tropical crops is an urgent issue. In addition, the introduction of tropical crops and their cultivation and dissemination technologies is expected to be one of the measures to combat global warming in Japan and contribute to the expansion of production areas and the diversification of food and nutrition sources.

The JIRCAS "Tropical crop genetic resources" project promotes the development of strategic genetic resources information, breeding technologies, varieties and materials, and cultivation and dissemination technologies based on the problems and research needs of each crop in Japan and overseas, taking advantage of the diverse and abundant genetic resources of tropical crops and the geographical advantage of our subtropical island research facility. In addition, by sharing and providing information and technologies, we aim to strengthen collaborations that will lead to the formation of networks with domestic and overseas research institutions to promote the utilization of tropical crop genetic resources.

In FY 2024, following its registration in Japan, the pasture grass "Isan" was registered as a new variety in Thailand, making it the first tropical grass variety of the genus *Urochloa* (formerly known as *Brachiaria*) in the Asian monsoon region. DNA markers were created to detect the presence or absence of resistance to cassava mosaic virus disease for the rapid evaluation of cassava genetic resources and breeding materials. A follow-up evaluation of the dissemination of virus-free passion fruit technology was conducted to clarify issues for practical application in production areas in Japan.

[Green Asia]

In 2021, Japan formulated the Strategy for Sustainable Food Systems, "MIDORI," which aims to enhance agricultural productivity potential and sustainability through innovation as a new approach for sustainable food systems. In line with this strategy, JIRCAS has been assigned to implement the "Green Asia" project (full title: Accelerating application of agricultural technologies which enhance production potentials and ensure sustainable food systems in the Asia-Monsoon region).

The International Scientific Advisory Board for Strategy MIDORI, composed of internationally renowned agricultural scientists and representatives from agricultural research institutes in the Asia-Monsoon region, was formed to guide the activities of Green Asia. In FY 2024, the fourth advisory board meeting was held in hybrid format in October 2024 where the ASEAN Secretariat attended for the first time. The fifth meeting was held online in March 2025. The International Center for Strategy "MIDORI," established under the project, has facilitated the collection, analysis, and sharing of existing and latest information on agricultural, forestry, and fisheries technologies in collaboration with domestic and overseas research institutes under advice from the advisory board.

Some of Green Asia's research products in FY 2024 include the "Technology Catalog Contributing to Production Potential and Sustainability in the Asia-Monsoon Region Ver.3.0," a compilation of technologies developed by universities and other national research institutes —including JIRCAS, NARO, FFPRI, and FRA —or through international collaboration. Technologies listed in Technology Catalog can potentially be scaled out to the Asia-Monsoon region, if tailored to local contexts, and have attracted a lot of interest from stakeholders in the region. Technologies in Technology Catalog have been listed in the ASEAN-Japan MIDORI Cooperation Plan. Technology Catalog has also been introduced on the websites of the UN Food Systems Coordination Hub, FAO, and the ASEAN Secretariat.

To disseminate the research activities and scalable technologies under Green Asia, JIRCAS attended several important international meetings, including the Workshop on Developing the Guidelines for the Reduction of Crop Burning in ASEAN, which resulted in the inclusion of three technologies listed in the Technology Catalog in the newly developed "ASEAN Guidelines for the Reduction of Crop Burning."

Consumers' preferences for nutritional/health, ingredient, and environmental attributes of plant-based meat in China

Rising income and changes in eating habits are driving global meat demand, with OECD/FAO projecting a 14% increase in meat-derived protein demand by 2030. This raises concerns about health and environmental sustainability. Plant-based meat, made from ingredients like soy, wheat, and peas, offers nutritional and environmental benefits as a sustainable alternative. Compared to traditional meat, plant-based meat has a variety of unique attributes, which could be used in promotion. However, since it is not yet widely available on the market, our understanding of consumers' preferences for its attributes is still insufficient. Further research on consumer preferences is needed to promote its widespread adoption. Given that traditional meat consumers are its potential consumers, this study conducted a large-scale consumer survey, which covered 2500 individuals, using the best–worst scaling method (BWS method, Figure 1) in five major cities in China, the world's largest meat and plant-based meat market, as well as the largest meat importer. We selected 13 quantifiable attributes of plant-based meat based on literature review and asked the respondents to identify the most and least favored attributes. Then, we analyzed consumers' preferences for these attributes and examined variations in preference patterns with respect to consumers' socio-demographic characteristics.

Results suggest that consumers prioritized nutritional/health attributes relative to ingredient and environmental attributes, ranking "rich in dietary fiber," "zero hormone," and "zero cholesterol" as the most favored attributes. In contrast, the least favored attributes were "pea protein," "carbon label," and "vegan formula" (Table 1). Using a latent class model, we classified consumers into three groups. Although all groups prioritized nutritional/health attributes, preferences were heterogeneous with respect to socioeconomic characteristics, with younger, higher-income males who spend more on meat favoring healthy nutrients, while others focused on avoiding unhealthy elements of traditional meat (Table 2).

These results could improve our understanding of consumer preferences for plant-based meat and could be used as a scientific basis for policymaking to promote the spread of plant-based meat, thus contributing to the realization of a sustainable and healthy food system. Since nutritional/health attributes were prioritized by consumers, these attributes could be used to attract consumers. Meanwhile, since preferences also varied among consumers, targeted promotional strategies are necessary. Nevertheless, as the survey was conducted in only five major Chinese cities, applying the findings in other contexts requires considering local consumer characteristics.

Authors: Wu, W. [JIRCAS], Yuan, R. [Guizhou Univ.], Jin, S. [Zhejiang Univ.]

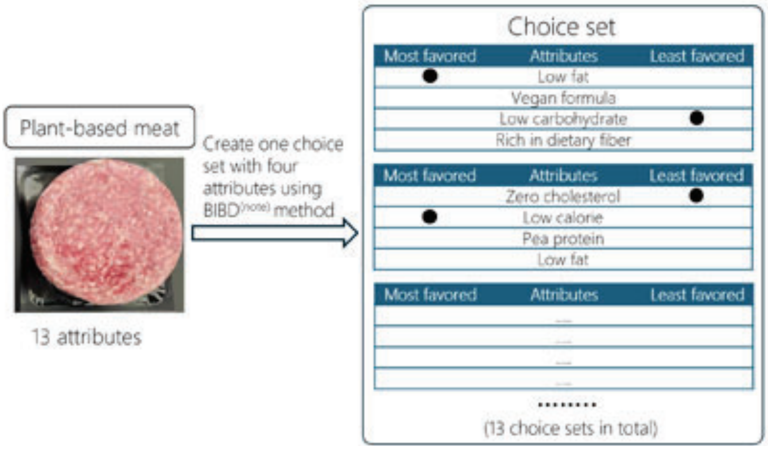


Fig. 1. Examples of BWS choice set presented to respondents

Respondents were asked to select one most and one least favored attribute from each set by marking ●.

(Note) BIBD: Balanced Incomplete Block Design

Attribute	Order of importance	Share of preferences
Rich in dietary fiber	1	17.0%
Zero hormone (note)	2	13.1%
Zero cholesterol	3	11.7%
High protein	4	11.5%
Zero trans fat	5	10.3%
Contains minerals (Fe+)	6	7.3%
Low fat	7	6.7%
Low calorie	8	5.3%
Soy protein	9	4.7%
Low carbohydrate	10	3.7%
Pea protein	11	3.4%
Carbon label	12	2.9%
Vegan formula	13	2.6%

Table 1. Share of preferences estimated by the mixed logit model

Blue: Nutritional/health attributes
Red: Ingredient attributes
Green: Environmental attributes
The share of preferences indicates the percentage of consumers who favor the attribute the most.
(Note) China has banned hormone usage in the livestock sector, but many consumers are still concerned (Wang (2022) *Meat Science* 194: 108982).

Table 2. Consumer segmentation and group characteristics using the latent class model (note)

	Top 3 favored attributes by each group		
Order of importance	Group that prefers healthy nutrients	Group with intermediate preference	Group that dislikes unhealthy elements
1	(+) Rich in dietary fiber	(+) Rich in dietary fiber	(−) Zero hormone
2	(+) High Protein	(−) Zero hormone	(−) Zero trans fat
3	(+) Contains minerals (Fe+)	(+) High Protein	(−) Zero cholesterol
Percentage of consumers	47%	24%	29%
Socioeconomic variables			
Income (7 groups: low to high)	0.19***	0.05	baseline
Age	−0.11**	−0.01	baseline
Gender (female=1, male=0)	−0.24**	−0.24**	baseline
Meat expenditures (4 groups: low to high)	0.43***	−0.01	baseline

(Note) The latent class model could allocate observed individuals to one of the latent classes.
(+) indicates an increase in healthy nutrients by consuming plant-based meat.
(−) indicates a decrease in unhealthy elements by consuming plant-based meat.
** and *** indicate significance at 5% and 1% levels, respectively (Wald-test).

Reference: Wu et al. (2024) *Future Foods* 9: 100384.

Development of a new methodology for controlling maturation in the whiteleg shrimp, *Litopenaeus vannamei*, using live feeds

In order to ensure the sustainability and profitability of whiteleg shrimp production, it is essential to secure a stable supply of high-quality post-larvae. In this study, it was determined that feeding live polychaetes belonging to the *Nereis sp.*, in combination with commercial pellets, is effective in promoting the induction of ovarian maturation in parent shrimp and increasing the number and frequency of spawning occasions.

Eyestalk ablation is employed worldwide in conventional hatcheries for the purpose of inducing maturation and spawning in female spawners. This methodology is effective because it removes the source of vitellogenesis-inhibiting hormone (VIH), allowing maturation to proceed. However, the eyestalks are responsible for the synthesis/secretion of many other important hormones that control essential life processes; eyestalk ablation thus imposes a heavy burden on the animal. Moreover, in recent years, this procedure has been deemed undesirable from the perspective of animal welfare. The overarching aim of this research is to combine feeding methods and hormonal manipulation to offer an alternative technology to the shrimp culture industry.

Four test groups were set up as shown in Figure 1, and nine female spawners were reared under each treatment. The effectiveness of each treatment was evaluated by following the scheme shown in Figure 2. With regard to the total number of times that maturation occurred in each test group, the eyestalk-ablated groups (B, D) showed a frequency 3.0- to 4.3-fold higher than the non-ablated groups (A, C) under the same feeding conditions. This indicates that eyestalk ablation is highly effective, but when the results are considered by comparison among feeding treatments, the use of live feeds yielded results 2.3-fold higher in group C compared to group A (Table 1). In addition, irrespective of whether eyestalk ablation was carried out, in the groups fed live polychaetes, maturation-inducing effects lasted for a longer duration than in individuals fed only commercial pellets (Fig. 3).

In addition, male spawners were employed for the purpose of implementing natural mating or artificial insemination. In terms of the total number of spawnings, group D (eyestalk ablation/live feed administered) showed the highest number of spawnings, but in terms of number of eggs per spawning, group C (eyestalks not removed/live feed administered) showed the highest values (Table 1).

By feeding female spawners with live feed in addition to commercial pellets, it is possible to enhance ovarian maturation and spawning. This is expected to become a component of a new technology that will replace the labor-intensive process of eyestalk ablation, and thus address issues that relate to animal welfare.

Authors: Wilder, M., Kang, B. J., Sultana, Z. [JIRCAS]

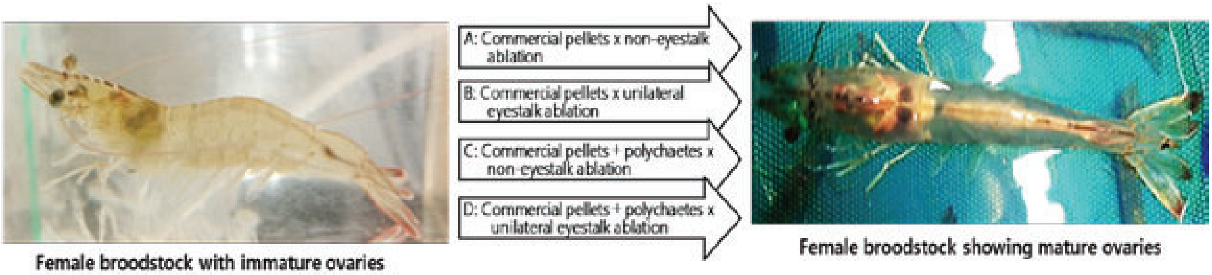


Fig. 1. Experimental design for evaluating the effects of feeding on ovarian maturation in the whiteleg shrimp, *Litopenaeus vannamei*

The effects of four experimental treatments on ovarian maturation were examined in *L. vannamei*. Animals were fed with either commercial pellets only or commercial pellets together with live feed (*Nereis* sp. polychaetes) at a ratio of 3:7. Each feeding protocol was combined with either non-ablation or unilateral eyestalk ablation.

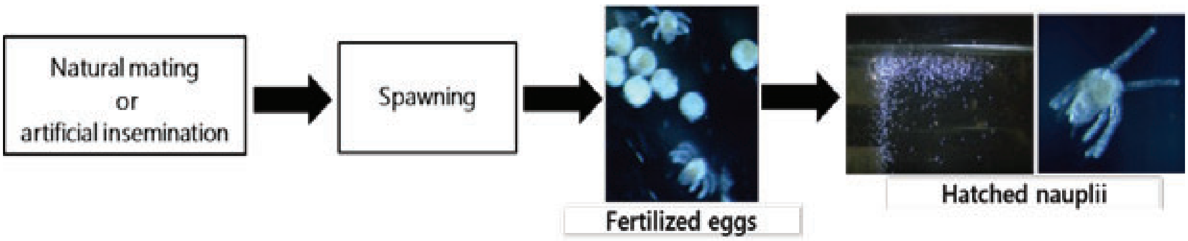


Fig. 2. Scheme for promoting spawning and obtaining fertilized eggs and hatched nauplii via natural mating or artificial insemination in *L. vannamei*

Table 1. Maturation and spawning of whiteleg shrimp (*L. vannamei*) broodstock for each of four experimental treatments

	Commercial pellets		pellets+polychaetes	
	A: pellets x non-eyestalk ablation	B: pellets x unilateral ablation	C: pellets + polychaetes x non-ablation	D: pellets + polychaetes x unilateral ablation
Total number of maturations	3	13	7	21
Total number of spawnings	1 (a)	2 (a)	4 (b)	7 (a)
Number of eggs per spawn	1.4×10^5 (-)	$(1.3 \pm 0.3) \times 10^5$ (a)	$(4.4 \pm 0.2) \times 10^5$ (b)	$(2.7 \pm 0.2) \times 10^5$ (a)

Results are expressed as the cumulative total of maturation and spawning incidents observed during an eight-week experimental duration (nine female broodstock per treatment), and the average number of eggs per spawning. Differing letters in the table indicate significant difference (One-way ANOVA followed by the chi-square test; $p < 0.05$); "-" indicates that statistical analysis was not performed due to that only one individual spawned under this treatment).

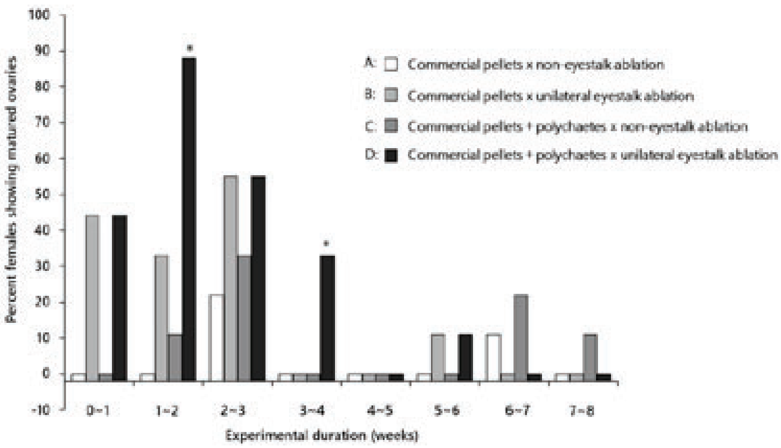


Fig. 3. Percentage of females showing matured ovaries per week for each treatment

Results for each of the four treatments, as detailed in Figure 1 and Table 1, are shown on a weekly basis for the duration of the experimental period. Groups that differ significantly (Friedman test, $p < 0.05$) are indicated with an asterisk.

Reference: Sultana et al. (2023) *Nippon Suisan Gakkaishi* 89: 127–136 (Fig. 1a, Fig. 3a, Table 2, Table 3).

Breeding and variety registration of “Isan,” the first *Urochloa* grass variety for the Asian monsoon

Urochloa (formerly known as *Brachiaria*) is a tropical grass widely grown in tropical and subtropical regions of the world. It has excellent forage characteristics such as high yield, strong drought resistance, aptitude for grazing, and high crude protein content. However, the breeding of *Urochloa* has been limited, only about 20 varieties have been registered in the world, most of which were bred in South America and Australia, and no varieties have been bred for the Asian monsoon region. On the other hand, beef and milk production is increasing in this region, and livestock farmers are under pressure to develop efficient feed production technology. Therefore, we will breed and develop tropical grass varieties that are suitable for the Asian monsoon climate and can be cultivated at a low cost with high yield and high quality.

“Isan” is the first variety of *Urochloa* pasture grass in Japan and Thailand (Figs. 1 and 2). Figure 3 shows the background of the breeding process and the roles of each organization. It has an average dry matter yield of 18.8 t ha^{-1} per year, about 12% higher than the average of 16.8 t ha^{-1} of existing varieties (Table 1). The dry matter ratio is about 2% lower than that of the existing varieties. It has excellent crude protein content, about 3% higher than the existing variety “Kennedy” at 17.2% in the first crop of the first year, and the TDN (Total Digestible Nutrients) content is similar to the existing variety. It can be easily established as a highly uniform pasture from seed due to apomixis.

