THE WORKSHOP ON THE PROJECT FOR STRENGTHENING ASEAN FOOD SECURITY INFORMATION SYSTEM (AFSIS) FUNCTION FOR EMERGENCY (SAFER)

"Promote Rice Planted Area and Production Estimation Using Space-based Technologies In Indonesia"

JAKARTA, INDONESIA

4 - 5 June 2025

Preface

To improve cooperation in the field of statistics across Southeast Asia, the Asian Food Security and Information System (AFSIS), in collaboration with the Japan Aerospace Exploration Agency (JAXA), the Remote Sensing Technology Center of Japan (RESTEC), and the Center for Agricultural Data and Information Systems (CADIS), organized a short training course focused on developing human resources in mapping.

The training program, known as INAHOR, specializes in monitoring rice crops using remote sensing technology. It is organized by the Japan Aerospace Exploration Agency (JAXA) in partnership with various organizations, including the Remote Sensing Technology Center of Japan (RESTEC) and AFSIS. INAHOR stands for “INternational Asian Harvest mOnitoring system for Rice.”

The goal of this training is to enhance participants' understanding and skills in mapping large land areas and rice production by utilizing remote sensing data, particularly satellite data. The training typically involves face-to-face sessions and aims to support food security in the Asian region, particularly in terms of monitoring rice crops.

The Center for Agricultural Data and Information Systems extends its sincere appreciation to the AFSIS Secretariat, the Japan Aerospace Exploration Agency (JAXA), and the Remote Sensing Technology Center of Japan (RESTEC) for their invaluable support and collaboration, which contributed significantly to the success of this event.

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1 Introduction

A. Background

The agricultural sector is vital to Indonesia's economy, contributing 12.66% to the GDP as of early 2025, with rice as the primary commodity for over 270 million citizens. Ensuring a sufficient rice supply is essential for food security. Accurate data is crucial for sustainable production, policy formulation, and effective agricultural strategies. However, traditional data collection often faces challenges in coverage and accuracy. Utilizing space-based technologies, such as satellite imagery and remote sensing, can significantly enhance data reliability and operational efficiency.

Indonesia's unique geographical and environmental challenges make remote sensing technology vital for agriculture, as it enables the monitoring of crop health, assessment of land use, and optimization of irrigation practices. This data is crucial for enhancing food security and improving crop yields.

Currently, rice production estimates are based on field surveys using the Area Sampling Frame (ASF) method, which aims to collect data on harvest areas and project potential yields up to three months in advance. However, this approach has limitations, such as restricted area coverage, high operational costs, and dependence on human resources. In contrast, advancements in remote sensing offer innovative opportunities for more extensive and efficient data collection.

Since 2015, the Indonesian Ministry of Agriculture has implemented the Rice Planting Monitoring System (SIMOTANDI), which utilizes remote sensing technology and Landsat 8 imagery to monitor rice cultivation phases and assess paddy field conditions. The system aims to improve policy planning by identifying growth stages—vegetative, generative, and harvest—through satellite image analysis. It also detects unplanted or fallow land to promote planting initiatives, thus striving to enhance the planting index and rice production in Indonesia.

The SIMOTANDI application prioritizes the use of optical satellite imagery and Synthetic Aperture Radar (SAR) to enhance the accuracy of paddy field analysis and ensure that monitoring results reflect actual field conditions.

The Ministry of Agriculture has launched strategic programs to achieve sustainable food self-sufficiency, requiring accurate tabular and spatial data. Law No. 21 of 2013 addresses spatial matters, including the use of remote sensing satellite data, while Government Regulation No. 11/2018 outlines the procedures for remote sensing activities following international standards. Remote sensing technology is vital in Indonesian agriculture for monitoring crop health, assessing land use, and optimizing irrigation, thereby enhancing food security and increasing crop yields for farmers.

In response to the increasing need for effective agricultural data management in Southeast Asia, the ASEAN Food Security Information System (AFSIS) collaborated with the Center for Agricultural Data and Information Systems (CADIS) of the Indonesian Ministry of Agriculture to organize a workshop focused on agricultural land mapping using space-based technologies and the **IN**ternational **A**sian **H**arvest m**O**nitoring system for **R**ice (INAHOR) software. Entitled "Promote Rice Planted Area and Production Estimation Using Space-based Technologies in Indonesia," the workshop was part of the AFSIS SAFER project - The Japan Aerospace Exploration Agency (JAXA) Advanced Land Observing Satellite (ALOS) - Asia-Pacific Regional Space Agency Forum (APRSAF) was held on June 4-5, 2025, at Ra Premiere Simatupang, Jakarta, and included presentations, interactive discussions, and practical training sessions, encouraging participants to apply their newly acquired skills to real-world scenarios.

