MIDORI∞INFINITY

Initiative for **N**et-zero compatible with
Food security through
INternational expansion of
Innovative Technolog**Y**

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MAFF

Index

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Initiative for **N**et-zero compatible with **F**ood security through **IN**ternational expansion of **I**nnovative **T**echnolog**Y**

1. Background

(1) Climate change as a global challenge

Climate change is an urgent global issue. Greenhouse gas (GHG) emissions have been increasing year by year and reached a record high level in 2019. Accordingly, the global annual average temperature has already increased by approximately 1.1°C compared to pre-industrial levels, and 2024 was the hottest year in recorded history, with the global average temperature approximately 1.55°C higher compared to pre-industrial levels, exceeding 1.5°C for the first time, although for a single year[1].

Climate change is imposing negative impacts accross various regions and sectors around the world. For example, in Japan's agricultural sector, heavy rainfall is occuring more frequently, causing increased flooding of farmland and damaging agricultural greenhouses, while growth problems and quality deterioration due to high temperatures also cannot be overlooked. In the livestock sector, it is reported that during the sumer, declines occur in milk yield and milk composition in dairy cattle; growth and meat quality in beef cattle, pigs, and meat chicken; and egg-laying rate and egg weight in egg-laying chickens. In the fisheries sector, rising seawater temperatures have caused changes in habitats of various fish species, causing decline in fish catches.

In summary, climate change is a challenge common to humanity that affects food security, and immediately addressing it both globally and domestically is an urgent issue.

(2) Challenges facing the agriculture and forestry sectors

Agriculture, Forestry, and Other Land Use (AFOLU) is a major source of GHG emissions, accounting for 22% of global GHG emissions, with approximately 8% of methane from paddy fields and 23% from enteric fermentation in livestock (2019[2]). Emission from the AFOLU sector tends to be particularly higher in countries where domestic industries rely heavily on agriculture. For example, Brazil, which serves as the Presidency of the 30th Conference of the Parties (COP30) to the United Nations Framework Convention on Climate Change (UNFCCC), has a large livestock industry, and emissions from the agricultural sector, including methane from enteric fermentation, account for 31% of domestic GHG emissions (2020[3]). Since a large proportion of GHG from the agricultural sector is generated through agricultural production,

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[1]IMO (2025), WMO confirms 2024 as the warmest year on record at about 1.55°C above pre-industrial level . https://wmo.int/news/media-centre/wmo-confirms-2024-warmest-year-record-about-155degc-above-pre-industrial-level

[2] Calculated by MAFF based on data from IPCC (2022), Climate Change 2022: Mitigation of Climate Change.

[3] Ministry of Science, Technology and Innovation of Brazil (2024), Fifth Biennial Update Report of Brazil to the United Nations Framework Convention on Climate Change. https://unfccc.int/sites/default/files/resource/BRA_BUR5_EN.pdf This does not include carbon dioxide of industrial origin.

etc., it is essential to promote GHG emission reductions while taking into account the trade-off with food production.

Comparing GHG emissions by origin, countermeasures are being taken globally for the energy sector, whereas countermeasures for non-energy sectors, especially agriculture and livestock, are not being adequately implemented[4]. In fact, only 4.3% of all climate finance are directed to the agricultural sector (2019-2020[5]). Moreover, Japan's bilateral crediting scheme, Joint Crediting Mechanism (JCM), which is advanced in the energy sector, is not fully utilized in the agriculture and livestock sector. Although the forest sector has promoted the use of JCM from the initial stage of the scheme, only two projects are registered, due to specific challenges, including long-term land management, and safeguards for environmental and social impacts.

(3) Growing international awareness in the agriculture, forestry, and fisheries sector in addressing climate change

In the recent years, circumstances surrounding the food, agriculture, forestry, and fisheries industries have been drastically transformed due to unstable international relations, natural disasters, and climate change. The importance of advancing GHG emission reductions in a manner compatible with policy objectives including food security and biodiversity conservation is becoming even more significant, and such increased momentum has been witnessed in various international fora[6][7].

In relation with the agriculture and forestry sectors, the Global Methane Pledge (GMP) was launched led by the United States and the European Union (COP26, 2021), committed to work together to collectively reduce global methane emissions by 30% by 2030 (compared to 2020 levels). In addition, various high-level meetings were held on the Food, Agriculture, and Water Day at COP29 (2024), where statements were made indicating that the food and agricultural sector will receive increased attention towards COP30. International initiatives in agriculture and forestry are launched every year by the COP Presidency, and 78% of the parties to the Paris Agreement include some form of agricultural sector initiatives in their Nationally Determined Contributions (NDCs)[8]. Moreover, the topic of the Mitigation Work Programme for 2025 and 2026 under the Paris Agreement was decided to cover the "Industry, AFOLU, and waste

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[4] IPCC (2022), Climate Change 2022: Mitigation of Climate Change.
[5] Climate Policy Initiative (2023), Landscape of Climate Finance for Agrifood Systems. https://www.climatepolicyinitiative.org/wp-content/ uploads/2023/07/Landscape-of-Climate-Finance-for-Agrifood-Systems.pdf
[6] The First Global Stocktake agreed upon at COP28 recognizes the fundamental priority of safeguarding food security (Preamble), and the IPCC Sixth Assessment Report calls for integrated approaches to meet multiple policy objectives including food security. (C3.5)).
[7] The First Global Stocktake recognizes the interconnectedness of climate change and biodiversity (in the context of mitigation in general, not specifically on the agricultural sector) (Preamble) and emphasizes the importance of biodiversity conservation, etc. (Paragraph 33). The Report of Working Group III of the IPCC Sixth Assessment Report also points out the existence of mitigation opportunities that provide co-benefits with biodiversity, etc. (C9 Headline).
[8] FAO (2024), Agrifood systems in nationally determined contributions: global analysis. https://openknowledge.fao.org/items/ee18576c-d9a4-4ee2 -bd62-253143064842

sectors". The work programme including the forest sector was discussed at COP30 taking into account the result of Global Dialogue on the forest sector in May 2025.

Also, in relation to the fisheries sector, guidelines for measuring carbon emissions and absorption are to be refined under the Intergovernmental Panel on Climate Change (IPCC) , and discussions are under way to update the methodology guidelines to include blue carbon and other absorptive measures. In summary, the agriculture, forestry, and fisheries sector is attracting increased attention in recent years in climate change discussions, and immediate action is required.

In recent years, various new ideas and approaches related to sustainable agriculture are being proposed, and GHG emission reductions in the agricultural sector are considered to play an important role. For example, in 2009, the Organization for Economic Cooperation and Development (OECD) proposed the concept of "bioeconomy"[9], which aims to attain a sustainable economy and society through the use of biotechnology and biomass, and in recent years the agricultural sector has been identified as the most relevant sector, with benefits for climate change mitigation and achieving food security, etc.[10] The "Bioeconomy Strategy" formulated in Japan in 2024 also positions agriculture as a means to achieve both reduction of environmental burden including GHG emission reductions, and improvement of productivity, as well as a means to secure a stable food supply. In addition, in "regenerative agriculture," which has recently been recognized as one of the approaches for achieving sustainable agriculture, climate change mitigation including GHG emission reductions is one of the major pillars, along with improvement of soil quality and conservation of biodiversity, and efforts are being made in the private sector. Such discussions on sustainable agriculture are rapidly advancing day by day, and it is an important perspective for Japan's policy development to grasp these global trends and consider Japan's climate change measures accordingly.

(4) Japan's climate change actions in the agriculture, forestry, and fisheries sector

Reflecting on climate change countermeasures in the agriculture, forestry, and fisheries sector in Japan, the Ministry of Agriculture, Forestry and Fisheries (MAFF) formulated the "MIDORI Strategy for Sustainable Food Systems (MIDORI Strategy)" in 2021 to enhance both productivity potential and sustainability in the food, agriculture, forestry, and fishery industries with innovation and to address various challenges facing Japan, including climate change, and to establish sustainable food systems. In 2024, the Act Partially Amending the Basic Act on Food, Agriculture and Rural Areas (Act No. 44 of 2024) included "establishing food systems in harmony with the environment" as a basic principle, reflecting the growing momentum in Japan

[9] OECD (2009), The Bioeconomy to 2030: Designing a Policy Agenda. https://doi.org/10.1787/9789264056886-en
[10] FAO (2023), Bioeconomy for sustainable food and agriculture. https://openknowledge.fao.org/server/api/core/bitstreams/d8f82717-d3f1-495c-a788-863f7512fa89/content

for climate change countermeasures compatible with food security.