“Isan” is distinguished by its high yield, high quality, and easy management, and has high potential to meet the needs of pasture grasses in the Asian monsoon region. In the frost-free zone of the Nansei Islands in Japan, it can be used as permanent grazing pasture or meadow. Because of its high crude protein content and suitability for rough grazing, it is expected to help farmers stabilize their business by reducing the need to purchase concentrate feeds, which are becoming increasingly expensive. The high summer temperatures in recent years have caused summer depression of temperate grasses. It is resistant to high temperatures and drought, and can reproduce by seed, so it is expected to be used in pastures from Kyushu to the Kanto region for a single year. Pre-drying is required to adjust moisture content to 60–70% for silage preparation due to its low dry matter content.

Authors: Shimoda, K. [NARO], Ando, S. [JIRCAS], Ebina, M. [NARO], Kouki, K. [Okinawa Pref.], Akashi, R. [Miyazaki Univ.], Suenaga, K. [JIRCAS], Ando, S. [NARO], Kanamori, N., Matsumoto, N. [JIRCAS], Nakamanee, G., Rimkeeree, K., Srisompom, W., Patipan, C., Mangpung, Y. [DLD]

Table 1. Key characteristics of "Isan" and control varieties

	Isan	Kennedy	Mulato II
Dry matter yield (t ha^{-1} y^{-1})			
1st year	22.7 a	20.7 b	19.6 b
2nd year	14.8 a	13.3 b	13.6 ab
2-year average	18.8 a	17.0 b	16.6 b
Dry matter ratio (%)			
1st year	17.5 b	19.9 a	18.3 ab
2nd year	20.4 b	22.1 ab	23.6 a
Feed ingredients (%)			
Crude protein	17.2 a	14.3 b	16.1 a
Crude fat	2.5 a	2.0 a	2.3 a
Crude ash	14.3 a	13.8 ab	13.0 b
ADF	34.3 a	31.0 a	32.3 a
NDF	59.5 a	60.3 a	55.6 a
ADL	3.3 a	2.9 b	3.2 a
TDN	61.3 a	61.9 a	61.9 a
Parthenogenesis (%)			
Embryo sac analysis	86.4	0.0	90.3

Note: Unpublished data (from Shimoda)

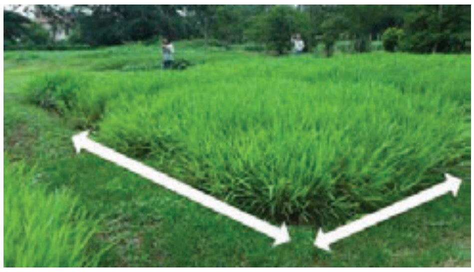


Fig. 2. Local adaptation test field at Nakhon Ratchasima Livestock Nutrition Research and Development Center (Pak Chong)

The area indicated by white arrows is the "Isan" plot (photo taken in September 2014).

Fig. 1. Grass form of "Isan"

Crossbreeding between "Miyaokikuni 1," a sexually reproduced tetraploid Ruzigrass intermediate parent created by chromosome doubling by the Faculty of Agriculture, University of Miyazaki, as seed parent and "Mulato," an apomixis hybrid transferred from the International Center for Tropical Agricultural Research (CIAT), as pollen parent at JIRCAS (2008–2009).

↓

Selection and determination of apomixis of the obtained crosses at the Nasu Research Station, Institute of Livestock and Grassland Science, National Agriculture and Food Research Organization (2010).

↓

Evaluation of agricultural characteristics at the Nakhon Ratchasima Livestock Nutrition Research and Development Center, Department of Livestock Development (DLD), Ministry of Agriculture and Cooperatives, Thailand (2011–2012).

↓

Local adaptation test of the three selected strains was conducted at five DLD-affiliated research centers in Thailand, including the Center, and the Okinawa Prefectural Livestock Research Center in Japan, to evaluate drought resistance in areas with severe dry seasons. Variety characteristics test was conducted at two locations, at the Center and at the Okinawa Livestock Research Center, and the final selection was made (2013–2014).

↓

JIRCAS applied for variety registration (March 2017), established criteria for variety registration examination (March 2020), and registered the variety in Japan (August 2021).

↓

DLD established criteria for variety registration examination (2020), applied for variety registration (May 2021), and registered the variety in Thailand (July 2024).

Fig. 3. Breeding history of "Isan" and the roles of each organization

Reference: Nakamanee et al. "Isan" Variety Registration No. 0924/2024 (2024/7/26 in Thailand).
Shimoda et al. "Isan" Variety Registration No.28580 (2021/8/5 in Japan).

Hybrid sterility between Asian and African rice can be mitigated by tetraploidization

Almost all rice varieties cultivated worldwide belong to the Asian rice (*Oryza sativa*), and modern rice varieties with high yielding capacity and good eating quality are developed through intraspecific crosses within *O. sativa*. In contrast, the African rice (*O. glaberrima*), cultivated only in limited regions of West Africa, exhibits distinct traits such as resistance to certain pests and diseases and adaptability to low-fertility soils. Hybridizing these two species may enable the development of varieties that can be cultivated in environments where *O. sativa* cultivation has been difficult. However, interspecific F_1 hybrids between *O. sativa* and *O. glaberrima* exhibit severe sterility of pollen grains (hybrid sterility), preventing seed production; thus, it is essential to develop fertile interspecific hybrids to overcome this sterility.

In this work, we investigated the relationship between hybrid sterility and ploidy level of the hybrid and found that tetraploid F_1 hybrids can restore pollen fertility and set seeds by self-pollination.

We examined the pollen fertility of F_1 hybrids between an *O. glaberrima* variety (Og) and three *O. sativa* varieties (Os1, Os2, and Os3 belonging to the *temperate japonica*, *indica*, and *aus* subspecies, respectively), and found that while diploid F_1 hybrids showed 0% pollen fertility (complete sterility), tetraploid F_1 hybrids exhibited pollen fertility ranging from 5.7% to 28.1%, enabling self-pollination (Fig. 1).

Genetic analysis of the fertile microspores in the tetraploid hybrids provided insight into the fertility restoration mechanism (Fig. 2). For example, in the *S2* locus, which is one of the loci inducing pollen grain sterility in the hybrid, all microspores carrying the *S2* allele from *O. glaberrima* would be sterile in diploid hybrids. However, they could maintain fertility in the tetraploid situation by carrying the *S2* allele from *O. sativa* simultaneously.

These results suggest that employing tetraploid hybrids can facilitate genetic exchange between the two species, allowing for the development of diverse hybrids with valuable traits, which was difficult in the diploid situation. Furthermore, diploid hybrids between the two species could be developed successfully by rescuing the fertile microspores in the tetraploid hybrid through anther culture methods. Further investigation on pollen fertility and agronomic traits of these diploid hybrids will be required to estimate their usability as hybrids with intermediate genomic compositions between the two species.

Authors: Kuniyoshi, D. [JIRCAS], Ishihara M., Yamamori K., Koide Y., Kishima Y. [Hokkaido Univ]

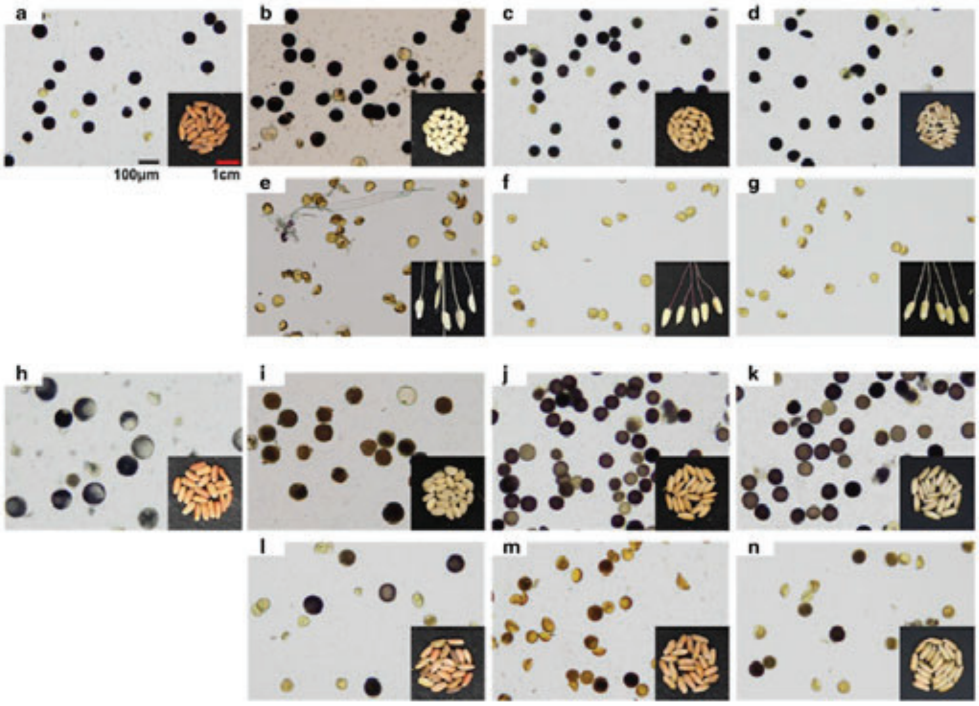


Fig. 1. Observation of fertility of pollen and self-pollinated seeds

Pollen samples were stained with I_2-KI staining then observed. Fertile pollen: black color. Sterile pollen: yellow to brown color.

a–g: Pollen and seeds in the diploid materials.

a: *O. glaberrima* variety (Og); b–d: *O. sativa* varieties (Os1, Os2, Os3). Os1, Os2, and Os3 belong to *temperate japonica*, *indica*, and *aus* subspecies, respectively.

e–g: Og/Os1, Og/Os2, Og/Os3 F_1 hybrids. Diploid hybrids were pollen-sterile, resulting in no seed set.

h–n: Pollen and seeds in the tetraploid materials.

h: Og; i–k: Os1, Os2, and Os3.

l–n: Og/Os1, Og/Os2, and Og/Os3 F_1 hybrids in the tetraploid situation. Pollen fertility was restored in the tetraploid situation; thus, self-pollinated seeds were obtained for all three combinations.

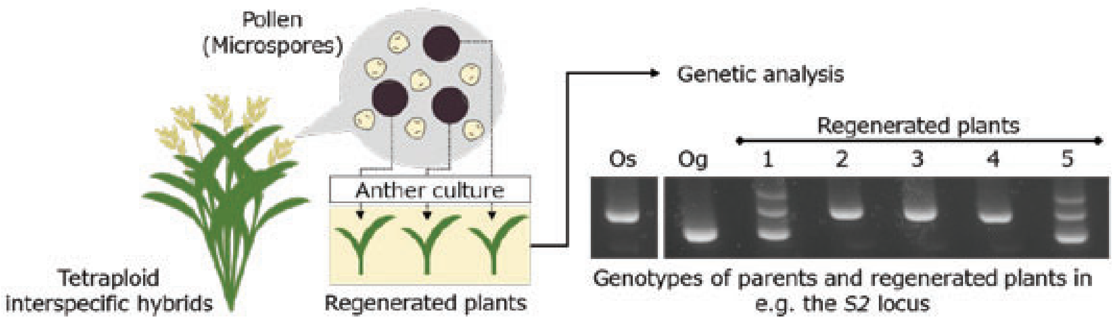


Fig. 2. Genetic analysis of hybrid sterility loci

Diploid plants were produced from fertile microspores of the tetraploid hybrids and analyzed. The hybrid sterility loci (e.g. the *S2* locus) which induce sterility of pollen were targeted for this analysis. The image of gel electrophoresis represents the result of analysis of the *S2* locus: among the plants induced from the fertile micropores, three plants (2, 3, and 4) carried the *S2-Os* allele while two (1 and 5) carried both *S2-Os* and *S2-Og*. Basically, microspores carrying the *S2-Og* allele would be sterile, but this result confirmed that they could maintain fertility in the tetraploid hybrid by carrying it with the *S2-Os* allele.

High water-use efficiency and associated accumulation of leaf metabolites in *Erianthus arundinaceus*

Erianthus arundinaceus (hereafter, *Erianthus*), a genetic resource of a closely related genus of sugarcane (*Saccharum* spp.), is believed to contribute to the improvement of drought tolerance in sugarcane through intergeneric crosses. However, there has been insufficient verification of the physiological determinants of drought tolerance in this species through comparison with sugarcane, and no progress has been made in searching for promising traits as selection indicators for drought tolerance. Research is needed on drought tolerance-related traits of this species, focusing not only on the root system but also on above-ground characteristics. Leaf water-use efficiency (WUE), which is the photosynthetic rate divided by the stomatal conductance, is considered to be one of the useful indicators. Here, in addition to WUE, we focus on related stomatal morphology and metabolites.

In a glasshouse at the Tropical Agriculture Research Front (TARF), JIRCAS, a pot experiment was performed under dry and wet conditions to investigate the response of WUE, primary metabolites in various plant parts by metabolomics, and stomatal morphology in sugarcane cultivar NiF8 and *Erianthus* accession JW630, and to search for useful traits in above-ground parts related to drought tolerance (Fig. 1).

Metabolomics of various plant organs and multivariate analysis (principal component analysis, hierarchical cluster analysis) showed that there is a linkage between parts of the plant with regard to metabolite composition, with interspecific differences and soil moisture effects clearly evident, particularly in the leaves. Regardless of soil moisture conditions, *Erianthus* exhibited higher WUE (Fig. 2a) and had fewer stomata on the lower side of its leaves (Fig. 2b). It also accumulated abundant betaine and γ-aminobutyric acid (GABA) in its leaves, which are involved in stomatal closure and stress responses (Fig. 3).

In addition to the known rooting ability, such as deep rooting, the above-ground leaf characteristics (stomatal density, metabolites) may be useful evaluation indicators with regard to the drought tolerance of *Erianthus*. On the other hand, the causal relationship between the high WUE of *Erianthus* (Fig. 2a) and the leaf traits should be investigated further. As a group of genetically distinct genotypes of *Erianthus* is known to exist, it is possible that there are genotypes that show different physiological responses to the present study, and studies focusing on the diversity of traits in the genetic resource population are underway. In the future, the possibility of simple selection for drought tolerance using these traits (stomatal density, leaf metabolites) as biomarkers will be tested using hybrid populations, etc., to improve the efficiency of drought tolerance breeding through the development of drought tolerance-related genetic markers.

Authors: Takaragawa, H. [JIRCAS], Wakayama, M. [Ehime Univ.]

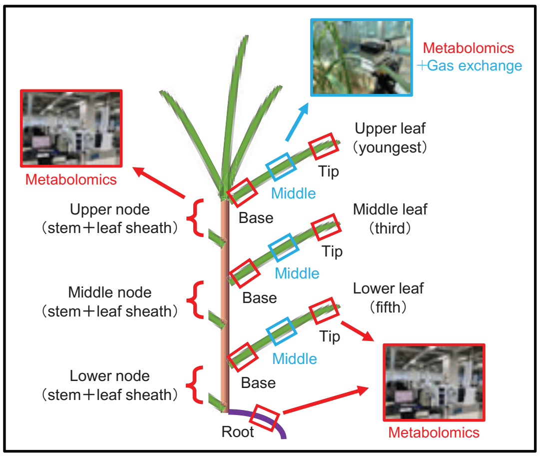


Fig. 1. Targeted plant parts for analysis in the present study

Gas exchange characteristics and stomatal morphology were targeted in the middle parts of the upper, middle, and lower leaves. For metabolomics, a total of 16 samples per plant were tested: nine leaves + three stems + three leaf sheaths + one root. All were sampled from the main stem.

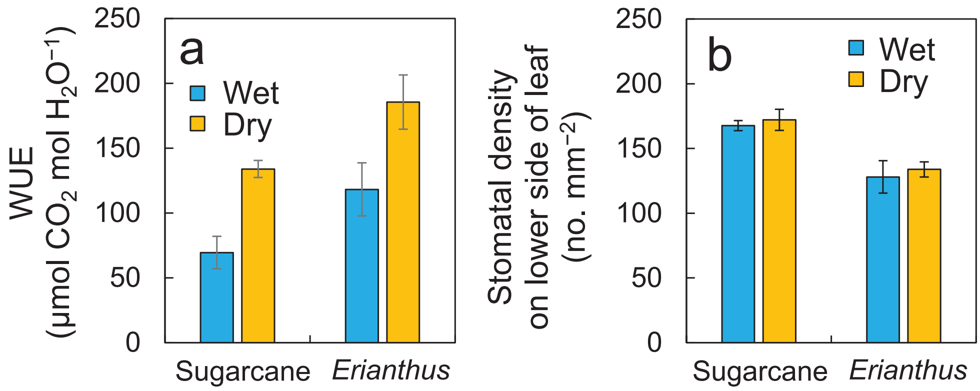


Fig. 2. Interspecific differences in water use efficiency (WUE) calculated from leaf gas exchange parameters (a) and stomatal density on the lower side of leaf (b)

Blue and orange bars represent soil wet and dry treatments, respectively. Error bars represent standard deviations (n=4). These are the measured values for the middle-aged leaves. WUE was measured at a light intensity of 500 μmol m^{-2} s^{-1}. Interspecific differences are significant for each variable in each treatment (*t*-test, p<0.01).

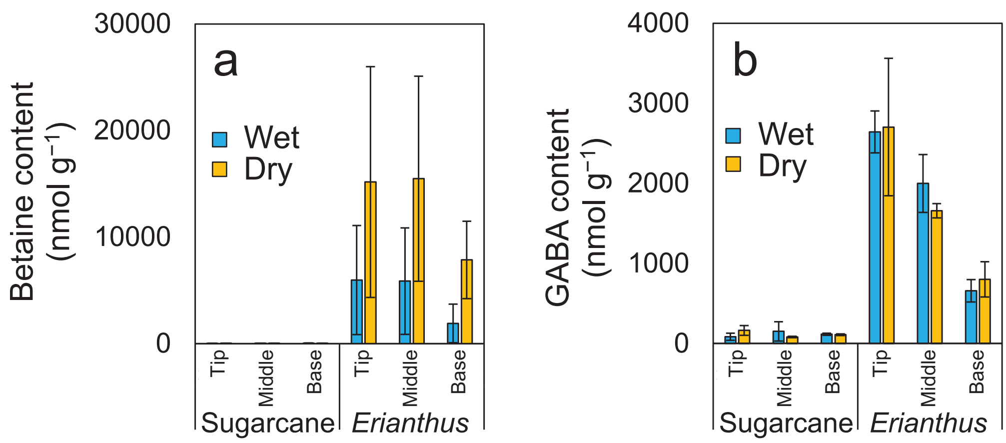


Fig. 3. Interspecific differences in betaine content (a) and GABA content (b) at different leaf parts (tip, middle, and base).

