

The Republic of the Union of Myanmar
Ministry of Agriculture, Livestock and Irrigation
Settlement and Land Records Department



**Completion Report on the Training and Workshop for Analyzing Rice
Cultivation Areas Using INAHOR Software**

July, 2025

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Summary Report for the workshop
“Promote rice planted area estimation using space-based technology in Myanmar” at Training
Room, Mekong-Lancang Crop Yield Assessment Centre, Pyinmana District Land Records
Office
Settlement and Land Records Department (SLRD)
23-24 June 2025

1. Introduction

ASEAN Food Security Information System (AFSIS) Secretariat has developed the implementation plan on the “Project for Strengthening ASEAN Food Security Information System 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:

- (i) to develop emergency information sharing mechanism
- (ii) to increase target commodities handled by AFSIS
- (iii) to monitor crop growing condition
- (iv) to develop crop area estimation method using satellite image
- (v) to manage project implementation and conduct evaluation.

The training program on rice cultivation area estimation using the INAHOR (INternational Asian Harvest mOnitoring and Reporting) software was organized with the objective of strengthening technical skills in the use of satellite-based tools for agricultural monitoring. INAHOR, developed by Japan Aerospace Exploration Agency (JAXA), enables the estimation of paddy rice cultivation areas by utilizing satellite imagery and remote sensing techniques.

This training aimed to build the capacity of participants in key areas such as satellite data interpretation, land classification using machine learning algorithms, and the integration of ground truth data to improve estimation accuracy. Hands-on sessions were also conducted to familiarize participants with the INAHOR software interface and workflow.

The training served as an important step toward enhancing data-driven agricultural decision-making and improving national capabilities in crop monitoring.

2. Participants

There were 35 participants from the Head Office of SLRD, the Central Land Records Development Training Center (CLRDTTC), and the Region and State Offices of SLRD. The Settlement and Land Records Department is organized with branch offices at the Region/State level. Through these branches, district offices, township offices, and village tract levels are structured, where land record clerks operate. Agricultural crop data is collected starting from land record surveyors at the village-level, and is gradually reviewed and submitted through each administrative level. Therefore, only staff members who have a basic knowledge of GIS and are already practically

engaged in land surveying and map drafting in the Regions and States are given priority for selection.

Since extensive computer knowledge and practical field experience are required, only male staff members are involved. In our department, office work and fieldwork are clearly separated. Fieldwork involves traveling to remote forested and mountainous areas for surveying and data collection, and therefore, only male staff members are assigned to these duties. The workshop accommodates 35 participants in only male staff (100%).

3. Activity

3.1 Data Preparation

Before the workshop took place, the statistical division of SLRD reported to senior officials to select Yamaethein District, Mandalay Region, for the pilot area. The Yamaethein District area consists of paddy fields located within the Mandalay Region, where crops are cultivated year-round during summer, monsoon, and winter seasons with sufficient irrigation provided by a dam water supply system. The cultivation systems are also well-organized and systematic, making field inspections convenient and straight forward.

It is also convenient to study field maps, area calculations, and paddy cultivation, as the training facility is located only about 10 kilometers away. Data related to cultivation, harvesting, and yield rates can also be easily obtained, as the training center and the Nay Pyi Taw Regional Office are located close to each other.

3.2 Account checking and software installation

Although the scheduled workshop date is 23-24 June 2025, 35 participants are attending the workshop starting from 21 June 2025 for the preparation of account checking and software installation. In two days, as of 21-22 June 2025, before the scheduled workshop date, participants from relevant states and regions have already prepared the following preparatory tasks:

1. Google Account Preparation

All attendees must have a working Gmail account for professional use.

2. Google Earth Engine Pre-Workshop Setup:

Train participants on basic account login and essential functions beforehand.

Provide a short pre-training session if necessary.

3. Shapefile Preparation:

Prepare the Shapefile of the selected study area to be used in the training.

4. Data Access Instructions:

Guide participants on how to retrieve necessary data from INAHOR Software in advance.

Explain the types of data required and methods for downloading them. Ensure registration for Google Earth Engine (<https://earthengine.google.com/>).

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 area for each specified administrative district. Thus, the training is necessary to verify the Gmail account (<http://account.google.com/signin>) and GEE account for participants prior to the workshop. Participants are encouraged to use their personal accounts for the training.

