Asia-RiCE

Implementation Report

2025 Update

Asia-RiCE has been formed to develop the rice crop estimation and monitoring component for the Group on Earth Observations Global Agricultural Monitoring (GEOGLAM) initiative. GEOGLAM aims to enhance agricultural production estimates through the use of Earth observations, and Asia-RiCE seeks to ensure that the observational requirements for Asian rice crop monitoring are reflected in the GEOGLAM priorities.

This report summarises the activities and achievements of Asia-RiCE in 2025. This document also aims to acknowledge and highlight the impact of contributions from data providers and the role of the Asia-RiCE initiative in facilitating these inputs.

Asia-RiCE has linkages with major international frameworks such as the 2030 Agenda for Sustainable Development (SDGs 1, 2, 3, 6, 10, 13 & 15), the Sendai Framework for Disaster Risk Reduction 2015-2030 (impact of drought and flood on agriculture, JASMIN agro-met system), and the Paris Climate Agreement (paddy field methane).

UN World Conference on Disaster Risk Reduction
2015 Sendai Japan

SUSTAINABLE DEVELOPMENT GOALS

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

Table of Contents

Introduction

Background

The Asia-RiCE initiative has been organised to develop the Asian Rice Crop Estimation and Monitoring (Asia-RiCE) component for the Group on Earth Observations Global Agricultural Monitoring (GEOGLAM) initiative. GEOGLAM aims to enhance agricultural production estimates through the use of Earth observations (EO), and Asia-RiCE seeks to ensure that the observational requirements for Asian rice crop monitoring are reflected in the GEOGLAM priorities.

The goal of Asia-RiCE is to foster the widespread use of EO for 'wall-to-wall', whole country, timely and accurate forecasts of rice production at national, regional, and global scales, as an input to the GEOGLAM Crop Monitor and AMIS Market Monitor.

Asia-RiCE Phased Approach

Asia-RiCE has leveraged existing agricultural monitoring programs and initiatives at local levels to develop, exercise, and refine processes, and now moves on to full implementation and product generation using SAR (i.e., radar) and other EO data for practical rice crop monitoring. This activity (implemented in phases) will contribute to national and regional food security, climate change adaptation/mitigation, and also Goal 2 of the SDGs by providing rice-related actionable information for improved decision making.

Phase 1 (2013 – 2015)

Phase 1A (2013-2014) consisted of four demonstration sites in three countries: Indonesia, Thailand, and Vietnam. Each of these was focused on the development of provincial-level rice crop area estimations. Note: Phase 1A only covered rice area statistics, maps, and yield estimates. In Phase 1B (2014-2015), additional technical demonstration sites in Chinese Taipei, Japan, and Malaysia were added.

Phase 2 (2016 – 2018)

Following the successful demonstration of the core functionality of Asia-RiCE, the initiative moved into Phase 2, which covered:

- Wall-to-wall SAR observation of selected countries and scaling-up rice crop monitoring using SAR from provincial-level to country/region-level estimates (Vietnam & Indonesia);
- Expanding rice growth outlooks using satellite-derived agro-meteorological data for Laos, Cambodia, and Myanmar; and,
- Continuing rice growth outlooks for FAO/AMIS and related agencies via GEOGLAM in collaboration with AFSIS (ASEAN+3 Food Security Information System).

Phase 3 (2019 – 2021)

Asia-RiCE Phase 3 (April 2019 – March 2021) aimed to:

- Promote the use of EO data for wall-to-wall rice crop monitoring in cooperation with GEORICE and Asia-RiCE team members and international donors;
- Promote the use of new generation tools for big EO data analysis, such as the Open Data Cube and cloud-based systems with available data sources and tools (such as INAHOR and GEORICE);
- Continue to promote the use of the Open Data Cube in Vietnam, Cambodia, and Chinese Taipei in cooperation with VNSC, GA, ESA/CNES, NSPO, and JAXA;
- Promote outcomes, output applications, research results, and progress at international conferences such as the ESA Living Planet Symposium, IGARSS, ACRS, etc.;
- Continue to promote the generation of rice crop outlooks in Asia using the agro-met information from Japan (JASMIN) and India (MOSDAC).

Phase 4 (2021+)

With the emergence of SAFE Project, Asia-RiCE has reconsidered the role that it played in this space. Asia-RiCE's connection to GEOGLAM and other international frameworks remains critical, so this will remain a key feature and role for the initiative. Concepts emerging from GEOGLAM such as the Essential Agricultural Variables (EAVs) will require a coordinated response on behalf of the rice monitoring community; this is a key role that Asia-RiCE plays. Other practical efforts including the collaboration with end users such as the ASEAN Food Security Information System (AFSIS) and the Ministry of Agriculture in Asia has been merged under the banner of the SAFE Rice Crop Monitoring Project.

Asia-RiCE

Rice Growing Outlooks (RGO)

Asia-RiCE members contribute to the monthly ASEAN Food Security Information System (AFSIS) Rice Growing Outlooks (RGOs), which support food security by publishing reports covering rice growing conditions and yield prospects, as well as implementing training sessions to enhance the use of space technologies.

The RGOs provide information on rice-growing conditions, indicating whether there are good / poor levels of rice growth, the general trends, and insights into weather damage using satellite-derived agrometeorological information provided by JAXA's Satellite-Based Monitoring Network (JASMIN). RGOs also contribute to the Market Monitor published by the Agricultural Market Information System (AMIS) as a component of the GEOGLAM by providing monthly reports on the regional status of rice. Earth observation satellites periodically provide meteorological information such as precipitation, surface temperature, and solar radiation, which are essential for crop growth. This information is especially important in Southeast Asia, where meteorological disasters such as floods and droughts occur frequently affecting food security. Agricultural statisticians identify abnormal weather that affects crop growth using JASMIN at an early stage, warn of the impact through the RGOs, and forecast final production. Earth observation satellites provide objective evidence to enhance the reliability of RGO evaluations. The RGO activity started in 2013 with four countries (Indonesia, Thailand, the Philippines and Vietnam) as 'Phase 1' and later expanded to Cambodia, Laos, and Myanmar in 'Phase 2'. The collaboration between statisticians in national agricultural ministries, AFSIS and JAXA has effectively integrated agricultural statisticians' experience and expertise with space technology.