Blue and orange bars represent soil wet and dry treatments, respectively. Values are the means of three leaves; error bars represent standard deviations (n=3). Significant interspecific differences are found for each variable in each treatment (*t*-test, p<0.05), except for betaine in the wet plot.

Reference: Takaragawa & Wakayama (2024) *Planta* 260: 90.

DNA markers for assisted selection of cassava resistant to cassava mosaic disease (CMD)

Cassava (*Manihot esculenta*) is an important crop cultivated in tropical and subtropical regions. The stable production of cassava is crucial for food security, as its starch is used in both food and industrial applications. However, cassava mosaic disease (CMD), a viral disease, has significantly hampered cassava productivity, particularly in Africa, India, and recently in Southeast Asia. Developing CMD-resistant cassava varieties is essential, but traditional breeding methods are time-consuming and costly. Therefore, there is a need for DNA markers that can identify the mutations providing CMD resistance to accelerate and reduce the cost of breeding resistant varieties.

As a result, the authors have confirmed mutations in the DNA polymerase δ subunit 1 (*MePOLD1*) gene, associated with CMD resistance, in cassava varieties and lines maintained by the Agricultural Genetics Institute (AGI) in Vietnam. These mutations, G680V and L685F, were found in lines introduced from the International Center for Tropical Agriculture (CIAT) in Colombia and the International Institute of Tropical Agriculture (IITA) in Nigeria, respectively. The developed DNA markers can distinguish these *POLD1* genotypes using two methods: the dCAPS method, which is cost-effective, and the KASP method, which is suitable for high-throughput screening. Field trials in CMD-infected areas showed that cassava lines with the G680V mutation exhibited significantly less severe symptoms compared to non-mutated lines, demonstrating the effectiveness of the DNA markers.

In terms of applications, the developed DNA markers enable the efficient selection of CMD-resistant cassava, thereby facilitating the breeding of varieties suited to conditions in Southeast Asia. These tools can be applied not only to combat CMD in Southeast Asia but also to develop resistant varieties against CMD races prevalent in Africa.

Authors: Tokunaga, H. [JIRCAS], Nhan, P.T., Hoa, T.M., Trang, N.T.H., Tung, N.B. [HLARC],
Huong, P.T, Anh N.H., Huong, L.T.M., Ham, L.H. [AGI],
Thuy, C.T., Zhang, X. [CIAT], Seki, M. [RIKEN]

A Southeast Asian variety (CMD-susceptible)   C-33 (CMD-resistant)

Fig. 1. Cassava mosaic disease-resistant varieties
Cultivation of cassava in CMD-infected fields in Vietnam for three months. While the typical Asian variety exhibits CMD symptoms, the C-33 line grows without any disease symptoms. Photo provided by Thuy, C. T. (CIAT).

Table 1. Mutations in the *POLD1* genes in CMD-resistant varieties and lines

Variety/Line	CMD susceptibility	Mutations in *POLD1* and corresponding amino acid replacements: 680th amino acid – Codon	680th amino acid – Amino acid	685th amino acid – Codon	685th amino acid – Amino acid
Asian varieties	Susceptibility	G G T	G	T T G	L
CIAT lines from Colombia	Resistance	G T T	V	T T G	L
IITA varieties from Nigeria	Resistance	G G T	G	T T C	F

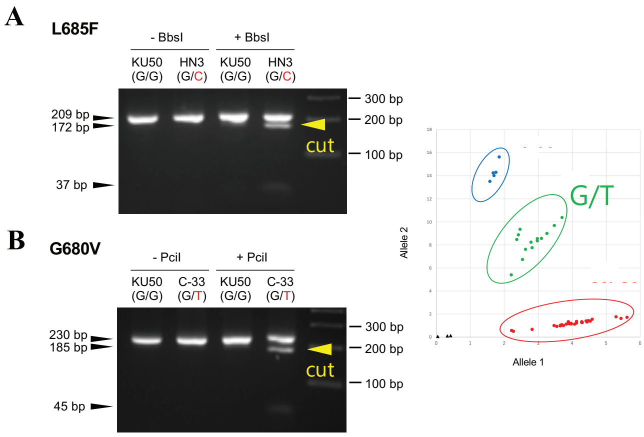


Fig. 2. Identification of *POLD1* mutations using DNA markers
(A, B) The dCAPS method creates restriction enzyme sites into PCR products, identifying *POLD1* gene mutations in WT (KU50), L685F (HN3), and G680V (C-33). PCR products treated with BbsI (A) or PciI (B) show WT if not cut, mutant type if cut. (C) The KASP assay rapidly identifies WT and G680V mutant *POLD1* genes, classifying individuals into WT G/G, heterozygous G/T, and homozygous T/T.

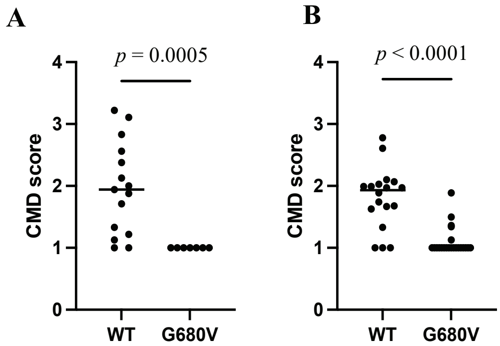


Fig. 3. Association between *POLD1* genotype and CMD resistance
(A, B) Observed CMD symptoms in progeny of G680V-resistant lines crossed with Southeast Asian (A) or South American (B) varieties after 3 months in CMD-infected fields. CMD symptom score 1 indicates no symptoms; higher scores indicate more severe symptoms. Significant differences in CMD scores were found between normal and G680V *POLD1* genes using the dCAPS method.

Reference: Tokunaga et al. (2025) *Breeding Science* 75: 111–118.

Training and Invitation Programs

Information Events

Invitation Programs at JIRCAS

In line with its mission as an international research institution, JIRCAS actively implements several invitation programs for foreign researchers and administrators from counterpart organizations. These programs are designed to promote the exchange of information and perspectives on research in agriculture, forestry, and fisheries. At the same time, they serve as a platform for strengthening collaborative ties among scientists and administrators, particularly in developing regions.

Following the COVID-19 pandemic, JIRCAS has reinforced its commitment to international collaboration by enhancing its invitation programs in FY 2024. The programs implemented during this fiscal year are summarized below.

Administrative Invitation Program

The purpose of this program is to invite administrators with a high level of specialized knowledge or management capabilities to Japan for strategic discussions to promote collaborative activities between the counterpart organizations and JIRCAS and to share cutting-edge information in the field through various workshops, seminars, and international symposiums organized by JIRCAS. In FY 2024, a total of forty-five (45) administrators visited JIRCAS under this program. The names of administrators who visited JIRCAS and their lengths of stay are listed below.

Administrative Invitations, FY 2024

Name	Institution/Organization	Duration
Patricia Mollinedo	Chemical Research Institute-Department of Chemistry-University of San Andres (Universidad Mayor de San Andrés UMSA), Bolivia	May 7 - 24, 2024
Rolando Gregorio Oros Martínez	FUNDACIÓN PROINPA, Bolivia	May 12 - 29, 2024
Giovanna Rocio Almanza Vega	Chemical Research Institute-Department of Chemistry-University of San Andres (Universidad Mayor de San Andrés UMSA), Bolivia	May 13 - 29, 2024
Máximo Torero	Food and Agriculture Organization of the United Nations (FAO)	Oct. 5 - 9, 2024
Pham Quang Minh	Food, Agriculture and Forestry Division, The ASEAN Secretariat, INDONESIA	Oct. 2 - 5, 2024
Jean Balié	CGIAR Poverty Reduction Livelihoods & Jobs Impact Area Platform, France	Sep. 30 - Oct. 5, 2024
Jacqueline D'Arros Hughes	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India	Sep. 28 - Oct. 5, 2024
Mohamed Zabawi Bin Abdul Ghani	Malaysian Agricultural Research and Development Institute (MARDI), Ministry of Agriculture and Food Industry, Malaysia	Oct. 2 - 5, 2024
Phisamai Srichayet	Institute of Food Research and Product Development (IFPRD), Kasetsart University, Thailand	Oct. 2 - 5, 2024
Fadjry Djufry	Indonesian Agency for Agricultural Instrument Standardization (IAAIS), Indonesia	Oct. 2 - 5, 2024
Nuning Argo Subekti	Indonesian Center for Food Crops Instrument Standards (ICFOS), Indonesian Agency for Agricultural Instrument Standardization (IAAIS), Indonesia	Oct. 2 - 5, 2024
Tilak Raj Sharma	Indian Council of Agricultural Research (ICAR), India	Dec. 1 - 7, 2024
Chandra Nath Mishra	Indian Council of Agricultural Research - Indian Institute of Wheat and Barley Research (ICAR-IIWBR), India	Dec. 1 - 8, 2024
Rajender Kumar	ICAR-Central Soil Salinity Research Institute (ICAR-CSSRI), India	Dec. 1 - 8, 2024
Ajay Kumar Bhardwaj	ICAR-Central Soil Salinity Research Institute (ICAR-CSSRI), India	Dec. 1 - 8, 2024
Arun Kumar Joshi	Borlaug Institute for South Asia (BISA), India	Dec. 1 - 7, 2024

Administrative Invitations, FY 2024		
Name	Institution/Organization	Duration
Nithya Rajan	Department of Soil and Crop Sciences, Texas A&M University (TAMU), USA	Nov. 16, 2024 - Feb. 10, 2025
Odeny Damaris	Cluster Leader, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India	Dec. 2 - 8, 2024
Nedumaran Swamikannu	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India	Dec. 2 - 8, 2024
Manish Kumar Vishwakarma	Borlaug Institute for South Asia (BISA), India	Dec. 1 - 8, 2024
Pradeep Kumar Bhati	Borlaug Institute for South Asia (BISA), India	Dec. 1 - 8, 2024
Michael Peters	Tropical Forages Program, International Center for Agricultural Research (CIAT), Kenya	Nov. 29, 2024 - Dec. 8, 2025
Jill Cairns	Global Maize Program, CIMMYT, Zimbabwe	Dec. 1 - 8, 2024
Jacobo Arango Mejia	Tropical Forages Program, International Center for Tropical Agriculture (CIAT), Colombia	Nov. 29 - Dec. 7, 2025
Nur Hajar Zamah Shari	Forestry and Environment Division, Forest Research Institute Malaysia (FRIM), Malaysia	Jan. 27 - Feb. 3, 2025
Venuprasad Ramaiah	International Rice Research Institute (IRRI), Philippines	Nov. 20 - 24, 2024
Sarada Krishnan	The Global Crop Diversity Trust (The Crop Trust), Germany	Nov. 20 - 24, 2024
Prakit Somta	Department of Agronomy, Faculty of Agriculture at Kamphaeng Sean, Kasetsart University, Thailand	Nov. 19 - 24, 2024
Deepak Pandey	National Wheat Research Program (NWRP), Nepal	Dec. 1 - 9, 2024
Mahesh Subedi	Department of Genetics and Plant Breeding, Nepal Agricultural Research Council (NARC), Nepal	Dec. 1 - 9, 2024
Khem Raj Pant	National Wheat Research Program (NWRP), Nepal	Dec. 1 - 9, 2024
Shi Weiming	Soil-Plant Nutrition and Fertilizers, Institute of Soil Science, Chinese Academy of Sciences (ISSCAS), China	Dec. 2 - 7, 2024
Veronica Faith Guwela	Agricultural System/Climate Change, International Maize and Wheat Improvement Center (CIMMYT), Mexico	Dec. 1 - 7, 2024
Carolina Saint-Pierre	Agricultural System/Climate Change, International Maize and Wheat Improvement Center (CIMMYT), Mexico	Dec. 1 - 7, 2024
William Lloyd Rooney	Department of Soil and Crop Sciences, Texas A&M University (TAMU), USA	Dec. 1 - 6, 2024
Oswald Raphael Crasta	Agricultural Research Service, United States Department of Agriculture (USDA-ARS), USA	Dec. 1 - 6, 2024
Timothy Darrow Searchinger	Princeton University, USA	Dec. 1 - 6, 2024
Dario Landa Silva	University of Nottingham, United Kingdom	Mar. 5 - 16, 2025
Seetha Jaganathan King	Agro-Biotechnology Institute, National Institutes of Biotechnology Malaysia (ABI, NIBM), Malaysia	Feb. 24 - 28, 2025
Raha Binti Abdul Rahim	National Institutes of Biotechnology Malaysia (NIBM), Malaysia	Feb. 24 - 28, 2025
K. Sudesh Kumar C. Kanapathi Pillai	School of Biological Sciences, Universiti Sains Malaysia (USM), Malaysia	Feb. 24 - 28, 2025
Joseph Agebase Awuni	University for Development Studies (UDS), Ghana	Mar. 7 - 16, 2025
Mustapha Mohammed	University for Development Studies (UDS), Ghana	Mar. 7 - 16, 2025
Vincent Kodjo Avornyo	University for Development Studies (UDS), Ghana	Mar. 7 - 16, 2025
Kwabena Darkwa	CSIR-Savanna Agricultural Research Institute (CSIR-SARI), Ghana	Mar. 7 - 16, 2025

Counterpart Researcher Invitation Program

The purpose of this program is to invite researchers from counterpart organizations of JIRCAS to facilitate competent collaboration by strengthening ties among researchers and improving research capabilities. The invited counterparts carry out data analysis in close cooperation with Japanese researchers, and they conduct experiments and advanced research using high-precision equipment. This makes it possible to effectively promote research activities. Besides JIRCAS, researchers from counterpart organizations also conduct in-depth research at other MAFF-affiliated national research and development agencies, prefectural research institutes, or national universities in Japan. A total of twenty-two (22) researchers were invited under this program in FY 2024. The names of counterpart researchers who visited JIRCAS, their research themes, and their durations of stay are listed below.

Counterpart Researcher Invitations, FY 2024

Name	Institution/Organization	Research Theme	Duration
Marina Monserrat-Diez	Archara Biology and Ecogenomics Unit, Department of Functional and Evolutionary Ecology, Faculty of Life Sciences, University of Vienna (UNIVIE), Austria	Soil nitrification-related microbial flora of BNI-enabled wheat field at JIRCAS	Mar.16 - Jun.1, 2024
Megan Leigh Schill	Department of Soil and Crop Sciences, Texas A&M University (TAMU), USA	Exploration of BNI compounds from wild sorghum	May 10 - 31, 2024
Jennifer T. Niones	Crop Protection Division, Philippine Rice Research Institute (PhilRice), Philippines	Evaluation of rice breeding lines with partial resistance gene for blast disease in the Philippines	Sep. 2 - 7, 2024
Salvacion E. Santiago	Crop Protection Division, Philippine Rice Research Institute (PhilRice), Philippines	Evaluation of rice breeding lines with partial resistance gene for blast disease in the Philippines	Sep. 2 - 7, 2024
Ouk Rachana	Royal University of Agriculture (RUA), Cambodia	The project for development and social implementation of greenhouse gas emission reduction technologies in paddy fields of West Tonle Sap Lake by establishing a large paddy area water management system	Aug. 18 - 31, 2024
Chea Sophors	Faculty of Forestry, Royal University of Agriculture (RUA), Cambodia	The project for development and social implementation of greenhouse gas emission reduction technologies in paddy fields of West Tonle Sap Lake by establishing a large paddy area water management system	Aug. 18 - 31, 2024
Namphueng Chomphukhiao	Khon Kaen Field Crops Research Center, Field and Renewable Energy Crops Research Institute, Department of Agriculture (KKFCRC, FCRI, DOA), Thailand	Development of IPM system against fall armyworm based on the ecological characteristics in Indochina peninsula	Aug. 23 - 31, 2024
Gao Xiang	Chinese Academy of Agricultural Sciences (CAAS), China	Nitrogen dynamics and plant physiological analysis in field trials of high and low BNI sorghum germplasm	Jul. 18 - Dec. 13, 2024
Jimmy Casto Ciancas Jimenez	Research, Development and Production, FUNDACIÓN PROINPA, Bolivia	SATREPS Project: Strengthening of Resilience in Arid Agro-Ecosystems Vulnerable to Climate Change, Through Research on Plant Resources and Technological Applications	Aug. 31 - Nov. 2, 2024
Singgih Utomo	Vocational College, Universitas Gadjah Mada (UGM), Indonesia	Evaluation of the Impact of Forest Restoration and Afforestation on Economy, Society and Environment	Sep. 23 - Oct. 2, 2024

Counterpart Researcher Invitations, FY 2024			
Name	Institution/Organization	Research Theme	Duration
Budiadi	Faculty of Forestry, Universitas Gadjah Mada (UGM), Indonesia	Evaluation of the Impact of Forest Restoration and Afforestation on Economy, Society and Environment	Sep. 23 - Oct. 2, 2024
Jangkung Handoyo Mulyo	Department of Agricultural Socio-economics, Faculty of Agriculture, Universitas Gadjah Mada, (UGM), Indonesia	Evaluation of the Impact of Forest Restoration and Afforestation on Economy, Society and Environment	Sep. 23 - Oct. 2, 2024
Md Hasri, Nur Hanis Alisa Binti	School of Biological Sciences, Universiti Sains Malaysia (USM), Malaysia	Analysis of the functional gene expression status of OPT sugar accumulation by metatranscriptome analysis	Nov. 6, 2024 - Mar. 7, 2025
Jorge Angel Nicolas Quezada Portugal	Instituto de Biología Molecular Biotecnología, Biology Department, Universidad Mayor de San Andrés (UMSA), Bolivia	SATREPS Project: Strengthening of Resilience in Arid Agro-Ecosystems Vulnerable to Climate Change, Through Research on Plant Resources and Technological Applications	Sep. 22 - Dec. 7, 2024
Milton Villca Sanchez	Research, Development and Production, FUNDACIÓN PROINPA , Bolivia	SATREPS Project: Strengthening of Resilience in Arid Agro-Ecosystems Vulnerable to Climate Change, Through Research on Plant Resources and Technological Applications	Oct. 18 - Nov. 18, 2024
Santiago Tarqui Tarqui	Department of Chemical Sciences, Universidad Mayor de San Andrés (UMSA), Bolivia	SATREPS Project: Strengthening of Resilience in Arid Agro-Ecosystems Vulnerable to Climate Change, Through Research on Plant Resources and Technological Applications	Oct. 19 - Nov. 18, 2024
Benjaluk Pavasopon	Institute of Food Research and Product Development (IFRPD), Kasetsart University, Thailand	The International Scientific Advisory Board for Strategy “MIDORI”	Oct. 2 - 5, 2024
Prosper Kpiebayaa	Department of Agricultural Engineering, School of Engineering, University for Development Studies (UDS), Ghana	Development of soil and crop management technology components that contribute to improve soil health in wet savanna	Nov. 12 - Dec. 7, 2024
Matthias Wissuwa	Institute of Crop Science and Resource Conservation (INRES), University of Bonn, Germany	Development of breeding materials of rice and vegetables targeting increase in food production and improvement in nutritional status in Africa	Oct. 11 - 31, 2024
Mohammad Salim Mian	Plant Pathology Division, Bangladesh Rice Research Institute (BRRI), Bangladesh	Fundamental collaborative research project for development of advanced differential system toward sustainable rice blast control in Bangladesh	Feb. 1 - 23, 2025
Siti Rokhiyah Binti Ahmad Usuldin	Agro-Biotechnology Institute, National Institutes of Biotechnology Malaysia (ABI, NIBM), Malaysia	Research and study for global deployment of next generation biomass upcycling technology	Feb. 24 - 28, 2025
Norsharina Binti Md Saad	Agro-Biotechnology Institute, National Institutes of Biotechnology Malaysia (ABI, NIBM), Malaysia	Research and study for global deployment of next generation biomass upcycling technology	Feb. 24 - 28, 2025

Project Site Invitation Program

The purpose of this program is to support international travel for counterpart researchers, not only to collaborate with JIRCAS scientists at the project sites but also to provide opportunities to actively participate in discussions at international symposiums. In FY 2024, a total of fourteen (14) researchers participated in this program and played significant roles in the symposiums and workshops with JIRCAS researchers, as listed below.