Furthermore, in recent years, private companies and startups in the agriculture, forestry, and food sector have advanced research, development, and dissemination of GHG emission reduction technologies, and have demonstrated a growing interest in overseas deployment of these technologies, including JCM. The Act Partially Amending the Act on Promotion of Global Warming Countermeasures (Law No. 56 of 2024, hereinafter referred to as the "Revised Act on Promotion of Global Warming Countermeasures") was enacted in June 2024. MAFF was newly appointed as the competent minister. The government's "Plan for Global Warming Countermeasures" was revised (Cabinet Decision on February 18, 2025; hereinafter referred to as the "The Government’s Plan for Global Warming Countermeasures") and the target for JCM was stipulated (to secure accumulated emission reductions and removals at the level of approximately 100 million t-CO_2 by FY2030 and approximately 200 million t-CO_2 by FY2040). The Government’s Plan for Global Warming Countermeasures and the "Plan for Global Warming Countermeasures of the Ministry of Agriculture, Forestry and Fisheries" (revised on April 15, 2025; hereinafter referred to as the "The MAFF's Global Warming Countermeasures") both include new numerical targets for GHG emission reductions in the livestock sector. In summary, climate change countermeasures in the field of agriculture, forestry, and fisheries are steadily implemented in Japan.

In response to the growing international recognition of the need for climate change countermeasures that are compatible with food security and biodiversity conservation, progress in domestic climate policies, and increasing momentum for the overseas deployment of GHG emission reduction technologies, MAFF has compiled the "Initiative for Net-zero compatible with food security through international expansion of innovative technology". This initiative seeks to promote the international deployment of GHG emission reduction technologies that contribute to food security, especially in Asia, Africa, and Central and South America.

2. About this initiative

(1) Composition of this initiative

This initiative showcases (1) GHG emission reduction technologies and initiatives that contribute to food security, and their current status of domestic expansion in Japan and overseas deployment, (2) JCM and other measures that support overseas technology deployment from Japan, and (3) support programs that can be used by Japanese companies, etc. domestically and internationally.

(2) The goals of this initiative

This initiative aims to attract decarbonization investment to the agriculture, forestry, and food sector that have been currently underinvested compared to the energy sector. This can be achieved by internationally deploying GHG emission reduction technologies that have been successfully developed, deployed, and utilized in Japan. International deployment of technologies also encourages Japanese companies and startups in the agriculture, forestry, and food sector to expand into the climate business and contributes to expanding relevant markets and industries. This initiative can also contribute to leading the discussion at COP30, where agriculture and forestry are expected to be the main topics of discussion. Furthermore, by effectively utilizing Japan's GHG emission reduction technologies, this initiative can contribute to ensuring global food security. In addition, the issuance of carbon credits through the implementation of JCM can support the achievement of the NDCs goals of Japan and partner countries.

The goals of this initiative

① Facilitate climate investment in the agriculture and food sectors and expand market opportunities for agricultural and food companies in the climate business.
② Lead the discussion at COP30 where agriculture and forestry are parts of the main topics of discussion.
③ Contribute to global food security through utilization of Japanese GHG emission reduction technologies.
④ Contribute to NDCs of Japan and partner countries.

3. GHG emission reduction technologies and initiatives in the agriculture, forestry, and fisheries sector

Regarding climate change mitigation measures in Japan in the field of agriculture, forestry, and fisheries that are being promoted based on the MIDORI Strategy and the MAFF's Plan for Global Warming Countermeasures.

In this initiative, MAFF has selected GHG emission reduction technologies and initiatives that can be deployed overseas and contribute to food security from among the technologies and initiatives listed in the MAFF's Plan for Global Warming Countermeasures. This initiative also refers to the "Technology Catalog Contributing to Production Potential and Sustainability in the Asia-Monsoon Region" compiled by Japan International Research Center for Agricultural Sciences (JIRCAS), and showcases technologies and initiatives The GHG generation mechanisms, GHG emission reduction/sequestration mechanisms, and the status of domestic and overseas initiatives for these technologies are described in detail for each emission source and sink. In addition, technologies and initiatives that form the basis for GHG emission reductions are described.

(1) GHG emission reduction technologies and initiatives

a. Methane emission reductions from paddy fields

- Rice is an important agricultural product for food security, especially in the Asia-monsoon region, because it has a high capacity to support population per unit area compared to other grains. In addition, rice paddies support unique ecosystems and contribute to the conservation of biodiversity. It is reported that organisms of 6,305 species have been found in rice paddies in Japan.
- On the other hand, when paddy fields are flooded with water, methanogenic bacteria (anaerobic bacteria) in the soil produce methane from carbon dioxide and acetic acid derived from the decomposition of organic matter in the soils and those provided as fertilizer. Since methane generated from paddy fields accounts for approximately 10% of the world's anthropogenic methane, its reduction is important.

(a) Alternate Wetting and Drying (AWD)

- Alternate Wetting and Drying (AWD) is a water management practice in which the paddy fields is drained to be dried out to a water depth of about 15 cm below soil surface and re-flooded several times during the crop season, except for during the period from 10 to 20 days after sowing, and for during the fertilization and flowering stages thereafter. AWD was developed by the International Rice Research Institute (IRRI) with the aim of reducing water consumption, and has also been proven to effectively mitigate methane emissions from rice production, with some studies estimating that AWD reduces methane emissions

by approximately 30% compared to constant flooding[11].

- Japan has contributed to the local deployment of AWD in the Asia-monsoon region., including through research and field demonstrations conducted by JIRCAS. In February 2025, the Joint Committee of the Japanese and Philippine governments approved the JCM methodology on AWD in the Philippines, which has been developed by the Asian Development Bank (ADB) with substantial contributions from JIRCAS experts.
- In addition to reducing water consumption, AWD is estimated to reduce methane emissions from soil by increasing the oxygen concentration in the soil, contributing to both climate change mitigation and food security.

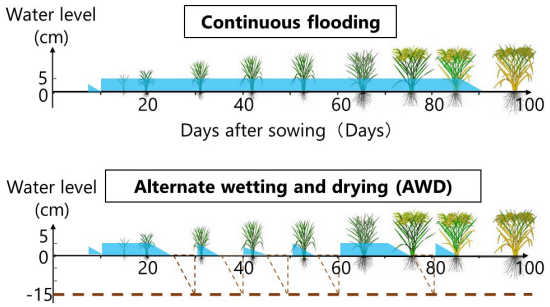

Figure 1: Illustrative example of water management during one cropping season in constant flooding and AWD

(b) Prolonging mid-season drainage

- Mid-season drainage is a conventional rice paddy water management practice in Japan, in which water is drained once during the cultivation period before ear emergence in order to prevent excessive tillering (branching from the root base) and to control the growth of rice. Mid-season drainage is normally practiced for approximately 1-2 weeks. In a study conducted by the National Agriculture and Food Research Organization (NARO), an average of approximately 30% reduction in methane emissions from paddy fields was achieved by prolonging the drying period for 7 days compared to conventional measures, without significantly affecting rice yield or protein content (Figure 3)[12].
- In Japan, "Prolonging mid-season drainage in paddy field rice cultivation" is one of the methodologies for the J-Credit Scheme. There may be a potential for expanding the technology in other countries where conditions so allow, including farmer capacity, water use infrastructure, impact on yield, etc.
- Prolonging mid-season drainage can reduce methane emissions from paddy fields without significantly affecting yields, thereby contributing to both climate change mitigation and food security.

[11] Based on research results from the National Institute of Agro-Environmental Sciences. (https://www.naro.go.jp/project/results/4th_laboratory/niaes/2017/niaes17_s12.html)
[12] Based on research results from the National Institute of Agro-Environmental Sciences. (https://www.jircas.go.jp/sites/default/files/TechCatalog_v3.0_ja.pdf)

- In Japan, some suggest that prolonging mid-season drainage may affect biodiversity (e.g., impact on the growth of dragonfly larvae). The impact on biodiversity can be alleviated through applying appropriate measures for each region, such as positioning biotopes or paddy fields not practicing mid-season drainage, adjusting crop calendars in order to disperse mid-season drainage periods, and creating places with water[13].