Participants are required to install QGIS software (http://www.google.com/intl/en_uk/earth/about/versions/) prior to using INAHOR on GEE. QGIS is a freeware and user-friendly Geographic Information System (GIS) that runs on Windows, macOS, Linux, Android, and iOS. Thus, the staff from the Surveying and Mapping division under SLRD prepared to verify user accounts via both Gmail and GEE accounts and QGIS installation. This software is useful for the creation of training data. For example, Google Earth Pro is used for the creation of training data whilst QGIS used for conversion to the shapefile format.

3.3 Training agenda

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

3.3.1 Module 1: Introduction to INAHOR

The introduction to INAHOR consists of several topics.

- Introduction to Workshop guidance and the AFSIS SAFER project (Mr. Yasuhiro Miyake, AFSIS expert).

This section provides an outline of the SAFER project, progress and future plans on Output 4, and challenges of INAHOR activities. In the SAFER Project, there are four main expected outputs, namely 1) to develop an emergency information sharing mechanism, 2) to increase target commodities handled by AFSIS, 3) to monitor crop growing condition, and 4) to introduce a crop area estimation method using satellite images using INAHOR software. In output (1), the background of this output is with the cooperation from ASEAN member states; AFSIS has been providing information related to serious disasters since August 2020. The activities are to standardize procedure and contents for sharing emergency information, the method in AFSIS and availability of information in member countries were reviewed. The final achievements of output (1) are that a new systematic mechanism will be developed with a guideline, including a new reporting form created by AFSIS, and the information and data will be shared on the AFSIS website promptly. In output (2), the background of this output is that in 2003, the number of commodities included in the database was five. And then, the member countries request to expand the range of commodities tracked in the

database. So that the activity is decided to include the eggs from laying hens as a new commodity. The final achievements are to produce the information data, such as the number of laying hen, egg production, farmgate and whole saleprice, egg production cost, and balance sheet of eggs, which are published in ACO and EWI reports. The brief of output (3) is about the RGO and MGO reporting. The final achievement, the Maize Growing Outlook report, is expected to be published in July 2025. In output (4), the main target is to introduce a crop area estimation method using satellite images using INAHOR software. In-country activities, such as workshops and field surveys, are planned to be conducted in six target countries during 2022-2025. In 2023, Lao PDR and Cambodia are implemented, and the workshops in Thailand and Vietnam are implemented in 2024. In 2025, Indonesia and Myanmar are planned to conduct this workshop. In November 2025, the project will be ended. Finally, challenges of INAHOR activities for each output, outcome, and expected goal under the SAFER project are clarified.

- Introduction to Japanese Earth Observation Satellite, SAFE project, and Overview of INAHOR (Dr. Kei Oyoshi, Earth Observation Research Centre, Japan Aerospace Exploration Agency (JAXA)).

This section briefly illustrates JAXA missions for space and aeronautical technologies and contributing to EO satellites by the Sendai Framework demonstration. Earth observation satellites are utilized for various purposes, particularly in monitoring land surface conditions, soil moisture, land temperature, rainfall, vegetation indices, and estimating crop cultivation areas, among other parameters. The importance of rice crop monitoring from space is described. The lecturer illustrates the relationship between rice phenology and SAR imagery, including an overview of the INAHOR algorithm. And then, rice crop monitoring from space, such as INAHOR software using ALOS-2 satellite data is explained, and the main two key technologies, ALOS-2 and Google Earth Engine (GEE), are clarified. Finally, the example of validation results from Pyinmana District (Formerly named Yamethin) (Myanmar) in 2024, the rainy season, is 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 Pyin mana (Former Name Yamethin) District, Nay Pyi Taw territory (Mr. Shoji Kimura, AFSIS expert).

This section highlights the comparison of INAHOR results with official SLRD data from the 2024 rainy season rice cultivation area, including the percentage of rice cultivated area at district level, The findings include the map validation sheet at the district level and the outputs of the whole district area are 933,626 hectares, the 2024 wet season rice cultivated area is 164,895 hectare, and the rate of rice cultivated is 17.7%. The results seem to distinguish paddy fields and other land use (e.g., aquaculture facilities). However, the results prove that it is clearly divided into paddy fields and

other land uses, and it can be distinguished between upland fields and rice paddy fields. But it is necessary to pay attention to recession rice in the late rainy season and in the dry season. The output of INAHOR judgment is based on the spatial resolution of ALOS-2; thus, the spatial resolution is 25 meters x 25 meters. Thus, the output appears as grid squares and may not be absolutely accurate. The limitation of INAHOR should be concerned with the determining ratio of ridges, waterways, and trees for actual rice cultivated area.