Project Site Invitations, FY 2024

Name	Institution/Organization	Purpose	Duration
Nguyen Cong Thuan	College of Environment and Natural Resources, Can Tho University (CTU), Vietnam	To attend the Workshop on Intermittent Irrigation for Methane Emission Reduction from Paddy and exchange views on climate change measures in the agriculture sector	Sep. 25 - 28, 2024
Tran Sy Nam	College of Environment and Natural Resources, Can Tho University (CTU), Vietnam	To attend the Workshop on Intermittent Irrigation for Methane Emission Reduction from Paddy and exchange views on climate change measures in the agriculture sector	Sep. 25 - 28, 2024
Dinh Thai Danh	College of Environment and Natural Resources, Can Tho University (CTU), Vietnam	To attend the Workshop on Intermittent Irrigation for Methane Emission Reduction from Paddy and exchange views on climate change measures in the agriculture sector	Sep. 25 - 28, 2024
Vongsakda Vongxay	Department of Irrigation (DOI), Ministry of Agriculture and Forestry, Lao PDR	To attend the Workshop on Intermittent Irrigation for Methane Emission Reduction from Paddy and exchange views on climate change measures in the agriculture sector	Sep. 25 - 28, 2024
Soulivanh Voravong	Department of Irrigation (DOI), Ministry of Agriculture and Forestry, Lao PDR	To attend the Workshop on Intermittent Irrigation for Methane Emission Reduction from Paddy and exchange views on climate change measures in the agriculture sector	Sep. 25 - 28, 2024
Keomany Thanasack	Department of Irrigation (DOI), Ministry of Agriculture and Forestry, Lao PDR	To attend the Workshop on Intermittent Irrigation for Methane Emission Reduction from Paddy and exchange views on climate change measures in the agriculture sector	Sep. 25 - 28, 2024
Widiyatno	Faculty of Forestry, Universitas Gadjah Mada (UGM), Indonesia	Workshop on DNA Profiling and DNA Barcoding for the Management and Utilisation of Forest Resources	Feb. 23 - 28, 2025
Widyanto Dwi Nugroho	Faculty of Forestry, Universitas Gadjah Mada (UGM), Indonesia	Workshop on DNA Profiling and DNA Barcoding for the Management and Utilisation of Forest Resources	Feb. 23 - 28, 2025
Sudarat Sirimantanawong	Royal Forest Department (RFD), Thailand	Workshop on DNA Profiling and DNA Barcoding for the Management and Utilisation of Forest Resources	Feb. 23 - 28, 2025
Anongkhanee Ruantip	Royal Forest Department (RFD), Thailand	Workshop on DNA Profiling and DNA Barcoding for the Management and Utilisation of Forest Resources	Feb. 23 - 28, 2025
Kongsang Puwinsaksakul	Royal Forest Department (RFD), Thailand	Workshop on DNA Profiling and DNA Barcoding for the Management and Utilisation of Forest Resources	Feb. 23 - 28, 2025
Kritchaya Maeban	Royal Forest Department (RFD), Thailand	Workshop on DNA Profiling and DNA Barcoding for the Management and Utilisation of Forest Resources	Feb. 23 - 28, 2025
Truong Huong Lan	Food Industries Research Institute (FIRI), Department of Food Technology and Nutrition, Vietnam	Attending research seminar on the safety, nutritional, and functional properties of koji-amazake products and related microorganisms, and liquefaction of fermented rice noodles	Mar. 6 - 8, 2025

Project Site Invitations, FY 2024			
Name	Institution/Organization	Purpose	Duration
Sayvisene Boulom	Faculty of Agriculture, National University of Laos (FAG-NUoL), Department of Rural Economy and Food Technology, Lao PDR	Attending research seminar on the safety, nutritional, and functional properties of koji-amazake products and related microorganisms, and liquefaction of fermented rice noodles	Mar. 6 - 8, 2025

Fellowship Programs at JIRCAS

JIRCAS Visiting Research Fellowship Program

The JIRCAS Visiting Research Fellowship Program is a key initiative of the Japan International Research Center for Agricultural Sciences (JIRCAS), aimed at promoting scientific advancement and enhancing the research capabilities of selected researchers from developing countries. This program provides fellows with the opportunity to conduct research under the guidance of JIRCAS scientists. Since its establishment in 1992, the program has welcomed numerous talented researchers from institutions in developing countries to engage in collaborative research activities.

In FY 2024, three fellows who were awarded the fellowship in FY 2023 successfully completed their research in October 2024. Among them, two researchers resumed their work at their home institutions, where they are now applying the knowledge and experience gained through the program to further their research initiatives. The remaining researcher was selected again for the FY 2024 fellowship program.

Including the fellow who was awarded a second time, a total of four fellows were chosen for the FY 2024 program—three for the program at the JIRCAS Headquarters in Tsukuba and one for the program at the JIRCAS research site in Madagascar. They commenced their research activities in October 2024 and will continue their work under the guidance of JIRCAS supervisors until October 2026. A detailed list of the fellows, their respective research topics, and their periods of stay is provided below.

JIRCAS Visiting Research Fellowship at Tsukuba

Name	Institution/Organization	Research Theme	Duration
Pattsarun Cheawchanlertfa	Office for Research and Development, Faculty of Medicine Siriraj Hospital, Mahidol University (MU), Thailand	Identification and application of genes involved in dramatic improvement of degradation ability of cellulose saccharifying microorganisms	Oct. 15, 2023 - Oct. 14, 2024
Zhang Haiyan	Hunan Vegetable Research Institute, Hunan Academy of Agricultural Sciences (HUNAAS), China	Hydrophilic- and Hydrophobic-BNI characterization of parental Maize CIMMYT Maize inbred Lines (CMLs) used in the development of DHL populations	Oct. 9, 2023 - Oct. 4, 2024
Zhang Wei	Institute of Industrial Crops, Jiangsu Academy of Agricultural Sciences (JAAS), China	Elucidation of genetic mechanism controlling root development in soybean	Oct. 16, 2023 - Oct. 11, 2024
Pattsarun Cheawchanlertfa	Office for Research and Development, Faculty of Medicine Siriraj Hospital, Mahidol University (MU), Thailand	Comprehensive analysis of the genes affected by high sugar accumulation in microbial saccharification technology microorganisms	Oct. 15, 2024 - Oct. 15, 2025
Lin Yuhu	Fujian Agriculture and Forestry University (FAFU), China	BNI characterization of parental Maize CIMMYT Maize inbred Lines (CMLs) used in the development of DHL populations	Nov. 5, 2024 - Sep. 30, 2025
Ramahaimandimby, Zoniaina S.	University of Antananarivo, Madagascar	Empirical analysis of factors related to food production and consumption of farmers in Madagascar	Oct. 2, 2024 - Oct. 1, 2025
Razakatiana, Adamson Tsoushima Ernest	National Center for Environmental Research (CNRE), Madagascar	Identification and functional analysis of useful indigenous nitrogen-fixing bacteria strains for improving bean productivity in Madagascar	Oct. 2, 2024 - Oct. 1, 2025

Other Fellowships

The JSPS International Postdoctoral Fellowships Program provides opportunities for postdoctoral researchers from other countries to conduct collaborative research with leading research groups in universities and other Japanese institutions. In addition, in response to requests from key collaborative research institutions, JIRCAS also accepts researchers under its Guest Researcher Program. This initiative includes training aimed at developing future research leaders who will serve as hubs for international collaborative research. JIRCAS hosted one JSPS International Fellow and one Guest Researcher in FY 2024, as listed below.

JIRCAS Visiting Research Fellowship at Project Site			
Name	Institution/Organization	Research Theme	Duration
Rajonandraina, Toavintsoa	Department of Plant Biology and Ecology (DBEV), University of Antananarivo, Madagascar	Elucidation of iron dynamics in rice possessing different tolerance mechanisms to iron toxicity	Oct. 21, 2024 - Oct. 19, 2025

Guest Researcher			
Name	Institution/Organization	Research Theme	Duration
Qiang Chen	Institute of Cereal and Oil Crops, Hebei Academy of Agriculture and Forestry Sciences (HAAFS), China	Identification and functional analyses of genes controlling root traits in soybean	Sep. 10, 2024 - Sep. 9, 2025

Workshops

“Bolivia Symposium: The Charms of Salar de Uyuni, Quinoa, and Llamas ”

On Monday, May 20, 2024, JIRCAS and the Embassy of the Plurinational State of Bolivia in Japan held the “Bolivia Symposium: The Charms of Salar de Uyuni, Quinoa, and Llamas” at the Japan Science and Technology Agency (JST) Tokyo Headquarters Annex. This hybrid gathering was recognized as a commemorative event for the 110th anniversary of the establishment of diplomatic relations between Japan and Bolivia and the 125th anniversary of Japanese immigration to Bolivia.

In the first session on “Quinoa and Llamas,” Dr. Rolando Gregorio Oros Martínez (General Manager of the PROINPA Foundation) introduced the “Diversity and Charm of Andean Crops,” Dr. Giovanna Rocio Almanza Vega (Professor at San Andrés University) presented the “Functionality of Quinoa and Bolivian Quinoa Cuisine,” and Dr. Yukari Nagatoshi (Project Leader at JIRCAS) discussed the “SATREPS Super Food Bolivia Project: The Charms of Quinoa.”

In addition, in light of the fact that 2024 was the International Year of the Camel, the Bolivian Ministry of Foreign Affairs screened a video about camelids (llamas, alpacas, guanacos, vicuñas, etc.), explaining their importance to local communities and to Bolivia’s economy and food security. This was followed by Dr. Yuji Toukura (Manager of Human Resource Development at Obihiro University of Agriculture and Veterinary Medicine), who spoke about “Camelids in South America – Llamas and Vicuñas.” Dr. Seiji Yanagihara (Vice-President of JIRCAS) closed Session 1 on behalf of the organizers.

In the second session, Ms. Natalia Fernanda Salazar Balderrama (Chargé d′Affaires ad interim of the Embassy of the Plurinational State of Bolivia in Japan) introduced Bolivian tourism and culture, and attendees had the opportunity to taste quinoa dishes and enjoy live performances of Andean folklore music.

Scene at the venue

Tasting quinoa dishes

Special Seminar with Dr. Máximo Torero, Chief Economist, FAO - Priority Policy and Investment Options for Global Food Security and Nutrition and Resilient Food Systems

In recent years, globalized food systems have faced a multitude of risks, including pandemics and geopolitical conflicts, which amplify uncertainty over global food security by triggering supply chain disruptions and export restrictions. Simultaneously, as global average temperatures are breaking records, extreme weather events such as heat waves, floods, and droughts, as well as outbreaks of plant and animal pests and diseases, are also observed around the world with increasing frequency, adding new risks of supply shocks. Consequently, decades of progress toward eliminating hunger have been diverted from the pre-COVID trend. The exposure of global food systems to cascading risks and subsequent uncertainty is becoming an increasing concern, especially in light of the goal to achieve SDG2 by 2030.

Dr. Máximo Torero, Chief Economist of the UN Food and Agriculture Organization (FAO) delivered the keynote speech at a special seminar titled “Priority Policy and Investment Options for Global Food Security and Nutrition and Resilient Food Systems.”

Beginning his remarks by outlining the current state of global food security, Dr. Torero cited the FAO’s updated statistics on 733 million hungry people. He pointed out that the COVID-19 pandemic, along with conflicts, climate change, and economic crisis, has played a crucial role in exacerbating hunger and is expected to continue doing so until 2030.

He then stressed the importance of increasing resilience to shocks such as droughts, tropical cyclones, floods, pandemics, heatwaves, locust infestations, and political conflicts through ‘anticipatory action,’ a response mechanism to disburse funds to concerned communities before a shock occurs. He also elaborated on the effectiveness of social protection programs in improving resilience. Given the limited resources that exist, he presented FAO’s efforts to guide the prioritization of hunger-related investment initiatives, which involve both short-term interventions like ICT, school feeding programs, emergency response, and social protection, as well as long-term interventions like agricultural extension services and agricultural research and development.

Referring to the FAO’s slogan, “Good Food for All, for Today and Tomorrow,” he emphasized the need to guarantee the right to food without breaching the 1.5°C climate target. This implies that society must produce more with less, and that the global community needs to build an efficient agrifood system while establishing better food distribution worldwide. He concluded by calling on the audience to work collectively toward achieving this goal, which will benefit the global population.

Following his keynote speech, he was joined by two distinguished panel members—Mr. Hiroyuki Yamaguchi, Vice President of JICA, and Dr. Akihiko Hirasawa, Research Counsellor at the Norinchukin Research Institute—to discuss priority policy investment options for global food security and resilient food systems.

Dr. Máximo Torero

Symposium

Symposium with Dr. Cary Fowler, 2024 World Food Prize Laureate "Dr. Fowler's Journey to Preserve Genetic Diversity and New Mission for Africa's Adapted Crops and Soils"

To commemorate the achievements of Dr. Cary Fowler, recipient of the 2024 World Food Prize, JIRCAS organized a special symposium titled "Dr. Fowler's Journey to Preserve Genetic Diversity and New Mission for Africa's Adapted Crops and Soils." The symposium was held on Friday, October 11, 2024, from 14:00 to 16:30 at the Ichijo Hall, Yayoi Auditorium, The University of Tokyo, and online. The event was hosted by JIRCAS and supported by the Ministry of Foreign Affairs of Japan (MOFA), the Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF), the Japan Intellectual Support Network in Agricultural Sciences (JISNAS), and the Science Council of Japan.

The diversity of crop genetic resources serves as the biological foundation of agriculture and, consequently, our civilization. These resources are essential for all future plant breeding and crop improvement efforts as humanity faces ever-increasing challenges from climate change, pandemics, conflicts, and other existential threats. However, the gradual loss of crop genetic diversity from farmers' fields necessitates the preservation of backups at gene banks. As we navigate uncharted territories in a world full of uncertainties, the diversity of crop genetic resources — featuring traits such as climate resilience, pest resistance, high nutritional value, and salt tolerance, among others — is a fundamental global common good that ensures resilient agriculture and thus food security.

Dr. Cary Fowler, the Special Envoy for Global Food Security at the US Department of State, has led global efforts to promote the conservation of crop species as well as their wild relatives over the decades. He is also known for leading the launch of a joint US Department of State–Food and Agriculture Organization (FAO)–Africa Union initiative, the Vision for Adapted Crops and Soils (VACS), with a focus on Africa.

The symposium began with opening remarks from Mr. Osamu Koyama (President, JIRCAS), Mr. Osamu Kubota (Deputy Assistant Minister, Export and International Affairs Bureau, MAFF), and Ms. Yasuko Nishimura (Director, Resource Security Division, MOFA), expressing their gratitude and highlighting Japan's contributions to genetic resource conservation and support for Enhanced Linkages between Private sector and Small-scale producers (ELPS) and VACS initiatives.

In Session 1, "Dr. Fowler's journey in preserving crop genetic diversity for resilient agriculture and food systems," Dr. Katsuhiro Matsui (National Agriculture and Food Research Organization, NARO) introduced Japan's gene bank efforts, followed by Dr. Masa Iwanaga (JIRCAS) presenting an overview of Dr. Fowler's career. Dr. Fowler then delivered his keynote speech, covering three themes: global food security, the VACS initiative, and the Svalbard Global Seed Vault.

Next, in Session 2 "Why VACS? Opportunities for the vision for adapted crops and soils to realize resilient food systems in Africa," Dr. Alexandros Gasparatos (University of Tokyo) discussed underutilized plant species, Dr. Kotaro Iseki (JIRCAS) presented on cowpea production systems, and Dr. Satoshi Nakamura (JIRCAS) introduced soil health and the Terra Africa project.

