

Summary report for the workshop
“Promote rice planted area estimation using space-based technology in Thailand”

at Meeting Room 3, Innovation Building, 3rd FL,

Office of Agricultural Economics (OAE)

21-22 October 2024

1. Introduction

ASEAN Security Information System (AFSIS) Secretariat has developed the implementation plan on the “Project for strengthening ASEAN Food Security Information System (AFSIS) Function for Emergency (SAFER)” over a period of three years, spanning from the first quarter of 2022 to 2025. The activities are consisted of 5 main activities as following:

- 1) To develop emergency information sharing mechanism
- 2) To increase target commodities handled by AFSIS
- 3) To monitor crop growing condition
- 4) To develop crop area estimation method using satellite image
- 5) To manage project implementation and conduct evaluation

As mention above, the Office of Agricultural Economics (OAE) and AFSIS realizes on the important of these activities especially developing crop area estimation method. Thus, the OAE, Ministry of Agriculture and Cooperatives (MOAC), represented by the director of Centre of Agricultural Information (CAI) have been signed the Letter of Agreement (LOA) between OAE and AFSIS Secretariat in 2024. The main objective of this agreement is to support several activities between Japan Aerospace Exploration Agency (JAXA), international consultants, and AFSIS Secretariat. To implement this activity, the AFSIS Secretariat allocated a budget 3,500 USD.

Under the AFSIS SAFER project/JAXA ALOS-2 (Advance Land Observing Satellite-2) Satellite Application/APRSAF SAFE Project, we are conducting the workshop in the topic of “Promote rice planted area estimation using space-based technology in Thailand”. The workshop aims to enhance knowledge and develop skilled personnel with a comprehensive understanding of the significance of accuracy and efficiency in collecting and analyzing rice planted area data based on satellite data. Participants will gain practical experience with the INAHOR (INternational Asian Harvest mOnitoring system for Rice) software developed by JAXA, which leverages ALOS-2 to estimate rice planted areas. In principle, the ALOS-2 satellite data operates using L-band frequency Synthetic Aperture Radar (SAR) and have high capability to estimate spatio-temporal especially crop cultivated area. The advantage of SAR data its ability to penetrate cloud cover and capture image in day-time and night-time. Consequently. This workshop has been organized to disseminate knowledge and facilitate direct exchange with experts from JAXA and Remote Sensing Technology Center (RESTEC), and AFSIS International consultant.

2. Participants

The participants consist of CAI staff and Regional Office of Agricultural Economics (ROAE) 1-12 staff. The organizational structure of ROAE 1 -12 includes at least 1 photogrammetrist or person who directly involved in Geo-Informatics (GI). Due to, CAI by the Agricultural Geo-Informatics Division and ROAE hold main responsibility for interpreting economic crop cultivated area by using moderate satellite imagery.

The workshop accommodates 45 participants, with a gender ratio of 17 males to 28 females.

3. Activity

3.1 Data preparation

Before the workshop took place, the CAI discussed with AFSIS Secretariat to select Suphan Buri province for the pilot area. Suphan Buri is the main rice cultivated areas in the central region of Thailand, where most of the rice cultivated area benefit from irrigation system.

Consequently, the CAI, OAE prepared information for AFSIS Secretariat such as the overall of Suphan Buri province, topography data, weather data (e.g., average maximum/minimum temperature, rainfall, and rainy day), and main crop commodities and livestock over the past three years (2022-2024). However, the International Consultant of AFSIS Secretariat requested additional information on crop cultivated area and their extents to ensure confidence in preparing training data for INHAOR. The International Consultant of AFSIS Secretariat expressed concerns about the reported percentage of crop cultivated areas in the Dan Chang district and need more information to confirm rice cultivated area or not. In response, CAI expert provided additional land use information and maps sourced from the Land Development Department (2017) for the Dan Chang district as a reference.

3.2 Account checking and software installation

Since INAHOR is developed on the Google Earth Engine (GEE) platform, which is a cloud-based computing platform that allows users to process geospatial data on Google's infrastructure, it is essential to ensure that participants are prepared. INAHOR utilizes median filtering of ALOS-2 data and applies a machine learning approach (Random Forest) to classify and estimate rice crop areas for each specified administrative district. Thus, the training is necessary to verify Gmail account (<https://accounts.google.com/signin>) and GEE (GEE) account for participants prior to the workshop. Participants are encouraged to use their personal accounts for the training.

Participants are required to install both QGIS software (<https://www.qgis.org>) and Google Earth Pro software (https://www.google.com/intl/en_uk/earth/about/versions/) prior to using INAHOR on GEE. The QGIS is a freeware and user-friendly Geographic Information System (GIS) that run on Window, macOS, Linux, Android, and iOS. Thus, the staff from the Agricultural Geo-Informatics Division under CAI prepared to verify user accounts via both Gmail and GEE account and QGIS installation. This software is useful for creation of training data. For

example, the Google Earth Pro is used for creation of training data whilst the QGIS is used for conversion to shape file format.