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 township, district, state, and region to 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.

3.3.2 Module 2: INAHOR operation parts

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

- INAHOR Demonstration and Overview of the Training (Dr. Pegah Hashemvand Khiabani, Remote Sensing Technology Center of Japan (RESTEC) Researcher)

In this section, the three-preparation steps consist of preparation, training data collection, and INAHOR operation. At present, the version of INAHOR is version 4.0 and was released in December 2024. The version detail is the 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.

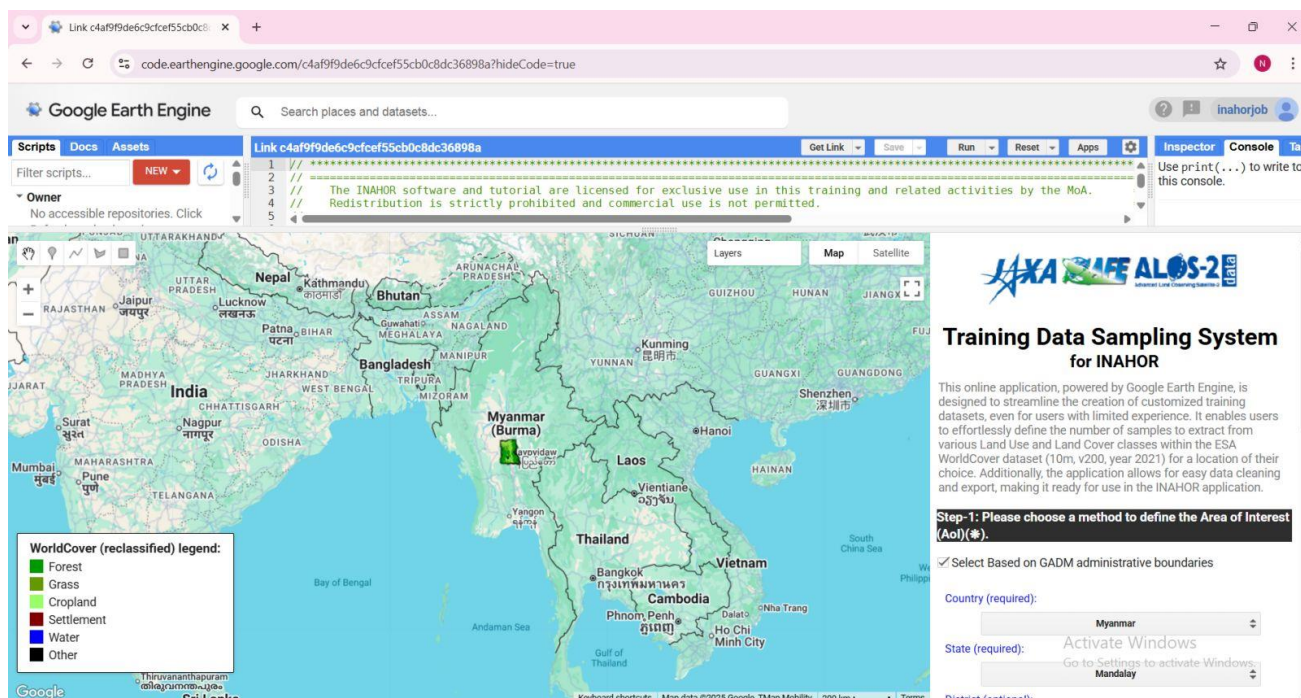
This section provides guidance on creating training data for excellent judgment of rice cultivation using ALOS-2 satellite images. The accuracy of INAHOR heavily depends on the interpreter's knowledge and experience. For example, how should a user interpret the appearance of a paddy, upland field, or orchard? The characteristics of paddy rice fields are shown in the high-resolution satellite image with cultivating conditions in the target season. The excellent characteristics of paddy rice fields for picture judgment are clarified. The surrounding/buffered areas of the input point are necessary and suggested to avoid unclear land use. As mentioned above, on spatial resolution of ALOS-2, the INAHOR make judgments using a half-pixel (equal to 12.5 meters for the radius), which must be carefully considered during training data preparation.

