

Green Asia Report Series

No.13

Green Asia Final Report

Lessons for Accelerating the Implementation of
Agricultural Technologies in the Asia-Monsoon Region

**Yasuro Funaki, Shintaro Kobayashi, Norihito Kanamori,
Miyuki Iiyama**



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March 2026



Green Asia

ISBN: 978-4-906635-34-4
<https://doi.org/10.64096/gars-e.13>

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This work is a product of JIRCAS staff with external contributions and is based on a study conducted under the project “Accelerating application of agricultural technologies which enhance production potentials and ensure sustainable food systems in the Asia-Monsoon region”, funded by the Ministry of Agriculture, Forestry and Fisheries, Japan.

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<https://doi.org/10.64096/gars-e.13>

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Acronyms

AIST	National Institute of Advanced Industrial Science and Technology
AMS	ASEAN member states
ASEAN	Association of Southeast Asian Nations
ASEC	ASEAN Secretariat
AWD	Alternate wetting and drying
BNI	Biological nitrification inhibition
CIMMYT	International Maize and Wheat Improvement Center (a CGIAR research center)
CO ₂	Carbon dioxide
COP28	28 th Conference of the Parties (to the UNFCCC)
COP30	30 th Conference of the Parties (to the UNFCCC)
CTCN	Climate Technology Center and Network
FAO	Food and Agriculture Organization of the United Nations
FAO RAP	FAO Regional Office for Asia and the Pacific
FFPRI	Forestry and Forest Products Research Institute
FFTC	Food and Fertilizer Technology Center for the Asian and Pacific Region
FRA	Fisheries Research and Education Agency
GARS	Green Asia Report Series
GHG	Greenhouse gas
IFRPD	Institute of Food Research and Product Development
IP	Intellectual property
IRRI	International Rice Research Institute (a CGIAR research center)
JIRCAS	Japan International Research Center for Agricultural Sciences.
LDC	Least Developed Countries
MAFF	Ministry of Agriculture, Forestry and Fisheries
N ₂ O	Nitrous oxide
NARO	National Agriculture and Food Research Organization
NGO	Non-governmental organization
NUE	Nitrogen-use efficiency
OODA	The OODA loop is a decision-making process: Observe-Orient-Decide-Act
R&D	Research and development

SPI	Science and Policy Interface
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNFSS+2	the first UN Food Systems Summit Stocktake
UNFSS+4	the Second UN Food Systems Summit Stocktake
WIPO	World Intellectual Property Organization (an agency of the United Nations)

Executive Summary

The Green Asia project was a four-year initiative assigned by the Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan aligned within the MAFF 'MIDORI Strategy for Sustainable Food Systems' (MIDORI Strategy). The Green Asia project was led by the Japan International Research Center for Agricultural Sciences (JIRCAS) to promote Japanese scalable agriculture, forestry, and fisheries technologies to support sustainable food systems in the Asia-Monsoon region under two international collaborative framework pillars: strategic information dissemination and joint research for field trials.

Under the first pillar, JIRCAS established the International Scientific Advisory Board, consisting of outstanding agricultural scientists and representatives of leading agricultural research institutions in the Asia-Monsoon region. The International Scientific Advisory Board provided advice to the JIRCAS International Center for Strategy "MIDORI". As part of the efforts to disseminate information from the Green Asia project, the 'Technology Catalog Contributing to Production Potential and Sustainability in the Asia-Monsoon Region' was compiled in cooperation with national research institutes and Japanese universities. The JIRCAS International Center for Strategy "MIDORI" contributed to the visibility of the technologies at major global forums such as UNFSS+2/+4, UNFCCC COP28/30, FAO, and at ASEAN meetings. Through these efforts, the Technology Catalog was featured on the websites of international organizations (e.g. the UN Food Systems Coordination Hub, FAO, the ASEAN Secretariat), and its technologies were incorporated into official ASEAN Guidelines on the Reduction of Crop Burning.

Scientific evidence must guide the promotion of scalable technologies for sustainable food systems in diverse regional contexts. To validate their local applicability, in Pillar 2 field trials and validation were conducted for three technologies: Alternate Wetting and Drying (AWD), Biological Nitrification Inhibition (BNI)-enabled wheat, and Rice Blast Control Using a Differential System, yielding valuable insights for the acceleration of technology adoption in various countries.

Through this project, JIRCAS coordinated with Japanese research institutions to compile and share information on scalable technologies, thereby enabling more targeted international responses. Strengthening science-policy interfaces proved effective to promote adoption of scalable technologies, including integration into regional policies and enhancing field trials. The application of technologies tailored to regional characteristics and enhanced policy coordination are expected to expand further in the Asia-Monsoon region and to other Global South countries.

1. Introduction

The year 2021 marked the acceleration of international discussions aimed at transforming both global and Japanese food systems toward enhanced sustainability. Building on the momentum of key global events, stakeholders increasingly recognized the urgent need to address environmental challenges and reshape food production practices. Collaborative frameworks and strategic dialogues were established to promote the adoption of innovative agricultural technologies, with particular emphasis on reducing greenhouse gas (GHG) emissions and improving resource-use efficiency. These efforts set the stage for subsequent initiatives and policy developments focused on achieving sustainable food systems in the Asia-Monsoon region and beyond.

The UN Food Systems Summit was held in September 2021, where UN Secretary-General António Guterres announced a “Statement of Action” calling for collaboration among governments, businesses, and civil society to collaborate in building sustainable and inclusive food systems (United Nations 2021). He emphasized that, as there is no one-size-fits-all solution, the diverse conditions, approaches, and perspectives of each region should be considered when dealing with problems.

Prior to this, in May 2021, Japan had formulated the ‘MIDORI Strategy for Sustainable Food Systems’ (MIDORI Strategy), which focused on enhancing both production potential and sustainability in food, agriculture, forestry, and fisheries through innovation (MAFF 2021). In line with the MIDORI Strategy, the Japan International Research Center for Agricultural Sciences (JIRCAS) in April 2022 launched the Green Asia project, officially titled ‘Accelerating application of agricultural technologies which enhance production potentials and ensure sustainable food systems in the Asia-Monsoon region.’ The Green Asia project was a four-year initiative with an annual budget of 85 million yen (approximately 30 million yen for Pillar 1 and 55 million yen for Pillar 2), amounting to a total of 400 million yen including overhead expenses.

The Green Asia project was designed to accelerate the application of scalable agriculture, forestry, and fishery technologies (hereafter referred to as ‘agricultural

technologies') in the Asia-Monsoon region. It sought to contribute to the transformation of food systems in the region through the establishment of international collaborative frameworks, strategic information dissemination, and joint research through networks of JIRCAS and other Japanese research institutions.