3.3 Training agenda

Training instructors consist of experts from several agencies including JAXA researchers, RESTEC specialist, AFSIS International consultant. The workshop is divided into two main modules as follows.

3.1.1 Module 1: Introduction to INAHOR

The introduction to INAHOR is consisting of several topics.

- Introduction to AFSIS SAFER project (Mr. Yasuhiro Miyake, AFSIS expert). This section provides an overview of AFSIS activities and components. The objective is strengthening food security in the region through the systematic collection, analysis, and dissemination of food security related information. Meanwhile, the component of AFSIS activities is focusing on human resource development and information network development. Additionally, the categories of food security information from AFSIS activities in terms reports, 2) statistics database, 3) report on serious disaster, and 4) dashboard are demonstrated. Finally, activity and final achievement for each output under the SAFER project are clarified. Four outputs are outlined under the SAFER projects: 1) to develop emergency information sharing mechanism, 2) to increase target commodities handled by AFSIS, 3) to monitor crop growing condition, and 4) to introduce crop area estimation method using satellite image using INAHOR software.

- Introduction to Japanese Earth Observation Satellites, SAFE project, and Overview of INAHOR (Dr. Kei Oyoshi, Earth Observation Research Center, Japan Aerospace Exploration Agency (JAXA)). This section is briefly illustrated JAXA missions for space and aeronautical technologies and contributing to EO satellite by the Sendai framework demonstration. Initially, the concept of Asia-Pacific Regional Space Agency forum (APRSAF) is presented and the upcoming APRSAF-30 which will be held in the November 2024 in Perth, Australia. The SAFE project is focusing 3 topics (responsible agencies): agromet project (Indian Space Research Organization (ISRO), India), rice crop monitoring project (GISTDA, Thailand), and CH₄ rice project (Vietnam National Space Center (VNSC), Vietnam). The important on rice crop monitoring from space are described. The lecturer illustrates the relationship between rice phenology and SAR imagery including an overview of INAHOR algorithm. Finally, the example of validation result from Lao PDR and Cambodia are demonstrated and cross-verified using the reference INAHOR maps and corresponding values.

- Overview of INAHOR estimation results for the 2024 rainy season rice planted area in Suphan Buri province (Mr. Shoji Kimura, International Consultant of AFSIS Secretariat). This section highlights the comparison of INAHOR results with official OAE data from 2023 including the percentage of rice cultivated area at the district level. The findings include the map validation sheet in district level and outputs of the whole district area, 2024 wet season rice cultivated area, and rate of rice cultivated (%). The results seem to distinguish paddy fields and other land use (e.g., aquaculture facilities). However, the result proves some recession rice fields around Krasiao Dam in the Dan Chang district. The output of INAHOR judgement is based on spatial resolution of ALOS-2; thus, the spatial resolution

is 25 metre x 25 metre. Thus, the outputs appear as grid squares and may not be absolutely accurate. The limitation of INAHOR should be concerned on the determining ratio of ridges, waterway, and tree for actual rice cultivated area.

- Preparing training data on Google pictures (Mr. Shoji Kimura, International Consultant of AFSIS Secretariat). This section provides guidance on creating training data for excellent judgement of rice cultivation using ALOS-2 satellite images. The accuracy of INAHOR heavily depends on the interpreter's knowledge and experience. For example, user should interpret what is appearance of paddy, upland field, or orchard? The characteristics of paddy rice fields are shown in the high-resolution satellite image with cultivating condition in the target season. The excellent characteristics of paddy rice fields for picture judgement are clarified. The surrounding/buffered areas of pin point is necessary and suggested to avoid in the unclear land use. As mention above, on spatial resolution of ALOS-2, the IHANOR makes judgement using a half - pixel (equally 12.5 metre for radius), which must be carefully considered during training data preparation.

- About the characteristics of INAHOR and its utilization (Mr. Shoji Kimura, International Consultant of AFSIS Secretariat). This explores the characteristics of INAHOR and its practical applications. The presentation highlights how INAHOR can be used to estimate rice cultivation areas and compares its estimated values with data provided by local offices responsible for agricultural reports at various administrative levels, such as commune, district, provincial, and national levels. Additionally, INAHOR's potential for estimating areas of other crops is discussed, emphasizing its applicability when users have prior knowledge of agricultural areas and conditions. This makes INAHOR a valuable tool for expanding agricultural monitoring capabilities beyond rice cultivation.

3.1.2 Module 2: INAHOR operation parts

This module is conducted by (Dr. Pegah Hashemvand Khiabani, Remote Sensing Technology Center of Japan) and consisting of several topics.