The panel discussion in Session 3 was moderated by Dr. Papa Saliou Sarr (JIRCAS), featuring Dr. Fowler and Session 2 speakers, who engaged in an interactive discussion on collaboration, Africa, and environmental challenges. The symposium concluded with closing remarks by Dr. Hiroshi Ehara (Nagoya University), summarizing the key points of the day. Throughout the event, Dr. Sakiko Shiratori (JIRCAS) served as MC. A networking reception followed the symposium and was held in the entrance hall.

There were 47 in-person (excluding speakers) and 162 online participants. The audience comprised a diverse range of participants, including representatives from the U.S. Department of State, MAFF, MOFA, national research institutes, universities, and international organizations.

An archived video of the symposium is available on the JIRCAS YouTube channel.
https://youtu.be/ITy36zJKXXk
(Part 1: Opening Remarks & Introduction of Dr. Fowler)
https://youtu.be/lPZUrBG90Hs
(Part 2: Keynote Speech)
https://youtu.be/z8XdlB3wDPk
(Part 3: Session 2 "Why VACS?")
https://youtu.be/f1nxqwfXcmQ
(Part 4: Panel Discussion & Closing Remarks)

Dr. Cary Fowler

Panel Discussion

International Symposiums, Workshops, and Seminars, FY 2024			
1	The 3rd Joint Coordination Committee Meeting for the SATREPS Bolivia Superfoods Project	May 16, 2024	Online
2	The Bolivia Symposium: The Charms of Salar de Uyuni, Quinoa, and Llamas	May 20, 2024	Tokyo, Japan and online
3	Special Seminar: The Novo Nordisk Foundation-CropSustaiN Project for Advancing BNI-Enhanced Wheat Globally	June 19, 2024	Tsukuba, Japan and online
4	Tsukuba Plant Researchers' Network Meeting	July 12, 2024	Tsukuba, Japan
5	Kickoff Meeting in Pursat Province and Workshop of the S2-2L Farmer Water Users Association in the Damnak Ampil Irrigation Area	July 31, 2024	Pursat Province, Cambodia
6	MoU and Work Plan Signing Ceremony with the Bureau of Soils and Water Management (BSWM), Department of Agriculture, Philippines	August 9, 2024	Quezon City, Philippines
7	The 2nd Joint Coordination Committee /2nd Technical Coordination Committee for the SATREPS project titled "Establishment of Nitrogen-efficient Wheat Production Systems in Indo-Gangetic Plains by the Deployment of BNI Technology"	September 4, 2024	New Delhi, India
8	Technical Training Workshop for the Sasakawa Africa Association	September 9-12, 2024	Nyampala, Ghana
9	The 146th Lecture & Workshop of the Japanese Society of Breeding titled "Practical Knowledge on Utilizing Overseas Genetic Resources from Various Case Studies"	September 19, 2024	Hiroshima, Japan
10	Mangrove Management and Monitoring −Recovery process of mangroves in Batan Bay	September 23-29, 2024	Batan Bay and Aklan State University, Aklan Province, Philippines
11	SATREPS Cambodia Kickoff Meeting	September 26, 2024	Phnom Penh City, Cambodia
12	SATREPS Cambodia Workshop	September 27, 2024	Phnom Penh, Cambodia
13	NARO-JIRCAS-FFTC International Symposium titled "Control of Greenhouse Gases Emissions and Rice Heavy Metals Absorption through Paddy Field Water Management"	October 1-2, 2024	Tsukuba International Congress Center
14	The Fifth Meeting of the International Scientific Advisory Board for Strategy "MIDORI"	October 3-4, 2024	Nara, Japan
15	Special Seminar with Dr. Máximo Torero, Chief Economist, FAO - Priority Policy and Investment Options for Global Food Security and Nutrition and Resilient Food Systems	October 8, 2024	Online
16	Workshop on Irrigation Development and Soil Health	October 9, 2024	Accra, Ghana

International Symposiums, Workshops, and Seminars, FY 2024			
17	Symposium with Dr. Cary Fowler, 2024 World Food Prize Laureate – Dr. Fowler's Journey to Preserve Genetic Diversity and New Mission for Africa's Adapted Crops and Soils	October 11, 2024	Tokyo, Japan
18	Seminar on the "Research, development, and dissemination of liquefaction suppression technology for fermented rice noodles" at the Vietnam Food Industries Research Institute	October 15-16, 2024	Hanoi, Vietnam
19	Demonstration Trial: Deep Planting of Sugarcane to Improve Productivity and Preserve the Environment	October 16, 2024	Ishigaki, Japan
20	Special Seminar: "From SATREPS to Social Implementation" — The First Step toward Sustainable Palm Plantation Management and Palm Biomass Utilization	October 22, 2024	Penang, Malaysia
21	The 6th (Final) Joint Coordination Committee Meeting for the SATREPS Project	October 22, 2024	Penang, Malaysia
22	The 2nd Joint Coordination Committee Meeting for the SATREPS Project	October 29, 2024	Yogyakarta, Indonesia
23	The 2024 RFD–JIRCAS Project Management Meeting	November 7, 2024	Bangkok, Thailand
24	Ishigaki Island Future Scenario Workshop — Designing the Past, Designing the Future	November 9, 2024	Ishigaki, Japan
25	Annual Meeting for the JIRCAS Research Project B4, titled "Development and dissemination of sustainable aquaculture technologies in the tropical area based on the ecosystem approach"	November 13, 2024	Iloilo, Philippines and online
26	JIRCAS–SEAFDEC Joint Workshop on "Development of Aquaculture Systems through the Introduction of Intermediate Rearing Techniques and System Dynamics Modeling"	November 14-15, 2024	Iloilo, Philippines
27	FY2024 Project Progress Report Meeting [TERRA Africa]	November 21-22, 2024	Tamale, Ghana
28	JIRCAS International Symposium 2024 : Resilient Genetic Resources for Food Security in the Era of Global Boiling – Opportunities and Challenges for Conservation and Utilization	November 22, 2024	Tokyo, Japan and online
29	The 5th BNI International Consortium Meeting; CropSustaiN Meeting; JIRCAS / CIMMYT / USAID / NNF / SAA Meeting	December 3-7, 2024	Tsukuba International Congress Center and online
30	Cut-Soiler Stakeholder Meeting	December 3, 2024	New Delhi, India
31	PRIMAFF Seminar: "Global Food Supply and Demand Outlook by the U.S. Department of Agriculture and IFPRI"	December 4, 2024	Tokyo, Japan
32	JIRCAS Symposium: Impacts of Climate Change on Japan's Food Security and Global Food Supply and Demand — An Analysis Using the Long-Term Global Food Model MELIAM	December 5, 2024	Tokyo, Japan
33	Workshop on "Mangrove Management and Monitoring: Malay Peninsula"	December 9 & 13, 2024	Selangor, Malaysia
34	Seminar on the "Introduction of Small Hydropower for the Promotion of Rice Cultivation in Africa (Ghana)"	February 11, 2025	Asutsuare, Ghana
35	The 3rd Technical Committee Meeting on Support Survey for the Promotion of Rice Cultivation in Africa (Ghana)	February 12, 2025	Akuse, Ghana and online
36	SRA–Farmers' Day	February 17, 2025	Pampanga Province, Philippines
37	Workshop on "Water Use and Irrigation Development"	February 19-20, 2025	Tamale, Ghana
38	Workshop on "DNA Profiling and DNA Barcoding for the Management and Utilisation of Forest Resources"	February 24-27, 2025	Kuala Lumpur, Malaysia
39	The 3rd Technical Committee Meeting on Support Survey for the Promotion of Rice Cultivation in Africa (Tanzania)	February 26, 2025	Arusha, Tanzania and online

International Symposiums, Workshops, and Seminars, FY 2024			
40	Information Exchange Meeting for Promoting the Use of Rice-Koji and Koji-Amazake in Laos	February 26, 2025	Vientiane, Laos
41	Seminar on "Recommended Technology Guidelines for the Promotion of Rice Cultivation in Africa"	February 27, 2025	Arusha, Tanzania and online
42	FY 2024 FRIM–JIRCAS Project Management Meeting	March 3, 2025	Kuala Lumpur, Malaysia and online
43	Workshop on "Yam Variety Identification Technology Dissemination"	March 4, 2025	Tamale, Ghana
44	JIRCAS Hands-on Workshop for Simulation Study of Forest Dynamics Using SEIB–DGVM	March 4-5, 2025	Forest Research Institute Malaysia
45	Seminar on the Safety, Nutritional, and Functional Properties of Koji-Amazake Products and Related Microorganisms, and the Liquefaction of Fermented Rice Noodles	March 7, 2025	Bangkok, Thailand
46	The Sixth Meeting of the International Scientific Advisory Board for Strategy "MIDORI"	March 14, 2025	Online
47	Workshop for Promoting the Dissemination of Biogas Generators	March 29, 2025	Can Tho University, Vietnam

Appendix

Publishing at JIRCAS

English

1. JARQ (Japan Agricultural Research Quarterly)

   Vol. 58 No. 3 (Published in July 2024)

   Vol. 58 No. 4 (Published in October 2024)

   Vol. 59 No. 1 (Published in January 2025)

   Vol. 59 No. 2 (Published in April 2025)

2. Annual Report

   2023 (Published on 31 October 2024)

3. JIRCAS Newsletter

   No.97 (Published on 18 November 2024)

   No.98 (Published on 31 March 2025)

4. JIRCAS Working Report

   No.94 (Published on 28 March 2025)

Japanese

1. Kōhō JIRCAS

   Vol. 14 (Published on 29 October 2024)

   Vol. 15 (Published on 28 February 2025)

2. JIRCAS NEWS

   No.97 (Published on 18 November 2024)

   No.98 (Published on 31 March 2025)

Refereed Journal Articles 2024-2025

Program A

Alisa, H., Uke, A.*, Sudesh, K., Kosugi, A. (2024.6) Accumulation of starch and sugars, and effect on pathogenesis-related proteins in felled oil palm trunks from the replanting period. *Industrial Crops and Products*, https://doi.org/10.1016/j.indcrop.2024.118863

Anzai, T.*, Okamoto, K., Sakai, K., Saito, T., Inosako, K., Shikina, Y., Maetsu, M., Hateruma, Y. (2024.7) Water-saving effects of subsurface irrigation system "OPSIS" for sugarcane cultivation: A case study on Ishigaki Island, Japan. *Journal of Arid Land Studies*, 34(S): 1–5.

Arai, M., Ikazaki, K.*, Anzai, T., Celestial, V. P., Tumbay, J. V., Santillana, I. S., Wagai, R. (2024.10) Protective role of reactive aluminum phases to stabilize soil organic matter against long-term cultivation in the humid tropics under volcanic influence. *Soil Science and Plant Nutrition*, https://doi.org/10.1080/00380768.2024.2415455

Arai, M.*, Ikazaki, K., Terajima, Y., Anzai, T., Minamiya, Y. (2024.9) Effects of organic amendment on earthworm density and biomass in sugarcane fields with different soil pH. *European Journal of Soil Biology*, 122: 103645.

Arai, T.*, Aikawa, S., Sudesh, K., Arai, W., Mohammad Rawi, N. F., Leh, C. P. P., Mohamad Kassim, M. H., Tay, G. S., Kosugi, A. (2024.6) Efficient production of polyhydroxybutyrate using lignocellulosic biomass derived from oil palm trunks by the inhibitor-tolerant strain *Burkholderia ambifaria* E5-3. *World Journal of Microbiology and Biotechnology*, 40: 242.

Azman, M. S., Sharma, S., Suwa, R.,, Palaniveloo, K., Zakaria, M. R.* (2025.2) Deforestation, emissions, and carbon sequestration potential of Merlimau mangrove forest: A landscape-level analysis. *Ecological Research*, 40(2): 133–149.

Baramee, S., Thianheng, P., Uke, A., Cheawchanlertfa, P., Tachaapaikoon, C., Waeonukul, R., Pason, P., Ratanakhanokchai, K., Liu, Y.-J., Kosugi, A.* (2024.10) Extracytoplasmic polysaccharides control cellulosomal and non-cellulosomal systems in *Herbivorax saccincola* A7. *Applied Microbiology and Biotechnology*, 108: 477.

Battulga, B.*, Nakayama, M., Matsuoka, S., Kondo, T., Atarashi-Andoh, M., Koarashi, J. (2024.8) Dynamics and functions of microbial communities in the plastisphere in temperate coastal environments. *Water Research*, 264: 122207.

Bourgeois, C. F., MacKenzie, R. A.*, Sharma, S., Bhomia, R. K., Johnson, N. G., Rovai, A. S., Worthington, T. A., Krauss, K. W., Analuddin, K., Bukoski, J. J., Castillo, J. A., Elwin, A., Glass, L., Jennerjahn, T. C., Mangora, M. M., Marchand, C., Osland, M. J., Ratefinjanahary, I. A., Ray, R., Salmo III, S. G., Sasmito, S. D., Suwa, R., Tinh, P. H., Trettin, C. C. (2024.7) Four decades of data indicate that planted mangroves stored up to 75% of the carbon stocks found in intact mature stands. *Science Advances*, 10(27): 5430.

Eat, S., Wulansari, S., Ketbot, P., Waeonukul, R., Pason, P., Uke, A., Kosugi, A., Ratanakhanokchai, K., Tachaapaikoon, C.* (2024.6) A novel cellobiose 2-epimerase from anaerobic halophilic *Iocasia fonsfrigidae* and its ability to convert lactose in fresh goat milk into epilactose. *Journal of the Science of Food and Agriculture*, https://doi.org/10.1002/jsfa.13680

Fan, Y., Mandal, M. S. H., Nakabayashi, M., Hosaka, T.* (2024.4) Visitor experience with biodiversity in tropical rainforests: A global-scale assessment using social media data. *Biological Conservation,* 293: 110590.

Fujimaki, H.*, Abd El Baki, H. M., Toderich, K., Onishi, J. (2024.10) Determination of irrigation depth for potato considering weather forecast and cost for water under a saline condition. *Journal of Arid Land Studies*, 34(S): 65–68.

Hamada, K.*, Nakamura, S., Kuniyoshi, D. (2024.10) Pipe experiment elucidates biochar application depth affects nitrogen leaching under crop present condition. *Scientific Reports*, 14: 22823.

Hamada, K.*, Jos van Dam, Miyamoto, T. (2024.10) SWAP model, its characteristics and application to the Japanese field. *Water Land Environ. Eng.*, 92(10): 17–20. (In Japanese)

Ichinose, Y.*, Matsui, K., Fukumasu, J., Matsuura, S., Takata, Y., Wagai, R. (2024.10) How do reactive aluminum and iron phases control soil organic carbon and phosphate adsorption capacity in agricultural topsoils across Japan?. *Soil Science and Plant Nutrition*, https://doi.org/10.1080 /00380768.2024.2410322

Indrioko, S.*, Na'iem, M, Widiyatno, Khomsah, N., Purnomo, S., Tani, N. (2025.1) The impact of selective logging on the genetic diversity of *Rubroshorea johorensis* in the tropical rainforest. *Forest Science and Technology*, 1–10.

Ishikawa, K., Shindo, S., Kitamura, K., Nakamura, Y.* (2024.4) Contributing to sustainable water and food security in Egypt through Japanese irrigation, drainage and rural engineering *Water Land Environ. Eng.*, 92(4): 245–248 (In Japanese)

Kawai, K., Ng, K. K. S., Lee, S. L. (2025.3) Relationships between plant traits and responses to soil drought in saplings of eight dipterocarp species with varying distributions along a rainfall gradient in Peninsular Malaysia. *Kanto Journal of Forest Research*, 76(1): 81–84. (In Japanese)

Keovongsa, I.*, Fitriyah, A., Okura, F., Noda, K., Yoshida, K., Keokhamphui, K., Kato, T. (2024.11) Analysis of paddy field changes (1989–2021) using Landsat images and flooding-assisted MLC in an urbanizing tropical watershed, Vientiane, Lao PDR. *Sustainability*, 16(22): 9776.

Koda, K.*, Onishi, J., Kameoka, T., Matsui, K., Lee, G., Yadav, G., Yadav, R. K., Neha, Prasid, G., Sharma, P. C. (2024.7) Effect of Cut-Soiler on Drainage of Saline Groundwater in Haryana, India. *Journal of Japan Rainwater Catchment Systems*, 30(1): 1–6.

Leon, A.*, Nedumaran, S. (2024.11) Estimating the effect of biological nitrification inhibition-enabled sorghum on nitrogen fertilizer consumption, life cycle GHG emissions, farmer's benefit and fertilizer subsidy from Indian sorghum production. *Science of the Total Environment*, 957: 177385.

Mandal, M. S. H., Suwa, R.*, Rollon, R. N., Albano, G. M. G., Cruz, G. A. A., Ono, K., Primavera-Tirol, Y. H., Blanco, A. C., Nadaoka, K. (2024.7) Aboveground biomass estimation of an old-growth mangrove forest using airborne LiDAR in the Philippines. *Ecological Research*, https://doi.org/10.1111/1440-1703.12503

Manisha., Yadav, G., Yadav, R. K., Rai, A. K., Hooda, V. S., Prasad, G., Onishi, J.*, Sharma, P. C. (2024.10) Reclamation of sub-surface sodicity with Cut-soiler drainage for rice-wheat production in Indo-Gangetic Plains. *Journal of Arid Land Studies*, 34(S): 25–28.

Matsui, K.*, Onishi, J. (2024.9) Changes in the soil drainage properties in different salinization treatments. *Journal of Arid Land Studies*, 34(S): 75–78.

Neha, Yadav, G., Yadav, R. K., Kumar, A., Rai, A. K., Prasad, G., Kumar, S., Narjary, B., Onishi, J., Omori, K., Chaudhari, S. K. (2024.12) Cut-soiler-constructed residue-filled preferential shallow sub-surface drainage improves the performance of mustard-pearl millet cropping system in saline soils of semi-arid regions. *Frontiers in Agronomy*, 6: 1492505.

Neha, Yadav, G., Yadav, R. K., Rai, A. K., Narjary, B., Prasad, G., Sharma, P. C., Onishi, J.*, Koda, K., Matsui, K., Lee, G. (2024.10) Salinity management with Cut-soiler drainage for mustard production in Indo-Gangetic Plain. *Journal of Arid Land Studies*, 34(S): 17–20.