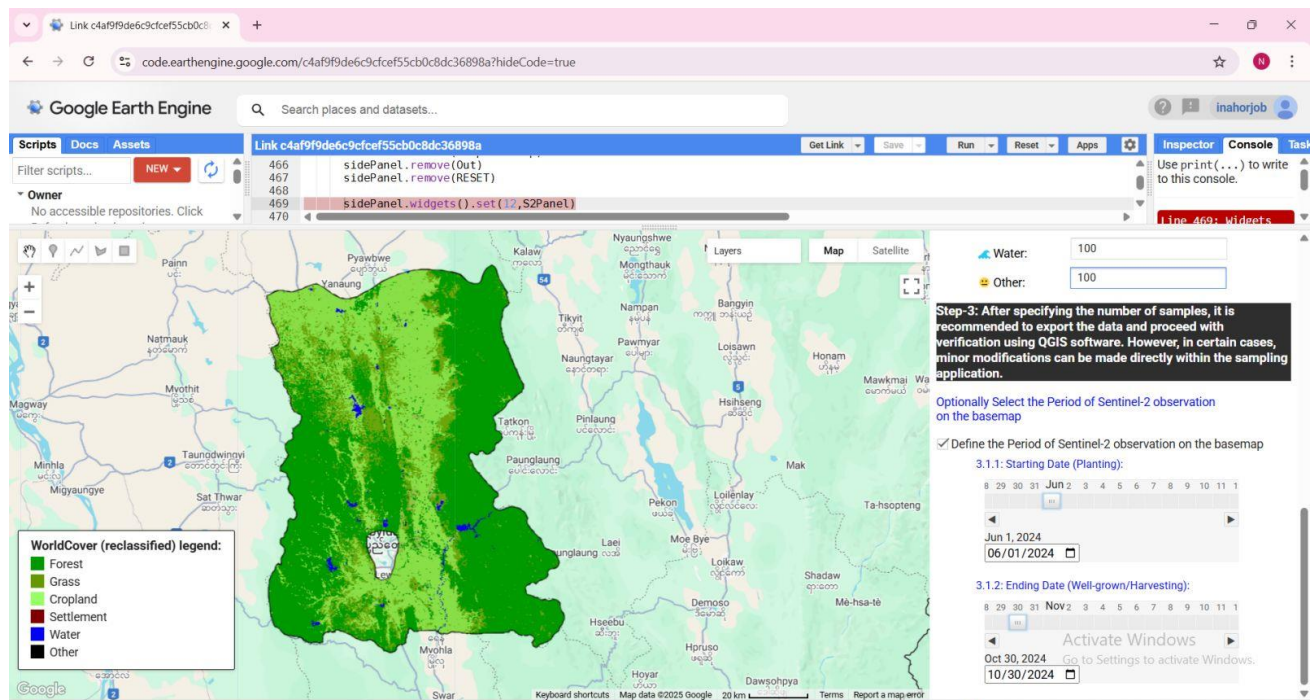
Checking / Exporting INAHOR output example / QGIS

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

- Step 1** Defining the Region of Interest (ROI). For example, Pyinmana District (Former Name is Yamethin District)
- Step 2** Specify the number of samples for each class, e.g., forest, grass, crop, settlement, water, and other.
- Step 3** Take sample and export the samples.
- Step 4** Cleaning the samples via Google Earth Pro and selecting for both crop and non-crop. If samples are not clear, they are suggested to move to the folder “Unclear.”
- Step 5** Merge KMLs and save as shape file (.shp) format.

To access the INAHOR interface, they are suggested to use their own GEE account and enter to this website <https://code.earthengine.google.com/c4af9f9de6c9cfcef55cb0c8dc36898a?hideCode=true>. Then, the INAHOR analyzed the Yamethin District paddy rice period between June and 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 consists of several sections that have 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 define the area of interest for generating the statistical data of rice and non-rice 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, for which there three methods available. 1) import from your GEE asset, 2) choose from the available datasets, and 3) prepare the training data on the GUI. However, methods 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 (meter unit) and inputting a numerical value. The smallest spatial resolution is 25 meters. Besides, the Coordinate Reference System (CRS) is predefined for the rice map as EPSG:4326 –WGS 84 (2185938N, 195820E).