Fig. 2: A paddy field under mid-season drainage

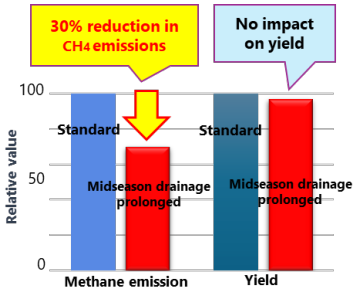

Fig. 3: Effect of prolonging mid-season drainage period on methane emissions and yield

b. Carbon storage increase in agricultural soils

Biochar application in farmlands

- Biochar is charcoal defined as "a solid material generated by heating biomass to a temperature in excess of 350°C under conditions of controlled and limited oxidant contentrations to prevent combustion" (IPCC, 2019[14]). Biochar can be made from biomass such as wood, animal manure, grasses, rice husks, nut shells, and biomass derived from sewage sludge.
- Carbon dioxide from the atmosphere is absorbed by the plant through photosynthesis, but simply burying the plant would only result in quick decomposition by microbial activity and carbon dioxide released into the atmosphere. However, carbonized plants resist decomposition and lock the absorbed carbon dioxide, storing carbon underground. The IPCC has recognized the carbon sequestering effect of biochar, or carbonized plants, as applied to farmland.
- Furthermore, biochar can improve soil quality. Biochar made from certain biomass material can improve the physical qualities of soil, such as permeability, water retention, and aeration, as well as convert acidic soil toward alkalinity and supply nutrients such as phosphorus. Moreover, the use of local unused biomass as biochar can lead to improvement in the local environment and promote resource recycling.
- Charcoal has traditionally been used for agriculture in Japan, and studies have been

[13] An "agricultural stream" is a ditch that can remain waterlogged throughout the growing season. The installation of a ditch helps to protect the ecosystem by creating a shelter for fish, aquatic insects, and other organisms when fields are dried out or flooded.

[14] IPCC.(2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch02_Ap4_Biochar.pdf

conducted to calculate the carbon sequestration associated with the agricultural use of biochar. In addition, the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, whose publication included contributions by Japanese researchers, proposed a method for calculating carbon sequestration from the application of biochar to mineral soils, and the following year, the J-Credit Scheme established the "Biochar addition to mineral soil in cropland/grassland" as one of its methodologies.

- Internationally, biochar is also attracting attention. In ASEAN countries, for example, various unused resources, including rice straws, rice husks, and pruned branches, are being utilized, partially from the perspective of a circular economy and prevention of fires from the open burning of crop residues. In addition, in Brazil, effects of restoring degraded soil in Cerrado are being evaluated. In this context, encouraging the promotion of production and manufacturing technolgies of Japan's high-performance biochar[15] can contribute to GHG absorption and the utilization of unused biomass in accordance with local circumstances.

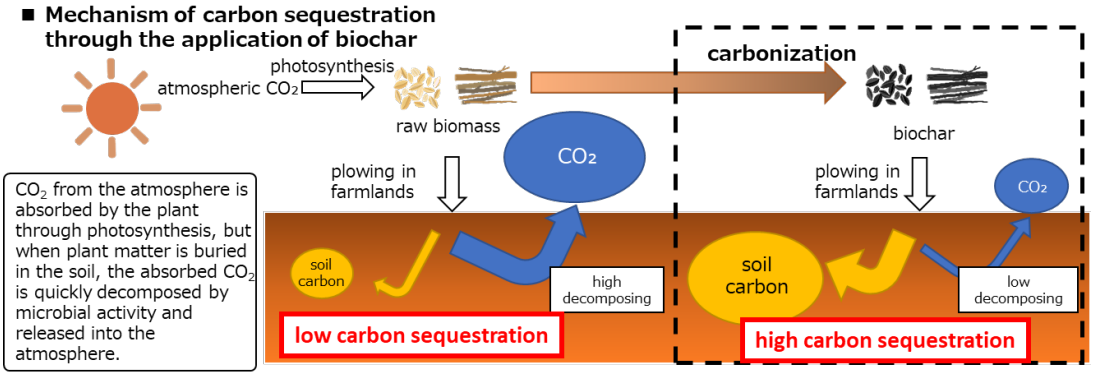

Fig. 4: Mechanism of carbon sequestration by biochar application

c. N_2O emission reductions with reduced fertilizer application

<u>Biological Nitrification Inhibition (BNI) technology</u>

- Wheat production is important for global food security because it covers approximately 200 million hectares of farmland worldwide and is a source of calories for many people.
- However, the majority of nitrogen fertilizers used during wheat production are not utilized by the crop and are lost to the environment as GHGs and nitrate nitrogen, affecting air and water quality. This is initiated by soil microorganisms that function to convert ammonium in fertilizers to nitrate (nitrification). This process generates N_2O formation, which has a global warming potential 265 times higher than that of carbon dioxide.
- Biological nitrification inhibition (BNI) is the phenomenon that certain plants secrete substances from their roots to inhibit nitrification. BNI-enabled crops (e.g., wheat) secrete nitrification-inhibiting substances from their roots, which inhibit nitrification in the soil.

[15] The function of useful microorganisms such as supplying nutrients in the soil as fertilizer components to crops and promoting healthy growth of crops is added to them.

As a result, BNI-enabled crops improve nitrogen use efficiency, leading to reduced fertilizer application. Consequently, N_2O emissions into the atmosphere are reduced. JIRCAS, in collaboration with International Maize and Wheat Improvement Center (CIMMYT)[16] and others developed the world's first BNI-enabled wheat. Research results demonstrate that BNI-enabled wheat can reduce N_2O emissions from rhizosphere soils by approximately 25%, compared with its parental line, and that BNI-enabled wheat maintains the same productivity as its parental line even with 60% less nitrogen fertilization[17].

- BNI-enabled wheat can reduce excessive use of nitrogen fertilizers and prevent water pollution, reducing GHG emissions without negatively affecting wheat production and while contributing to biodiversity conservation.

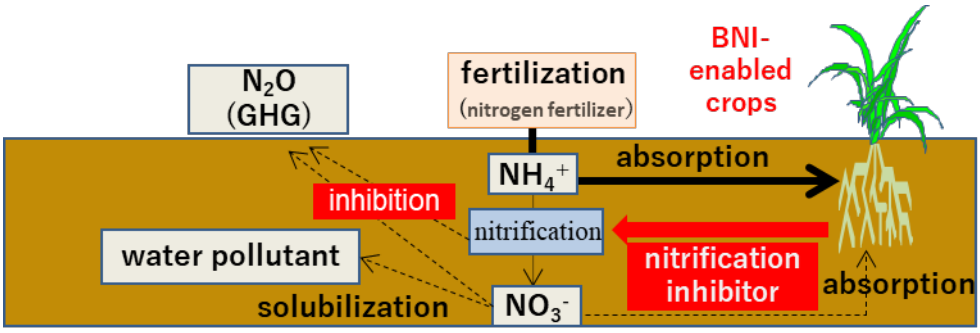

Fig. 5 Mechanism of BNI

d. Methane and N_2O emission reductions from livestock production

- Livestock products are an important source of protein and calories, accounting for approximately 25% of protein intake and 20% of caloric intake internationally. On the other hand, livestock waste and enteric fermentation emit methane and N_2O.
- When cattle and other ruminant animals digest grass in their first stomach (rumen), methane is produced through fermentation by microorganisms. Methane is released from the animal's body through belching.
- In addition, N_2O is emitted when nitrogen-containing organic matter in livestock waste undergoes nitrification and denitrification by microorganisms. By deploying the following technologies, GHG emission reductions can be achieved without reducing the supply of livestock products.

(a) Amino acid balanced feed [reductions of N_2O].

- The efficiency of protein utilization in the livestock body is determined by the least sufficient essential amino acid content. Therefore, in order to meet the protein requirements

[16] CIMMYT is an international research center for corn and wheat under the umbrella of the Consultative Group for International Agricultural Research (CGIAR), a consultative body that aims to improve the welfare of developing countries by improving productivity in agriculture, forestry, and fisheries.
[17] Based on research conducted by JIRCAS (https://www.jircas.go.jp/sites/default/files/TechCatalog_v3.0_ja.pdf).

of livestock with conventional feeds, excessive protein is given to supplement the least sufficient essential amino acid. Excessive protein not utilized by the livestock is decomposed and disposed of, leading to increased N_2O emissions from livestock waste.

- Amino acid balanced feeds adjust the content of each amino acid by supplementing the least sufficient amino acid and enhance the feed efficiency in livestock.
- Mainly domestic studies show that amino acid balanced feeds can reduce the nitrogen content in waste and reduce N_2O emissions from waste in cattle, swine, and broilers without negatively affecting productivity[18].
- In Japan, it has been approved as one of the methodologies in the J-Credit Scheme.