In 2023, the RGO activity was transferred to AFSIS under the SAFER project initiated by the Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan to expand the RGO activity nationwide. The RGO report now includes all ASEAN countries except Singapore for contributing to regional food security. This approach is intended to enhance the efficiency of field operations, with collaborative efforts from MAFF, JAXA, space agencies in the region, AFSIS, and member countries.

http://www.aptfsis.org/publication/rgo

JASMIN/JASMAI

JAXA's Satellite based MonItoring Network (JASMIN) system for the Food and Agriculture Organization (FAO) AMIS Market Monitor provides satellite derived agrometeorological information including precipitation, drought index, soil moisture, solar radiation, land surface temperature, and vegetation index. The tool is able to generate two types of product for each parameter – current condition, and anomaly, which is the deviation from past years' averages. JASMIN can generate either a map of the whole country or time series graphs at a number of predefined locations. The outputs assist the AFSIS and target country agricultural statistics experts in preparing AMIS outlooks for Asia-RiCE. This tool has been integrated into Japan's Satellite Monitoring System of Agrometeorological Information (JASMAI), which is operated by the Ministry of Agriculture, Forestry, and Fisheries (MAFF) in Japan. JASMAI provides visualisation of weather and vegetation data such as soil moisture content, precipitation, and vegetation indices. RGO also utilises JASMAI's agromet data.

http://suzaku.eorc.jaxa.jp/JASMIN/index.html

VEDAS

ISRO's VEDAS provides precipitation data covering South and Southeast Asia. This system, developed by ISRO, provides precipitation data and is open to the public. The data is also utilised by agricultural statisticians in ASEAN to generate monthly AFSIS's RGO report.

https://vedas.sac.gov.in/AFSIS

Since 2022, satellite-derived near-real-time agrometeorological data from VEDAS and JASMAI have been regularly used as scientific and objective reference information in the RGO report to assess rice growing conditions and production. JASMAI, developed by MAFF/Japan in collaboration with JAXA, and VEDAS, developed by ISRO, are also featured on the AFSIS website as sources of satellite-based agrometeorological information. In 2025, VEDAS has recently received ALOS-2 ScanSAR archive data to facilitate rice monitoring activities in the ASEAN region, with further plans to integrate JAXA and ISRO's rice mapping tools into the platform.

https://www.aptfsis.org/publication

Market Monitor by AMIS

The AMIS Market Monitor provides a synopsis of major developments in international commodity markets, focusing on wheat, maize, rice and soybeans. The analysis is a collective assessment of the member organisations of AMIS concerning the international market situation and outlook. Published ten times a year, the report aims at improving market transparency and detecting emerging problems that might warrant the attention of policy makers. Asia-RiCE is a contributor via the RGO activity with AFSIS.

http://www.amis-outlook.org/amis-monitoring

Crop Monitor by GEOGLAM

The Crop Monitors were designed to provide a public good of open, timely, science-driven information on crop conditions in support of market transparency for the G20 AMIS. Reflecting an international, multi-source, consensus assessment of crop growing conditions, status, and agro-climatic factors likely to impact global production, focusing on the major producing and trading countries for the four primary crops monitored by AMIS (wheat, maize, rice, and soybeans). The Crop Monitor for AMIS brings together over 40 partners from national, regional (i.e. sub-continental), and global monitoring systems, space agencies, agriculture organisations and universities. Asia-RiCE is a contributor via the RGO activity with AFSIS.

https://cropmonitor.org/

CEOS Tools

The Committee on Earth Observation Satellites (CEOS) Analytics Lab (CAL) is a cloud-based platform designed to support scalable EO data analysis. It provides a customised JupyterLab environment, enabling users to process large datasets and scale computational resources as needed. The lab is hosted by the CEOS Systems Engineering Office (SEO) to provide:

- Examples of Future Data Architecture components in active use including new discoverability and access approaches;
- A shared Analysis Ready Data (ARD) storage and access capability for candidate ARD outcomes and comparative analysis by CEOS teams to support ARD validation;
- Connection to existing and emergent CEOS and Agency services for data discoverability and access; and,
- Collaboration on analytics tools for integrated analysis, including sample data, using Jupyter Notebooks.

The confluence of CAL, CEOS-ARD for SAR, and the rice crop monitoring community grown via GEOGLAM / Asia-RiCE / APRSAF – and the tools they have developed – provides a unique opportunity to explore how each of these components might be used to answer questions related to interoperability and demonstrate the power of cloud-based, collaborative analysis platforms and associated data.

https://ceos.org/cal/

INAHOR

JAXA developed the International Asian Harvest Monitoring System for Rice (INAHOR), a crop planted area estimation tool, to assist AFSIS and target countries' agricultural statistics experts in preparing AMIS outlooks for Asia-RiCE. Through an Asian Development Bank Technical Assistance project and SAFE projects under APRSAF, INAHOR (using ALOS-2) has been demonstrated to achieve mapping accuracies of 80-90% for target provinces in Laos, Thailand, Vietnam (North), Philippines, Myanmar, Cambodia, and Indonesia. A machine learning version of the software was developed in 2018. Higher accuracies can be achieved with this new version. The INAHOR tool and the derived rice planted area maps have been used for many projects including the 2020 ISRO CEOS Chair Initiative and to improve rice cultivated area statistics in Cambodia (APRSAF/SAFE Rice Mapping Project).

Recognising the benefits of the cloud environment and the ability to reduce the movement and downloading of data, a cloud version, INAHOR-NEO has also been developed. INAHOR is available on Google Earth Engine (GEE).

2025 Updates

Agromet Project

- The project was successfully completed in 2024 and continues to support the regular AFSIS ASEAN Rice Growing Outlooks (RGO).

CH4Rice Project (Methane)

- Established an international validation network in Asia to compare satellite data with paddy field water levels, supporting climate change mitigation and carbon credit trading through methane Measurement, Reporting and Verification (MRV).
- Conducted water-level and CH4 flux measurements using shared ALOS-2 PALSAR-2 and ALOS-4 PALSAR-3 Full-pol data.
- Highlighted the need for standardised ground data collection and plans to publish project results to promote satellite data use in carbon credit schemes.
- Welcomed the Earth Observatory of Singapore (EOS) of Nanyang Technological University (NTU) to the CH4Rice Project.
- Engaged with CEOS, AOGEO, GEOGLAM, and AFSIS, while initiating stakeholder dialogues for practical applications.
- Exploring the combined use of ALOS-2 and ALOS-4 to improve observation frequency.