The Green Asia project focused on identifying and compiling agricultural technologies developed through Japanese and international research partnerships applicable to countries in the Asia-Monsoon region. The project emphasized dissemination through field trials and validation adapted to the climatic and production characteristics and socioeconomic conditions of the countries of the region. Unlike conventionally funded projects in JIRCAS, which primarily focus on research and development, this project placed greater emphasis on technologies ready for practical application on the ground.

This report summarizes and reviews the four-year activities of the Green Asia project, describing the background of the project and its position in the international context, providing details of the activities undertaken (e.g. the establishment of international collaborative frameworks, strategic information dissemination, field trials, and outputs/outcomes). The lessons learned and challenges identified through these activities are also described and future perspectives and recommendations are presented.

The Green Asia project, in the context of MIDORI Strategy, believes this report will provide information, data and perspectives to contribute to discussions and practical efforts to promote sustainable food systems in the Asia-Monsoon region and beyond.

2. Background of the Green Asia project

2.1 Challenges surrounding global food systems

Since the beginning of the 21st century, global food systems have been facing increasingly complex challenges. These include a growing demand for food due to population increases, heightened production risks, resource constraints, and escalating environmental burdens from greenhouse gas (GHG) emissions derived from agriculture (Willet et al. 2019). Moreover, emissions from food systems may account for approximately 30% of the total GHG emissions, making the transition to sustainable food systems an urgent need (Tubiello et al. 2021).

At the UN Food Systems Summit held in 2021, the transformation of food systems was one of the highest priorities of the international community. The Summit emphasized the need to ensure sustainability throughout the entire process, from production to consumption and disposal, and highlighted the importance of solutions driven by science, technology, and innovation (von Braun et al. 2021a, b). This global trend is also reflected in the increased focus on development and dissemination of agricultural technologies that are expected to achieve both environmental sustainability and enhanced production potential.

2.2 Japan's 'MIDORI Strategy for Sustainable Food Systems' and promotion of agricultural technologies in the Asia-Monsoon region

In response to both national needs and global trends, Japan formulated its MIDORI Strategy in May 2021, ahead of the UN Food Systems Summit held in September 2021. This strategy aims to achieve net zero GHG emissions from agriculture, forestry, and fisheries in Japan by 2050. It also emphasizes both enhancing production potential and reducing environmental impacts through measures such as reducing the use of chemical fertilizers and pesticides, and expanding the adoption of renewable energy (MAFF 2021).

The MIDORI Strategy states: "Japan should actively propose this strategy as a new model and for sustainable food systems in the Asia-Monsoon region, which differs from Europe and the United States in terms of climate conditions and production

structures, and participate in international rulemaking.” The Asia-Monsoon region shares environmental and socioeconomic characteristics with Japan, including a hot and humid climate, predominantly rice-based agriculture, and a high proportion of small- and medium-scale farmers. Therefore, many agricultural technologies developed in Japan are applicable to this region. Promoting Japanese technologies tailored to the Asia-Monsoon region and advancing the field trials and validation of promising technologies will contribute to the development of sustainable food systems across the region.

2.3 Importance and challenges of the Asia-Monsoon region

The Asia-Monsoon region, encompassing East Asia, Southeast Asia, and South Asia, is a vast agricultural zone where approximately 44% of the global population (approximately 3.3 billion people) resides. This region has a critical role in global food supply, accounting for approximately 90% of the world’s rice production but the agricultural sector in this region is also responsible for approximately 40% of the global non-CO₂ agricultural GHG emissions. Major GHG emission challenges include methane (CH₄) emissions from paddy fields and nitrous oxide (N₂O) emissions caused by excessive use of nitrogen fertilizers (Iiyama et al. 2023).

Moreover, the impacts of climate change in the Asia-Monsoon region are severe, with increasing risks of extreme weather events, such as floods and droughts (Clarke et al. 2022), as well as outbreaks of known and new pests and diseases (Lv et al. 2023, Wang et al. 2025). In addition, the predominance of small-scale farmers presents socioeconomic constraints to the adoption and dissemination of new technologies. Against this backdrop, the identification and dissemination of technologies that can maintain or enhance production potential while reducing environmental impacts has become an urgent priority.

2.4 Launch of the Green Asia project

In April 2022, the Ministry of Agriculture, Forestry, and Fisheries (MAFF) assigned JIRCAS to implement the project titled “Accelerating application of agricultural technologies that enhance production potentials and ensure sustainable food systems in the Asia-Monsoon region”; JIRCAS conducted this initiative as the ‘Green Asia project’.

As a National Research and Development Agency under MAFF, JIRCAS was designated the coordinating role in international collaborations through its own research network in the fields of agriculture, forestry, and fisheries in Japan, in addition to conducting international collaborative research.

However, to actively promote the MIDORI Strategy as a model for sustainable food systems in the Asia-Monsoon region and to participate in international rule making, JIRCAS efforts alone were insufficient. Achieving these goals required the mobilization of partners and their contributions to compile information on scalable technologies developed in Japan and through international research partnerships. JIRCAS collaborated with Japanese research institutes through the Green Asia project to jointly achieve the goal of promoting Japan's MIDORI Strategy as a model for sustainable food systems.

The Green Asia project implemented its activities through two main pillars:

- Pillar 1: Establishing frameworks for international collaboration and disseminating information that contributes to the MIDORI Strategy
- Pillar 2: Accelerating the application of scalable agricultural technologies through joint research

The Green Asia project was a unique initiative which emphasized identifying and sharing information about existing Japanese agricultural technologies and validating them through field trials, rather than developing entirely new technologies. By tailoring scalable technologies to local contexts, this study aimed to accelerate the transformation of sustainable food systems in the Asia-Monsoon region.

3. Pillar 1: Building a system for international collaboration and disseminating information

3.1 Institutional development for Green Asia project activities

To operationalize the MIDORI Strategy, JIRCAS established a system of international collaboration and information dissemination. The International Scientific Advisory Board was established comprising globally-recognized agricultural scientists, and representatives from leading agricultural research institutions in the Asia-Monsoon region. The advisory board members were as follows, and there were no replacements throughout the project.