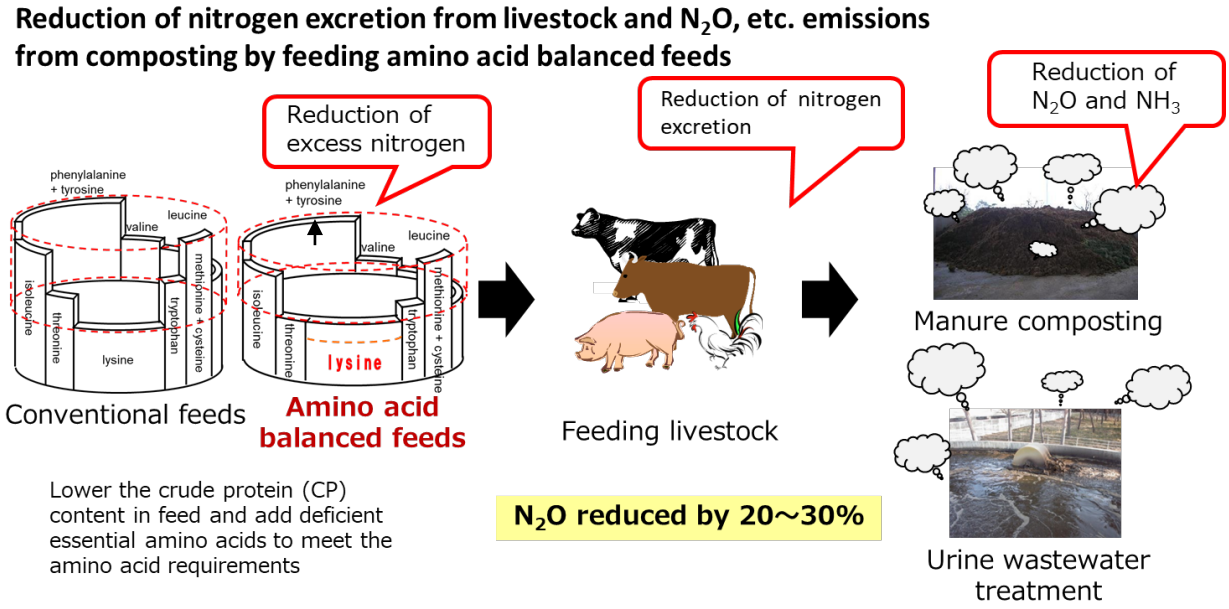

Fig. 6: Reduction of nitrogen excretion from livestock and N_2O, etc. emissions from composting by feeding amino acid balanced feeds

(b) Bypass amino acids feed [methane and N_2O reductions].

- Cattle feed containing bypass amino acids (amino acids that are often deficient in cattle processed to reach the small intestine without being decomposed in the stomach) promotes growth of cattle, shortens the fattening period, reduces GHG emissions per carcass[19], and improves productivity. The feed is also expected to reduce production costs by improving productivity.
- In Japan, feeding bypass amino acids to beef cattle is approved as one of the methodologies in the J-Credit Scheme.

[18] According to some companies, feeding amino acid balanced feed is expected to reduce N_2O by approximately 25%. This result is derived from applying feed with both amino acid balancing effect and bypass amino acid effect..

[19] According to some companies, feeding bypass amino acids is expected to reduce N_2O and methane by approximately 25% and 10%, respectivly. This result is derived from applying feed with both amino acid balancing effect and bypass amino acid effect.

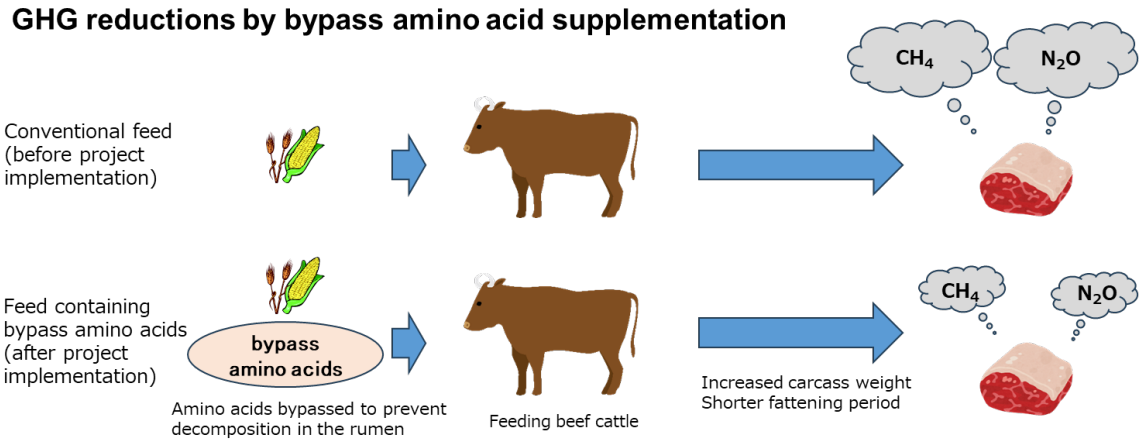

Fig. 7 GHG reductions by bypass amino acid supplementation

(c) Feed additive (cashew nut shell liquid) to reduce methane emissions from cattle belching [methane reductions].

- Cashew Nut Shell Liquid (CNSL) is an oily liquid obtained from the shells of cashew nuts, accounting for approximately 30% of weight of nut shells. Providing feeds containing CNSL to ruminant animals can replace methane-producing bacteria in the rumen and reduce methane emissions from livestock belching[20].
- JIRCAS has conducted research on a local cattle breed in Vietnam and has reported reduction in methane emissions from belching (approximately 20% reduction[21]). Cashew nuts are mainly produced in the Asia-monsoon region and African countries, where demand for livestock products is expected to increase in the future. Private companies are currently working toward collaboration with local partners and demonstrating the effects of cashew nuts with a view to overseas expansion.
- In Japan, materials that directly reduce methane from enteric fermentation through feeding and claim GHG reduction effects must be designated as feed additives under the Act on Safety Assurance and Quality Improvement of Feed (Law No. 35 of 1953) in order to be sold and distributed in Japan. CNSL was designated as a feed additive in May 2025.
- In addition, related companies, etc. are working toward the development of a methodology in the J-Credit Scheme (as of May 2025).

[20] According to some companies, it also has effects on normalizing the condition inside the rumen and contributes to maintaining cattle productivity.
[21] (https://www.jircas.go.jp/sites/default/files/TechCatalog_v3.0_ja.pdf) According to the results of a study by the International Agricultural Research Institute.

Fig. 8: Cashew nut shell liquid[22]

e. Reducing emissions from deforestation and forest degradation and ehnancement of forest carbon sinks

- GHG emissions from the forestry and other land use sector are estimated to account for approximately 10% of the world's total emissions. Prevention of deforestation and forest degradation as well as afforestation/reforestation contribute significantly to GHG emission reductions and removals. In addition, forests provide various ecosystem services, including conservation of biodiversity, water resources, and soil. Forest-based conservation is attracting international attention as Ecosystem-based Disaster Risk Reduction (Eco-DRR[23]). Forests also contribute to food security by maintaining water management functions necessary for food production and preserving agricultural land.

(a) REDD +[24]

- REDD+ is a climate change mitigation measure to reduce GHG emissions from deforestation and forest degradation in developing countries through sustainable forest management and appropriate forest conservation. Article 5 of the Paris Agreement encourages countries to take actions to implement and support REDD+.
- The REDD+ efforts include diverse activities such as land-use classification, appropriate forest management including patrolling against forest fires and illegal logging, provision of alternative livelihood for local people including agroforestry, and monitoring the changes in forest area and condition.
- Japan has promoted REDD+ activities through providing technical assistance to developing countries and Japanese companies, developing JCM guidelines for the implementation of forest JCM projects, and committing financial contributions to the Green Climate Fund (GCF). Also, the Forestry and Forest Products Research Institute (FFPRI) published technical manuals for REDD+ and Eco-DRR and supports the activities

[22] Extracted from the report of "Feasibility Study Project for the MIDORI Strategy for Sustainable Food Systems deployment in the ASEAN region".

[23] Eco-DRR: Ecosystem-based Disaster Risk Reduction

[24] Reducing Emissions from Deforestation and Forest Degradation in Developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries.

of various stakeholders, such as developing countries and private companies.