Rice Crop Monitoring Project

- Enhanced regional cooperation on data sharing (ALOS-2/PALSAR-2 and ALOS-4/PALSAR-3 ScanSAR) and tool access (rice mapping software) through cloud platforms such as ISRO's VEDAS, and Google Earth Engine.
- Launched a new capacity-building project (Proponent: GISTDA) funded by the Japan-ASEAN Integration Fund (JAIF), started in January 2025 at GISTDA HQ and ARTSA, in collaboration with MoA in ASEAN countries, AFSIS, and MAFF/Japan.

Future work

- Continue capacity building by using available international donor funds.
- Continue the support of satellite data utilisation using various available platforms such as VEDAS, ODC, GEE, TELLUS, etc. to contribute to regional issues.
- Continue to implement the two ongoing projects: Rice Crop Monitoring and CH4Rice, while following up on the successfully completed Agromet Project.
- Encourage participating organisations to submit new SAFE project proposals for consideration at the next SAFE Executive Board Meeting (Q1 2026) and/or APRSAF-32, with interest expressed in areas such as land use/land degradation, water quality, and air quality.

SAFE Project

SAFE Evolution was adopted during the 2017 APRSAF-24 SAFE Workshop. It introduced a new approach that was proposed to move beyond the SAFE Prototype concept. The focus was on promoting multilateral cooperation and knowledge sharing for Asia-Pacific regional environmental issues. The objective remains to leverage the applications and capabilities developed in the SAFE Prototype phase.

The SAFE initiative has expanded its scope to include three agricultural related projects, one of which was completed in 2024, while two are ongoing. The primary objective is to transition from bilateral collaboration to a more comprehensive multilateral approach, fostering enhanced cooperation. The initiative aims to promote the sharing of data, tools, and knowledge, while simultaneously focusing on capacity building to effectively address common agricultural challenges across the region.

SAFE CH4Rice (Methane Emissions from Rice Crops) Project

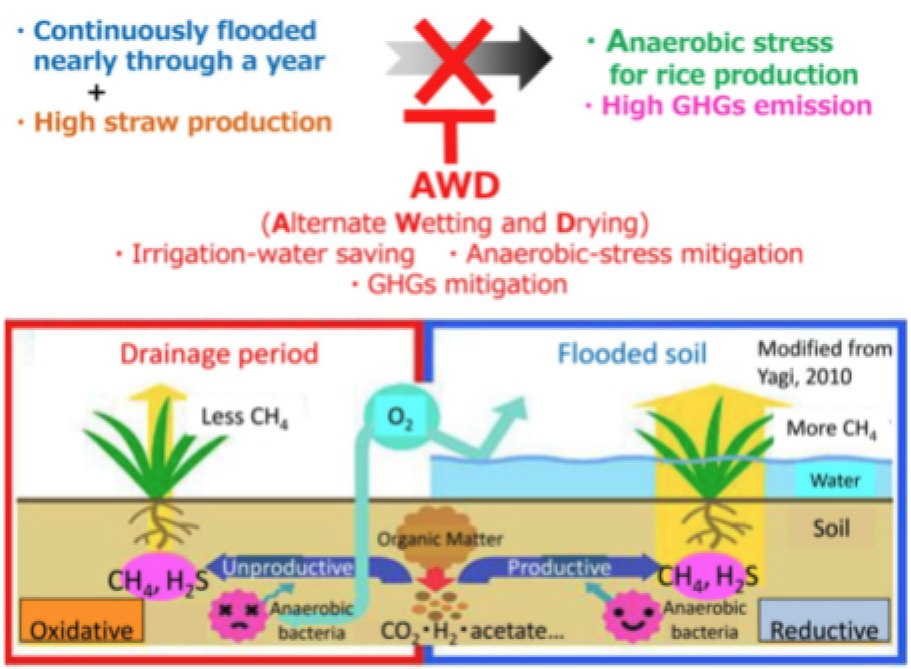
Project Leader: Vietnam National Space Center (VNSC)

The "Assessment of Methane Emission from Rice Paddies and Water Management," also known as CH4Rice, is a multilateral SAFE project approved at APRSAF-28 in November 2022.

Background

Methane (CH_4) is 30 times stronger than carbon dioxide as an absorber of infrared radiation. Reducing CH_4 emissions would be an effective option for rapid climate change mitigation, particularly on a decadal timescale. According to the Intergovernmental Panel on Climate Change (IPCC), atmospheric CH_4 has been regrowing in concentration since 2007, which is largely driven by emissions from fossil fuels and agriculture.

CH_4 emissions from rice paddies are estimated to represent about 8% of total global anthropogenic methane emissions. CH_4 emissions from rice paddies can vary depending on the number and duration of crops grown, water regimes, soil type, temperature, and rice cultivar. Rapidly reducing methane emissions from paddy rice is regarded as the single most effective strategy to reduce global warming in the near term since methane



Alternate Wetting & Drying (AWD)

has a shorter lifetime in the atmosphere than carbon dioxide (about 9 years).

Methods such as Alternate Wetting and Drying (AWD) are found to be effective in reducing methane emissions. AWD is a management practice in irrigated rice characterised by periodically drying and flooding fields to reduce water use and CH_4 emission. In addition, AWD approaches can improve the sustainability of water use in rice production.

Remote sensing can contribute to assessing CH_4 emissions from paddy fields more precisely through monitoring rice cultivation and improved water management.