Nhim, S., Baramee, S., Tachaapaikoon, C., Pason, P., Ratanakhanokchai, K., Uke, A., Ceballos, R. M., Kosugi, A.*, Waeonukul, R*. (2025.1) Effective semi-fed-batch saccharification with high lignocellulose loading using co-culture of *Clostridium thermocellum* and *Thermobrachium celere* strain A9. *Frontiers in Microbiology*, 15: 1519060.

Noda, I.*, Himmapan, W., Furuya, N. (2025.1) Effects of two-Stage thinning of coppices on growth and stem conditions in a clear-cut teak (*Tectona grandis* L.) plantation in Thailand. *Japan Agricultural Research Quarterly*, 24J02.

Okamoto, K.*, Anzai, T., Sakai, K., Saito, T., Inosako, K. (2024.7) Evaluation of soil water dynamics in the subsurface irrigation system OPSIS using lysimeter experiments. *Journal of Arid Land Studies*, 34(S): 69–73.

Okura, F.*, Kamei, A., Kato, T., (2025.2) Water balance analysis of hydrological processes in cyclic irrigation: A case study of the Imbanuma irrigation area in Chiba, Japan. *Journal of Hydrology: Regional Studies*, 57: 102111.

Okura, N., Oka, N., Kato,T.(2024.10) An approach to solving water management issues utilizing ABM and game theory. Water Land Environ. Eng. 92(10): 25–28. (In Japanese)

Onishi, J.*, Koda, K., Matsui, K., Lee, G., Yadav, R. K., Yadav, G., Neha., Sharma, P. C., Fujimaki, H. (2024.10) Change in soil moisture and salinity under border irrigation, every furrow irrigation and permanent skip furrow irrigation. *Journal of Arid Land Studies*, 34(S): 33–37.

Shiraki, S.*, Kywae, Ni, N., Cho, T. M., Thu, A. K., Horikawa, N. (2025.2) Ratoon rice strategy for enhanced water resource management: A simulation-based study in tropical monsoon climates. *Agricultural Water Management*, 307: 109251.

Suwa, R.*, Mandal, S. H. M., Tanaka, K., Noguchi, S., Ohtani, T., Hoshino, D., Nur Hajar, Z. S. (2025.3) Simulation of the initial survival rate of dipterocarp plantation forests in the Peninsula Malay using an individual-based model. *Kanto Journal of Forest Research*, 76: 85–88. (In Japanese)

Takenaka, K.*, (2024.3) Damage to young trees of two fast-growing tree species due to pest attack on Ishigaki Island. *Kanto Journal of Forest Research*, 75: 21–24. (In Japanese)

Tanaka, K.*, Hattori, D., Meleng, P., Wasli, M. E., Ichie, T. (2024.9) Bark biomasses and nutrient concentrations in tropical secondary forest trees of Malaysia. *Forest Ecosystems*, 11: 100242.

Tanaka, K.*, Kawai, K., YONEDA, R., Azani, M. A., Nur Hajar, Z. S. (2025.3) Relationships between growth and wood traits of ten tree species planted in Peninsular Malaysia. *Kanto Journal of Forest Research*, 76(1): 45–48.(In Japanese)

Tanaka, K.*, Yoneda, R., Azani, M. A. (2024.7) Leaf functional traits in relation to growth performance in Malaysian teak (*Tectona grandis* L.f.). *Tropics*, 33(2): 73–85.

Tancharoen, S., Iwasaki, S.*, Watanabe, T., Luanmanee, S., Nobuntou, W., Amonpon, W., Chumsuwan, N., Paisancharoen, K., Bumrung, S., Matsumoto, N. (2024.10) Carbon sequestration and soil fertility management in sandy and clayey soils revealed by over four decades of long-term field experiments in Thailand. *Land Degradation & Development*, https://doi.org/10.1002/ldr.5310

Tani, N., Hong Ng, C., Leong Lee, S., Ting Lee, C., Muhammad, N., Kondo, T., Tsumura, Y., Sugiyama, S., Niiyama, K., Ripin, A., Rahman Kassim, A., Musa, S., Wu, J., Liu, X. (2025.2) Negative frequency-dependent selection through variations in seedling fitness due to genetic differentiation of parents'pair in a tropical rainforest tree, *Rubroshorea curtisii* (Dipterocarpaceae). *Frontiers in Genetics*, 16: 1552024.

Uke, A.*, Hanis, A., Sudesh, K., Kosugi, A.* (2025.2)

Application of old oil palm trunks affects the growth performance of oil palm seedlings. *Journal of Oil Palm Research*, https://doi.org/10.21894/jopr.2025.0009

Watanabe, S., Anzai, T., Oka, N., Shimada, N., Suzuki, K., Demura, S., Noda, K., Fujioka, Y., Araya, K. (2024.4) International collaboration and SDGs through Ishigaki Island future workshop. *Water Land Environ. Eng*, 92(4): 241–244. (In Japanese)

Watanabe, M.*, Okita, J., Kitada, H., Takano, S. (2024.4) Developing directions and challenges on utilization utilization of carbon credits as local resources management. *Water Land Environ. Eng.*, 92(4): 23–26. (In Japanese)

Yadav, G., Yadav. R. K., Rai, A. K., Kumar, S., Neha, Verma, R., Sharma, P. C., Onishi, J.*, Koda, K., Matsui, K., Lee, G. (2024.10) Optimization of Cut-soiler drainage spacing for salinity management in Indo-Gangetic Plain. *Journal of Arid Land Studies*, 34(S): 21–24.

Yadav, R. K., Yadav, G., Manisha., Rai, A. K., Kumar, S., Neha, Prasad, G., Sharma, P. C., Onishi, J.*, Koda, K., Matsui, K., Lee, G. (2024.10) Reclamation of sub-surface sodicity by placement of amendment and crop residue with Cut-soiler drainage in Indo-Gangetic Plains. *Journal of Arid Land Studies*, 34(S): 29–32.

Zhang, K.*, Fiwa, L., Kurata, M., Okazawa, H., Luweya, K. A. B., Mandal, M. S. H., Sakai, T. (2024.12) Precise LULC classification of rural area combining elevational and reflectance characteristics using UAV. *Scientific African*, 26: e02431.

Program B

Andrianarijaona, L., Andriamananjara, A.*, Razafimbelo, T., Raminoarison, M. A., Rabenarivo, M., Tsujimoto, Y., Oo, A. Z.* (2025.3) Impact of manure and mineral fertilizer management on rice growth and methane emissions in nutrient-deficient lowlands of Madagascar's highlands. *Scientific African*, 28: e02675.

Andrianary, B. H., Tsujimoto, Y.*, Ozaki, R., Rakotonindrina, H., Ramifehiarivo, N. (2024.11) Optimizing transplanting densities for lowland rice production under low-yielding environments in the Madagascar highlands. *Field Crops Research*, 318: 109601.

Awuni, J. A., Kodjo Avornyo, V., Koide, J., Muranaka, S., Nakamura, S., Yageta, Y.* (2024.11) Examining farmers' perceptions of soil fertility and its use in field practices in Northern Ghana. Available at SSRN, https://doi.org/10.2139/SSRN.5017268

Bagayogo, A., Kam, H., Sawadogo, J., Konate, M., Sie, M., Nakamura, S., Nagumo, F., Sawadogo, M. (2024.4) Mitigating iron toxicity by using rock phosphate to improve rice productivity. *Agricultural Sciences*, 15: 423–438.

Dan, H.*, Adachi, T., Oki, Y., Agodzo, S., Adzraku, H. (2025.2) Impact assessment of cover plants on soil physiochemical properties of earth canals at paddy field in Ghana. *Paddy and Water Environment*, https://doi.org/10.1007/s10333-025-01017-8

Du, Z., Nakagawa, A., Fang, J., Ridwan, R., Astuti, W. D., Sarwono, K. A., Sofyan, A., Widyastuti, Y., Cai, Y.* (2024.6) Cleaner anaerobic fermentation and greenhouse gas reduction of crop straw. *Microbiology Spectrum*, https://doi.org/10.1128/spectrum.00520-24

Grondin, A., Natividad, M.A., Ogata, T., Jan, A., Gaudin, A.C.M, Trijatmiko, K.R., Liwanag, E., Maruyama, K., Fujita, Y., Yamaguchi-Shinozaki, K., Nakashima, K., Slamet-Loedin, I.H., Henry, A.* (2024.4) A case study from the overexpression of *OsTZF5*, encoding a CCCH tandem zinc finger protein, in rice plants across nineteen yield trials. *Rice*, 17: 25.

Hasada, K., Phonhnachit, P., Yamada, R. (2024.5) Animal protein intake disparity among farm households and its factors in rural villages of Lao PDR. *J. Agric. Dev. Stud.*, 34(3): 11–19. (In Japanese)

Hirooka, Y., Eda, S., Ikazaki, K., Batieno, J. B., Iseki, K. (2024.11) Development of a simple prediction model for cowpea yield under environmentally growth-restricted conditions. *Scientific Reports*, 14: 28706.

Iseki, K.*, Ikazaki, K., Nakamura, S., Sidibe, H. (2024.9) Effect of rock phosphate direct application on tropical legumes under different soil types of Sudan Savanna. *Plant Production Science*, https://doi.org/10.1080/1343943X.2024.2400084

Iseki, K.*, Olaleye, O., Matsumoto, R. (2024.5) Impact of different planting date on shoot growth and tuber development of white Guinea yam grown in Guinea Savanna. *Plant Production Science*, DOI: 10.1080/1343943X.2024.2351623

Ishikawa, H.*, Matsumoto, R., Iseki, K. (2025.3) Changes in folic acid, phenolic components, and angiotensin-converting enzyme inhibitory activity in cowpea (*Vigna unguiculata*) green pods with pod maturity. *Science Progress*, 108(1). https://doi.org/10.1177/00368504251320163

Iwasaki, S.*, Kanda, T., Nakamura, S., Uchida, S., Saïdou, S., Barro, A., Nagumo, F. (2024.10) Integrating field surveys and remote sensing to optimize phosphorus resource management for rainfed rice production in the Central plateau of Burkina Faso. *PLOS ONE*, 19(10): e0312070.

Koala, J.*, Takenaka, K. (2024.12) Litterfall dynamics of agroforestry systems in parkland of the north Sudanian zone, Burkina Faso. *Journal of Plant Studies*, 13(1): 40–53.

Kobayashi, Y., Fujita, Y.* (2024.10) Epidermal bladder cells play a role in water retention in quinoa leaves. *Plant Biotechnology*, 41(4): 447–452.

Kobayashi, Y., Hirakawa, H., Shirasawa, K., Nishimura, K., Fujii, K., Oros, R., Almanza, G. R., Nagatoshi, Y., Yasui, Y., Fujita, Y.* (2024.8) Chromosome-level genome assemblies for two quinoa inbred lines from northern and southern highlands of Altiplano where quinoa originated.

Frontiers in Plant Science, 15: 1434388.

Kumawat, G., Dong Cao, D., Park, C., Xu, D.* (2024.4) C-terminally encoded peptide-like genes are associated with the development of primary root at qRL16.1 in soybean. *Frontiers in Plant Science*, 15: 1387954.

Kusano, E.*, Poapongsakorn. N., Jantarasiri, U., Pantakua, K., Tran, C. H., Khin Akari Tar, Kong, T., Phimphachanhvongsod, V. V., Kobori, Y. (2025.1) Government and farmer responses to the fall armyworm outbreak in mainland Southeast Asia. *Frontiers in Insect Science*, 4: 1455585.

Lee, G., Pratiwi, A., Farikhah, Suzuki, A., Kurosaki, T. (2024.12) Online communities of practice as agricultural information platforms: A case study of Indonesian shrimp farmers during the COVID-19 pandemic. *Bulletin of Indonesian Economic Studies*, 1–43.

Maeno, K. O.*, Benahi, A.S., Jaavar, M. E. H. (2024.5) Risk of migration: Not all gregarious locust nymphs reach appropriate refuges. *The Science of Nature*, 111(3): 28.

Maeno, K. O.*, Benahi, A. S., Jaavar, M. E. H. (2025.2) Moulting stage is not defenceless: Antipredatory strategy of gregarious locusts during moulting. *Animal Behaviour*, 220: 123044.

Maeno, K. O.*, Ely, S. O., Mohamed, S. O., Jaavar, M. E. H., Benahi, A. S., Ebbe, M. A. O. B. (2024.9) Mate-guarding male desert locusts act as parasol for ovipositing females in an extremely hot desert environment. *Ecology*, e4416.

Marescot, L., Fernandez, E., Dridi, H., Benahi, A. S., Hamouny, M. L., Maeno, K. O., Escorihuela, M. J., Paolini, G., Piou, C. (2025.1) A forecasting model for desert locust presence using real-time satellite imagery. *Remote Sensing Applications*: *Society and Environment*, 37: 101497.

Marui, J.*, Shiraishi, Y., Takeura, M., Shompoosang, S., Varichanan, P., Boulom, S. (2025.1) Combined use of rice-koji cultured with *Aspergillus oryzae* and *Aspergillus luchuensis* for enhanced dephosphorylation of phytate to myo-inositol in brown rice-koji-amazake, a sweet brown rice beverage. *Food Science and Technology Research*, 31(2).

Mundschenk, E.*, Remus, R., Augustin, J., Wissuwa, M., Staudinger, C., Oburger, E., George, E., Holz, M. (2024.5) Fertilizer addition modifies utilization of different P sources in upland rice on strongly P-fixing andosols. *Journal of Soil Science and Plant Nutrition*, https://doi.org/10.1007/s42729-024-01774-1

Nakagawa, A. C. S.*, Iseki, K., Ikazaki, K. (2024.9) Development of a simple evaluation method of soybean seedling emergence against soil crust. *Plant Production Science*, https://doi.org/10.1080/1343943X.2024.2392296

Nasukawa, H.*, Tajima, R., Pereira, M. C. F., Pedro, J. A., Nakamura, S., Fukuda, M., Koide, J., Oya, T., Homma K. (2025.3) Management strategies for regenerative agriculture based on the assessment of soil fertility in northern Mozambique. *Geoderma Regional*, 40: e00912.

Nignan I., Ouedraogo J., Nakamura, S., Coulibaly, K., Serme, I. (2024.8) Short-term effect of the distance between the point of application of phosphate fertilizers (CBKCa and TSP) and the crown of the plant on the evolution of the fractions and the phosphorus balance of a Lixisol. *African Journal of Agricultural Research*, 20(8): 632–640.

Nishigaki, T., Ikazaki, K.*, Shinjo, H., Tanaka, U., Fatondji, D., Funakawa, S. (2025.2) Pearl millet yield reduction by soil erosion and its recovery potential through fertilizer application on an Arenosol in the Sahel. *Soil and Tillage Research*, 246: 106324.

Oka, N.*, Shaibu, A. G. (2025.3) Quantification of domestic water use for estimating irrigation water availability of small reservoirs in northern Ghana. *Scientific Papers Series "Management, Economic, Engineering in Agriculture and Rural Development"*, 25(1): 697–704.

Oo, A. Z., Tsujimoto, Y., Mukai, M., Nishigaki, T., Takai, T., and Uga, Y. (2024.9) Significant interaction between root system architecture and stratified phosphorus availability for the initial growth of rice in a flooded soil culture. *Rhizosphere,* 31: 100947.

Ozaki, R.*, Tsujimoto, Y., Andriamananjara, A., Rakotonindrina, H., Sakurai, T. (2024.10) Optimizing fertilizer use by providing soil quality information: experimental evidence from Madagascar. *Agriculture & Food Security*, 13: 45.

Pratiwi, A., Lee, G., Farikhah, Kettunen, E. (2025.2) The adoption of green technologies in Indonesia: shrimp farmers' Facebook group as an online community of practice. *International Journal of Training and Development*, https://doi.org/10.1111/ijtd.12362

Rabi, H. M. L.*, Ndiaye, S., Guisse, A., Diallo, D., Sarr,P. S. (2025.1) Effects of microdose fertilization and plant density on maize (*Zea mays* L,) production in the Centre-West region of Senegal. *Agro-Science*, 23(1): 19–24.

Sagnon, A., Traore, M., Tibiri, E. B., Zongo, S., Bonkoungou, I. J. O., Nakamura, S., Barro, N., Tiendrebeogo, F., Sarr, P. S.* (2024.11) Enhancing the use of phosphate rock through microbially-mediated compost transformation to improve agronomic and economic profitability in sub-Saharan Africa. *Frontiers in Sustainable Food Systems*, 8: 1445683.

Shiratori, S.*, Abeysekara, M. G. D., Ozaki, R., Rafalimanantsoa, J., Rasolonirina Andrianjanaka, B. H. (2024.10) Effects of risk and time preferences on diet quality: empirical evidence from rural Madagascar. *Foods*, 13(19): 3147.

Suzuki, A., Olivia, S., Nam, V. H., Lee, G. (2024.12) Contaminated water spillovers or peer effects? Determinants of disease outbreaks in shrimp farming in Vietnam. *Agricultural Economics*, https://doi.

org/10.1111/agec.12872

Takai, T.*, Oo, A. Z., Okamoto, T., Nakano, H. (2024.9) *MP3*, a quantitative trait locus for increased panicle number, improves rice yield potential in Japan by connecting with high source and translocation traits. *Field Crops Research*, 318: 109566.

Takenaka, K.*, Koala, J., Yamadera, Y. (2024.7) Characteristics of the root system of four tree species planted on Plinthosols in Burkina Faso: application of the soil-briquette method. *Journal of Arid Land Studies*, 34(1): 17–33.

Ueda, Y.* (2024.12) Development of an infiltration-based RNA preservation method for cryogen-free storage of leaves for gene expression analyses in field-grown plants. *Plant Methods*, 20: 187.

Ueda, Y.*, Kondo, K., Saito, H., Pariasca-Tanaka, J., Takanashi, H., Ranaivo, N. H., Rakotondramanana, M., Wissuwa, M. (2024.9) Characterization of quantitative trait loci from DJ123 (*aus*) independently affecting panicle structure traits in *indica* rice cultivar IR64. *Molecular Breeding*, 44(9): 57.