- INAHOR training data preparation guidance. The three-preparation step consist of preparation, training data collection, and INAHOR Operation. At present, the version of INAHOR is at the version 3.0 and released in August 2024, the revision detail is development of INAHOR GEE Apps with an updated GUI. There are two main technologies associated with the INAHOR system: ALOS-2 and INAHOR, which is hosted on the freely accessible cloud platform as Google Earth Engine.

- Checking/Export INAHOR output example/QGIS

The training data sampling system for INAHOR is accessible via the link (<https://ee-alos2geeapp.projects.earthengine.app/view/trainingdata-sampling-system-for-inahor>). There are 5 main steps:

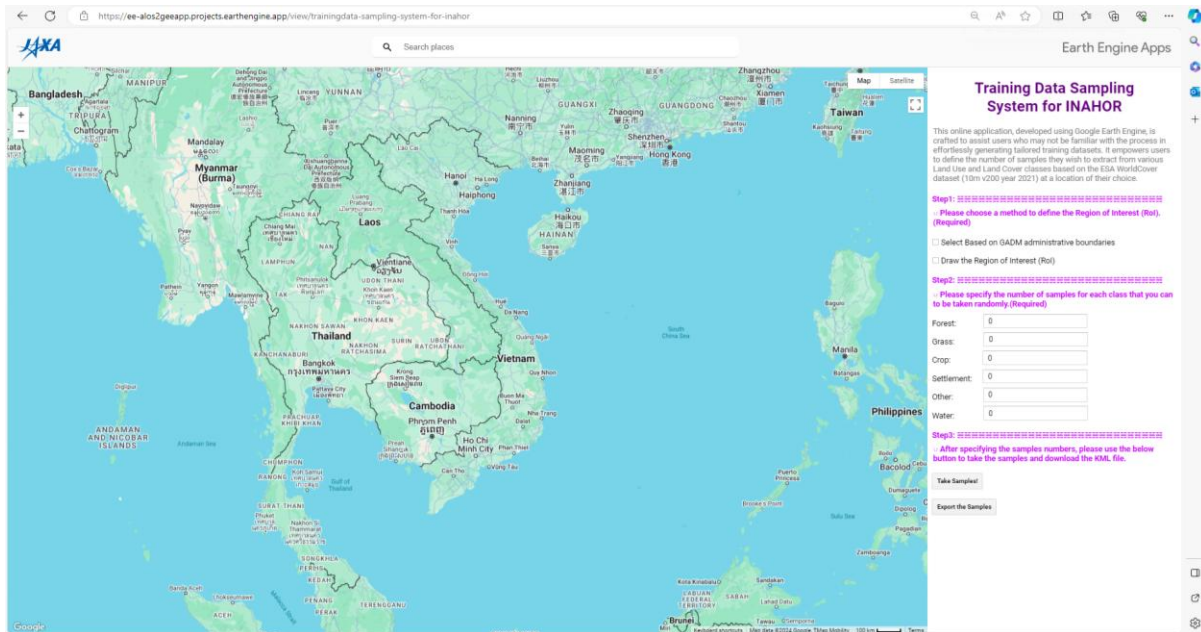
Step 1 Defining the Region of Interest (ROI)

Step 2 Specify the number of samples for each class e.g., forest, grass, crop, settlement, water, and other

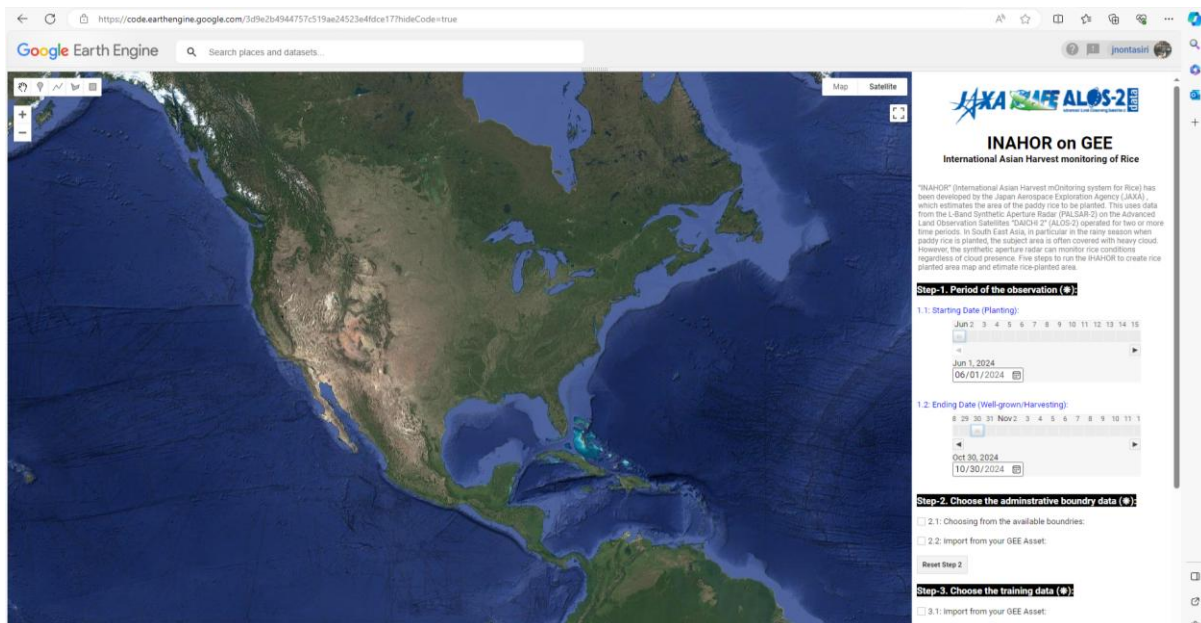
Step 3 Taking sample and export the samples

