The Final Report on the Project to Build Agro-climate Information Service System in Vanuatu - Phase III

July 2023

Overseeing Organization: APEC Climate Center

Implementation Organization: EPINET Co., Ltd.

Statement of Presentation

Dear the Executive Director of APEC Climate Center,

This document is hereby submitted as the final report on the project for "building agro-climate information service system in Vanuatu" (duration: September 01, 2022 - August 31, 2023).

July 2023

Overseeing organization: APEC Climate Center
Department/Person-in-charge: Department of Predictive technology/Jong An Jeon
Project implementation company: EPINET Co., Ltd.
Outsourced project leader: Yong Kyu Han, Representative Director of EPINET Co., Ltd.
Working-level leader: Sang Hyun Park, Project Manager of EPINET Co., Ltd.
Working-level person in charge of development: EPINET Co., Ltd. (Sang Hyun Park, Moonil Ahn, Sinae Park, and Gook Tae Kim)

Contents

Ⅰ Project Overview

1. General Information

A. Project Name: Building agro-climate information service system in Vanuatu - phase Ⅲ

B. Project Objective: To provide agro-climate information service to the Vanuatu Meteorology and Geohazards Department (VMGD) and Vanuatu Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity (MALFFB) to help them utilize and manage agricultural climate data

C. Overseeing organization: APEC Climate Center

D. Duration: September 01, 2022 - August 31, 2023 (12 Months)
[Contract number: 2022080C2E0]

E. Budget: KRW 164,900,000 (Incl. VAT)

F. Implementation organization: EPINET Co., Ltd.

2. Background and Objective

❍ Background

- The Climate Information Services for Resilient Development Planning in Vanuatu (hereinafter GCF-Vanuatu) project has been in implementation by two agencies, (Vanuatu Meteorology and Geohazards Department [VMGD)[1] and Secretariat of the Pacific Regional Environment Programme [SPREP][2]), and three cooperation organizations (APCC, Bureau of Meteorology[3], and Commonwealth Scientific and Industrial Research Organization[4]) since January 2018.
- The agro-climate information service in Vanuatu for stakeholders in the agricultural sector including farmers is a web/app-based decision-making support system that provides weather and climate information as well as various information applicable to agriculture.
- As an outsourced project, this system development has been in implementation in a total of 3 phases, and the first and second phases have been completed.

※ The 1st phase (2020, completed) → the 2nd phase (February 2022, completed) → the 3rd phase (the currently proposed project)

❍ Objective

- This is a 3rd phase project of the web-based agro-climate information service system to be operated by the VMGD and MALFFB to be able to provide to the public a national agro-climate information service. It improves already embedded functions and builds a service system for agro-climate information bulletin (Agromet bulletin) to support agricultural decision-making.

1) VMGD, Vanuatu Meteorology and Geohazards Department
2) SPREP, Secretariat of the Pacific Regional Environment Programme
3) BOM, Bureau of Meteorology
4) CSIRO, Commonwealth Scientific and Industrial Research Organization

3. Goals and Orientation

A. Goals

Goal	**To provide agro-climate information service that enables the VMGD and MALFFB to utilize and manage agricultural climate data**

Detailed Goals	○ **Agromet bulletin service** ○ **Decision-making recommendation service** ○ **Soil map service for Vanuatu** ○ **Upgrading the crop model-based agricultural decision-making service** ○ **Upgrading weather and climate service and agricultural index service** ○ **Upgrading web/app-based Crop Climate Diary**

B. Strategy

○ Implementation by incorporating experience and knowhow gained from the execution of prior projects

○ Implementation by assembling optimal specialists from each sector

○ Implementation by using the experience and knowhow gained from the execution of similar prior projects

○ Improving the completion level of achievements assisted by a panel of expert consultants