B. Purposes

The objective of this workshop was:

1) To enhance participants' knowledge and skills in agricultural land mapping using satellite technology.
2) It provided training on the INAHOR software for mapping and monitoring agricultural lands, focusing on rice cultivation and production.
3) Additionally, the workshop sought to promote collaboration among ASEAN member countries in utilizing technology for food security data management.

2 Participants

The workshop participants represented various institutions essential to land and agricultural mapping, along with related agencies. Specifically, representatives from the Non-Commodity Division of CADIS attended, with a particular focus on the Social, Facilities, and Infrastructure Data Work Team, which specializes in agricultural land data, predominantly concerning paddy fields. Additionally, participants from the Commodity Data Group, tasked with responsibilities related to data concerning food crop areas, horticulture, livestock, and plantations, included members from the Food Crop Data Work Team and the Livestock and Plantation Data Work Team. The relevant directorates that were invited included the Directorate of Land Mapping under the Directorate General of Agricultural Land and Irrigation, which oversees essential functions in land mapping. In addition to the Directorate of Cereals and the Secretariat Directorate General of Food Crops, these entities are responsible for formulating and implementing policies aimed at enhancing production and promoting the downstream processing of food crops.

The workshop comprised a total of 34 participants, exclusively from the Ministry of Agriculture. This group included 26 (76.47%) representatives from the Center for Agricultural Data and Information Systems (CADIS) and 8 (23.53%) participants from affiliated institutions. Specifically, the attendees from these institutions comprised 1 individual from the Bureau of Foreign Cooperation (KLN), 4 representatives from the Directorate of Land Mapping within the Directorate General of Agricultural Land and Irrigation, 2 members from the Secretariat General of Food Crops under the Directorate General of Food Crops, and 1 participant from the Directorate of Cereals, also within the Directorate General of Food Crops. The participant gender distribution comprised 15 males, which represents 44.12% of the total, and 19 females, accounting for 55.88%. This finding reflects a noteworthy balance, with a slightly higher proportion of female participants in the group.

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❸ Activity Details

The workshop is structured into three distinct phases: the pre-workshop phase, the workshop implementation phase, and the post-workshop phase. The pre-workshop phase includes preparatory activities designed to facilitate the effective execution of the workshop. Additionally, the post-workshop phase encompasses evaluations aimed at enhancing the implementation of similar initiatives in the future.

A. Pre-Workshop activities consist of a series of essential preparations undertaken before the execution of the workshop. These preparations encompass both technical and administrative dimensions:

1) Administrative Preparations: This includes assistance with visa arrangements for Remote Sensing Technology Center of Japan (RESTEC) researchers who will participate as experts or instructors, as well as the organization of the venue for workshop activities, which entails the setup of all necessary equipment.

2) Technical Preparations: This phase involves the development and configuration of applications to be employed during the INAHOR utilization workshop focused on rice production estimation. The applications to be utilized include Google Earth Engine (GEE) and Quantum GIS (QGIS) for mapping purposes:

a) Install the GEE application.

The installation of the GEE application entails several prerequisites, including the following:

1. Users must possess a Gmail account and log in to their Google Account. Subsequently, they should access GEE via the following link: https://earthengine.google.com/ and select the option to "Get Started."
2. To utilize GEE, it is imperative to link the GEE account to a Google Cloud project. Each Google Account must have a distinct Google Cloud project created.

b) QGIS mapping application

The installation steps of the QGIS mapping application are as follows:

Step 1. Download the installer.

- Open a browser and visit the official QGIS website
- Click "Download Now."

- Select the OSGeo4W Network Installer version (recommended) or Standalone Installer

Step 2. Run the Installer

- Open the Downloads folder, double-click the installer file (example: QGIS-OSGeo4W-3.36.1-1-Setup-x86_64.exe)
- If a security warning appears, click "Yes."

Step 3. Start the Installation Process

- Select the installation option:
- "Advanced Install" → "Install from Internet"
- Specify the installation location (leave default: C:\OSGeo4W)

Step 4. Select Packages

- On "Select Packages":
- Select "Desktop" → "QGIS Desktop" with the LTR (Long-Term Release) version
- Make sure the green ✓ sign appears. Click "Next" to start the package download

Step 5. Wait for the Installation Process

- Wait for the progress bar to finish (download & installation process ±10-30 minutes, depending on the internet)

Step 6: Complete the Installation

- Check "Create Desktop Icon" and "Create Start Menu Shortcut"
- Click "Finish."