- Dato' Dr. Mohamad Zabawi bin Abdul Ghani (Director General, Malaysian Agricultural Research and Development Institute (MARDI), Malaysia)
- Dr. Jean Balié (Senior Advisor, Strategy and Partnerships, Office of the Chief Economist, Food and Agriculture Organization (FAO), former Director General, International Rice Research Institute (IRRI), the Philippines and Regional Director, South East Asia and the Pacific, CGIAR)
- Professor, Dr. Joachim von Braun (President of the Pontifical Academy of Sciences; Distinguished Professor for Economic and Technological Change Center for Development Research (ZEF), Bonn University, Germany)
- Professor, Dr. Fadry Djufrj (Director General, Indonesian Agency for Agricultural Development and Modernization (BRMP), former Director General of Indonesian Agency for Agricultural Research and Development (IAARD), Indonesia)
- Professor, Dr. Shenggen Fan (Chair Professor and Dean, Academy of Global Food Economics and Policy (AGFEP), China Agricultural University (CAU), China)
- Dr. Jacqueline d'Arros Hughes (Former Secretary General of World Agriculture Forum, former Director General of International Crops Research Institute for the Semi-Arid Tropics (ICRISAT))
- Dr. Phisamai Srichayet (Researcher (Professional Level), Institute of Food Research and Product Development (IFRPD), former Director of IFRPD, Kasetsart University, Thailand)

(Organizer)

- Mr. KOYAMA Osamu (President, JIRCAS)

This Board was convened to provide guidance for the activities of the Green Asia project, including the dissemination of information through International Center for Strategy “MIDORI”.

3.1.1 Establishing the International Scientific Advisory Board for Strategy “MIDORI”

Since the launch of the Green Asia project, International Scientific Advisory Board meetings have been held biannually (Table 1). The first meeting was held in October 2022, with opening remarks delivered by the Vice-Minister for International Affairs of MAFF. From the outset, in line with the “All-Japan” approach to promoting the application of agricultural, forestry, and fisheries technologies developed in Japan, key national research institutes—NARO (National Agriculture and Food Research Organization), FFPRI (Forestry and Forest Products Research Institute), and FRA (Fisheries Research and Education Agency)—were invited to participate as observers (Figure 1).

Recognizing the importance of collaboration with international organizations, partnerships with the FAO Regional Office for Asia and the Pacific (FAORAP), the ASEAN Secretariat (ASEC), and the UN Food Systems Coordination Hub were considered critical in the early stages of the project. FAORAP joined as an observer at the second meeting, ASEC at the fifth meeting, and the UN Food Systems Coordination Hub at the seventh meeting (Table 1).

Advisory Board members also participated in field visits to understand the progress in agricultural management and technologies in Japan that were aligned with the MIDORI Strategy.



Figure 1 Group photograph of the first meeting of International Scientific Advisory Board

*Japanese sustainable food systems strategy was initially called “MeaDRI” and renamed as “MIDORI” later.

Since the inception of the Green Asia project, biannual meetings have provided important opportunities for advice and suggestions from Board members to guide Green Asia activities. The Green Asia Secretariat reported at subsequent meetings on how it responded to the advice and suggestions, and shared the actions taken to ensure implementation.

Some examples of actions taken in response to advice and suggestions are as follows:

- Clarification and redefinition of concepts and terms in the implementation of the Green Asia project were required. For example, technologies to be tested and disseminated were called “scalable technologies” instead of ‘basic technologies’ (1st meeting).
(Action taken) The Secretariat adopted the term ‘scalable technology.’
- Target technology areas in the Technology Catalog Contributing to Production Potential and Sustainability in the Asia-Monsoon Region (“Technology Catalog”) should be expanded so that the technologies can be used to contribute to improving not only sustainability at the production stage, but also efficiency in processing and other stages (3rd meeting).
(Action taken) The Secretariat included more technologies in the area of procurement in Ver.3 and processing in Ver.4.

Table 1. Meetings of the International Scientific Advisory Board for Strategy “MIDORI”

No.	Date & Location	Main Discussion Points	Participation from IOs	Field Trips
1 st	October 25, 2022 Tokyo (hybrid)	<ul style="list-style-type: none"> ● Introduction of the Strategy “MIDORI” and the Green Asia project ● Determination of TORs of the International Scientific Advisory Board for Strategy “MIDORI” 		Agri-business Creation Fair (Tokyo); paddy rice fields, Inbanuma (Chiba Pref.)
2 nd	March 16, 2023 Online	<ul style="list-style-type: none"> ● Progress in collaboration with international organizations and countries in the Asia-Monsoon region ● Field trials ● Green Asia Report Series ● Technology Catalog Ver.1 	FAO	-
3 rd	September 21, 2023 Tokyo (Hybrid)	<ul style="list-style-type: none"> ● Progress of Strategy “MIDORI” ● Technology Catalog Ver.2 	FAO	The showroom of the Institute of Agricultural Machinery, NARO/Ogawa Town known for organic agriculture (Saitama Pref.)
4 th	March 15, 2024 Online	<ul style="list-style-type: none"> ● Follow-up of progress after the 2nd meeting ● Approaches for collaborating with stakeholders to implement each demonstration project for the next two years 	FAO	-
5 th	October 03, 2024 Nara Pref. (Hybrid)	<ul style="list-style-type: none"> ● Progress of Strategy “MIDORI” and the ASEAN-Japan MIDORI Cooperation Plan ● Approaches for social implementation of scalable technologies ● Technology Catalog Ver.3 	FAO, ASEC	Kyoto Food Tech Expo 2024 (Kyoto Prefecture)/ Fukuhara Farm (Shiga Pref.)
6 th	March 14, 2025 Online	<ul style="list-style-type: none"> ● Follow-up of progress after the 5th meeting ● Challenges encountered during research activities in the Green Asia project 	FAO, ASEC	-
7 th	October 28, 2025 Tsukuba (Hybrid)	<ul style="list-style-type: none"> ● Updating information and progress of Green Asia activities toward finalization ● Discussion of the Green Asia Phase 2 	ASEC, UN Food Systems Coordination Hub	NARO/ FFPRI (Ibaraki Pref.)
8 th	Online	<ul style="list-style-type: none"> ● Finalization of the Green Asia project, including the Green Asia Report Series ● Conclusion 	ASEC	-

- Implementation of a pilot study was recommended to identify the constraints and enabling factors for the adoption of technologies listed in the Technology Catalog in ASEAN member states (AMS) (4th meeting).
(Action taken) The Secretariat conducted a pilot study to explore the adoption of selected technologies in the Technology Catalog (see Green Asia Report No. 7).
- Social science studies should be implemented to evaluate public acceptance and other factors in technology adoption (5th meeting).
(Action taken) Two social science researchers conducted rural surveys in association with the field trials of water management technologies in Pillar 2 (see Green Asia Report No. 9).
- The topics that Green Asia project highlights were found to fit very well with the innovation component of upcoming stock-taking event (UN Food Systems Summit +4 Stocktake (UNFSS+4)) on the innovation side and participation was suggested (6th meeting).
(Action taken) The Secretariat attended and participated in the official side event of the UNFSS+4 held in Ethiopia on July 27, 2025, and introduced the Green Asia project's activities.