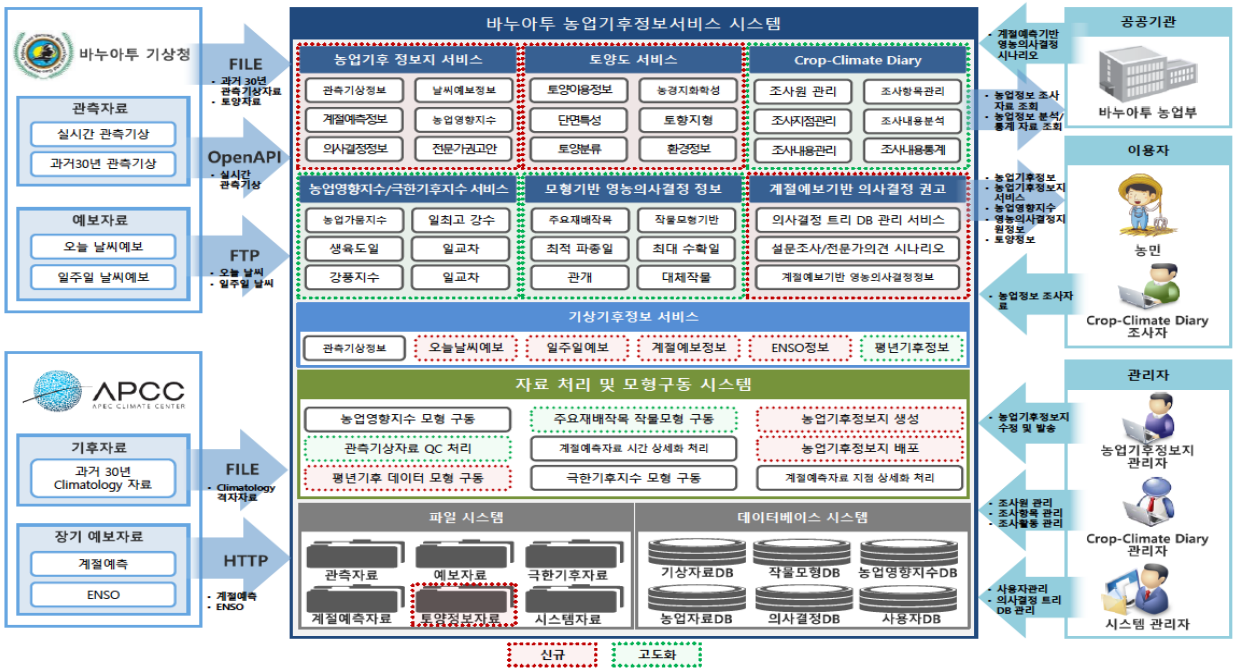
○ Developing a system that is easily usable for anyone in compliance with the web standards and responsive web