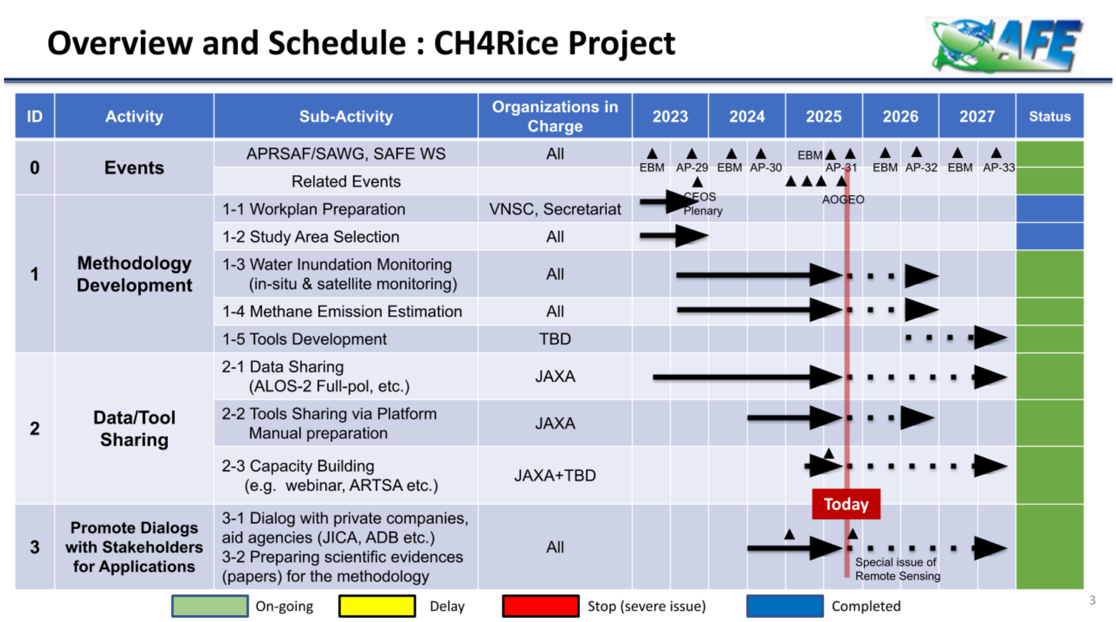
Objectives

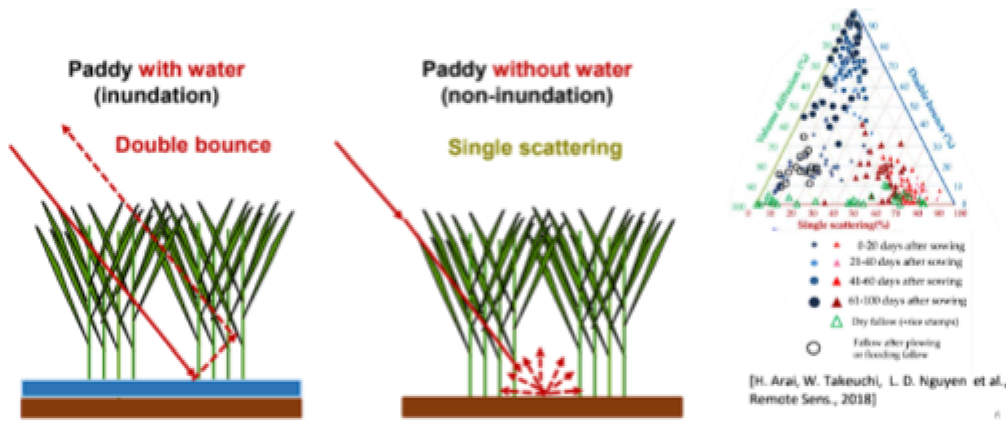
An accurate assessment of CH_4 emissions is necessary for achieving sustainable rice cultivation. The CH4Rice project aims to:

- Demonstrate how climate change mitigation activities such as carbon credits could be enabled through CH_4 Monitoring, Reporting and Verification (MRV) for rice paddies using satellite and in-situ data.
- Manage water efficiently through irrigation methods that result in lower CH_4 emissions, such as AWD.
- Promote and participate in regional and global sustainable agriculture related initiatives.

Methodology to Estimate CH_4 Emissions from Rice Paddies

The CH_4 emission estimation from rice paddies uses a bottom-up approach where emission factors are multiplied by the cultivation period and harvested area to provide a final estimate.





Water inundation monitoring

Implementation Activities

The work plan for CH4Rice was developed and confirmed at the SAFE Executive Board Meeting on 21 June 2023. Key activities include:

Water Inundation Monitoring

- Conducting field surveys and installing in-situ IoT water level sensors at study sites.
- Comparing in-situ data with ALOS-2 PALSAR-2 and ALOS-4 PALSAR-3 Full-pol SAR data to refine monitoring algorithms.
- Expanding research across regions and publishing findings to build the scientific evidence base.

Methane Emission Estimation

- Deploying low-cost gas sampling systems to measure CH_4 flux at study sites (in situ).
- Enhancing data collection to improve methane emission modelling.

Data and Tool Sharing

- Providing JAXA ALOS-2 PALSAR-2 (Full-pol) data to study sites.
- Developing and sharing monitoring tools via platforms and manuals.
- Improving water-level sensor calibration for a standardised ground-based database.
- Three decomposition components made available through Google Earth Engine (GEE).

Stakeholder Engagement and Policy Impact

- Publishing research papers to provide scientific evidence for policy and real-world applications, with two publications accepted in 2025 related to the CH4Rice project. ASEAN countries are preparing to submit a paper to the Remote Sensing Journal to disseminate the project's achievements.
- Engaging with public and private sector stakeholders to explore practical implementations.

Water Inundation Monitoring using L-band SAR

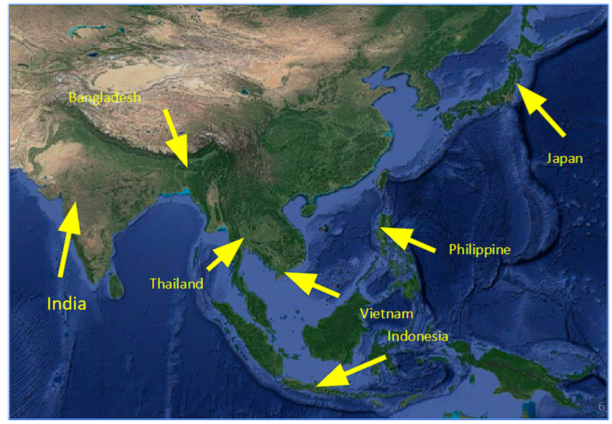
L-band SAR penetrates the rice canopy and can identify the existence of water under rice. As per the research conducted by Arai et. al. in 2018, an inundated paddy field shows strong double-bounce scattering.