- 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

The Head Office and State and Region staffs are acquiring the skills to operate the INAHOR using satellite images (ALOS-2 data) to estimate the rice cultivated area in Pinyinmana District (Formerly named Yamethin).

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

The expected outcome is that trainees will be able to adopt the satellite-based technological tools to utilize in agricultural statistics within the National Statistical System (NSS).

5. Challenges and Lessons Learned

5.1 Challenges

- 1) Boundary data downloaded from Google Maps does not accurately reflect actual field conditions.
- 2) The Artificial Intelligence (AI) system directly estimates paddy and non-paddy areas using point-based predictions, leading to unreliable results.
- 3) Areas with thick vegetation (trees and shrubs) are incorrectly classified by the AI's color-based detection system, causing location mismatches.
- 4) Since the AI system relies on color differentiation, which can misclassify non-paddy areas (e.g., sandbars, waterlogged islands) as paddy fields if they share similar hues.(Example: The Ayeyarwady River's floating islands are falsely identified as cultivated paddy areas.)
- 5) Although the system claims to use Stratified Random Sampling (SRS), there is no clear documentation or demonstration of the sampling process. Instead, pre-coded AI-generated sample files are used without validation.
- 6) Discrepancies in sample size or sampling area selection can lead to significant variations in paddy field estimates.
- 7) The boundaries provided by INAHOR Software do not match Myanmar's current administrative boundaries, making it difficult to compare paddy field area estimates generated by INAHOR with official government data.

5.2 Lesson Learned

- 1) Participants gained a clear understanding of the INAHOR software and its practical application.
- 2) Practical experience was obtained in processing satellite imagery and conducting area estimations.
- 3) Awareness was raised on the importance of integrating ground truth data to enhance model accuracy.
- 4) Collaborative knowledge exchange was facilitated among participants from different regions.

6. Documents for supporting

- 1) An official letter approved from the Head Office of SLRD for the workshop is included as Appendix A.
- 2) A photo gallery of the workshop is provided as Appendix B.
- 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.
- 4) Feedback collected from participants by SLRD is summarized and presented as Appendix D.
- 5) The results of the INAHOR software application in Pyinmana District (Formerly named Yamethin) are detailed in Appendix E.

A photo record of the opening remarks delivered by Director General Dr. Win Htut and AFSIS Manager Dr. Sumanya Ngandee at the training and workshop on studying and analyzing rice cultivation areas using INAHOR Software.



A documentary photo of the training and workshop being conducted on studying and analyzing rice cultivation areas using INAHOR Software.



A documentary photo of the training and workshop being conducted on studying and analyzing rice cultivation areas using INAHOR Software.



A documentary photo of the training and workshop being conducted on studying and analyzing rice cultivation areas using INAHOR Software.



Findings from Post-Workshop Individual Survey Questionnaire Analysis

Based on the results of the survey questionnaire, 94.28% of the trainees had prior experience in statistical or data-related work. However, 77.4% of them had not previously heard about the workflow of the INAHOR software covered in this training. On the other hand, 88.57% of the trainees had experience using satellite-based technologies, particularly in mapping and land surveying tasks with QGIS and Geomedia software.

Regarding the subjects and technologies taught in the training, 48.57% of the trainees reported that they were able to learn without difficulty, while 40% indicated that they could grasp the content with some effort. Only 11.43% expressed that they found the training somewhat difficult.

About 40% of the trainees agreed that the course duration and the schedule were appropriate and well-balanced. Furthermore, 45.71% of the trainees stated that the instructors' teaching methods were easy to understand and the instruction was clear and accessible.

More than half of the participants (51.43%) reported that the software introduced in the training is highly useful. Overall, the training was considered highly beneficial, as 42.85% of the trainees expressed positive feedback in their evaluations.

We would like to express our sincere gratitude to the experts from Japan and Thailand for their valuable technical support and assistance throughout the training program.

Feedback from Participants Attending the INAHOR Software Training and Workshop

1. Mr. Thein Min (Statistics Division)

It was an excellent training. Comparing field survey data with INAHOR Software records would be very beneficial.