○ Supporting a sustainable system via systematic technology transfer

4. Project Scope

A. Overview

○ System Composition Diagram

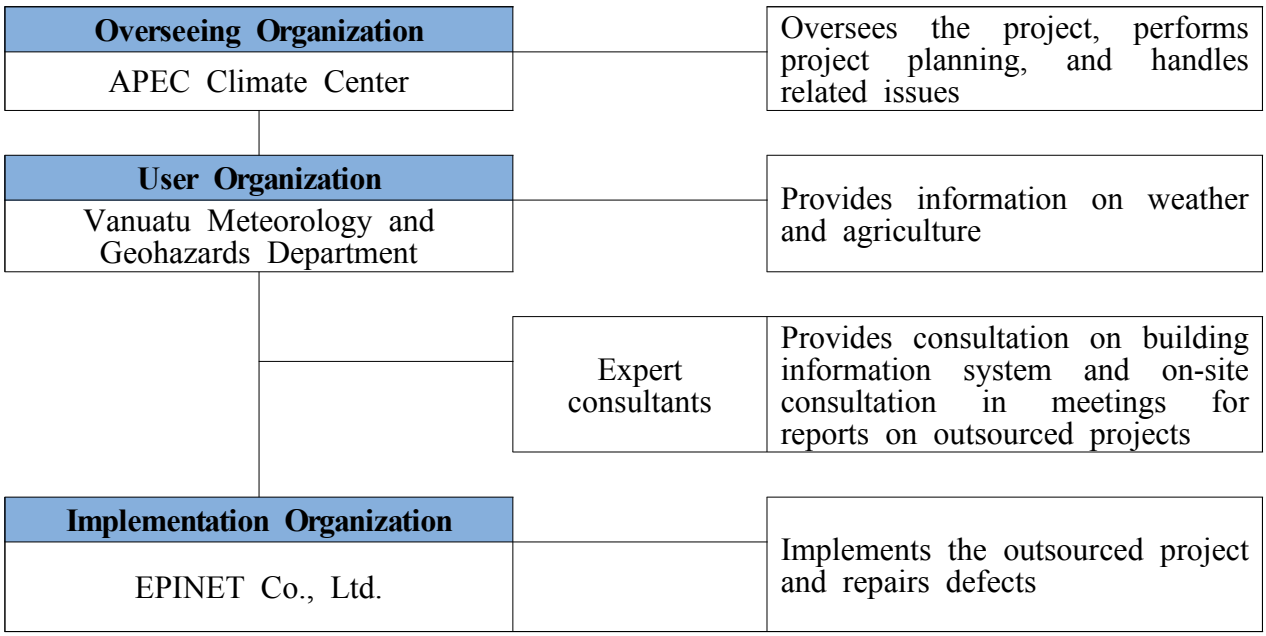


B. Scope of Implementation

Type	Contents
Service to make, search and distribute Agromet bulletin	● Builds a system that semi-automatically makes monthly Agromet bulletin ● Builds a function to send it periodically via email ● Develops Agromet bulletin service optimized to mobile devices ● Builds a communication function that can receive feedback from users
Service for recommendations in a decision-making tree format	● Builds a database of recommendations for each scenario from expert consultants ● Builds a database of recommendations per scenario incorporating the opinions from local people per scenario ● Builds a function that adds a new recommendation ● Builds a function for recommendation service in a decision-making tree format
Service for GIS-based soil map of Vanuatu	● Builds digital data of Vanuatu's soil map in French ● Builds a database of soil map attributes in OSCAR system ● Displays Vanuatu's soil information on a GIS-based map
Upgrading a service for supporting crop model-based agricultural decision-making	● Adds a service target crop to Island Taro ● Adds information for supporting agricultural decision-making by using data for seasonal forecast ● Improves the user interface for agricultural decision-making based on the result of crop model
Upgrading weather and climate service and agricultural index service	● Adds weather and climate forecast service and improves its functions ● Upgrades quality control (QC) of weather data ● Adds a function that adds and renews Vanuatu's climatological normal ● Data on agromet index and climate extreme index
Upgrading web/app-based Crop Climate Diary service	● Adds a new region to offline map on Android app ● Adds and modifies Android app functions ● Adds a function to calculate crop weight based on deep learning technique ● Adds and improves web functions of Crop Climate Diary