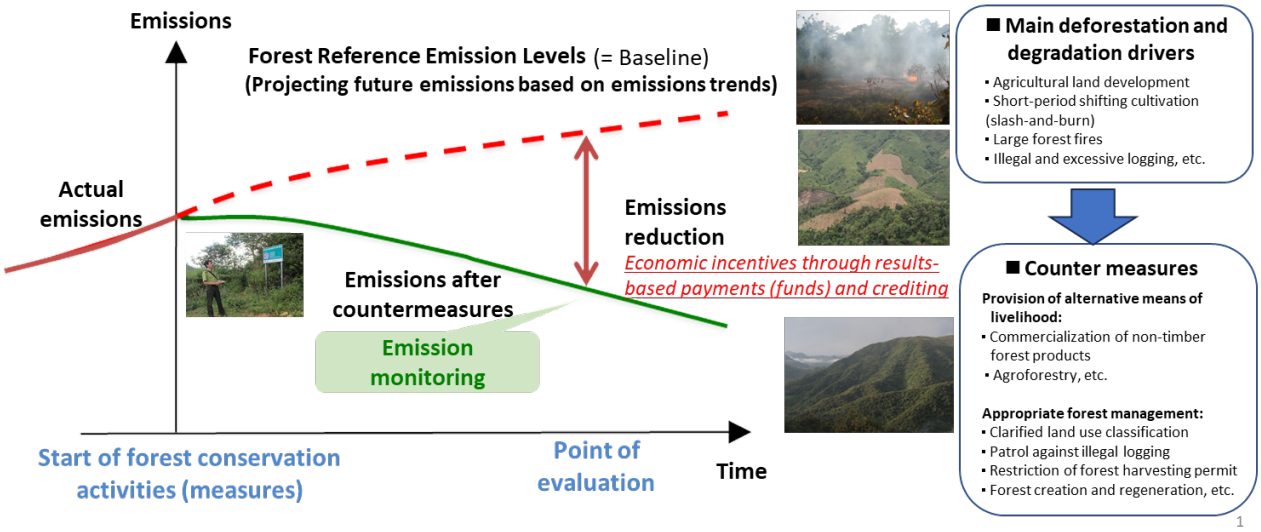

Fig. 9: About REDD+

(b) Afforestation/Reforestation

- Afforestation/reforestation is a practical approach to remove atmospheric carbon dioxide through the growth of trees and stock carbon.
- The revised JCM guidelines for the forest sector have been developed to expand the scope to afforestation/reforestation in addition to REDD+.
- Japan International Forestry Promotion and Cooperation Center (JIFPRO) is working on the development and dissemination of "Long Rooted Seedling" in semi-arid areas of Kenya and Myanmar in order to enhance the survival rate of planted seedlings under severe dry conditions. In addition, JIFPRO has been conducting technical development such as post-planting monitoring with the participation of local residents, and methods of digging deep planting holes using construction equipment in collaboration with Japanese companies.

f. Technologies contributing to GHG emission reductions in the future

(a) Utilization of unused agricultural residues

- Agricultural residues left unused and discarded are a source of GHG emissions such as methane, and can also lead to reduced agricultural productivity, etc. Technologies for their sustainable management can both reduce GHG emissions and ensure food security, and are expected to be deployed overseas[25]. In particular, the following technologies have been integrated in the ASEAN Guidelines on the Reduction of Crop Burning formulated in October 2024 to address air pollution, health, soil degradation, and other problems

[25] The utilization of unused agricultural residues is being promoted worldwide. For example, in the rice paddies of Thailand, the Thai Rice NAMA initiative, which combines AWD with rice straw management, etc., is being promoted.

associated with burning agricultural residues in the ASEAN region.

- Utillization by "Multi-Biomass Treatment Process" of unused biomass discharged from the palm oil industry.

  Palm oil is a vegetable oil extracted from oil palm fruits and is used in products such as snacks, ice cream, instant noodles, etc. Its sustainable procurement contributes to establishing a sustainable food systems. JIRCAS has developed a manufacturing technology (Multi-Biomass Treatment Process) to convert the diverse and enormous amount of unused biomass (Oil palm trunks, fronds, empty fruit bunches, mesocarp fiber) discharged from the palm oil production process into fuel pellets and wood substitute pellets in the same process. In a demonstration conducted in Malaysia, the utilization of palm waste wood achieved a reduction of approximately 100,000 tons of GHG emissions per year at a processing plant with an annual capacity of 20,000 tons. This process can be deployed in Malaysia and other palm-producing countries.

- Low-cost, high efficiency production of methane gas and hydrogen from agricultural residues through "microbial saccharification" and "bio-methanation".

  Microbial saccharification is a novel enzyme-free saccharification method that can saccharify and solubilize agricultural residues using only microorganisms without cellulolytic enzymes. Microbial saccharification can efficiently convert solid agricultural residues into biogas and biohydrogen by decomposing and liquefying them into carbohydrates and organic acids. Furthermore, CO_2 and biohydrogen generated through the microbial saccharification and methane fermentation can produce methane again through the biomethanation process to facilitate energy production and recycling of unused agricultural residues as well as emission reductions in the processing. If conditions so allow, e.g. those associated with the initial investment, collection and transportation of the residues as raw materials, and energy production efficiency, the technology can be deployed overseas.

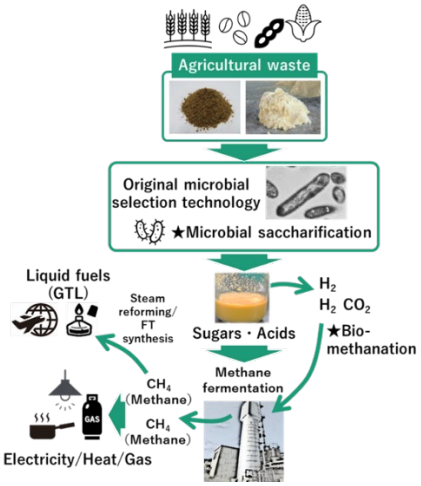

Fig. 10 Overview of a low-cost, high efficiency production of methane gas and hydrogen production technology combining JIRCAS technology for microbial saccharification of agricultural residues with biomethanation.

(2) Foundational technologies and frameworks for supporting GHG emission reductions

a. Measurement, Reporting, and Verification (MRV)

- MRV refers to "Measurement, Reporting and Verification" and serves as the foundation for ensuring the accuracy and reliability of measuring GHG emissions attributed to any entity's own activities and estimating the outcomes of projects related to GHG emission reductions and absorption.
- Internationally, inventory reporting, including the calculation method of emissions and absorptions, is obligatory for the parties to the Paris Agreement, and MRV is also required for issuing carbon credits. In Japan, businesses above a certain size are required to calculate and report GHG emissions under the calculation, reporting, and publication system based on the Law Concerning the Promotion of the Measures to Cope with Global Warming (1998 Law No. 117), and similar trends are also spreading at the local government level. In addition, it is important to continuously monitor and disclose the results of such monitoring in order to avoid greenwashing. Given the high level of uncertainty associated with the agriculture, forestry, and fisheries sector, MRV plays a critical role in ensuring transparency and credibility in these areas.
- Japan's strength in MRV is backed up by research results on GHG emissions and absorption from agricultural land and forests accumulated over many years, basic data on agricultural land, forests, and soil, and a monitoring system of activity levels (e.g., area under appropriate paddy field water management, amount of fertilizer applied). These elements have enabled inventory reporting based on highly accurate emissions accounting and they have been applied to MRV at the project level under the J-Credit Scheme in Japan.
- In addition, in recent years, startups and private companies have been actively seeking overseas deployment of related technologies, including satellite-based systems for monitoring agricultural land, forests, soil, and activity levels; automatic water management systems that monitor and control water levels in rice paddies; and applications that integrate farm management data. In addition, the Japan Aerospace Exploration Agency (JAXA) has been working on the development of a new technology for more accurate monitoring. These technologies are particularly important for countries that do not have MRV infrastructure. In recent years, they are attracting more and more attention amid the need to strengthen the implementation of the Paris Agreement, including the submission and implementation of new NDCs, including developing countries, and amid the growing movement to utilize credit systems for GHG reduction and absorption efforts in the agriculture and forestry sector. In implementing these technologies in JCM and other projects, the government needs to provide guidance to ensure their accuracy, precision, and reliability.
- Deploying Japan's MRV initiatives and related technologies overseas can help improve

basic agricultural statistics and promote appropriate farm management in developing countries, and create an enabling environment for implementing GHG emission reduction and sequestration projects such as JCM.

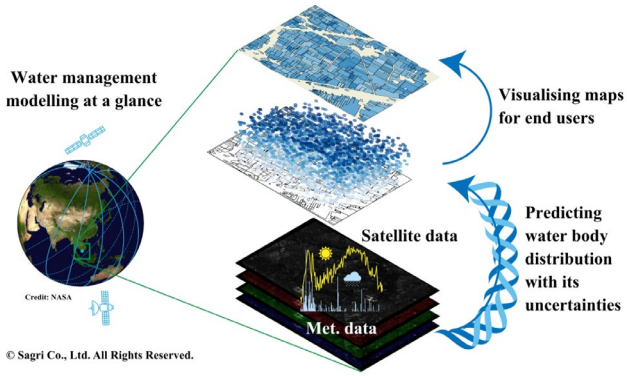

Fig. 11 The MRV technology for paddy fields

- In the field of fisheries, the Japan Fisheries Research and Education Agency (FRA) has been working on the development of an evaluation method for Blue Carbon[25]. In November 2023, FRA published a calculation method for carbon dioxide storage by type of seagrass/seaweed bed and sea area as the "Guidebook for Calculating CO_2 Sequestration of Seagrass and Macroalgal Beds." In April 2024, Japan became the first country in the world to reflect both seagrass beds and seaweed beds in its inventory, and reported the results to the United Nations.

b. Smart agriculture technology

- Smart agriculture technologies that utilize robots, AI, IoT, and other information and communication technologies enable automation of farming operations, precision agriculture tailored to crop conditions, and contribute to GHG reductions through optimal use of resources.
- For example, agricultural machinery equipped with an automatic steering system is expected to reduce fuel consumption by using Global Navigation Satellite Systems (GNSS) to accurately determine its own position and drive optimal routes for field operations, which are set by AI.
- In addition, based on soil conditions and crop growth conditions determined by remote sensing using satellites and drones, drones and other equipment are used to deliver the necessary amount of chemical fertilizer to the necessary places at the right time, thereby reducing excessive fertilizer application and contributing to GHG emission reductions.
- Regarding rice cultivation technologies, where Japan has a particular strength, variable fertilization rice transplanters are commercially available. These machines use real-time sensing of soil fertility during transplanting to apply the appropriate amount of fertilizer. In addition, a technology has been developed that uses GNSS to precisely control planting positions and transplant rice seedlings in an evenly spaced grid pattern (using a rice

transplanter for square-transplanting). This allows for mechanical weeding not only inter-rows but also intra-rows, without relying on pesticides.