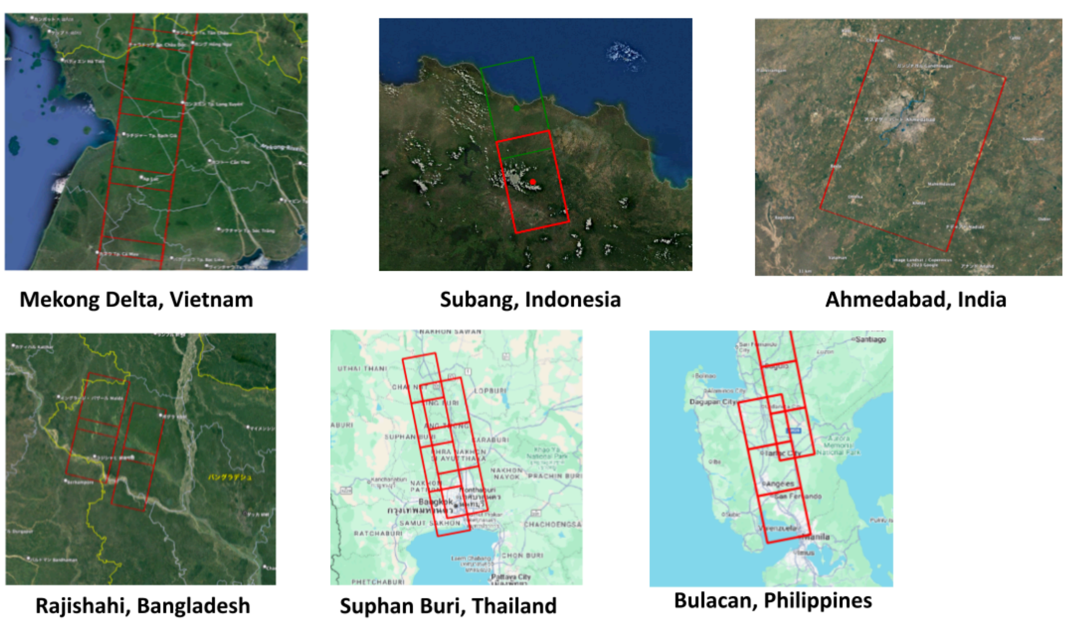
Selection of Study Areas

The project currently utilises full-polarimetric L-band ALOS-2 PALSAR-2 and ALOS-4 PALSAR-3 radar satellite images for the selected study sites alongside in-situ water level measurements.

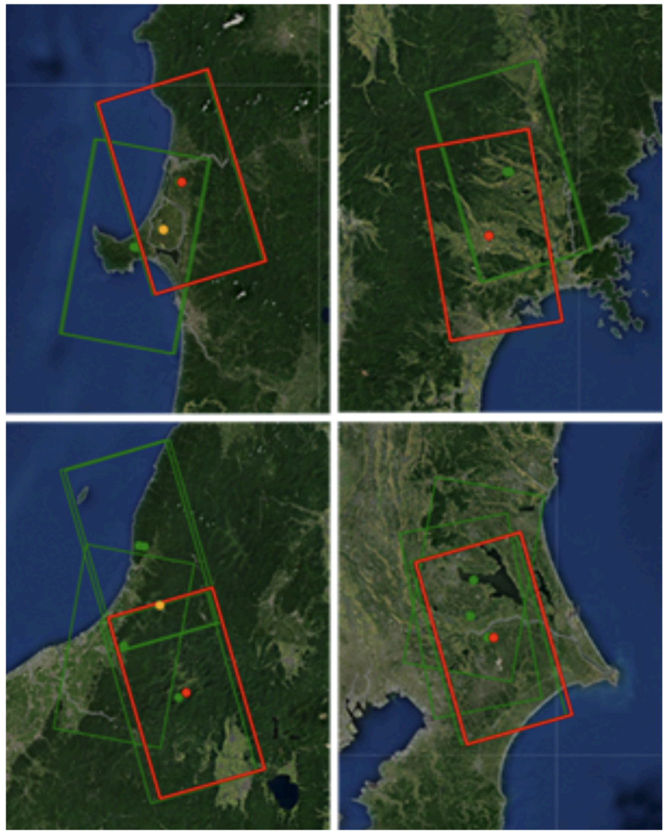
As of November 2025, the selected supersites include:

- Subang in Indonesia,
- Suphan Buri in Thailand,
- Nawagam in India, Miyagi,
- Miyagi, Akita, Niigata, and Ibaraki in Japan,
- Bulacan, Nueva Ecija in the Philippines,
- Rajshahi in Bangladesh,
- Mekong Delta, An Giang, and Bac Lieu provinces in Vietnam.

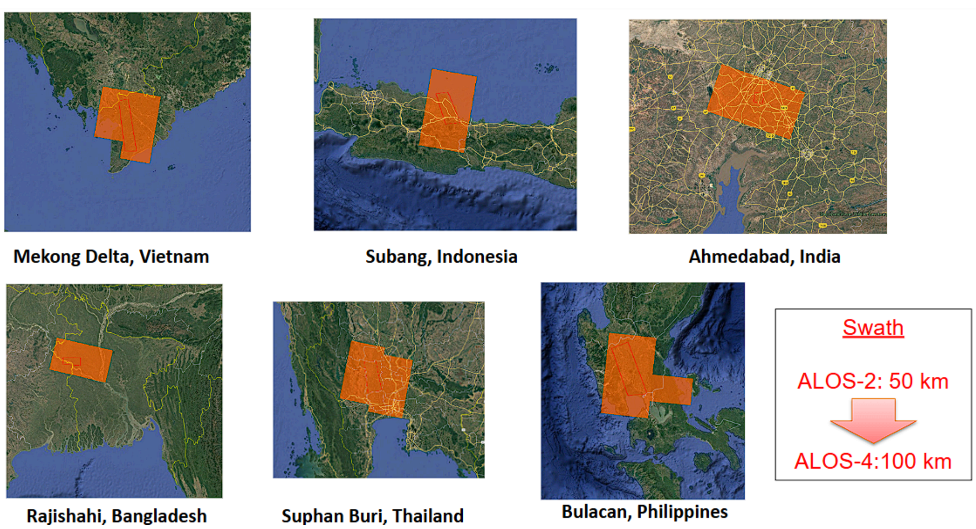




CH4Rice Study Sites and ALOS-2 Full-Pol Observation Sites



As of January 2026 there are now four CH4Rice study sites in Japan, shown above.