5. Project Implementation System

A. Overall Implementation System

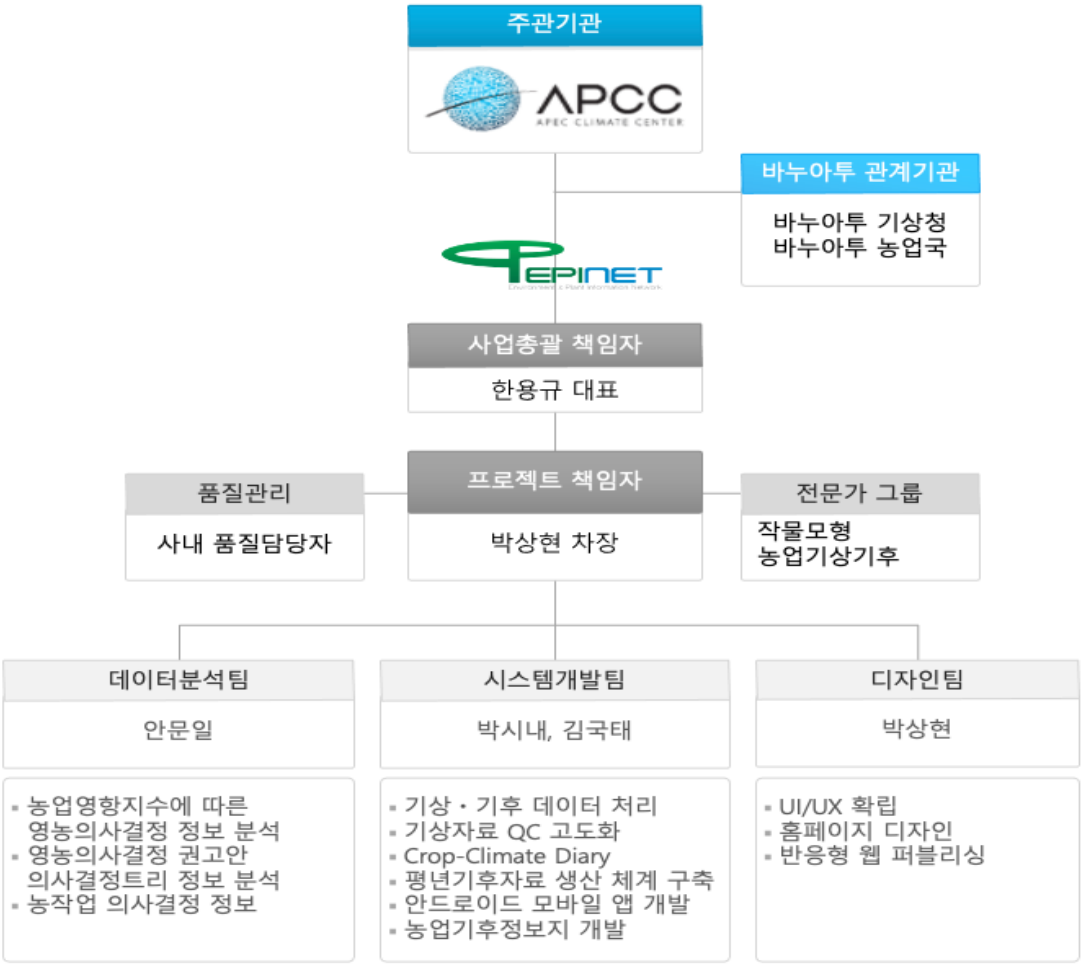


B. Roles of Each Entity

Type	Major Tasks
Overseeing organization	○ Makes requests to the agro-climate information service system ○ Builds a system for coordination and cooperation regarding requests made by relevant departments ○ Handles other related issues needed to implement the project
User organization	○ Provides weather data ○ Registers data on agricultural survey ○ Provides data on soil map
Expert consultant	○ Provides consultation on the establishment of information system
Project implementation organization	○ Builds the system and develops the services ○ System installation, training on operation & technology transfer, and repair and maintenance ○ Pilot operation and post-completion management support ○ Other tasks that need to be implemented

C. Implementation System of Project Entities

- Organizational structure of project entities



- Information on all participating members of personnel

Role	Name	Affiliation	Position	Task	Technical Expertise Level	Participation Rate
PM	Sang Hyun Park	EPINET Co., Ltd.	Deputy Manager	Design	Mid-level	50%
Planning	Moonil Ahn	EPINET Co., Ltd.	Senior Manager	Planning	Advanced	30%
Development	Sinae Park	EPINET Co., Ltd.	Associate Manager	Development	Beginner	50%
Development	Gook Tae Kim	EPINET Co., Ltd.	Associate	Development	Beginner	20%