- In addition, by linking agricultural machinery equipped with sensing functions for crop yield, quality, soil conditions, and work performance to a Farm Management Information System (FMIS), data can be automatically recorded and accumulated. These data are used to design site-specific fertilizer application plans, which are expected to reduce excessive chemical fertilizer use and contribute to lowering GHG emissions.
- In addition, the automatic weed suppression robot for paddy field stirs the soil, blocks sunlight, and suppresses weed growth and germination without using pesticides, thereby contributing to GHG emission reductions. A field survey is currently being conducted in Vietnam under a project implemented by the Japan International Cooperation Agency (JICA).
- In greenhouse horticulture, the conversion of combustion-type heaters that use a lot of fossil fuels to air conditioners that use biomass fuels and heat pumps, as well as the introduction of integrated environmental control combined with AI and sensing that can reduce energy input, is expected to contribute to GHG emission reductions.
- In this way, the use of smart agricultural technologies can contribute to reducing GHG emissions while maintaining and improving productivity, thereby achieving both climate change countermeasures and food security.

Fig. 12: Rice planting using square-transplanting technique

c. Visualization of efforts to reduce environmental burden

- For products produced while applying GHG-reducing technologies and/or practices, indicating their carbon footprint (CFP: Carbon Footprint of Products)[26] is a significant measure to encourage consumers' behavioral change. In recent years, along with the spread of environmental labels, CFP indication on various products has been drawing attention. Also for agricultural products and processed foods, indicating CFP has become an actively-discussed topic both in Japan and abroad.
- Based on the MIDORI Strategy, Japan is promoting an initiative of visualizing farmers'

[26] Carbon Footprint of Products (CFP): GHG value emitted throughout their life cycle.

efforts to reduce environmental burden, in order to support consumers' informed choices. In this scheme, GHG emission/absorption at the production stage are quantitatively calculated, using primary information possessed by farmers － such as the amount of chemical fertilizers / chemical pesticides / fossil fuels used, biochar application, as well as the way of water management in paddy fields. Then, compared to the average farming practices in the region, "avoided GHG emission rate" is calculated and graded as the number of stars to be indicated on a label (nickname of the label: "ChoiSTAR"). MAFF has developed a simplified GHG emission/absorption calculation tool for 24 commodities (as of the end of April 2025), including rice, vegetables, fruits, potatoes, and green tea, and has operated the scheme for voluntary calculation and for graded labeling, in accordance with the guidelines. For rice, farming practices for biodiversity conservation can also be evaluated based on a score reflecting the implemented activities, and can be displayed together with the GHG reduction contribution.

- In the future, MAFF aims to increase the number of targeted commodities in Japan, and to generate initial cases of exporting ChoiSTAR-labeled agricultural products and their processed foods.
- Furthermore, MAFF aims to apply and spread Japan's "visualization" scheme － which enables direct reflection of farmers' efforts, as primary information, in GHG emission calculations done by food processing and distribution businesses － to the Asia-monsoon region.

Both Japanese and English version of the labels are registered trademarks of MAFF.

Fig. 13: ChoiSTAR

4. Measures for promoting technologies overseas

In order to realize overseas deployment of GHG emission reduction technologies, it is necessary to improve the environment for overseas deployment of technologies such as GHG emission reduction technologies' research and development and startup development in Japan, and to further utilize the JCM framework. In promoting these efforts, MAFF will utilize existing frameworks such as ASEAN-Japan MIDORI Cooperation Plan and Global MIDORI Cooperation Plan, and promote cooperation with related ministries and agencies.

When deploying technologies, thorough management should be ensured to prevent leakage of data, know-how, etc. It is also important to prepare for the risk of counterfeit products, etc., by obtaining intellectual property rights in the countries where the technology is to be deployed. It is also necessary to strategically protect and utilize intellectual property by formulating an intellectual property strategy that considers business development, including the strategic licensing of technology.

(1) Frameworks and methods for overseas deployment of technologies

① Frameworks for overseas deployment

- The following conceptual diagram (partially revised) on the "Transformation to a Sustainable Food System through Technology Development" discussed at the meeting of the International Scientific Advisory Board[27], can be referred to as a common framework and includes items to consider when private companies, startups, and research institutes work on overseas deployment of GHG emission reduction technologies and initiatives.

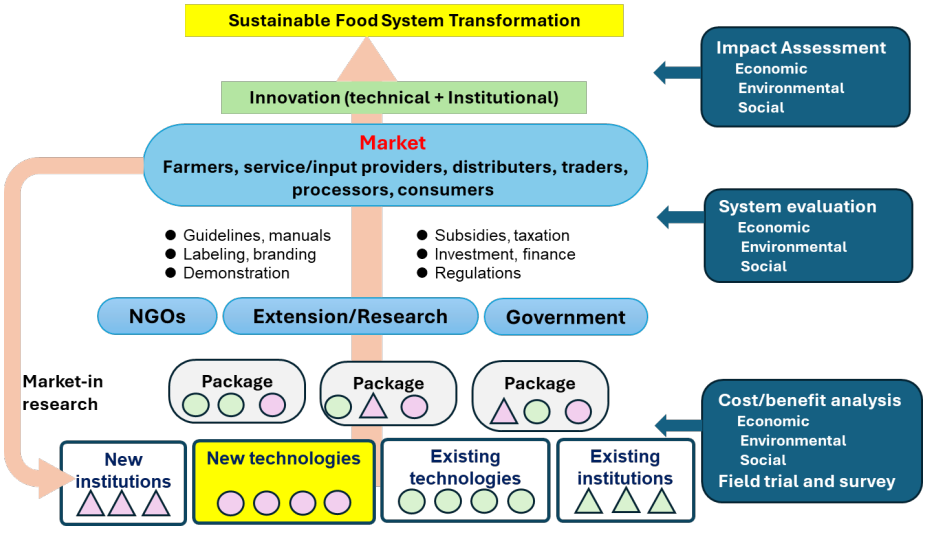

Fig. 14: Transformation to a Sustainable Food System through Technology Development Source: Japan International Research Center for Agricultural Sciences (JIRCAS)

[27] Meetings of the International Scientific Advisory Board are held at the International Center for Strategy "MIDORI" in cooperation with domestic and foreign research institutions. The center was established as part of the project "Accelerating application of agricultural technologies which enhance production potentials and ensure sustainable food systems in the Asia-Monsoon region" implemented by JIRCAS.

- In the first step, estimation technologies developed by private companies, startups, and research institutes will be disseminated and introduced in each country/region by integrating them with new technologies or other existing technologies, as well as national and regional systems. When the technologies are disseminated and introduced, it is necessary to take into account the different social, economic, and natural conditions in each country and region. For example, in addition to differences in language, land ownership, and family systems, conditions such as commodities, scale of operations, existing cultivation techniques, labor wage levels, and soil and weather conditions, often vary significantly from country to country and region to region. In addition, it should be noted that there are different institutions and systems in place for the introduction of technology in each country and region. For example, each country/region has different standards for promoted varieties, standard cultivation techniques, agricultural machinery, and communications, and these systems and the organizations in charge of them are also different. In addition, the political and economic situation overseas, such as exchange rates, trade systems, and prices, must also be taken into account, and in some cases, unexpected changes to plans may be necessary. After analyzing the relevant social, economic, and natural conditions of the target country/region in the field, specific technologies will be demonstrated in the field, and cost/benefit analyses will be conducted. Stakeholders involved in technology dissemination are diverse. In addition to engaging with government agencies, it is also desireble to collaborate with local private companies and extension/research departments, and to understand the activities of local NGOs related to the environment, agriculture, forestry, and fisheries, and to consider collaborating with them when possible.
- After on-site demonstrations and cost-benefit analyses provide a certain level of prospect for the introduction of technology, efforts should be made to develop the market by targeting various local stakeholders involved in the supply chain － such as producers, service providers, processors, and distributors, traders, and consumers － through making guidelines and manuals for the introduction of the technology, as well as branding and other methods. In doing so, the company will appropriately address subsidies, taxes, investment and financing systems, and various regulations and standards, including intellectual property. In addition, it is important to conduct project management and operation related to the introduction of technology in the process of market formation, as well as system evaluation to measure the effectiveness of activities. It is also crucial to verify whether the expected results are being achieved, and evaluate the short-, medium-, and long-term social and economic impact of the solutions developed by each company and startup. Since overseas technological needs are diverse, it is also necessary to use a market-in approach to accurately identify needs in the process of market formation, customize solutions accordingly, and develop new technologies and provide new services.