3.1.2 Setting up the International Center for Strategy “MIDORI”

The International Center for Strategy “MIDORI” is a virtual organization established within JIRCAS just before the first meeting of International Scientific Advisory Board. It served as a hub for the collection, analysis, management, and dissemination of the research findings and outputs generated by the Green Asia project. The Center was primarily operated by the JIRCAS researchers involved in Pillar 1 of the project.

Under the guidance of the International Scientific Advisory Board, the Center compiled Green Asia project-branded publications, such as the Technology Catalog and the Green Asia Report Series. These outputs are made available through the Center's website in downloadable formats and promoted as tools for information dissemination, greatly contributing to raising awareness of the Green Asia project outputs and outcomes, and improving the visibility of Japanese technologies when introduced at major global forums.

3.1.3 Strengthening the JIRCAS Southeast Asia Liaison Hub

JIRCAS's Southeast Asia Liaison Hub has been in operation since 1972, with its office in Bangkok, Thailand. Owing to its physical location in the center of the Asia-Monsoon region, it has a strategic role in networking with partners and disseminating information through, and from, the Green Asia project. The presence of the JIRCAS Regional Coordinator in Bangkok, Thailand facilitated in-person engagement with the UN agencies in the city. The Hub's location also offered convenient access to field trial sites across the region as well as easier connection with ASEC in Jakarta, Indonesia.

In 2023, the Liaison Hub's 50th Anniversary Symposium was a venue for the Green Asia project to be introduced to partners in national agricultural research institutions, universities, and to international organizations, thus to facilitate discussion on the future direction of collaborative research and networking in Southeast Asia. During the Symposium, the participants reaffirmed the Southeast Asia Liaison Hub's importance and that it played a key role in the application of scalable agricultural technologies developed in Japan, and in developing international research partnerships. Leveraging its strategic location and active participation in FAORAP and ASEAN, field trials, and in workshops conducted under the Green Asia project, the Hub has strengthened its function and works based on the shared understanding and demand articulated during the Symposium (Figure 2).

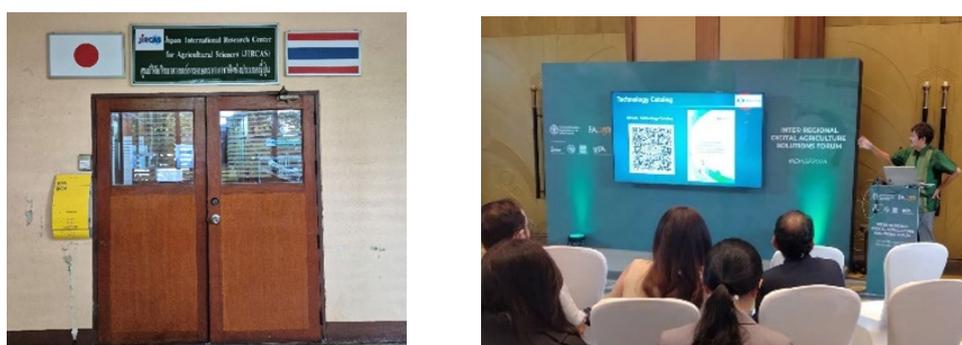


Figure 2. The JIRCAS Southeast Asia Liaison Hub in Bangkok, Thailand (left) and a presentation by the representative of the JIRCAS Southeast Asia Liaison Hub at the Inter-regional Forum on Digital Solutions for Agrifood Transformation (IDASF 2025) 3-5 September 2025, Bangkok, Thailand (right)

3.2 Disseminating information

3.2.1 Technology Catalog

The Asia-Monsoon region has distinctive agro-ecological and socioeconomic conditions. Therefore, food system transformation efforts in the Asia-Monsoon region's agricultural sector should address the context- and location-specific constraints of the region's intensive farming systems, characterized by a hot and humid climate, rice paddy farming, and small-scale farming, to reduce GHG emissions without compromising the food and nutrition security needs of the populations. Rather, because of these common features, economies of scale for technology applications can be achieved by leveraging collective actions to share knowledge and mobilize commitments. Given the shared characteristics of countries and economies in the Asia-Monsoon region, some agricultural technologies developed and applied in Japan, as well as those developed for the countries and economies in the region through various international collaborative studies with national agricultural research institutes and universities in Japan, could be applicable to this region if modified to address local needs.

From this perspective, the Green Asia project initiated the "Technology Catalog" that is a compilation of the technologies developed in Japan and through international research partnerships over the past ten years. The criteria for a technology to be selected for the Catalog are in line with the MIDORI Strategy target areas, such as the reduction of GHG emissions, and reduced use of chemical fertilizers and chemical pesticides.

Since its first publication, the Technology Catalog has expanded the list of technologies and the partners involved. In Ver.1 (March 2023) there were 23 agricultural technologies from JIRCAS and NARO. It was updated as Ver.2 (September 2023) to include 31 technologies from all the National Research and Development Agencies under the Ministry of Agriculture, Forestry, and Fisheries (MAFF), that is, JIRCAS, NARO, FFPRI, and FRA. Ver.3 included 40 technologies with potential to scale out in the Asia-Monsoon region, including addition of technologies developed by the National Institute of Advanced Industrial Science and Technology (AIST), under the Ministry of Economy, Trade and Industry, and Japanese universities. Ver.4 (Figure 3) is the final version of the Technology Catalog under the Green Asia project, with a

total of 44 technologies by adding the four latest scalable technologies provided by JIRCAS.

The Technology Catalog is available in both downloadable (PDF) and web-based formats on the International Center for Strategy “MIDORI” website to ensure accessibility and usability across diverse contexts. The PDF version, available in Japanese and English, can be downloaded freely for offline reference and dissemination. To complement this, a web-based database was developed to enable users to search for technologies using various parameters, including technology name, stage of technology (demonstration or implementation), target process within the food supply chain (production, input, processing and distribution, or procurement), institutions that developed the technology, and thematic area of contribution. This database also includes country-specific search functions and information on collaborative research institutions, thereby enhancing its utility for stakeholders.



Figure 3. Technology Catalog Ver.4

In cooperation with MAFF, JIRCAS has been actively engaged in introducing and promoting the Technology Catalog in international forums, including the International Rice Congress in 2023, the UN Food Systems Summit+2 and +4 meetings held in 2023 and 2025 respectively, 4th Asia Pacific Food Systems

Transformation Meeting in 2026, the Conferences of the Parties to the UN Framework Convention on Climate Change (COP28 and COP30) in 2023 and 2025, and various workshops and forums held by ASEC. With its comprehensive, easily navigated and well-organized structure, the Technology Catalog has attracted the attention of a broad spectrum of stakeholders, far beyond what would be expected from presenting the individual technologies in isolation. The Technology Catalog now features the websites of international organizations, including the UN Food Systems Coordination Hub, FAORAP, ASEC, International Rice Research Institute (IRRI), and Food and Fertilizer Technology Center (FFTC). The broad appeal of the Technology Catalog has led to meaningful outcomes, including recognition within regional and international policy frameworks. As a result of these activities, the Technology Catalog is now featured in the documents of the Japanese government, ASEAN official documents, and in ASEAN member states, contributing to supporting global, regional and national rulemaking.