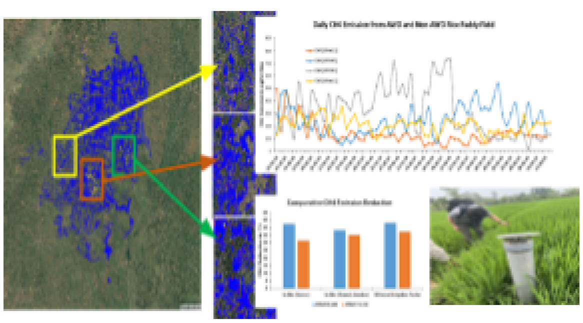


CH4Rice Study Sites and ALOS-4 Full-Pol Observation Sites

Water Inundation Monitoring

<u>Bangladesh</u>

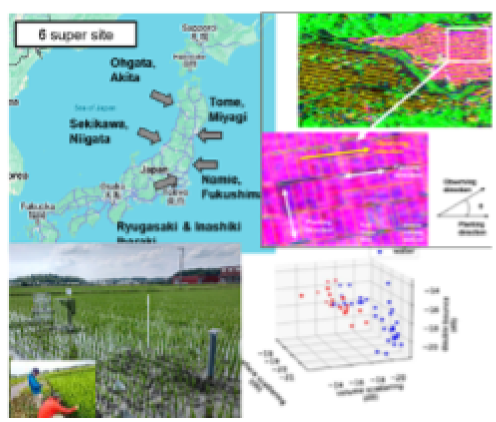
Six AWD sites with automated water table monitoring were established in Rajshahi, Bangladesh, with the support of the Bangladesh Agricultural Research Council (BARC), with 89 sites in total across the country. Expanded adoption of AWD was reported in a workshop titled *"Sustainable Rice Production Pilot test water sensor IOT irrigation and low carbon rice using AWD,"* held in Rajshahi on September 29, 2025. IOT-based smart irrigation systems and household surveys on low-carbon rice farming using AWD were piloted, with a reduction in CH4 emissions shown in AWD fields.



AWD site in Rajshahi Bangladesh and CH4 emission reduction graph

<u>Japan</u>

Efforts for Water Inundation Monitoring in Japan include the installation of automatic water-level measurement equipment (IoT) and an Automatic Gas Sampling System for CH_4 and N_2O. A portable CH4 sensor was developed and tested, and UAV lidar measurements were conducted in July 2025. Collaboration with the University of Tokyo is underway to develop 3D rice crop models and estimate plant height using drone data for the SAR RT model. A comparison between in-situ water inundation and ALOS-2 PALSAR-2 Full-pol data was acquired, and in 2025, a paper titled *Planting and Observation Geometry Effects on L-band SAR for Water Management Monitoring in Paddy Fields,* was published. As of January 2026 there are now four CH4Rice study sites in Japan, shown below.



Supersites in Japan

Vietnam

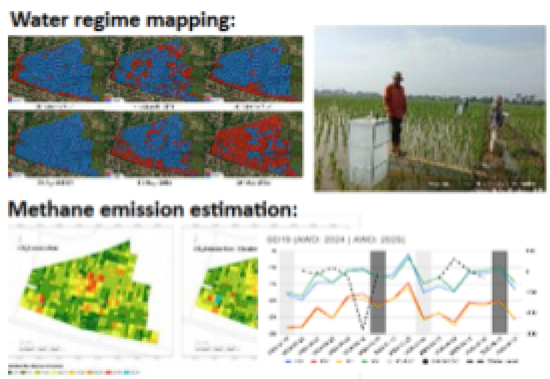
Water Inundation Monitoring efforts involve collaboration among VNSC, CESBIO & GlobEO, An Giang University, Bac Lieu University, and Rynan Technologies. Ground data collection is supported by CNES CESBIO and GlobEO, as well as JAXA and RESTEC. 30 automatic water-level monitoring stations, provided by Rynan Technologies, have been installed in the Mekong Delta. VNSC is processing ALOS-2 full-pol data to classify paddy flooding, and Sentinel-1 data to classify rice growth stages.

Philippines

The AWD methodology will be implemented under the Joint Crediting Mechanism (JCM), aiming to cover 30,000 hectares by 2030. Preliminary data from the eddy covariance flux system at a rice field in Nueva Ecija, along with a comparison to Sentinel-2 data, were shared at AsiaFlux in October 2025. Procurement of a methane gas analyser is ongoing, with installation planned for Q1 2026. A surface reflectance analysis found a strong correlation between plant height and volume scattering.

Indonesia

Water Inundation Monitoring activities in Indonesia include field measurements and satellite observations over four study sites in Subang, West Java. Field measurements were collected over three planting seasons during 2024-2025. RYNAN IoT radar sensors were installed in the study sites and gathered measurements of CH_4 flux, crop height, water level, soil wetness, and transplanting dates. Sentinel-1 and ALOS-2 data were processed to estimate



Automatic water-level measurement in Subang, Indonesia

CH_4 emissions using the IPCC formula. Capacity-building efforts include coordination with the Ministry of Agriculture (BBPadi) and field measurement training with JAXA.

Thailand

Water Inundation Monitoring activities include data processing and field measurements. Rice phenology has been analysed using VH polarisation data from Sentinel-1, and various polarimetric decomposition parameters from ALOS-2, combined with 20 ground measurements, have been analysed. ALOS-2 data from late 2023 has been analysed to classify rice growth stages and identify flooded and alternately flooded/dried paddies, with methane emissions estimated using IPCC guidelines. Field measurements involve the installation of water-level sensors in Suphan Buri and Chainat provinces, with 22 automatic sensors deployed across 18 sites and manual water level measurements conducted in 49 sites. In June 2025, an article was published in the *Remote Sensing Journal*, highlighting the project's investigation of multi-sensor data for CH4 estimation under different water management practices.

AWD site in Thailand

Singapore

NTU Singapore announced plans to collaborate with IAE Vietnam to deploy approximately 100 low-cost IoT sensors to provide high quality in-situ data and train machine learning models. The collaboration aims to establish an integrated monitoring framework combining in-situ and satellite-based inundation mapping to enable scalable and affordable CH_4 emission modelling and MRV accuracy.

Singapore's cost effective IoT water level monitoring

Tools Sharing via Platform Manual Preparation

The following activities were undertaken as part of the platform manual preparation under the tools-sharing initiative:

- Installed water level measurement sensors in each country.
- Evaluated differences between Komomi, Rynan, MIHARAS, and Sony water level measurement devices.
- Shared evaluation results with manufacturers to improve device quality.
- Shared measurement results and ALOS-2 full-pol data among space agencies via cloud platform.
- Recognised the importance of device calibration, cross-device calibration, on-site measurement quality, and cost-effective CH4 measurement devices.

Future Plan

- Continue to conduct field surveys, in-situ water level measurements and CH_4 flux monitoring.
- Compare in-situ water-level with ALOS-2 PALSAR-2 and ALOS-4 PALSAR-3 full-pol data, and explore the addition of NISAR data.
- Coordinate and cooperate with private companies' activities (emission trading).
- Validate satellite-based CH_4 and water inundation data using field surveys.
- Engage with stakeholders to integrate satellite data into carbon credit methodologies such as Verra, Gold Standard and JCM.
- Provide feedback to sensor manufacturers to improve methane and water-level monitoring technology.
- Submit papers to the Special Issue of Remote Sensing (MDPI, ISSN 2072-4292) to disseminate project achievements.
- Hold a workshop to share technical information among space agencies and expand the project activities with public and private stakeholders.