Step 4 Cleaning the samples via the Google Earth Pro and selected for both crop and non-crop. If samples are not clear, they were suggested to move to folder “Unclear”.

Step 5 Merging KMLs and save as shape file (.shp) format



To access the INA HOR interface, they are suggested to use own GEE account and entering to this website <https://code.earthengine.google.com/3d9e2b4944757c519ae24523e4fdce17?hideCode=true>. Then, the INA HOR analyzed the Thailand paddy rice period between June to October 2024. However, concerns were raised regarding the boundaries of the ALOS-2 satellite imagery used for the analysis, emphasizing the need for precise delineation to ensure accurate results.



The current version of INAHOR consist of several sections which are different functionality. The interface of INAHOR includes the following components:

1) A section related to adjusting the period of observation.

This function is necessary to specify the period of observation by assigning the starting and ending dates.

2) A section related to defining the Area of Interest (Administrative Boundaries)

This function requires the administrative boundaries to defined the Area of Interest for generating the statistical data of rice and non-rice area at the country and state level. Also, users are able to import the boundaries from your GEE asset (.shp).

3) A section related to defining the training data.

This function requires the definition of training data, which are 3 methods available – 1) import from your GEE Asset, 2) Choosing from the available datasets, and 3) preparing the training data on the GUI. However, method 2 and 3 are currently under development. The training data has 2 values: 1 for rice and 0 for non-rice samples.

4) A section related to adjusting the resolution of the output map.

This section is optionally allowing users to modify the details of the output result map by specifying the scale of the rice map (metre unit) and inputting a numerical value. The smallest spatial resolution is 25 metres. Besides, the Coordinate Reference System (CRS) is predefined for the rice map as EPSG: 4326.

5) A section related to running and downloading results

This section facilitates the execution of the analysis and the subsequent downloading of the results. Once the process is complete, the rice map is generated and made available for download in the specified format.

4. Outcomes and achievements

4.1 CAI staff and Regional Office of Agricultural Economics (ROAE) staff are acquiring the skills to operate the INAHOR using satellite images (ALOS-2 data) to estimate rice cultivated area in Suphan Buri province.

4.2 Expected outputs are that, upon completing the training, each trainee will be able to prepare training data for the INAHOR, and estimate rice cultivated area and create rice map by using INAHOR software efficiently.

4.3 Expect outcome is that trainees will be able to adopt the satellite-based technological tools to utilize in agricultural statistics within the National statistics system.

5. Challenges and lessons learned

5.1 Challenges

1) The staff face limitations in coding skills, which restrict their ability to fully utilize Google Earth Engine (GEE) for script editing and customization.

2) The data is constrained by the availability of satellite imagery, which does not comprehensively cover certain areas and periods. This limitation hampers the effective use of the platform in carrying out missions.

3) Satellite image interpretation for rice cultivation area classification requires specialized knowledge, expertise in image analysis, and an understanding of overall land use in the study area to ensure accurate image interpretation.

5.2 Lesson learned

1) The staff learned how to use the INAHOR platform and classify rice cultivated areas through a user-friendly GUI that is straightforward and does not require extensive specialized expertise.

2) The data analyzed using the INAHOR platform is processed quickly. Although there are challenges with clearly defining plot boundaries, the platform provides an overall perspective of land use.

3) The staff gained knowledge of the principles for creating accurate and appropriate training datasets to enhance the model's ability to classify rice cultivated areas effectively.

6. Supporting documents

6.1 An official letter approved from the OAE secretary General for the workshop is included as Appendix A.

6.2 A photo gallery of the workshop is provided as Appendix B.

6.3 All participants registered during the workshop, with the registration forms organized by date and further categorized into trainers and trainees, are included as Appendix C.

6.4 Feedback collected from participants by CAI is summarized and presented as Appendix D.

6.5 The results of the INAHOR software application in Suphan Buri and Ang Thong province are detailed in Appendix E.