By bringing about systemic change across the entire process from technology development to its introduction and diffusion, MAFF aims to realize sustainable food systems.

- Regarding the framework and approach to promote overseas deployment, an inductive approach will be adopted to compare and analyze common factors of success and failure for private companies, startups, and others, with continuous updates using the OODA Loop[28] concept.

[28]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: 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.

② Direction of GHG emission reduction technologies and initiatives by region

The following table summarizes GHG emission reduction technologies that can be deployed overseas, by region.

Area	Technology and Initiatives	Example Countries
Asia-Monsoon	AWD	Philippines, Vietnam, Thailand, Laos, Myanmar, Cambodia, Bangladesh, India, etc.
	Biochar	Thailand, Laos, Indonesia, Philippines, Vietnam
	BNI enabled wheat	India, Nepal, etc.
	Amino acid balanced feed	Vietnam, Malaysia, India, etc.
	Cashew nut shell liquid	Thailand, Vietnam, Indonesia, Malaysia, etc.
	REDD+, Afforestation/Reforestation	Laos, Cambodia, Philippines, etc.
Central and South America	Biochar	Brazil, Mexico, Guatemala, Ecuador
	Amino acid balanced feed	Brazil
Africa	AWD* field irrigation	Zimbabwe
	Biochar	Uganda, Cameroon
	REDD+, Afforestation/Reforestation	Kenya
Oceania	Biochar	Australia, Papua New Guinea
North America	Biochar	United States of America

(2) Technology development and business support

With a view to internationally deploying Japan's GHG emission reduction technologies through JCM, etc., Japan will facilitate the development of technology, research and development, local demonstration, and startup development through the following policy tools. In addition, other government organizations that are providing overseas business support schemes for Japanese private companies are also listed below.

① Promoting technology development, R&D and on-site demonstration

- International joint research will be promoted to develop climate-smart technologies, including the development of BNI-enabled crops and establishment of cultivation systems involving the use of such crops, with Japan's major national research institutes, including NARO, JIRCAS, FFPRI, and the FRA, being at the core, working together with universities and businesses and in close collaboration with international research centers of CGIAR, and utilizing the platforms of the Global Research Alliance (GRA) etc.
- Efforts to develop and internationally deploy climate change mitigation technologies, such as technology for measuring methane emissions from cattle belchies, carbon sequestration in farmland using biochar application, and research on blue carbon utilization.
- For offshore blue carbon, which has great potential as a carbon sink, the Ministry of the Environment will lead the assessment on the possibility of attaining GHG removal by producing and cultivating seaweed, capturing and storing it in the deep sea, and measuring and reporting the absorbed carbon as sinks. In order to also consider the utilization of seaweed as a biological resource, discussions will be held on ideal use of ocean zones in terms of fishery development, technological development on large-scale seaweed bed generation and their sedimentation in the deep sea, and impact monitoring of the marine environment.
- Field demonstrations will be promoted on advanced agricultural water management that contributes to climate change countermeasures, such as the introduction of AWD using ICT-based water management.
- Development of methods to visualize the contribution of enhancement of forest sinks and biodiversity conservation by private companies, as well as methods to address the issue of long-term land management and environmental and social impacts, through field demonstration.
- The deployment of advanced MRV technology of Japan will be promoted through satellite data and technical cooperation by JAXA in collaboration with related organizations.
- The evaluation of methane emission reduction effects, etc. will be promoted by midterm-drainage of paddy fields using emission estimation technology of the GOSAT series.

② Promoting startup development and Capacity Building

- Opportunities for SMEs will be increased to utilize subsidies, etc. for research and

development and utilize the SBIR system to support the commercialization of the research results, as well as promote initiatives to support foster startups aimed at problem-solving and commercializing GHG emission reduction technologies in the agriculture, forestry, and fisheries sector.

- Training of technicians on GHG emission reduction technologies will be promoted in order to ensure the effective utilization of Japanese technology overseas.
- In implementing projects, technical manuals compiled in Japan will be disseminated, and knowledge and information will be shared to technical staff for use in the field.

③ Supporting business development

- Through seminars and workshops including through the utilization of the MIDORI Decarbonization Overseas Deployment Consortium, all-Japan marketing of technologies and matching between Japanese companies with GHG emission reduction technologies and domestic and overseas partners will be promoted. In the forest sector, information will be shared among various stakeholders such as JICA, research institutions, and private sector, through the utilization of the "Japan Public-Private Platform for Forest-based Solutions".
- Japan External Trade Organization (JETRO) and JICA's "Small and Medium Enterprises-SDGs Business Support Project (JICA-Biz)" provide support such as sharing the know-how for overseas business development by Small and Medium Enterprises (SMEs). In addition, Japan's decarbonization technologies will be promoted through symposiums, events, business meetings, etc., mainly in the ASEAN region.
- The Japanese business support officers at the diplomatic missions overseas provides support based on inquiry and requests from Japanese companies, including the provision of local political and safety information, advice on overseas promotion, and lobbying foreign governments to improve the business environment and troubleshoot. These missions provide the ambassador’s residence and other official facilities as venues for events such as product exhibitions by Japanese companies, as well as for seminars aimed at business development and networking with local companies and related organizations.
- Acknowledging the requests of business owners and working in close relation with diplomatic missions and other organizations, consider establishing a system to encourage overseas deployment of GHG emission reduction technologies.
- Facilitating the flow of information on various support tools available in order to promote overseas business investment by Japanese companies that have the technology and the will (Global Business Investment Support Office (GBIS), Cabinet Secretariat).
- Development and overseas deployment of GHG emission reduction technologies, etc. by private companies, etc. will be accelerated through investment and loan programs by government-affiliated financial institutions, etc. (Japan Green Investment Corp. for Carbon Neutrality (JICN) is not eligible for support at the development stage).

- Support the attainment of intellectual property overseas (plant breeders' rights, trademark rights, etc.) and strategic international licenses regarding Japan's high-quality varieties, while acknowledging the international competitiveness of GHG emission reductions technologies as one of Japan's strengths, as it is important for handlers of technologies that can be deployed overseas and owners of intellectual property, including varieties and know-how, to develop and carry out strategies to effectively protect and utilize their intellectual property at every stage from research to social implementation.

④ Addressing the taxonomy[29]

- Utilizing the Cabinet Office's Standard Utilization Acceleration Support Program, etc., the development of Japanese smart agriculture technology and GHG emission reduction and absorption technologies will be promoted overseas, involving domestic startup companies, etc.
- In order to facilitate the overseas deployment of GHG emission reduction technologies in agriculture, forestry, and fisheries, it is desirable for Japan's technologies to be specifically described in the Technical Screening Criteria (TSC) for the agricultural sector of the taxonomy of each country and region, to attract the attention of each country and to provide credibility of the technologies. To this end, NARO has been working with the ASEAN Secretariat, Thailand, Vietnam, and Indonesia to promote the adoption and inclusion of Japanese technologies in the agricultural TSCs of the taxonomies of each country and region.
- Efforts will be continued by cooperating with relevant organizations and ministries in order to position Japan's technologies in the taxonomy of other countries and regions.

(3) The Joint Crediting Mechanism (JCM) Framework

The JCM is a mechanism that contributes to GHG emission reductions in partner countries through the introduction of decarbonization technologies and initiatives, that also contributes to the international expansion of Japanese companies and realization of NDCs targets through the creation of decarbonization markets.

In order to further promote the JCM, the Revised Act on Promotion of Global Warming Countermeasures newly stipulates procedures to strengthen the JCM implementation structure, and the Minister of Agriculture, Forestry and Fisheries, together with the Minister of the Environment and the Minister of Economy, Trade and Industry, has been designated as a competent minister to play an important role in the JCM. In addition, the Designated Implementing Agency System was established, allowing an agency designated by the

[29] Taxonomy refers to the classification criteria for activities that fall under the category of "environmentally sustainable economic activity" and is expected to accelerate decarbonized investment while eliminating greenwashing. If the object of funding falls under the taxonomy classification, it is considered "eligible" and the investor or other party is deemed to be engaged in an environmentally sustainable business. In the EU, the Taxonomy Regulation became law in 2020, and in ASEAN, the first edition of the taxonomy was prepared in 2021, with a third edition to be published by 2024.

competent ministers to carry out parts of administrative tasks related to the JCM. The designated implementing agency (JCM Implementation Agency, designated by the Government of Japan: JCMA) undertakes a wide range of administrative tasks, including coordination with partner countries, procedural support for JCM project implementation, and public relations activities related to the JCM. Specifically, the following activities are conducted.