2. Mr. Kyi Min Thant (Statistics Division)

This training will be very helpful for crop statistical data management.

3. Mr. Kyaw Swar Hein (Statistics Division)

This is an excellent training with comprehensive learning materials.

4. Mr. Zaw Min Tun (Survey & Mapping Division)

This training is closely tied to mapping techniques and area-based methodologies. However, the field boundaries used in the exercises do not match official records. It would be significantly more effective if calculations and presentations could align with the field boundaries published by the department.

5. Mr. Ko Ko Aung Myo Nyunt (Survey & Mapping Division)

In the Sample Frame generated by INAHOR Software, the number of sampling points appears insufficient. The Sampling Method should be clearly documented. Additionally, since the data displays rice acreage for other regions, there may be significant discrepancies in some areas.

6. Mr. Nyein Chan Htay (Survey & Mapping Division)

The Sample Frame generated by INAHOR Software shows minor discrepancies in recording paddy acreage locations. Since the system identifies crops based on rice plant color, areas with similar coloration are frequently misclassified. For example, riverine islands (alluvial deposits) are often marked as rice fields even when other crops are cultivated there.

7. Mr. Sa Myo Zaw (CLRDTTC)

The software is highly useful for estimating rice cultivation areas. However, I find the training period to be excessively brief. The program should incorporate hands-on practice with sample areas, including detailed analysis of paddy field acreage.

8. Mr. Ye Htet (CLRDTTC)

While INAHOR Software demonstrates clear operational workflows, we've observed geospatial mismatches between its output maps and our local reference maps, showing slight positional inaccuracies.

9. Mr. Si Thu Hlaing (CLRDTTC)

The software demonstrates strong potential for application beyond paddy field analysis to include other crop types. Its design and functionality are outstanding.

10. Mr. Ye Lin Naing (Nay Pyi Taw)

The software proves extremely valuable for analyzing paddy field acreage, though I believe the training period could benefit from being more extensive.

11. Mr. Kyaw Thi Ha (Nay Pyi Taw)

This is an excellent training program.

12. Mr. Kyaw Zin Win-1 (Kayah State)

Through its integration with GIS software, the training delivered extensive expertise in spatial analysis and related disciplines.

13. Mr. Aung Chit Htwe (Kayah State)

The training provided extensive and valuable knowledge.

14. Mr. Kyaw Zin Lin (Kayin State)

This is an excellent software, and its accuracy would be further enhanced with improved spatial precision.

15. Mr. Saw Thein Myint (Kayin State)

This is an excellent training program.

16. Mr. Myint Htay (Sagaing Region)

The training program is excellent, but the duration is too short.

17. Mr. Zaw Min Tun (Sagaing Region)

It would be significantly more effective if the area measurements from field survey maps matched those generated by INAHOR Software.

18. Mr. Aung Zin Myo (Bago Region)

The training would be more effective if conducted both online and in-person by expert instructors.

19. Mr. Myo Naing Htun (Bago Region)

This is an exceptionally well-designed training program that delivered substantial knowledge gains.

20. Mr. Kyaw Lin Thu (Bago Region)

This is an exceptionally outstanding training program.

21. Mr. Min Thant Htet (Magway Region)

This is an excellent training program.

22. Mr. Hein Htet Aung (Magway Region)

This is an excellent training program.

23. Mr. Nay Myo Zaw (Mandalay Region)

The training would be more effective if conducted both online and in-person by expert instructors.

24. Mr. Chit Ko Ko (Mandalay Region)

The training program is excellent, but the duration is too short.

25. Mr. Thaw Zin Tun (Mandalay Region)

The training program is excellent, but the duration is too short.

26. Mr. Kaung Soe Htet (Mon State)

This is an excellent training program.

27. Mr. Aye Min Ko

This is an exceptionally outstanding training program.

28. Mr. Kyaw Myint Oo

This is an exceptionally outstanding training program.

29. Mr. Paing Myo Oo

This is an exceptionally outstanding training program.

30. Mr. In Bwe Gansang

This is an exceptionally outstanding training program.

31. Mr. Ye Lin Aung

This is an exceptionally outstanding training program.