SAFE Rice Crop Monitoring Project

Project Leader: Geo-Informatics and Space Technology Development Agency of Thailand (GISTDA)

The SAFE Evolution Rice Crop Monitoring Project was approved in 2018 to provide regional-scale, high-quality, space-based rice crop maps. Multiple types of Synthetic Aperture Radar (SAR) data in Southeast Asia, especially in the Mekong Region are used for cross-comparison studies.

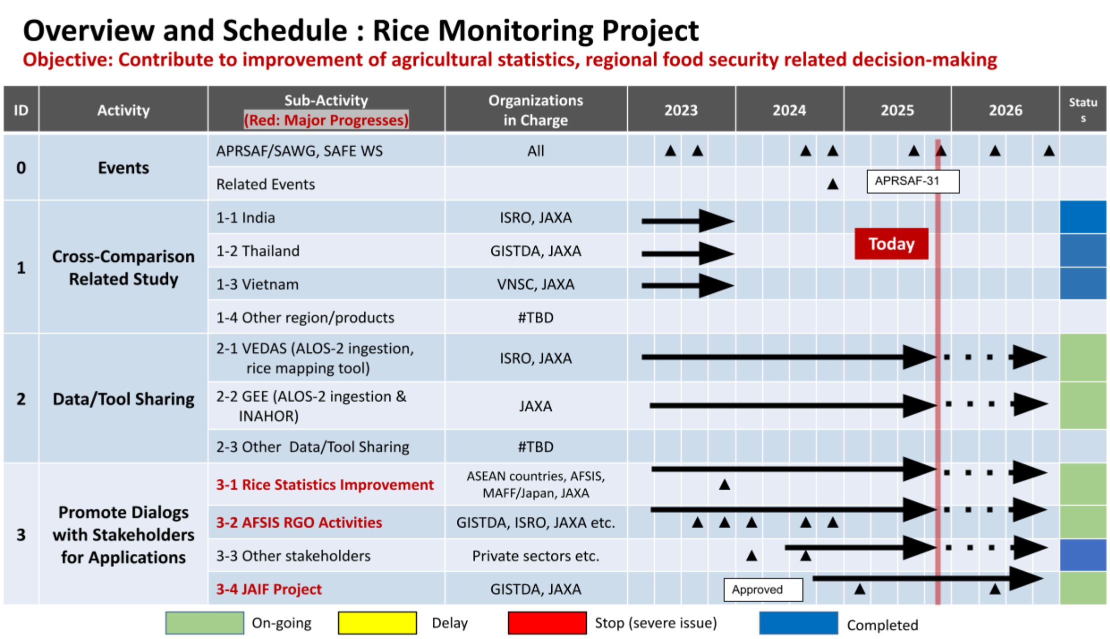
The project aims to:

- Produce national agricultural statistics (rice area) and products to support decision making in agricultural policy;
- Contribute to regional and global food security activities (e.g., the AFSIS Rice Growing Outlooks and FAO AMIS through GEOGLAM, etc.)

Implementation

The ongoing activities under this project include:

- **Cross-comparison studies of rice maps for algorithm improvement**: Completed a rice mapping algorithm comparison between GISTDA, ISRO, and JAXA, using the findings to enhance the rice mapping algorithm. The cross-comparison study was continued and expanded for BIMSTEC countries as part of the CEOS 2019 chair initiative by VNSC for the Lower Mekong River and the CEOS 2020 chair initiative by ISRO.
- **Data/tool/knowledge sharing and capacity building:** JAXA developed the rice mapping software "INAHOR" as a Google Earth Engine (GEE) version



to enable easier use by end-users, such as Ministry of Agriculture officials, for improving rice statistics with scientific evidence. ALOS-2 ScanSAR data is available on GEE within two weeks of observation, enhancing timely access to satellite data. Collaboration with end-user agencies in ASEAN countries continues, alongside AFSIS and MAFF/Japan. INAHOR training workshops were held in Cambodia, Lao PDR, and Myanmar during 2024-2025.

- **Promote dialogue with end users/stakeholders:** JAXA attended the AFSIS Special Workshop on 22-23 October 2025 in Tokyo, Japan, reporting progress on the SAFE and JAIF projects and INAHOR rice mapping tool. The workshop saw the introduction of the FY2025-2027 AFSIS-GIS project, which aims to gather data for food studies using GIS tools including satellite-based rice maps. Ongoing collaboration with AFSIS was highlighted as a key aspect of strong end-user engagement and support to the SAFE Rice Crop Monitoring Project.
- A series of three in-country INAHOR training workshops were conducted across ASEAN member countries, which confirmed the importance of having a sufficient number of high-quality training datasets and recognised the difficulty in classifying regions with small land parcels.

23rd AFSIS Focal Point Meeting held in Yangon, Myanmar on 17-18 June 2025

INAHOR Training workshop in Nay Pyi Taw, Myanmar on 23-24 June 2025

INAHOR Training Workshop in Phnom Penh, Cambodia on 6-7 August 2025

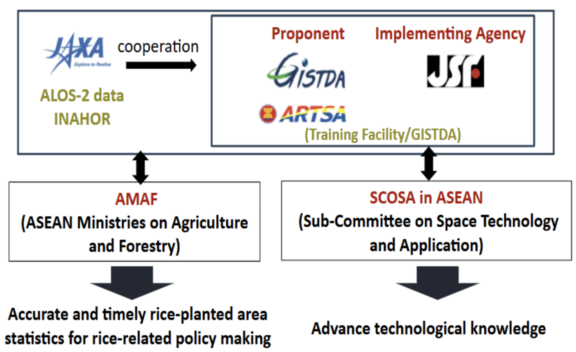
Next Steps

- Continue cross-comparison of rice mapping algorithms between ISRO and JAXA and enhance rice mapping tools based on study results.
- Facilitate data and tool sharing and integration for scientific, governmental, and business use.
- Explore collaboration on natural disaster rice damage assessment, with ISRO sharing its experience from India.
- Implement the JAIF project on *"Improvement of Paddy Rice Area Statistics and Damage Assessment using Earth Observation Satellites for ASEAN. Training workshops are planned to resume in May 2026."*
- Strengthen coordination with stakeholders, including continued engagement with government statistical departments to utilise the SAFE project's results.
- Continue discussions with the private sector to support the operational use of project outcomes in agriculture-related businesses.
- Consider integrating multi-SAR data sources to enhance mapping capabilities, with missions such as ALOS-2/4 (L-band), NISAR (S/L-band), and LOTUSat-1 (X-band).
- Promote the application of satellite-derived rice maps and area statistics in ASEAN countries, leveraging synergies with the JAIF project and the AFSIS-GIS initiative.