① Promoting feasibility studies and demonstration projects

- The basis of JCM projects will be established for initiatives for measuring and reporting on Japanese GHG emission reduction technologies, implementation status, and effects by conducting feasibility studies and demonstration projects of GHG emission reduction effects in partner countries with various natural and social circumstances.
  The smooth implementation of Japanese technologies and initiatives in partner countries will be promoted by establishing cooperative relationships between Japanese companies and local governments and/or research institutions (e.g., through signing Memorandums of Understanding) and providing support for matching Japanese companies with local companies, leading to enhanced project feasibility and increased demand for Japanese technologies in partner countries.

② Promoting development of methodologies and projects

- In order to deploy JCM projects with partner countries, specific methodologies for individual technologies are required. In the agricultural sector, the first JCM methodology for methane emission reductions by water management in rice paddy fields using AWD in the Philippines was approved by a Joint Committee ofthe Japanese and Philippine governments in February 2025. Following this achievement, the development of private sector projects based on this methodology will be promoted, which will eventually lead to the issuance of carbon credits in the agricultural sector and the expansion of the methodology and initiatives to other JCM partner countries.
- Moreover, Japan promotes the expansion of JCM methodologies, such as applying biochar to farmland and feeding livestock amino acid balanced feed. With regard to biochar, preliminary research for the development of JCM biochar methodology is being conducted.
- In the forest sector, project participants propose their own methodologies based on the JCM guidelines for the forest sector. Advice and technical knowledge through field demonstration will be provided in order to support the project participants to develop the methodologies to meet the guideline requirements. The JCM guidelines for forest sector require an observation period of at least 10 years after crediting period to ensure the permanence of approved mitigation outcomes.
- Scientific reliability is essential in developing approvable JCM methodologies. Acknowledging and utilizing J-Credit methodologies, new JCM methodologies will be considered flexibly, also referring to existing methodologies specified by partner countries,

if any. At the same time, efforts will be made to enhance the accuracy of Japan's MRV technologies, and these proven, reliable technologies will be actively utilized in methodologies.

- The environment will be improved for the expansion of methodologies, such as by providing guidance materials that Japanese private companies can refer to when preparing their own methodologies.

③ Establishing relationships with partner countries

- Japan established the JCM with 30 partner countries (as of May 30, 2025), and projects are developed and promoted mainly in the energy sector. In the agriculture sector, in addition to developing projects with existing partner countries, discussions with other countries that have potential for the deployment of Japanese technology and have large GHG emissions in the agricultural sector, such as Brazil and India, will be encouraged in cooperation with the relevant ministries and agencies. In the forest sector, the JCM guidelines for forest sector will be continuously updated, and Japan and partner countries will discuss agreement on the guidelines, considering the country-specified issues such as local circumstances and available technologies.
- For the establishment of new partnerships, the government will collaborate with the Japanese private sector by introducing their initiatives expected to become JCM projects, and both the public and private sectors will work to gather information on the partner countries. Furthermore, the development of JCM projects will be facilitated by assisting partner countries in following the process of approving JCM methodologies and by explaining the concept of credit allocation to partner countries. Such coordination with partner countries will be arranged in close cooperation with relevant ministries and agencies including Japanese embassies in partner countries, by taking advantage of opportunities such as COP30 or other bilateral policy dialogues.

(4) International cooperation frameworks

Overseas deployment of Japan's GHG emission reduction technologies will be promoted by utilizing the following international cooperation frameworks and other existing bilateral cooperation frameworks.

① Asia Zero Emissions Community (AZEC)

- Japan proposed this framework as a cooperative platform for Asian countries to share the concept of decarbonization and promote energy transition toward carbon neutrality/net zero. The framework includes policy coordination including developing rules with other countries and cooperation in individual projects. The first summit was held in December 2023. The partner countries are Japan, nine ASEAN countries (except Myanmar), and Australia.

- At the 2nd Leaders Meeting in October 2024, the AZEC Leaders' Joint Declaration was adopted, including an Action Plan for the Next 10 years, which clearly stated the promotion of emission reductions, absorption, and removal through the diffusion of technology and innovation in the agriculture and forestry sector, the creation of specific projects for such promotion, and cooperation through the Asia Zero Emission Center established at the Economic Research Institute for ASEAN and East Asia (ERIA).

② ASEAN-Japan MIDORI Cooperation Plan

- Following the formulation of the MIDORI Strategy, the ASEAN-Japan MIDORI Cooperation Plan was adopted at the Meeting of ASEAN-Japan Ministers of Agriculture and Forestry in October 2023, in order to expand Japan's agriculture, forestry, and fisheries activities to the Asia-Monsoon Region.
- The ASEAN region and Japan have similarities in weather and agricultural production conditions, such as high humidity and temperature, high risk of pests and diseases, abundance of paddy fields, and small- and medium-sized farmers. Cooperative projects deploying Japan's technology and experience are implemented in order to build a resilient and sustainable agriculture and food systems in the ASEAN region. Projects utilizing GHG emission reduction technologies, such as paddy field methane emission reductions, are also being implemented under this plan.

③ Global MIDORI Cooperation Plan

- In December 2024, the "Global MIDORI Cooperation Plan" was formulated to promote tailor-made partnerships and cooperation with countries in the Global South, such as Latin America and Africa, which have various natural and social conditions, by taking advantage of the experience in the Asia-Monsoon Region.
- In order to establish resilient, sustainable, and highly productive agriculture, forestry, and fisheries industry, including initiatives on GHG emission reductions, technologies and initiatives addressing regional particularities will be selected, demonstrated, and promoted to expand its implementation. By fully applying industry-academia-government-finance partnership, the relationship between Japan and the Global South will be strengthened and the international deployment of Japanese technologies and overseas expansion of private companies will be promoted.

④ Strategy for Climate Change Measures in Agriculture and Rural Development Cooperation" (JICA)

- In October 2024, the "Strategy for Climate Change Measures in Agriculture and Rural Development Cooperation" was formulated to clarify the projected growing impacts of climate change on the agricultural and rural sector, as well as the influence of JICA’s projects on climate change, and to provide directions for JICA stakeholders in advancing

specific initiatives. The Strategy for Climate Change Initiatives in Agriculture and Rural Development Cooperation" was formulated in October 2024.

- In response to the significant impact of climate change on agriculture and rural development, JICA aims to create sustainable agriculture and farming villages through both "adaptation measures" to reduce the impact of climate change and "mitigation measures" to reduce GHG emissions. Specifically, this Strategy will strengthen efforts to address local climate risks through irrigation, introduction of resistant crops, and water and soil management. In addition, more effective measures will be realized through forest conservation and collaboration with other sectors.
- Projects Implemented
  - 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 field area water management system (Cambodia)
  - Project for establishment of nitrogen-efficient wheat production systems in Indo-Gangetic plains by the deployment of BNI-technology (India)
  - Needs Assessment on Aigamorobo weed suppressant for high quality and low emission rice cultivation in Vietnam (Vietnam)
  - Business demonstration on improving farmers' livelihoods and decarbonization through carbon credit generation by reducing methane in rice paddies in Vietnam (Vietnam)
  - Needs Assessment Study on the Promotion of Water-saving Rice Cultivation through the Bilateral Credit System in the Philippines (Philippines)
  - Project for Transforming Cassava Production System by Building Smart Carbon Farming for Sustainable Starch Supply Chain (Vietnam)

5 Support programs for Japanese companies

MIDORI ∞ INFINITY also provides information on cross-ministerial and cross-agency support programs, including financial and informational supports, that Japanese companies can utilize both domestically and internationally. The following organizations are involved.

・Ministry of Agriculture, Forestry and Fisheries (MAFF)
・Cabinet Secretariat
・The Cabinet Office
・Ministry of Foreign Affairs of Japan（MOFA）
・Ministry of Education, Culture, Sports, Science and Technology（MEXT）
・Ministry of Economy, Trade and Industry (METI)
・National Center for Industrial Property Information and Training (INPIT)
・Japan Aerospace Exploration Agency (JAXA)
・Japan External Trade Organization (JETRO)
・Japan International Cooperation Agency (JICA)
・New Energy and Industrial Technology Development Organization (NEDO)
・JCM Implementation Agency (JCMA)
・Japan Finance Corporation (JFC)
・Japan Green Investment Corp. for Carbon Neutrality (JICN)