Step 7. Verify Installation

- Open QGIS from the Desktop Shortcut or the Start menu
- The initial QGIS display is ready to use!

B. Workshop

Participants of the initial preparation workshop are required to bring a laptop for creating a GEE account and installing QGIS software. The objective of this workshop is to present the findings related to the estimation of the rainy season rice planting area in West Java Province, utilizing INAHOR software derived from ALOS-2 satellite imagery.

This workshop will leverage training data specific to West Java Province, which includes 23 districts and cities. Five districts have been selected for focused analysis: Indramayu, Karawang, Subang, Majalengka, and Bekasi. The results of the 2024-2025 rainy season rice field area estimation for West Java Province, employing INAHOR in conjunction with L-Band Synthetic Aperture Radar (PALSAR-2) data from the Advanced Land Observation Satellite "DAICHI 2" (ALOS-2) from October 2024 to April 2025, are as follows:

1. Total area of West Java: 3,705,867 hectares
2. Wet season rice crop area: 598,750 hectares
3. Percentage of rice crop area: 16.2%

The estimation results derived from INAHOR exhibit significant variance in the southern region of West Java, encompassing areas such as Sukabumi, Cianjur, Garut, and Tasikmalaya. This discrepancy can be attributed to the following factors:

1. INAHOR computes the rice paddy area by interpreting two cultivation cycles on the same paddy field within a single season as constituting one cultivation cycle.
2. The differentiation between intensive rice cultivation in lowland areas and terraced rice cultivation presents considerable challenges when utilizing INAHOR satellite imagery.

Characteristics of INAHOR that should be known:

1. INAHOR is conducted in spatial resolution units measuring 25 meters by 25 meters.
2. It is essential to ascertain that the condition of the paddy fields appears to be accurately delineated.
3. Upon closer examination, it becomes evident that the boundaries are not precisely defined.
4. There exists a margin of error, as the area is estimated by evaluating each plot. Infrastructure such as roads, buildings, and other facilities adjacent to the farmland may be inaccurately included in the farmland assessment. Additionally, features such as ridges, waterways, and trees are also considered in the farmland evaluation. Consequently, it is imperative to factor in the proportion of these elements in the INAHOR estimation outcomes.

Participants of the workshop were provided with the code INAHOR, which was subsequently accessed through GEE by AFSIS. This application enables users to specify the desired number of samples to be extracted from various land uses and covers, utilizing the ESA WorldCover dataset (10m v200 in 2021) at locations of their choosing within ASEAN countries.

To access INAHOR software, participants must possess a GEE account, preferably created using Google Chrome. The subsequent steps to access INAHOR within GEE are as follows:

1. Step 1: Establish the observation period.
2. Step 2: Define the administrative boundaries.
3. Step 3: Identify the training data.
4. Step 4: Adjust the resolution of the output map.
5. Step 5: Download the resulting data.

The workshop was conducted by instructors from RESTEC, with assistance provided by instructors from the AFSIS Secretariat.

The methodology employed during the workshop incorporated a blend of presentations, interactive discussions, and hands-on practical sessions. Participants were encouraged to actively engage and implement the skills acquired during the half-day session focused on the material. The subsequent session featured data processing practice utilizing datasets prepared by the instructional team. The data used in this workshop originated from the West Java region, which was subsequently clipped into smaller segments to restrict the scope of the processed data area, thereby facilitating more efficient data processing.

Participation in the workshop titled "Promote Rice Planted Area and Production Estimation Using Space-Based Technologies in Indonesia," organized within the framework of the AFSIS SAFER - JAXA ALOS - APRSAF collaborative project, demonstrated notable and enthusiastic engagement throughout the series of activities. The involvement of participants was evident not only through their consistent and timely attendance but also through their active participation in each training session, particularly during the presentations and in the question-and-answer segments. All workshop attendees engaged directly in the practical application of the INAHOR software via GEE and QGIS. Additionally, participants were afforded the opportunity to consult with the resource personnel regarding any challenges encountered during hands-on activities, ranging from the setup of GEE accounts to the stages involved in creating training data for rice paddy estimation using INAHOR.

During the discussion session, participants were actively engaged by posing questions to the speakers. One participant inquired about the methods for determining the optimal number of samples within the INAHOR software, particularly to ensure valid data representation in regions characterized by complex geospatial features in Indonesia. Additionally, some participants suggested that future iterations of INAHOR could evolve into software capable of not only classifying rice and non-rice land but also identifying the growth phases of rice plants, including the vegetative, generative, and fallow phases. This enhancement would render the estimation results more precise and significantly more beneficial for subsequent analyses.