The 2025 MAFF ‘Initiative for Net-zero compatible with Food security through International expansion of Innovative Technology (MIDORI∞INFINITY)’ aims to “facilitate climate investment to the agriculture, forestry, and food sector and expand market opportunities” (MAFF, 2025a) refers to the Technology Catalog and showcases its technologies.

The ASEAN-Japan MIDORI Cooperation Plan was originally formulated in 2023 to commemorate the 50th anniversary of ASEAN-Japan relations and was subsequently revised in October 2025. The revised Cooperation Plan includes a range of collaborative projects that leverage new technologies and innovations developed in Japan. Notably, the Technology Catalog was featured in Annex 3 of the revised plan, which was officially adopted at the ASEAN-Japan Ministers of Agriculture and Forestry Meeting in October 2025 (MAFF, 2025b). The Technology Catalog is an important and significant contribution to the ASEAN-Japan Revised Cooperation Plan.

Furthermore, the inclusion of technologies from the Technology Catalog in documents such as the ‘ASEAN Guidelines on the Reduction of Crop Burning’ (three technologies featured in the Technology Catalog were included) and the ‘Thailand Taxonomy (Agricultural Sector)’ represents noteworthy achievements as Japanese technologies, despite Japan not being a member of ASEAN, have been adopted. These

results demonstrate the Technology Catalog's significant contribution to regional and national rule-making efforts in the Asia-Monsoon region. In addition, in October 2025, the technology titled 'Energy-saving low-carbon technology in greenhouse horticulture utilizing thermal energy irrigation canals' featured in the Technology Catalog, was included in the 'Green Technology Book' by WIPO (World Intellectual Property Organization) (WIPO 2025), and CTCN (Climate Technology Center and Network) in response to JIRCAS's presentation on the Green Asia project at COP28 in 2023.

3.2.2 Green Asia Report Series

The Green Asia Report Series (GARS) serves as a knowledge repository and record of the Green Asia project. There are thirteen reports, Report No.1 describes the background and key issues of the Green Asia project. The other reports address Alternate Wetting and Drying, Biological Nitrification Inhibition, biochar, rice ratooning, rice blast control using the differential system and others (see Table 2). This series provides policymakers, researchers, extension officers, and private sector stakeholders with structured insights into the background, scientific mechanisms, challenges, and opportunities related to scalable agricultural technologies that contribute to the development of sustainable food systems in the Asia-Monsoon region.

3.2.3 International JIRCAS Symposium

On October 27, 2025, the International JIRCAS Symposium titled "Accelerating Application of Agricultural Technologies in the Asia-Monsoon Region" was held to review the activities of the Green Asia Project, which concluded in FY2025 (March 2026), and to showcase its achievements from a global perspective on food systems transformation. In addition to members of the International Scientific Advisory Board, the session featured the Head of Food, Agriculture and Forestry at the ASEAN Secretariat and the Director of the UN Food Systems Coordination Hub, both of whom also participated in the 8th International Scientific Advisory Committee meeting and the field trip on the following day.

As a result of these engagements, an article titled "Japan's Innovation Engine: How JIRCAS and NARO Are Shaping the Future of Sustainable Food Systems" was published on the UN Food Systems Coordination Hub website (UN Food Systems

Coordination Hub, 2025), highlighting the high recognition of research activities based on Japan’s MIDORI Strategy both domestically and internationally.

Table 2. List of the published Green Asia Report Series (GARS)

No.	Year of Publication	Title	Outline
No.1	2023	Driving sustainable food systems transformation in the Asia-Monsoon region with science, technology, and innovation: background and key issues for “Green Asia” project	The background of the Green Asia project, the definition of the target area, and the main issues.
No.2	2023	Accelerating intermittent irrigation for low-carbon and resilient rice production systems in Asia: progress, challenges and opportunities	Analysis of the adoption status, effects, challenges, and outlook of AWD technology.
No.3	2023	BNI technology: a genetics-based solution to global challenges in the 21 st century	The scientific background, application cases, and challenges of biological nitrification inhibition (BNI) technology
No.4	2025	Local biochar use for sustainable agriculture in Asia	Scientific findings, effects, and implementation conditions regarding the agricultural use of biochar
No.5	2025	Rice ratooning for low-input rice cultivation	Technical overview of ratooning rice, shoot cultivation, implementation effects, challenges, and potential for widespread adoption
No.6	2026	Sustainable use of small indigenous fish species for nutritional and livelihood improvement in inland rural areas of Indochina	Overview of sustainable inland fisheries and aquaculture to improve nutrition and livelihoods in Indochina
No.7	2026	Exploring the adoption of technologies in technology catalog: “cashew nutshell liquid feeding” and “the pH control technology for maintaining the acidity of fermented rice noodles”	Evaluating the significance of implementing technologies listed in technology catalog.
No.8	2026	Baseline estimation and mitigation of GHG emission from SE Asia livestock system	Technical overview of the GHGs emission from livestock manure management
No.9	2026	Guidelines for improving rice yield through climate-smart water management in the Asia-Monsoon region	Guidelines for climate-smart water management to boost yields while reducing GHG emissions, supporting farmers and policymakers toward resilient, low-carbon rice systems
No.10	2026	BNI-enabled wheat in Nepal toward social implementation	Overview of BNI-enabled wheat to improve nitrogen use efficiency and reduce environmental impact, with trials in Nepal aiming to boost yields and support sustainable, climate-smart wheat production.
No.11	2026	International collaborative research for the implementation and dissemination of a differential system of rice blast	Overview of using a differential system with resistant varieties and pathogen monitoring in the Asia-Monsoon region
No.12	2026	Development concept and early demonstration of nitrogen-use-efficient rice varieties	Development of early-heading rice varieties to improve nitrogen use efficiency and promote sustainable cultivation in the Asia-Monsoon region
No.13	2026	Green Asia final report: lessons for accelerating the implementation of agricultural technologies in the Asia-Monsoon region	Outline of and lessons learned from the Green Asia project

3.2.4 Other activities

The following two activities were also implemented as part of Pillar 1 information dissemination.