32. Mr. Khon Wai Kho

This is an exceptionally outstanding training program.

33. Mr. Hla Win

This is an exceptionally outstanding training program.

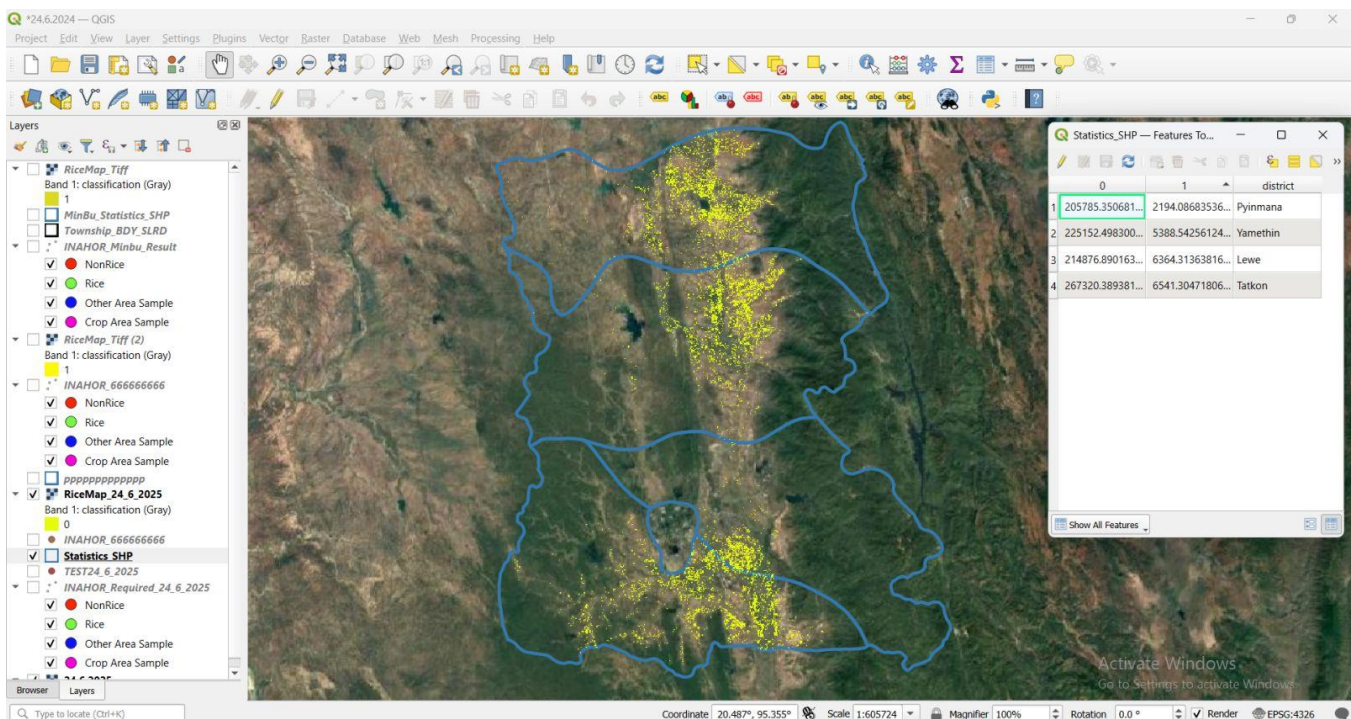
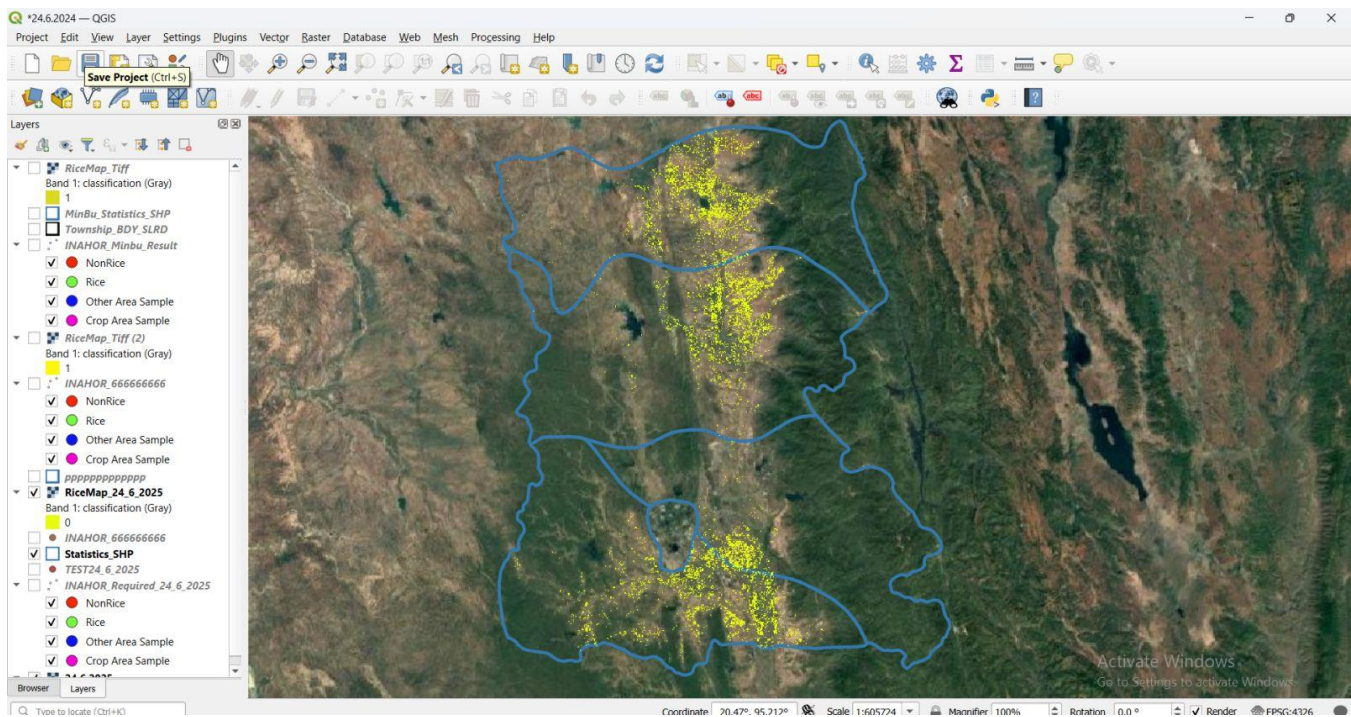
34. Mr. Kyaw Naing Oo