C. Post-Workshop

This phase involves activities related to the evaluation and preparation of activity reports. It is conducted during a meeting at the CADIS, where the overall results of the workshop activities are assessed. This assessment encompasses the preparation, implementation, and evaluation of the workshop's outcomes. Additionally, this stage is carried out simultaneously with the preparation of the activity report.

Following the conclusion of each final session, an evaluation of the participants was conducted, focusing on the instructional materials and the overall organization of the workshop. The insightful feedback from participants:

1. Using Space-based Technology

   The majority of participants possess experience in utilizing space-based technology, particularly for the creation of polygons and the mapping of agricultural land dedicated to the cultivation of rice, corn, and sugarcane. The Ministry of Agriculture in Indonesia employs Landsat 8 and Sentinel 1 imagery to assess the growth stages of rice crops.

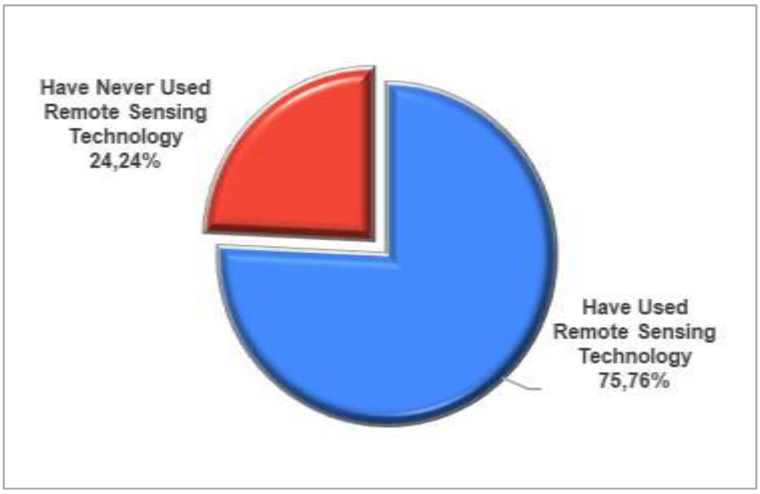

Figure 1. Use of Remote Sensing Technology

2. Understanding the Materials

   The materials provided to participants were generally comprehensible. They acquired knowledge regarding the characteristics of INAHOR, the necessary preparations before its utilization, as well as the processes of data training, operation, and result analysis associated with INAHOR. The majority were able to follow the materials effectively with guidance from the expert.

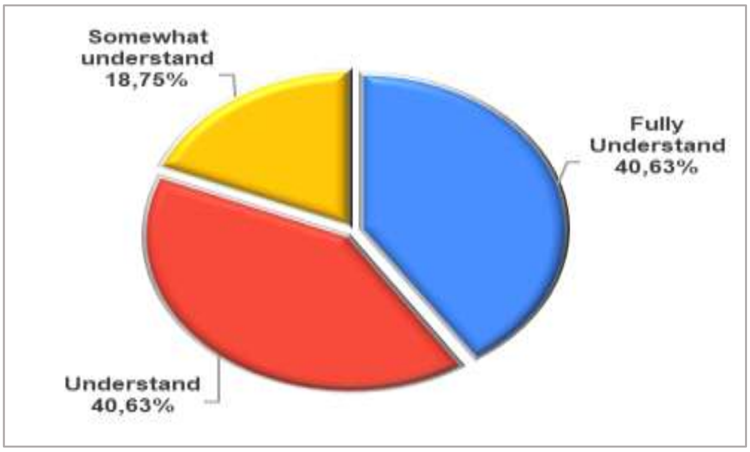

Figure 2. Comprehension of Material

3. Workshop Evaluation

The workshop was effectively organized and was met with significant enthusiasm from the participants. They expressed a recommendation for the workshop to be extended in duration, as the material presented is quite comprehensive, necessitating field visits to accurately assess the various types of plants.