Update of the Thai fermented food database: Reducing food loss in the fermented food sector is an important area in the food systems of the Asia-Monsoon region, which has significant cultural diversity of traditional fermented foods. The database, based on literature from the Institute of Food Research and Product Development (IFRPD), Kasetsart University, introduces traditional Thai fermented foods categorized by raw materials, photographs, and production methods. Publicly available on the JIRCAS website since 2013, it aims to systematize information for researchers, the government, and industry to help reduce food loss by ensuring product quality and maintaining the expected shelf life and, if possible, extending it. Each entry includes names in local languages and English, raw materials, fermentation conditions, microorganisms, and nutritional properties. As part of the Green Asia project, an update was made to the 2024 database, adding revised photographs and microbial data that can be further utilized for research and development (JIRCAS 2025a).

Developing the regional livestock manure treatment GHG emission database: The livestock sector is among the agricultural sectors responsible for GHG emissions in the Asia-Monsoon region, and properly reporting emissions is important for countries to abide by international climate policies. From this perspective, the Green Asia project implemented data collection and analysis aimed at developing country-specific emission factors that consider local cattle breeds, feed types, and climatic conditions and built an integrated database of these factors. In Vietnam, composting trials using cattle manure were conducted to obtain the necessary data to establish emission factors for the country. (For further details, see Green Asia Report No. 8).

These activities play important roles within the project. The fermented food database strengthens demand-side evidences and stakeholder engagement (Pillar 1), while the livestock manure GHG factor development provides foundational data for mitigation technology scaling (Pillar 2). Both activities contribute directly to the outcomes and are therefore integral to the project logic.

4. Pillar 2: Accelerating application of scalable agricultural technologies through joint research

The Technology Catalog serves as a reference for stakeholders in the Asia-Monsoon region, including government officials, researchers, extension officers, producers, and the private sector. Scientific evidence must guide the promotion of scalable technologies for sustainable food systems in diverse contexts within the Asia-Monsoon region. The dissemination of agricultural innovations cannot be approached using a one-size-fits-all strategy because of the heterogeneity of local agroecological conditions, including climate variability, soil characteristics, water resource availability, and the prevalence of pests and diseases.

To validate their local applicability, field trials were conducted to evaluate the performance and applicability of three agricultural technologies:

- Alternate Wetting and Drying (AWD): Water management technologies designed to mitigate methane emissions from paddy fields while simultaneously enhancing crop productivity.
- Biological Nitrification Inhibition (BNI) wheat: a soil fertility management approach that improves crop nitrogen use efficiency by inhibiting nitrification by microorganisms.
- International Differential System for Rice Blast Disease (Rice Blast Control): A diagnostic framework to characterize and manage rice blast pathogens across different geographic regions

Field trials for AWD, BNI and Rice Blast Control were conducted with demand and scaling partners. It is essential to induce behavioral changes to accelerate the adoption of technologies and the dissemination of innovations. After the field trials, evidence on the impact and conditions needed for the application and uptake of each technology was compiled. When these innovations are widely adopted, the expected increases in agricultural productivity will occur, and negative impacts will be mitigated in the Asia-Monsoon region. Figure 4 shows the identification of activities to employ evidence-based technologies effectively to achieve outcomes and impacts in the field trials of Pillar 2. These trials provide valuable insights to accelerate technology adoption in various contexts and countries. The detailed activities and

Monsoon region. JIRCAS's extensive network with partner institutes in the Asia-Monsoon region allows intermittent irrigation field monitoring to be widely conducted to determine the environmental and agronomic factors that constantly improve yields. The environmental and agronomic factors that enable rice yield increases by intermittent irrigation were elucidated from field monitoring campaigns at seven sites across four countries (Bangladesh, Indonesia, Thailand, and Vietnam) to evaluate the likelihood of voluntary dissemination. In Bangladesh and Vietnam, a socioeconomic study was conducted to evaluate profitability and elucidate the factors for farmers to accept and implement intermittent irrigation.

Results and lessons learned: interim results showed that MiDi (midseason drainage followed by intermittent irrigation, conventional practice in Japan) and AWD15 (both with moderate drainage intensity) increased rice yields on average by 7% and 3%, respectively, relative to continuous flooding practice, whereas there was no increase or decrease in yield in AWD25 (with severe drainage intensity). The potential of intermittent irrigation to reduce methane emissions is limited when its positive effects on rice yields are maximized. Based on these results, guidelines on climate-smart water management were developed to support policymakers, researchers, and agricultural extension professionals in the region, while also facilitating the dissemination and adoption of this technology through NGOs in countries such as Bangladesh.

4.2 Biological Nitrification Inhibition (BNI)-enabled wheat

Background and expectation: Since all nitrogen fertilizers in Nepal are imported, nitrogen application to the staple crop, wheat, is directly linked to food security. The technology introduced by the Green Asia project can contribute to the further use of BNI-enabled wheat for successful inclusion in the Nepal variety registration process, so that these varieties will then be available to farmers.

Enabling factors and prioritized activities: CIMMYT-bred varieties are widespread in Nepal. JIRCAS's prototype BNI-enabled wheat varieties were established based on these varieties. BNI-enabled wheat varieties adapted to Nepali conditions were introduced through multi-location trials to replace existing varieties with BNI-enabled varieties. Hilly and plain (terai) areas where the wheat varieties Munal and Borlaug 100 had been adopted were selected and multilocation

trials conducted with reduced N fertilizer applications to check N fertilizer responses of their BNI-enabled lines (BNI-Munal and BNI-Borlaug 100).

Results and lessons learned: results of the two cropping seasons clearly showed the effect of BNI on higher (equivalent to recommended) and lower nitrogen fertilizer applications. Higher nitrogen application resulted in an approximately 10% increase in yield, whereas lower nitrogen application (50% nitrogen reduction) resulted in a yield level almost equivalent to the recommended nitrogen application in both BNI-Munal and BNI-Borlaug 100. Reducing nitrogen fertilizer use has an effect equivalent to subsidy reduction in countries such as India, where fertilizer application rates are high because of government subsidies. In such cases, governments have an incentive to promote BNI-enhanced wheat adoption. However, in least developed countries (LDCs) such as Nepal, where subsidies are insufficient and fertilizer application rates for wheat are already low, BNI-enhanced wheat may be grown to increase food production. GHGs emissions can be reduced using BNI-enabled wheat varieties; however it is important to note that the significance of the same technology will differ depending on the specific national context, not only environment, demand, availability of fertilizers and subsidies, but also the broader political environment prevailing.

4.3 International differential system of blast toward reducing chemical pesticide application with blast resistant lines

Background and expectation: Rice blast is a major trans-boundary disease of rice in the Asia-Monsoon region. If proper control is not carried out using chemical fungicides, rice production will decrease by 30-60% due to rice blast infection. Therefore, using resistant varieties together with minimal fungicide application is an economically and environmentally sound approach to disease control.