This is an exceptionally outstanding training program.

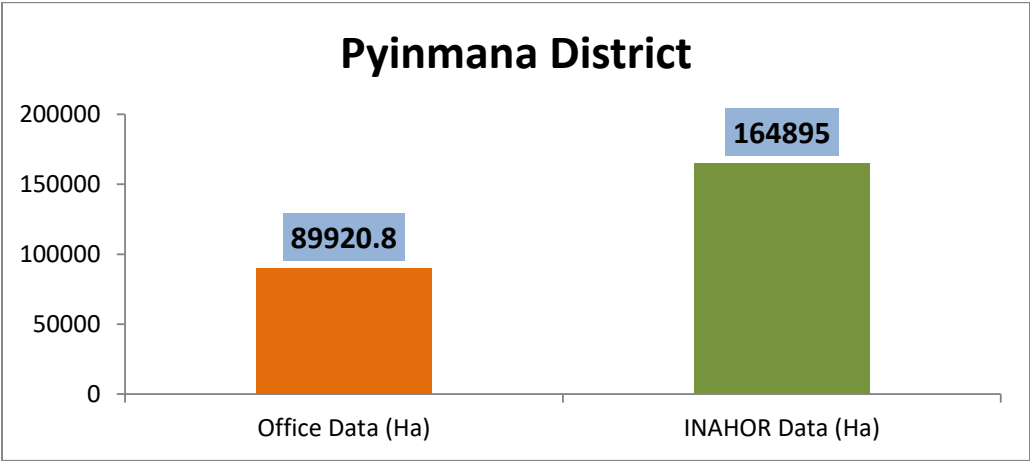
35. Mr. Maung Maung Soe

This is an exceptionally outstanding training program.

Comparison between Rice Cultivation Areas from INAHOR Software and Department Data



Comparison between Rice Cultivation Areas from INAHOR Software and Department Data



Rainy paddy planted Area (2024–2025)(Hectares)