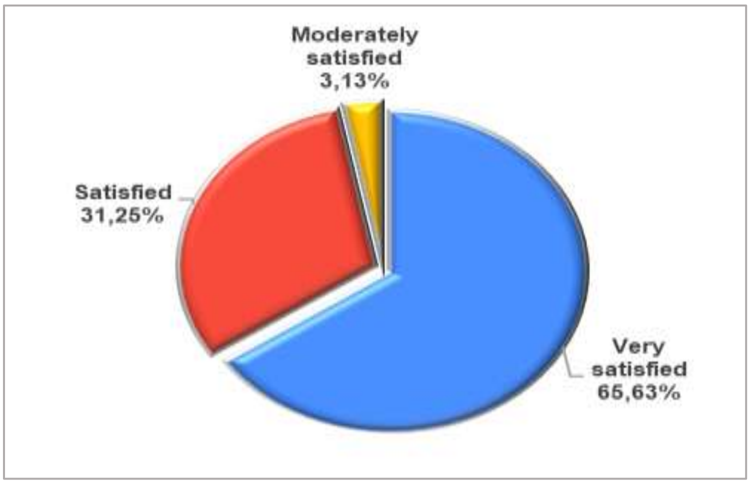

Figure 3. Evaluation of Workshop Implementation

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4 Achievements and Outcomes

A. Key Learning Outcomes and Skills Acquired by Participants

- ❖ Participants will gain a comprehensive understanding of the fundamental concepts and objectives associated with INAHOR.
- ❖ Participants will become proficient in the methodology employed by INAHOR for analysing the geographic distribution of rice cultivation and for estimating rice production levels.

B. Significant Achievements and Milestones Attained

The Ministry of Agriculture currently prioritizes a program aimed at achieving food self-sufficiency by expanding rice cultivation. This expansion encompasses both traditional rice fields and non-traditional areas, including dry land and plantation land. INAHOR can be utilized to assess the effectiveness of the ministry's program. The output from INAHOR is essential for planning, evaluating, and setting monthly planting targets.

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5 Issues, Challenges, and Lessons Learned

A. Issues and Challenges

Several issues emerged during the activity, including:

- ❖ Google Maps has not undergone recent updates, leading to discrepancies between its interpretations and the actual conditions on the ground. For instance, regions that are depicted as rice fields are, in reality, cultivated with alternative crops such as shallots, chili peppers, or various other vegetables.
- ❖ INAHOR is unable to compute the monthly planting area, as it takes into account only a single planting season.
- ❖ INAHOR is unable to produce a map indicating the distribution of rice planting phases, as it is limited to identifying whether the land is utilized for rice cultivation or non-rice crops.
- ❖ The procedural steps necessary to ascertain whether a parcel of land is cultivated with rice or non-rice crops utilizing the INAHOR application entail a lengthy and intricate process, particularly for individuals who are new to the application.
- ❖ The classification and delineation of rice and non-rice cropland exhibit a considerable level of subjectivity, necessitating a substantial degree of experience in this area.

During the activity, several challenges were encountered:

- ❖ It is important to note that INAHOR possesses the capability to estimate and evaluate the planted area every month, extending beyond the growing season and surpassing traditional estimation methods.
- ❖ Additionally, INAHOR can produce harvest distribution maps, which encompass more than merely rice plantings.
- ❖ Furthermore, INAHOR is equipped to generate maps illustrating various growth phases of rice.
- ❖ Training data must be properly verified to ensure its accuracy.

B. Lessons Learned and Suggestions for Improvement

- ❖ It is essential to utilize the most recent version of Google Maps to enhance the accuracy of identifying the types of commodities cultivated within the field.

- To enhance the precision of INAHOR results, it is imperative to conduct verification in the field.
- The INAHOR application should take into account the utilization of training data derived from field observations, including geotagging (point) data that encompasses attributes related to commodity types. This approach would enhance the quality of the training data utilized in INAHOR.
- Indonesia has developed a mapping application known as the System for Mapping of Paddy Fields (SIMOTANDI), which is specifically based on standard rice field criteria. However, this application has limitations, as it does not cover rice cultivation that occurs outside of the designated standard rice fields. To address this gap, the INAHOR application can serve as a complementary tool to SIMOTANDI, facilitating the identification of rice cultivation areas beyond the scope of rice field area-based maps.
- The minimum number of samples required that should be taken as training data could be determined from INAHOR.

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6 Documentations

	
The workshop was officially inaugurated by Mrs. Intan Rahayu, Director of the Center for Agricultural Data and Information Systems.	Welcome Address By Mr. Yasuhiro Miyake, AFSIS Expert,
	
Opening Remarks By Dr. Kei Oyoshi, Senior Researcher, Earth Observation Research Center Japan Aerospace Exploration Agency (JAXA)	Overview of INAHOR By Mr. Shoji Kimura, International Consultant of AFSIS Secretariat
	
Dr. Pegah Hashemvand Khiabani, Remote Sensing Technology Center of Japan (RESTEC) Researcher	Remembrance Gift from AFSIS

Group Photo Session of The Promote Rice Planted Area and Production Estimation Using Space-based Technology in Indonesia

Group Photo Session Following the Workshop – Participants confidently present their workshop certificates

Remembrance Gift from The Republic Of Indonesia

The atmosphere of the workshop - Engaging interaction between participants and instructors

The workshop atmosphere – the participants actively engaged in hands-on practice

The atmosphere of the workshop - Active engagement between participants and instructors

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