Enabling factors and prioritized activities: There is an urgent need to introduce effective rice blast control systems in this region. For example, in Vietnam, a novel blast fungus that was not identified in 2012 surveys was observed in 2022, whereas in Bangladesh, the introduction of partial resistance genes led to reduced damage by rice blast fungi with lower chemical pesticide application. This study assessed a possible reduction in the use of chemical pesticides by conducting three activities: race designation of the blast fungus, characterization of resistant rice varieties, and

chemical pesticide reduction trials, using the differential system in Bangladesh and Vietnam.

Results so far and lessons learned: The differential system and DNA marker analysis revealed that the virulence of the blast fungus caused a rice blast disease outbreak in a major variety in Vietnam in 2017. Monitoring of rice blast fungi using a differential system to suit the current situation is required in both countries. In Vietnam, monitoring and farmer-level demonstration trials were conducted before broader implementation. These anticipatory activities provide valuable insights into local pathogen dynamics, varietal performance, and farmers' responses to reduced pesticide practices. To help connect the research findings with local implementation, these pilot efforts will serve as a foundation to design and scale up larger demonstration and monitoring programs.

4.4 Additional field research: Development and field validation of nitrogen-use efficient rice for the Asia-Monsoon region

In 2023, another field research project was added to Pillar 2. The details are described in Green Asia Report Series No.12. The analysis was organized into three key dimensions as follows:

Background and expectation: In the Asia-Monsoon region, the intensive use of chemical fertilizers in rice cultivation often induces excessive vegetative growth at the heading stage, resulting in a dense canopy where the upper leaves shade the lower leaves. Such a canopy structure limits light penetration during grain filling, and reduces photosynthetic activity in the lower leaves, leading to lower productivity and sub-optimal nitrogen use efficiency (NUE). A preliminary survey showed that improving the canopy structure of rice to improve light distribution could lead to maintaining or even improving yields with reduced nitrogen fertilizer input.

Enabling factors and prioritized activities: The Philippines and Indonesia, located in the Asia-Monsoon region, have very large populations. Rice is the staple food; they are also major rice-importing countries. Thus, there is strong interest in the implementation and widespread dissemination of rice varieties with improved NUE, which can contribute up to a 30% reduction in chemical fertilizer application.

Results so far and lessons learned: In Indonesia, field trials were conducted in farmer plots for varieties EHD10 and EHD16, which were developed by introducing different early maturity genes into the major variety Ciherang. Under the recommended fertilization conditions, both varieties' yields exceeded that of Ciherang, demonstrating the potential to reduce nitrogen use by approximately 20%. Furthermore, the yields of EHD10 and EHD16 were maintained even under no-fertilizer conditions, overcoming the conventional challenge of yield reduction associated with early maturity.

5. Lessons learned from Green Asia project activities

The two pillars of the Green Asia project functioned in a mutually reinforcing manner. The information disseminated under Pillar 1 includes an overview of the technologies selected for field trials under Pillar 2, updates of their implementation status, and preliminary results. Moreover, through information dissemination activities under Pillar 1, dialogue with interested countries led to the identification of potential candidate countries for field trials under Pillar 2. The complementarity between the two pillars is discussed below as the lessons learned from the Green Asia project from a broad system-wide perspective are explored.

Three key points crucial to the implementation of the project were identified.

First, before the launch of the Green Asia project, information on scalable agricultural, forestry, and fishery technologies developed through Japanese R&D was disseminated individually by each research institute. While such individual dissemination by each institution is necessary for applying technologies in different areas, it is difficult for such an institution to determine in which countries there is potential demand for a specific technology or a portfolio of technologies based solely on these separate efforts.

The Green Asia project coordinated various Japanese research institutes and universities to identify scalable agricultural technologies developed in Japan through international research partnerships that contribute to both increased production potential and sustainability. These technologies were compiled into the ‘Technology Catalog’ as a single, aggregated information resource, which significantly improved the visibility of Japanese agricultural technologies in international forums such as UN Food Systems Coordination Hub, FAO and ASEC, contributing to regional rule-making initiatives in the ASEAN region, as described earlier. This enhanced communication facilitates the alignment of technological solutions with actual needs in the Asia-Monsoon region and holds significant potential to further enhance Japan’s contribution to the transformation of food systems in the Asia-Monsoon region through scalable agricultural technologies.

Second, as an initiative that strongly supports the alignment of solutions to the needs,

the Green Asia project strengthened its Science and Policy Interfaces (SPIs). According to Hove (2007), SPIs are defined as “social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making.” In the context of the Green Asia project, the compilation of the Technology Catalog has had a major role in fostering and strengthening relationships between researchers who contributed their technologies to the Technology Catalog and policymakers. As scientific evidence plays a vital role in shaping public policy by guiding decision makers with reliable information (Suazo-Galdames et al 2025), the development and enhancement of SPIs enable evidence-based policymaking.

Efforts by the Green Asia project to strengthen SPIs included the following:

- The Technology Catalog and its featured technologies have been referenced in key regional and international frameworks, including MIDORI∞INFINITY, the ASEAN-Japan MIDORI Cooperation Plan, the ASEAN Guidelines of Reduction of the Crop Burning, the Thailand Taxonomy (Agricultural Sector), and the Green Technology Book.
- At major international events such as the UN Food Systems Summit+2 and +4, as well as COP28 and COP30, JIRCAS, together with policymakers from MAFF, actively disseminated information about Green Asia’s activities.
- At several ASEAN meetings attended by both MAFF and ASEAN AMS policymakers, JIRCAS researchers engaged in discussions on the Green Asia project’s activities, with a particular emphasis on the Technology Catalog.

SPIs also strengthened the effectiveness of field trials in which policymakers and researchers in Japan and targeted countries gathered to discuss critical issues, such as constraints and necessary policy frameworks associated with Pillar 2, and *vice versa*.

The third point concerns project development. Flyvbjerg (2023) highlighted that successful projects require a clear and sustained understanding of their purpose and rationale, which is maintained throughout their lifecycle. At its inception, the Green Asia project adopted a technology-driven, supply side approach, hypothesizing that efforts to disseminate information among decision makers on the technologies listed

in the Technology Catalog could incentivize their voluntary adoption, thus accelerating sustainable food system transformation. Given this assumption, field trials were implemented from technical perspectives with local national research institutions. These trials were designed to validate technologies that would improve sustainability without compromising productivity if modified and tailored to locally specific contexts. However, in its early stages, the Green Asia project neither defined target beneficiaries nor addressed their economic considerations of technology adoption. The International Scientific Advisory Board reminded the Green Asia project team of the need to approach the local adaptation of technologies from the perspective of demand-impact pathways, considering stakeholders' needs as well as enabling and constraining conditions for technology adoption.