Outreach Activities and Capacity Building Programmes

JAPAN-ASEAN Integration Fund (JAIF) Capacity Building

The JAPAN-ASEAN Integration Fund (JAIF) capacity building project under the Rice Monitoring project aims to enhance agricultural statistics and damage assessment capabilities in ASEAN countries through the use of Earth Observation satellite technologies. The overall objective of the project is to develop innovative geospatial analysis methods and satellite remote sensing technologies to support agricultural statistics across ASEAN member states.



The expected outcome is the provision of accurate, reliable, and timely assessments and estimation of agricultural statistics derived from Earth Observation (EO) satellite data.

Target participants include the Agriculture and Forestry ministries of ASEAN member countries, along with the ASEAN Sub-Committee on Space Technology and Applications (SCOSA). Close collaboration is maintained with AFSIS (ASEAN Food Security Information System) and MAFF/Japan to ensure the success of the project.

A proposal titled *"Improvement of Paddy Rice Area Statistics and Damage Assessment using Earth Observation Satellite for ASEAN"* was submitted to JAIF, with GISTDA serving as the proponent agency and Japan Space Forum (JSF) as the implementing agency. The proposal was approved in June 2024.

An inception Workshop was held from 22-24 January 2025 at GISTDA, with the next Training Workshop planned for May 2026. The results of the project have been explored for potential utilisation by private companies in the agribusiness sector.

Inception Workshop at GISTDA

Additionally, a two-day INAHOR training course for ASEAN Ministries on Agriculture and Forestry (AMAF) and

SCOSA members was conducted at GISTDA from January 23-24, 2025, marking the first training of its kind under the project.

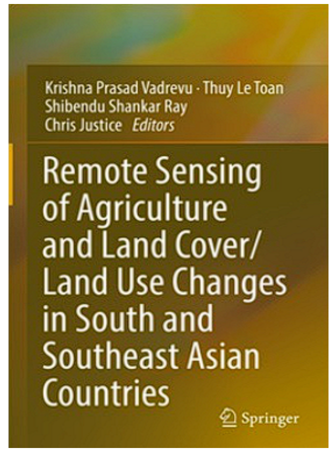
1st Training for AMAF and SCOSA members held at GISTDA ARTSA

Progress of the JAIF project was reported by Thailand at the 14th Meeting of the ASEAN-Japan Joint Consultation Committee on Science and Technology (AJCCST-14) on 19 June 2025 in Jakarta, Indonesia.


AJCCST-14 in Jakarta, Indonesia

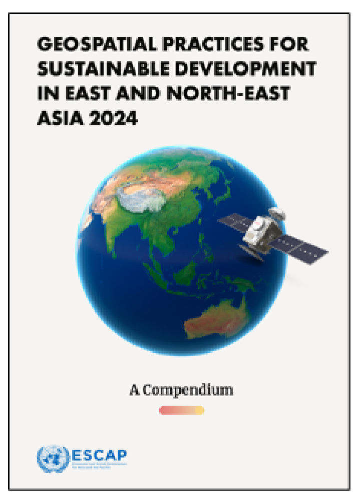
Outreach: Academic Publication and UN ESCAP Report

A chapter related to the SAFE Rice Monitoring project was included in the academic book titled *"Remote Sensing of Agriculture and Land Cover/Land Use Changes in South/Southeast Asian Countries,"* edited by Krishna Prasad Vadrevu (USA), et al.



A collaborative study titled *"Rice Monitoring in Southeast Asia Using Earth Observation Satellite Data,"* involving GISTDA, VNSC, MoA/Indonesia, MAFF/Cambodia, JAXA, and CESBiO, was published by Springer in April 2022.

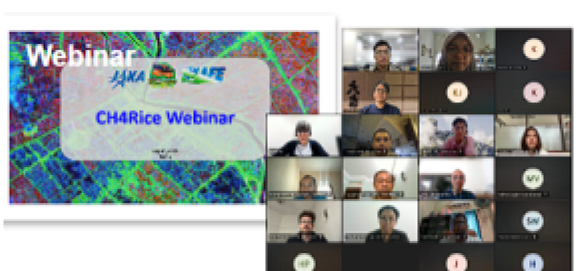
In 2024, UN ESCAP published the report "Geospatial Practices for Sustainable Development in East and North-East Asia," which included articles related to the SAFE rice monitoring project.



Stakeholder Engagement and Capacity Building for CH4Rice Implementation

A series of CH4Rice project and stakeholder meetings, webinars, and regional forums were held to strengthen technical capacity and foster collaboration. Project meetings in January and April 2025, along with discussions at the SAFE Executive Board meeting in August 2025, reported strong technical progress across the six CH4Rice test sites, addressed implementation challenges, and explored pathways for societal application.

A technical webinar in July 2025 introduced a standard analytical workflow for ALOS-2 data processing and supported understanding of field-based statistical indicators. CH4Rice activities were also presented at AOGEO 2025, facilitating knowledge exchange among Asia-RiCE partners and promoting the operational use of EO outputs.



Stakeholder engagement was further strengthened through a dedicated meeting in Bangkok in January 2025, which identified requirements from both public and private sectors, highlighted the need for additional test sites, and emphasised the importance of aligning methodologies with carbon credit standards in consultation with private sector certifiers such as Verra. These meetings underscored the growing emphasis on private sector collaboration to support credible and scalable methane monitoring solutions.

CH4Rice Stakeholder meeting in Bangkok, Thailand

Conclusion

A Critical and Unique Space Agency Service

The Asia-RiCE Initiative continues to demonstrate its value by making available the flow of CEOS satellite data from space agencies to national agricultural authorities and researchers across the region. This has been possible through the collective efforts of CEOS Agencies and partnerships with GEOGLAM, APRSAF SAFE, and other regional stakeholders. Key efforts under the initiative, including the CH4Rice project, Agromet project, and the Rice Crop Monitoring project, have played an important role in enhancing rice production monitoring, supporting methane emission estimation, and strengthening regional capacity for agricultural applications of Earth observation.

Ensuring the harmonisation and promotion of these efforts will be crucial to maximising synergies across CEOS, GEOGLAM, and APRSAF SAFE activities.