Ueda, Y., Yanagisawa, S.* (2024.10) A microplate-based expression monitoring system for Arabidopsis *NITRATE TRANSPORTER 2.1* using the luciferase reporter. *Bio-protocol*, 14(23): e5127.

Urano, K., Oshima, Y., Ishikawa, T., Kajino, T., Sakamoto, S., Sato, M., Toyooka, K., Fujita, M., Kawai-Yamada, M., Taji, T., Maruyama, K., Yamaguchi-Shinozaki, K., Shinozaki, K. (2024.10) Arabidopsis DREB26/ERF12 and its close relatives regulate cuticular wax biosynthesis under drought stress condition. *The Plant Journal*, https://doi.org/10.1111/TPJ.17100

Yurimoto, T., Kassim, F. M., Matsuoka, K., Man, A. (2024.7) Sexual maturation of the blood cockle, *Tegillarca granosa* (Linnaeus, 1758), in aquaculture grounds along the Selangor Coast, Malaysia. *Journal of Shellfish Research*, 43(2): 181–190.

Yurimoto, T.*, Kassim, F. M., Rahim, M. A. (2024.8) Mass mortality event of the aquaculture oysters caused by high precipitation in Setiu Lagoon, Peninsular Malaysia, during the wet season. *EQA-International Journal of Environmental Quality*, 63: 1–11.

Yurimoto, T.*, Kassim, F. M., Rahim, M. A. (2024.11) Development of a nursery upweller for young oysters in tropical mangrove estuaries. *EQA-International Journal of Environmental Quality*, 66: 43–51.

Zhang, W., Li, S., Xu, W., Wang, Q., Zhang, H., Liu, X., Chen, X., Xu, D.*, Chen, H.* (2025.2) Knocking out artificial selected gene *GmAOC4*H8 improves germination in soybean. *Theoretical and Applied Genetics*, 138: 54.

Program C

Iizumi, T.*, Sakai, T., Masaki, Y., Oyoshi, K., Takimoto, T., Shiogama, H., Imada, Y., Makowski, D. (2025.3) Assessing the capacity of agricultural research and development to increase the stability of global crop yields under climate change. *PNAS Nexus*, https://doi.org/10.1093/PNASNEXUS/PGAF099

Kuniyoshi, D.*, Ishihara, M., Yamamori, K., Koide, Y., Kishima, Y.* (2024.6) Tetraploid interspecific hybrids between Asian and African rice species restore fertility depending on killer–protector loci for hybrid sterility. *Genetics*, https://doi.org/10.1093/genetics/iyae104

Takaragawa, H.*, Wakayama, M. (2024.9) Responses of leaf gas exchange and metabolites to drought stress in different organs of sugarcane and its closely related species *Erianthus arundinaceus*. *Planta*, 260(4): 90.

Wu, W.*, Yuan, R., Wang, Q., Jin, S. (2024.6) Consumers'preferences for the attributes of plant-based meat in China: a best-worst scaling approach. *Future Foods*, 9: 100384.

Xia, S., Takakura, J., Tsuchiya, K., Yamakawa, T., Wu, W., Park, C. Y., Hasegawa, T., Fujimori, S., Takahashi, K. (2025.4) Fish as food: prioritizing domestic fish consumption to reduce the health burden. *Food Policy*, 132: 102828.

Others

Abe, T.*, Kubota, T., Noguchi, S., and Hosoda, I. (2025.2) Snowmelt runoff from mountain forest watersheds and the impact of logging on it: from long term observations at the Kamabuchi Experimental Watershed. *Water Science*, , 401: 93–114 (In Japanese)

Ezura, K.*, Lu, Y., Suzuki, Y., Mitsuda, N., Ariizumi, T.* (2024.4) Class II knotted-like homeodomain protein SlKN5 with BEL1-like homeodomain proteins suppresses fruit greening in tomato fruit. *The Plant Journal*, https://doi.org/10.1111/tpj.16727

Hanamura, Y.*, Hardianto, E., Fukuchi, J., Imai, H., Siow, R., Kanak, K. M., Islam, M. R., Tsutsui, I., Kassim, F. M. (2024.5) Taxonomic assessment of *Acetes indicus* (Crustacea, Decapoda) as revealed from molecular and morphological analyses: Re-validation of *A. spiniger* Hansen, 1919 and designation of a new species. *Bulletin of the National Museum of Nature and Science. Series A, Zoology*, 50(2): 49–68.

Iida, S.*, Noguchi, S., Levia, D. F., Araki, M., Nitta, K., Wada, S., Narita, Y., Tamura, H., Abe, T., Kaneko, T. (2024.11) The influence of forest thinning on hydrological processes: insights from sap flow measurements in a Japanese cedar stand. *J. Jpn. Assoc. Hydrol. Sci.*, 54: 79–83 (In Japanese)

Ikeura, H.*, Fujimaki, H. (2024.10) Enhancing the collectivity of water vapor in a plastic film tunnel using an improved underground condensation system. *Paddy and Water Environment*, https://doi.org/10.1007/s10333-024-

01001-8

Iwagami, S.*, Noguchi, S., Shimizu, T., Kubota, T., Iida, S. (2024.7) Field measurement of entrapped pore-air pressure and the effect of rising groundwater level in the soil layer. *Hydrological Processes*, 38(7): e15235.

Kodama, M.*, Onduka, T., Tanita, I., Takahashi, M., Sanda, T., Iwasaki, T., Yamada, H. (2024.10) Disturbance of epifauna in seagrass-seaweed mixed beds by pesticides discharged into the coastal area: asymmetric effect on crustaceans and molluscs. *Marine Pollution Bulletin*, 209: 117123.

Koyama, O (2024.9) 100th Anniversary Commemorative Lecture II : The future of agriculture and the position of agricultural economics in Japan, *Journal of Rural Economics*, 96(2): 104-114 (In Japanese)

Koyama, O. (2025.3) The future of agriculture and the position of agricultural economics in Japan. *Japanese Journal of Agricultural Economics*, 27: 28–31.

Kozan, O., Kameoka, T. (2024.6) Current situation of tropical peatland fires and countermeasures: A case study of TL Village, Riau Province, Indonesia. *KASAI,* 74(3): 20-25 (In Japanese)

Nagasaki, H., Shirasawa, K., Hoshikawa, K., Isobe, S., Ezura, H., Aoki, K., Hirakawa, H. (2024.7) Genomic variation across distribution of Micro-Tom, a model cultivar of tomato (*Solanum lycopersicum*). *DNA Research*, 31(5): 16.

Nakahata, R.*, Azuma, W. A., Tanabe, T., Kawai, K., Hiura, T. (2024.6) Genotypic variation appears in fine root morphological traits of *Cryptomeria japonica* trees grown in a common garden. *Ecological Research*, https://doi.org/10.1111/1440-1703.12492

Noguchi, S., Abe, T. (2024.4) Climate Change and Throughfall during the Snow-Covered Season. *Water science*, 68(1): 102–119. (In Japanese)

Okamoto, T.*, Hotta, Y., Shinjo, R., Masuda, Y., Nishihara, A., Sasaki, R., Hirai, M. Y., Nishiwaki, R., Miyado, S., Sugiura, D., Kondo, M.* (2025.1) Unelongated stems are an active nitrogen-fixing site in rice stems supported by both sugar and methane under low nitrogen conditions. *Rice*, 18: 2.

Otake, T., Ichiyanagi, K.*, Tanoue, M., Iizumi, Y., Takahashi, M. (2024.11) Seasonal variability of stable isotope ratios of precipitation and the influence of Typhoons at Ishigaki Island, Southwest Islands of Japan. *J. Jpn. Assoc. Hydrol. Sci.*, 54: 85–95 (In Japanese)

Sakata, T. *, Matsuyama, S., Kawai, K., Yasumoto, K., Sekikawa, S., Ishida, A. (2024.5) Interspecific variation in Rubisco CO_2/O_2 specificity along the leaf economic spectrum across 23 woody angiosperm plants in the Pacific islands. *New Phytologist*, https://doi.org/10.1111/nph.19820

Tanaka, S., Ariyoshi, Y., Taniguchi, T., Nakagawa, A. C. S., Hamaoka, N., Iwaya-Inoue, M., Suriyasak, S., Ishibashi, Y.* (2024.6) Heat shock protein 70 is associated with duration of cell proliferation in early pod development of soybean, *Communications Biology*, vol.7(4), p.755-0, https://doi.org/10.1038/s42003-024-06443-8

Uchida, A.*, Kameoka, T., Ise, T., Matsui, H., Uchida, Y. (2024.12) Social factors of urban greening: Demographics, zoning, and social capital. *City and Environment Interactions*, 24: 100160.

This list includes papers published by staff members of overseas collaborating research institutes.
Underline indicates researcher at JIRCAS.
*Corresponding author

Fifth Medium to Long-Term Plan of the Japan International Research Center for Agricultural Sciences

The Japan International Research Center for Agricultural Sciences (JIRCAS) has been contributing to the improvement of practices and technologies related to agriculture, forestry and fisheries in tropical and subtropical regions, as well as in other developing regions overseas, by conducting technical tests and research.

During the First Medium-Term Goal period (FY 2001 - FY 2005), JIRCAS worked on research and development (R&D) for the sustainable development of agriculture, forestry and fisheries, as well as on the expansion of international research exchanges and networks, taking into account both domestic and overseas situations, such as the adoption of the United Nations Millennium Development Goals for the eradication of poverty and hunger in the world.

During the Second Medium-Term Goal period (FY 2006 - FY 2010), JIRCAS created a multilateral collaborative research system, promoted collaborative research with world-class research organizations led by the Consultative Group on International Agricultural Research (CGIAR), established a dynamic research system, and implemented major research projects. In FY 2008, JIRCAS took over the international operational activities of the former Japan Green Resources Agency and strengthened its field activities overseas.

During the Third Medium-Term Goal period (FY 2011 - FY 2015), a program/project scheme was developed for three principal research areas, namely, environment and natural resource management, stable food production, and livelihood improvement of the rural population. In addition, flagship projects to which research resources were intensively allocated were set up to promote research. Furthermore, systems were developed to strengthen the process of disseminating research results and ensuring the safe management of experimental materials.

During the Fourth Medium to Long-Term Goal period (FY 2016 - FY 2020), environment and natural resource management, stable agricultural production, and high value-adding technologies were positioned as priority research areas, and innovations in research management were promoted to maximize R&D outcomes. In addition, operations related to the collection, analysis, and dissemination of information on international agriculture, forestry, and fisheries were strengthened.

In the Fifth Medium to Long-Term Goal period (FY 2021 - FY 2025), JIRCAS has been focusing on research areas that address the growing expectations for the development of technologies in the agriculture, forestry, and fisheries sectors to achieve the Sustainable Development Goals (SDGs), in accordance with the "Basic Plan for Food, Agriculture, and Rural Areas" (approved by the Cabinet on March 31, 2020) and the new policy "Measures for Decarbonization and Resilience with Innovation (MIDORI)." These research areas include the development of agricultural technologies for climate change, resource recycling and environmental conservation; technology development towards building a new food system with improved productivity, sustainability and resilience; and strengthening function as an international hub for providing strategic information on agriculture, forestry and fisheries, and mobilizing new research partnerships with prioritized resource allocation. In addition, with an eye on the post-coronavirus society, new R&D and management methods will be established.

Through these efforts, as the sole research institution in Japan mandated to carry out comprehensive international research in agriculture, forestry and fisheries, JIRCAS is committed to strengthen its framework of collaboration with related organizations, play a key role in research and development targeting developing regions, and contribute to solving global food problems and enhancing Japan's research in agriculture, forestry and fisheries.

Section 1. Improving the Quality of Operations and Maximizing R&D Outcomes

The following four operational activities will be promoted as individual segments and evaluated in accordance with the guidelines and criteria set by the Ministry of Agriculture, Forestry and Fisheries (MAFF).

- ○ Management of research and development activities (Planning Segment)
- ○ Development of agricultural technologies for addressing climate change, resource recycling and environmental conservation (Environment Segment)
- ○ Development of technologies towards building a new food system with improved productivity, sustainability and resilience (Food Segment)
- ○ Strengthening function as an international hub for providing strategic information on agriculture, forestry and fisheries, and mobilizing new research partnerships (Information Segment).

1. Management of research and development activities (Planning Segment)

(1) Strategic promotion of R&D in accordance with government policies

In order to strategically promote R&D aimed at addressing global issues related to climate change mitigation and the establishment of new food systems that will benefit both Japan and developing regions, JIRCAS will undertake the following efforts.

a) Establish a research agenda that can flexibly respond to local conditions, and build a research promotion system that includes collaboration with international research institutions and research networks, as well as the utilization of domestic research facilities, in order to address potential constraints on activities in the target regions.
b) Manage the progress of research projects in accordance with their schedules, implement selection and concentration based on evaluation results, and review each project flexibly in response to research progress and changes in social conditions.
c) Provide incentives to research staff at the discretion of the President, enhance the research environment, actively pursue external funding, and make efficient use of research funds.
d) Promote goal-oriented basic research that will lead to the creation of future technological seeds and the development of innovative technologies.
e) Establish a system utilizing information and communication technology (ICT), among other tools, that enables effective and efficient research to be conducted even under conditions where the movement of people is restricted due to the impact of COVID-19.

(2) Strengthen industry-academia-government collaboration and cooperation

JIRCAS actively promotes international joint research and personnel exchange with research institutes and universities in developing regions and developed countries, international research institutions such as CGIAR, private organizations including NGOs, and international research networks, in order to contribute to raising the level of research and solving problems related to agriculture, forestry, and fisheries in developing regions.

In addition, JIRCAS supports the establishment of strategic partnerships in the Information Segment, and expands opportunities for exchange of information, personnel, and research with the National Agriculture and Food Research Organization (NARO), Forest Research and Management Organization (FRMO), Japan Fisheries Research and Education Agency (FRA), and other organizations, to promote R&D and other activities that leverage the strengths of each research agency and bring about synergies. As the sole research institute in Japan that comprehensively conducts international research on agriculture, forestry and fisheries, JIRCAS contributes to the advancement of R&D in domestic agriculture, forestry, and fisheries by strengthening cooperation, including personnel exchange with NARO, FRMO, FRA, and other organizations, while playing a central role in research on agriculture, forestry, and fisheries in the tropical/subtropical regions and developing countries.

(3) Strategic promotion of intellectual property management

The R&D outcomes are considered as global public goods and will be handled from the perspective of promoting their utilization in developing regions. The following measures will be taken to promote strategic management of intellectual property for rapid social implementation and dissemination of technology.

a) The most appropriate method will be adopted based on the necessity and effectiveness of the invention in terms of confidentiality, rights (including agreement on the ownership/sharing ratio of rights, licensing policy, and handling of improved inventions), standardization, and public knowledge at the time of invention, as well as the release of patents and other rights after acquisition, exclusive licensing, and other measures.
b) In conducting joint research, a nondisclosure agreement will be concluded as necessary to prevent infringement of intellectual property, such as outflow of technology or leakage of information. In addition, the handling of intellectual property obtained through joint research will be stipulated in the joint research agreement.

(4) Strengthen efforts for social implementation of R&D outcomes

The following measures will be undertaken to promote the dissemination and social implementation of R&D outcomes, while utilizing investments, as well as human and technical support measures as necessary, in accordance with the Law on the Revitalization of Science, Technology and Innovation Creation (Act No. 63, 2008).

a) The possibility of obtaining rights and the need for confidentiality will be considered for R&D outcomes, and those results that are desirable to be made public knowledge will be published in the JIRCAS Research Highlights and academic journals, etc.
b) In countries and regions where the results are expected to be utilized, seminars, workshops, and explanatory meetings for local residents will be held to promptly provide information to the beneficiaries.
c) Results that are expected to be of particular use will be selected as Research Highlights or Scalable Research Achievements for dissemination to promote their actual utilization.

d) Support efforts in the Information Segment for technology dissemination and application through strategic partnerships with the development sector and businesses.
e) Conduct follow-up surveys on major R&D outcomes in a systematic manner and publicize them on the website, etc.

(5) Promote public relations activities and interactive communication with the public

The following efforts will be made to promote public understanding of the activities and achievements, the need for international research and development targeting developing regions, and the contributions to science and technology diplomacy through research activities.

a) Support efforts of the Information Segment to provide strategic information. Expand opportunities for information dissemination and interactive communication both domestically and internationally by making effective use of the media, including press releases and media coverage, as well as by utilizing a variety of media and communication tools, such as printed publications, sending out e-mail newsletters, and participation in various external events.
b) In addition to the public open house, engage in outreach activities such as participation in exhibitions, science cafes, and visiting lectures, as well as in new types of outreach activities, such as online symposiums and seminars.
c) Promote efforts to enhance the understanding of local residents in the regions where the research is being conducted by holding on-site workshops and explanatory meetings, in collaboration with partner institutions of joint research and government agencies of those countries.

(6) Strengthen cooperation with government departments

The following efforts will be promoted in order to ensure appropriate R&D activities and measures that respond and contribute to national policies.

a) Coordinate closely with relevant government departments, exchange information at each stage of research from research design to dissemination and practical application of results, and request their participation in annual review meetings to discuss the needs and verify the results.
b) Respond to requests from government departments for cooperation in conducting emergency operations, holding liaison meetings and symposiums, and dispatching experts to international organizations, academic conferences, etc.
c) Respond to requests from national and local governments, organizations, or universities, etc. to perform analyses and appraisals that require expertise of staff and are difficult for other bodies to perform.

2. Development of agricultural technologies for climate change, resource recycling and environmental conservation (Environment Segment)

In order to cope with global climate change and prevent further environmental degradation in developing regions that depend heavily on agriculture, forestry, and fisheries, it is necessary to balance sustainable agriculture, forestry, and fisheries with appropriate resource management by maximizing resource use efficiency without crossing the so-called planetary boundaries, based on scientific assessment of risks related to the maintenance of the global system. To achieve this objective, the following research initiatives will be undertaken.

- Develop water-saving cropping systems in rice paddies and their water management methods, and technologies to reduce greenhouse gas emissions by effectively utilizing livestock waste, etc., targeting developing regions—mainly in Asia—while also taking domestic benefits into consideration.