For example, AWD has been a well-known practice in the Asia-Monsoon region for decades or even centuries. However, its adoption has been low in many local contexts, not only because of agro-climatic conditions defining productivity-sustainability trade-offs addressed by field trials, but also because of its lack of compatibility with locally specific socio-economic conditions, such as land and labor markets, institutional arrangements on water management, and locally available seed varieties. The Green Asia project responded to the request of MAFF and followed the recommendations of the International Scientific Advisory Board to implement additional activities for AWD, such as cost-benefit analyses and household surveys. To ensure alignment between our research direction and the needs of partner countries, we intentionally increased opportunities for communication with stakeholders. This includes a series of presentations by JIRCAS on the AWD research results of the Green Asia project, as well as subsequent stakeholder discussions, both conducted at the "3rd ASEAN Task Force Meeting: Finalizing the Strategic Framework for Food, Agriculture, and Forestry" (JIRCAS, 2025b).

The four-year Green Asia project yielded valuable experience in running the project while learning, modifying, or improving the approaches. In promoting future technologies, productivity and sustainability will be improved and food system transformation supported. Local needs will be identified and matched, enabling/constraining factors determined, stakeholders identified, and using an impact pathway to identify and plan actions.

From this perspective, Koyama (2025) proposed a strategic approach to promote the international deployment and social implementation of Japanese agricultural technologies as part of the lessons learned at the 6th meeting of the International Scientific Advisory Board as follows:

- For the overseas deployment of technologies, it is essential to first analyze the social, economic, and natural conditions of the target country or region. These include differences in language, land tenure, farming practices, labor costs, climate, and soil.
- Technologies should be integrated into existing systems and adapted accordingly. Field demonstrations and cost-benefit analyses help assess feasibility, whereas collaboration with government agencies, local companies, research institutions, and NGOs is crucial.
- The market formation phase requires outreach to stakeholders across the supply chain, which is supported by manuals, branding, and alignment with local regulations, subsidies, and intellectual property (IP) systems. Project management and impact evaluations must be conducted to ensure effectiveness. A market-in approach helps to identify local needs and customize solutions.
- Success and failure factors will be continuously analyzed and updated using the OODA Loop framework* to guide systemic transformation toward sustainable food systems.

* The OODA Loop is a decision-making concept proposed by John Boyd of the U.S. Air Force and is an acronym for the following four processes: Observe the situation around you and gather raw data; Orient: use the raw data gathered to determine how the situation is developing; Decide: decide what to do or plan to do based on your judgment of the situation; Act: follow the plan you have decided to do. After O→O→D→A, it is important to connect to the next OODA loop.

This proposal (Figure 5) has been incorporated into the Ministry of Agriculture, Forestry and Fisheries (MAFF) as a contribution to the MIDORI∞INFINITY initiative, and is also included in the main body of the MIDORI∞INFINITY document (MAFF, 2025a)

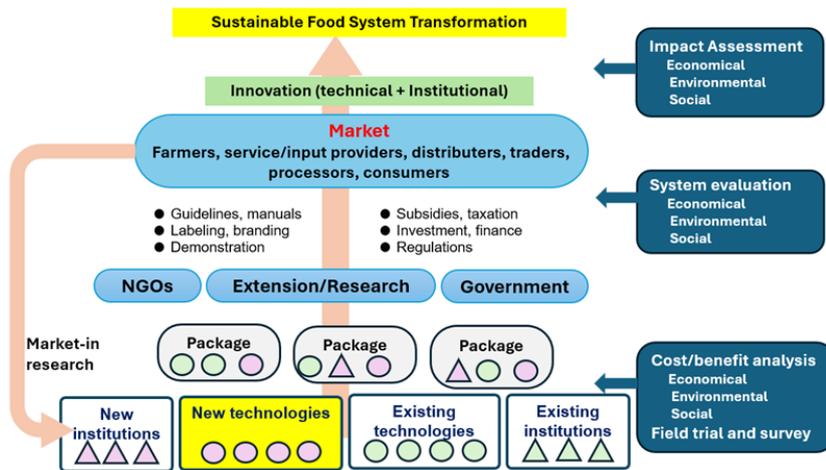


Figure 5. Transformation to a sustainable food system through technology development

Source: Koyama (2025)

6. Conclusions

Through the implementation of this project, three key points were identified as crucial to accelerate the application of Japanese agricultural technologies in the Asia-Monsoon region: 1) exercising a coordinating function by analyzing, compiling, and disseminating technologies as aggregated information resources; 2) strengthening SPIs; and 3) recognizing the importance of strategic planning from the outset.

It has become evident that, for agricultural technologies developed in Japan and through international research partnerships to effectively contribute to food system transformation in the Asia-Monsoon region, JIRCAS must conduct such projects in partnership. It is essential to leverage JIRCAS's coordinating function and engage in collective efforts in collaboration with other national research institutions to disseminate technologies as aggregated information resources, such as technology catalogs.

Furthermore, SPIs have also been identified as a critical factor for achieving meaningful impacts. The Green Asia project has actively fostered collaboration between researchers and policymakers. The Technology Catalog serves as a bridge, enabling evidence-based policymaking. SPIs were strengthened through presentations at international events and direct engagement with policymakers and researchers in the Asia-Monsoon region.

A clear understanding of project goals and the intended use of results is essential from the beginning, along with the identification of enabling factors, emphasizing the need for strategic planning throughout the project lifecycle.

MAFF developed a new strategic document 'Japan's Global MIDORI Cooperation Plan' (MAFF, 2024) in response to the growing interest among many Global South countries to enhance their agricultural production potential, ensure sustainability, and establish resilient food and nutrition systems. MAFF proposed a strategic approach that leverages the expertise and technologies developed by both the public and private sectors. The lessons learned from the Green Asia project, particularly the three points stated above, will serve as useful references for future efforts with the Global South to ensure sustainable food and nutrition security for all.

Authors contribution statement

Conceptualization of the contents, YF and MI; Writing-original draft, YF and NK, Writing-review and editing, YF, MI, NK and SK, Visualization, SK, NK.

Acknowledgement

This report was based on a study conducted under the project "Accelerating application of agricultural technologies which enhance production potentials and ensure sustainable food systems in the Asia-Monsoon region", which has been financially supported by the Ministry of Agriculture, Forestry and Fisheries.

The authors are especially grateful to the following:

- The members of the International Scientific Advisory Board for Strategy "MIDORI" for their valuable comments and guidance on the manuscript.
- Dr. Jacline Hughes for her valuable assistance with editing this report.
- Dr. Kazunori Minamikwa, Dr. Tadashi Yoshihashi, Dr. Mitsuhiro Obara for input of the information on their joint research in the Green Asia.

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