- Develop carbon recycling technologies to convert agricultural waste into resources, using the power of microorganisms to break down and convert agricultural waste into raw materials for fuels and chemical products.

- Develop low-impact agricultural production systems by utilizing biological nitrification inhibition (BNI) technology in order to reduce the environmental burden caused by fertilization using nitrogen compounds.

- Develop afforestation technologies to enhance forestry productivity and environmental adaptability of tropical forests by utilizing the indigenous genetic resources of tropical forests in Southeast Asia and other regions.

In addition, environmental conservation technologies will be developed through the yama-sato-umi agroecosystem connectivity in subtropical islands, soil conservation technologies in drylands, and technologies to mitigate the risk of drought.

3. Development of technologies towards building a new food system with improved productivity, sustainability and resilience (Food Segment)

In order to respond to the diversified agricultural development needs of developing regions and to contribute to stable food production in the target regions as well as to international food supply and demand and food and nutrition security, a new food system that improves agricultural productivity and nutrition will be established. To achieve this objective, the following research initiatives will be undertaken.

- Develop breeding materials and production technologies that contribute to enhancing the resilience of major crops and local indigenous crops, in order to contribute to sustainable production in harsh environments and improved nutrition in developing regions, by utilizing advanced technologies. In addition, technologies will be developed to acquire breeding materials, agricultural products, and food products that will benefit both Japan and developing regions, mainly in the Asian region, which shares a common food culture with Japan, by clarifying the characteristics of various indigenous crops, utilizing genetic resources, introducing the Internet of Things (IoT) to cultivation management, and meeting new demand through food processing.

- Develop efficient and environmentally friendly control technologies for transboundary pests, which are a global problem, in cooperation with international organizations.

- Develop sustainable aquaculture technologies through community-based aquaculture management that maintains ecosystem functions in order to revitalize the fisheries industry through appropriate management of aquaculture fishing grounds.

- Develop water management technologies, breeding materials, and cultivation technologies effective for doubling rice production in the Sub-Saharan Africa as a contribution to the Coalition for African Rice Development (CARD).

- Develop field crop systems that can improve the productivity, profitability and sustainability of small-scale farming including field crops and livestock production, to contribute in the improvement of agricultural productivity and resilience in the African region.

4. Strengthening function as an international hub for providing strategic information on agriculture, forestry and fisheries, and mobilizing new research partnerships (Information Segment)

The following initiatives will be undertaken to disseminate information domestically and internationally.

To understand the challenges and development needs of agriculture, forestry, fisheries, and food systems in developing regions, JIRCAS will analyze the current status of food supply and demand, nutrition improvement, and food systems in other countries, forecast the future under various scenarios, and evaluate the impact of developed technologies. A system for continuous, systematic, and organized collection, organization, and dissemination of a wide range of information to researchers, government organizations, companies, etc. will be established. In addition, JIRCAS will actively participate in international discussions on food and the environment through the G20 Meeting of Agricultural Chief Scientists (MACS) and other forums. High-quality information will be provided by creating original content and effective dissemination methods to target audiences will be devised through various media and opportunities, including participation in external events, exhibitions, and creation of publications and videos.

As part of efforts for social implementation of R&D outcomes that also benefit Japan, cooperation in developing regions, participation in domestic and international forums related to R&D, and the establishment of strategic partnerships with domestic and foreign organizations will be promoted in order to disseminate developed technologies. Furthermore, demonstration tests for dissemination and commercial deployment, information gathering for the application of digital technologies such as ICT, and research on subtropical agriculture in Japan using the Tropical Agriculture Research Front (TARF) will be conducted.

In addition, the following efforts will be made by utilizing the center functions.

a) Cooperate in the promotion of domestic breeding and gene bank projects by utilizing the research environment possessed by JIRCAS.
b) Conduct international joint research projects and special projects for dispatch of researchers to foster researchers in developing regions and Japan, and to accept trainees from other national research institutes, universities, national and public institutions, the private sector, and overseas institutions to contribute to human resource development and the improvement of technical standards.

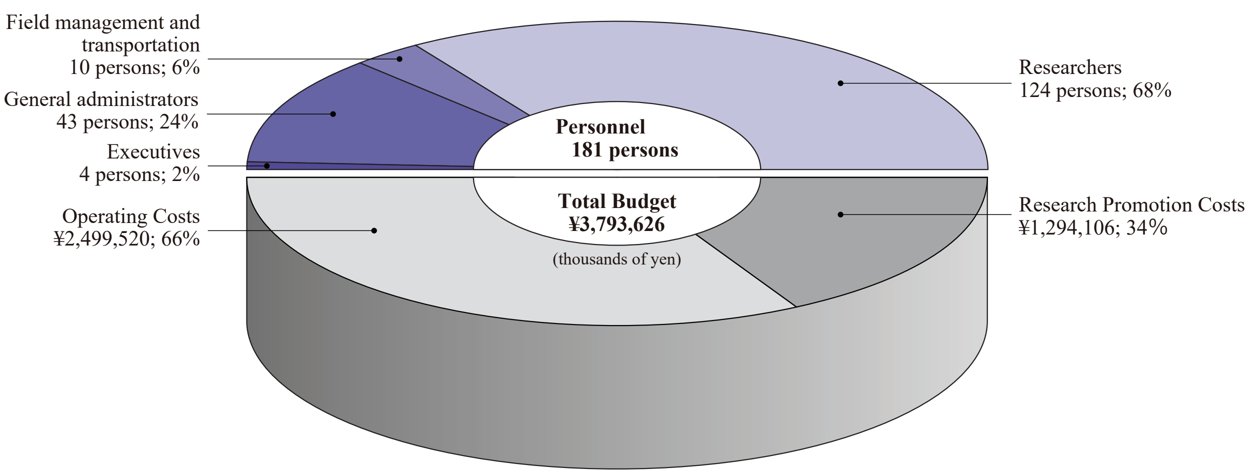
FINANCIAL Overview

Fiscal Year 2024

	thousands of yen
TOTAL BUDGET	**3,793,626**
OPERATING COSTS	**2,499,520**
Personnel (181)	2,144,546
President (1), Vice-President (1), Executive Advisor & Auditor (2)	
General administrators (43) Field management (10) Researchers (124) * Number of persons shown in ( )	
Administrative Costs	354,974

RESEARCH PROMOTION COSTS	**1,294,106**
Research and development	736,075
Overseas dispatches	178,431
Collection of research information	146,080
International collaborative projects	207,009
Fellowship programs	26,511

Budget FY 2024 (Graph)



Members of the External Evaluation Committee

Members of the JIRCAS External Evaluation Committee

Hironobu SHIWACHI	Professor, Department of International Agricultural Development, Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture (Tokyo NODAI)
Yasuhiko TORIDE	Professor, Institute for International Strategy, Tokyo International University
Eriko HIBI	Director, Food and Agriculture Organization of the United Nations (FAO) Liaison Office in Japan

JIRCAS Staff in FY 2024

President

Osamu Koyama

Vice-President

Seiji Yanagihara

Auditors

Teruyoshi Kumashiro
Hiroko Isoda

Information and Public Relations Office

Keisuke Omori, Head

Public Relations and Publications Section
Masako Fujita, Head
Takanori Hayashi, Information Management Expert

Collaborative Exchange Section
Satoru Muranaka, Head

Regional Coordinator
Norihito Kanamori, Representative of Southeast Asia Office (Thailand)

Project Leader
Sakiko Shiratori, Agricultural Economics

Program Directors

Keiichi Hayashi, Program A: Environment
Yasunari Fujita, Program B: Food
Miyuki Iiyama, Program C: Information

Research Planning and Partnership Division

Tomohide Sugino, Director

Research Planning and Management Office
Takeshi Watanabe, Head

Research Planning Section
Ishizaki Takuma, Head
Shotaro Ando, Senior Researcher

Research Management Section
Mie Kasuga, Head
Hiroko Furuno, Intellectual Property Expert

Field Management Section
Hiroyuki Ishiyama, Field Operator
Kaichi Matayoshi, Field Operator

Communications Advisor
Michael Nabor Quiros

Research Support Office
Takashi Oosato, Head
Masaki Shiraishi, Designated Expert, Research Support

Research Coordination Section
Tadashi Imai, Head
Toshiki Kikuchi, International Affairs Expert
Naomi Yamaguchi, Overseas Affairs Subsection Head
Yuma Sukegawa, Overseas Affairs Subsection Staff
Sota Toyoshima, Overseas Travel and Invitation Program Subsection Staff

Research Support Section
Akemi Nomiya, Head
Harumi Sawasato, Support Subsection Head
Gen-ichiro Hanaoka, Budget Subsection Head

Research Platform Office
Tetsuji Oya, Head

Digital Transformation Advisor
Shinji Hattori

Digital Technology Section
Hiromi Miura, Information Security Expert
Shota Miyai, Information System Management Subsection Staff

Safety Management Section
Masaki Morishita, Head
Kazuo Nakashima, Senior Researcher

Administration Division

Hiroshi Mizufune, Director

General Affairs Section
Jun Yatabe, Head
Katsunori Kanno, General Affairs Assistant Head
Toshiaki Sato , Personnel Management Assistant Head
Natsumi Sakurai, General Affairs Staff
Takehito Kato, Welfare Subsection Staff
Yoshiyuki Seki, Personnel Subsection 1 Head
Yume Nakano, Personnel Subsection 1 Staff
Asami Takatsu, Personnel Subsection 2 Head

Accounting Section
Koji Abe, Head
Koichi Fuse, Accounting and Examination Assistant Head
Yuji Shirata, Procurement and Asset Management Assistant Head
Kazuhiko Okada, Designated Expert, Procurement and Asset Management
Ryoichi Mise, Financial Subsection Head
Maki Hashimoto, Accounting Subsection Head
Takayuki Yamamoto, Audit Subsection Head
Aki Tamura, Audit Subsection Staff
Yuta Nagata, Procurement Subsection 1 Head
Takuro Ebihara, Procurement Subsection 2 Staff

Tadahisa Akiyama, Facilities Subsection Head

Administration Section
(Tropical Agriculture Research Front)
Makoto Nishiyama , Head
Ryousuke Itami, General Affairs Subsection Head
Maretomo Fujimoto, Accounting Subsection Head

Risk Management Office

Satoru Nirasawa, Head

Akira Hirokawa, Designated Expert

Compliance Management Section
Noriko Osonoe, Management Subsection Staff

Audit Office

Yoshinori Kawasaki, Head

Rural Development Division

Mitsuo Ishijima, Head

Project Leader
Jun-ya Onishi, Irrigation

Deputy Project Leader
Mamoru Watanabe, Rural Development

Senior Researchers
Taro Izumi, Rural Development
Shinji Hirouchi, Agricultural Engineering
Koichi Takenaka, Rural Development Forestry
Naoko Oka, Agriculture Water Management
Haruyuki Dan, Rural Development
Hiroshi Ikeura, Irrigation
Masakazu Yamada, Agricultural Engineering
Shutaro Shiraki, Rural Development
Katsumi Hasada, Rural Development
Ken-ichi Uno, Agricultural Engineering

Researchers
Shin-ya Iwasaki, Soil Science
Kayo Matsui, Soil Science
Fumi Okura, Irrigation and Drainage
Taishin Kameoka, Area Studies
Ke Zhang, Agricultural Information Engineering

Social Sciences Division

Yasuro Funaki, Director

Senior Researchers
Shunji Oniki, Agricultural Economics
Shintaro Kobayashi, Environmental Economics
Toru Sakai, Remote Sensing and GIS
Eiichi Kusano, Agricultural Economics
Junji Koide, Agricultural Economics
Ai Leon, Environmental Impact Assessment
Jun Furuya, Agricultural Economics
Rie Muraoka, Agricultural Economics

Researchers
Guenwoo Lee, Development Economics and International Cooperation Studies
Wenchao Wu, Agricultural Economics
Ryosuke Ozaki, Agricultural Economics
Yoshie Yageta, Agricultural Development
Win Sithu Maung, Remote Sensing and GIS

Biological Resources and Post-harvest Division

Akihiko Kosugi, Director

Project Leaders
Tadashi Yoshihashi, Food Science
Kyonoshin Maruyama, Plant Molecular Biology

Senior Researchers
Donghe Xu, Plant Molecular Genetics
Yoshinori Murata, Applied Microbiology
Naoki Yamanaka, Plant Molecular Genetics
Mitsuhiro Obara, Plant Physiology and Genetics
Takamitsu Arai, Molecular Microbiology
Jun-ichiro Marui, Molecular Microbiology
Yukari Nagatoshi, Plant Molecular Biology
Toshiaki Kondo, Molecular Ecology
Shimpei Aikawa, Applied Microbiology
Takuya Ogata, Plant Molecular Biology
Kotaro Iseki, Crop Science and Breeding
Takeshi Kashiwa, Plant Pathology
Kazuhiro Sasaki, Plant Breeding and Genetics
Ken Hoshikawa, Horticulture Science
Masahiro Kishii, Wheat Wide Crossing and Cytogenetics
Junnosuke Otaka, Natural Products Chemistry

Researchers
Cheolwoo Park, Plant Breeding and Genetics
Yasufumi Kobayashi, Plant Molecular Biology
Ayaka Uke, Molecular Microbiology
Kentaro Ezura, Plant Molecular Biology and Biotechnology

Crop, Livestock and Environment Division

Seishi Yamasaki, Director

Project Leaders
Satoshi Nakamura, Soil Science
Youichi Kobori, Entomology
Yasuhiro Tsujimoto, Crop Science

Senior Researchers
Kazunori Minamikawa, Biogeochemistry
Toshiyuki Takai, Crop Science and Genetics
Koki Maeda, Environmental Science, Manure Management and Microbial Ecology
Papa Saliou Sarr, Soil Microbiology
Aung Zaw Oo, Crop Science
Kenta Ikazaki, Soil Science
Kotaro Maeno, Entomology
Hidetoshi Asai, Crop Science
Guntur V. Subbarao, Crop Physiology, Genetics & Nutrition
Tetsuro Kikuchi, Biogeochemistry
Tomohiro Nishigaki, Soil Science

Researchers
Mizuki Matsukawa, Plant Protection
Andressa C. S. Nakagawa, Crop Science
Miwa Arai, Soil Ecology and Soil Science
Yoshiaki Ueda, Plant Physiology and Genetics
Kanako Takada, Crop Science
Jinsen Zheng, Soil Science

Forestry Division

Shoji Noguchi, Director

Senior Researchers
Naoki Tani, Forest Genetics
Kenzo Tanaka, Forest Ecology and Tree Ecophysiology
Rempei Suwa, Forest Ecology
Masaki Kobayashi, Tree Molecular Biology

Researchers
Kiyosada Kawai, Tree Physiology and Wood Anatomy
Mohammad Shamim Hasan Mandal, Ecology

Fisheries Division

Satoshi Honda, Director

Project Leader
Marcy N. Wilder, Crustacean Biochemistry

Senior Researchers
Isao Tsutsui, Aquaculture
Ryogen Nambu, Benthic Biology
Tatsuya Yurimoto, Aquatic Biology
Tomoyuki Okutsu, Aquatic Animal Physiology
Bong Jung Kang, Aquatic Animal Physiology
Tetsuya Sanda, Aquaculture

Researchers
Minoru Saito, Aquatic Ecology
Ryuya Matsuda, Marine Phycology

Tropical Agriculture Research Front

Shinsuke Yamanaka, Director

Public Relations Officer
Kunimasa Kawabe, Plant Pathology

Project Leader
Toshihiko Anzai, Irrigation and Drainage

Senior Researchers
Nobuya Kobayashi, Plant Breeding
Yoshifumi Terajima, Sugarcane Breeding
Hiroki Saito, Molecular Breeding and Genetics
Ken Okamoto, Agricultural Engineering
Masakazu Nakayama, Vegetable Crop Science
Hiroshi Matsuda, Tropical Pomology

Researchers
Hiroki Tokunaga, Plant Molecular Genetics
Hiroo Takaragawa, Crop Science
Takashi Kanda, Soil Science
Kosuke Hamada, Soil Science
Daichi Kuniyoshi, Rice Breeding
Munirah Hayati Binti Hamidon, Agricultural Image Processing

Technical Support Office
Eizo Tatsumi, Head
Masato Shimajiri, Designated Expert, Technical Support
Takashi Komatsu, Machine Operator
Masakazu Hirata, Machine Operator
Yasuteru Shikina, Machine Operator
Masashi Takahashi, Machine Operator
Masahide Maetsu, Machine Operator
Yuto Hateruma, Machine Operator
Takaya Shinmori, Machine Operator

The Japanese Fiscal Year and Miscellaneous Data

The Japanese Fiscal Year and the Annual Report 2024

The Japanese fiscal year is defined as the period of fiscal activity occurring from April 1 through March 31 of the following year. Thus, Fiscal Year (FY) 2024 covers the period from April 1, 2024 through March 31, 2025.

The Annual Report 2024 summarizes the full extent of JIRCAS activities that occurred during this period. The subsequent Annual Report will detail events and programs from April 1, 2025 through March 31, 2026 (FY 2025).

Buildings and campus data

Land	(units: m^2)
Tsukuba premises	109,538
Okinawa Tropical Agriculture Research Front	294,912
Total	404,450

Buildings	(units: m^2)
Tsukuba premises	11,098
Okinawa Tropical Agriculture Research Front	9,485
Total	20,583

Annual Report 2024

(April 2024-March 2025) No.31 (October 2025)

Published by

Japan International Research Center for Agricultural Sciences (JIRCAS)
1-1 Ohwashi, Tsukuba, Ibaraki 305-8686, JAPAN
Tel. +81-29-838-6313
Fax. +81-29-838-6316
Homepage https://www.jircas.go.jp

2025年（令和7年）10月 31日 発行
発行者　国立研究開発法人　国際農林水産業研究センター
理事長　小山　修
〒305-8686 茨城県つくば市大わし1−1
電話：029-838-6313
FAX：029-838-6316

JAPAN INTERNATIONAL RESEARCH CENTER
FOR AGRICULTURAL SCIENCES