6. Project Implementation Progress and Schedule

A. Progress

Task	Date	Contents of task
Contract signed	Sep. 01, 2022	Signed the outsourcing contract to implement the project
Meeting to report project initiation	Sep. 07, 2022	Report on project initiation (Jeollanam-do Agricultural Research & Extension Service)
Analysis of requests	Oct. 11, 2022	Identified the requests via discussions with users
Meeting with expert consultants	Oct. 27, 2022	Consulted with agricultural experts
Meeting of analysis on climate data	Nov. 22, 2022	Reviewed agromet index
Meeting to discuss tasks	Jan. 30, 2023	Reviewed system design
Interim report meeting 1	Feb. 28, 2023	Interim report meeting
Meeting with expert consultants	Mar. 27, 2023	Consulted with design experts
Meeting to discuss tasks	Mar. 30, 2023	Reviewed the system
Meeting to discuss tasks	Apr. 07, 2023	Discussed the functions of crop model
Meeting with expert consultants	Apr. 10, 2023	Consulted with design experts
Meeting to discuss tasks	May 18, 2023	Discussed and reviewed the development of functions
Meeting to discuss tasks	Jun. 19, 2023	Discussed and reviewed the development of functions
Meeting with expert consultants	Jun. 21, 2023	Consulted with agricultural experts
Meeting with expert consultants	Jun. 21, 2023	Consulted with design experts
Interim report meeting 2	Jul. 05, 2023	Interim report meeting
Report on completion	Jul. 20, 2023	Reported the completion of implementation
Submission of completion notice	Jul. 20, 2023	Submitted the project completion notice and achievements

B. Schedule

Phase	Task	Sep	Oct	Nov	Dec	Jan 2023	Feb	Mar	Apr	May	Jun	Jul	Aug
Project management	- Task report	■					■					■	
	- Quality review											■	
	- Expert consultation		■					■	■		■	■	
Design	- Upgrading the weather and climate data service		■	■	■	■	■	■	■	■			
	- Upgrading web/app-based Crop Climate Diary service					■	■	■	■	■	■	■	
	- Building the service of recommendation in a decision-making tree format						■	■	■	■	■		
	- Upgrading the crop model-based agricultural decision-making support service				■	■	■	■	■	■			
	- Building Vanuatu's GIS-based soil map service				■	■	■	■				■	
	- Building the service of making, searching and distributing Agromet bulletin									■	■	■	
Currently in progress	- Preparing manual											■	
	- Training users/operators											■	

Ⅱ Details of Project Implementation

1. List of Requests

A. Function to provide weather and climate information via OSCAR

Request ID	Name of request	Details on implementation
001	Weather and climate forecast service	a. Building VMGD's system for collecting information on today's weather forecast b. Augmenting and improving the system for collecting data on APCC's MME seasonal forecast c. Building the systems for collecting and displaying data on APCC's ENSO forecast d. Displaying the information on today's weather forecast on a GIS-based map e. Displaying the data on weekly weather forecast on a graph or table for each major island f. Displaying the data on seasonal forecast on a GIS-based map and on a graph or table for each major island ※ If needed, whether to provide a certain service is to be determined in consultation with the VMGD
002	Upgraded quality control (QC) of weather data	a. Adding a function to check time consistency and internal consistency b. Adding a function to roll post-QC data back to the original data c. Adding a function that fills the gap in omitted weather data (the gap filling technology to be provided by the APCC)
003	Added climatological normal data	a. Adding satellite-based, long-term, and high-resolution daily Tmax and Tmin data and updating climatology map b. Updating indexes and display data generated by climatological data c. Calculating climatological normal of Vanuatu by using re-analyzed data and adding the functions of A and B mentioned above

B. Function to provide agricultural service via OSCAR

Request ID	Name of request	Details on implementation
004	Agromet index and climate extremes index	a. Updating the agromet index service database by assembling the panel of expert consultants and seeking their consultation (including the provision of detailed information on decision-making based on crop growth timeline or changes in

	information service	crop condition, and information on warning regarding agromet index) ※ The information on decision-making and warning may be updated based on the opinions of local people. b. Upgrading the agromet index display system (information on customized graph and map to be provided) c. Adding user-friendly descriptions for each index (descriptions based on specific examples to be provided)
005	Crop model-based agricultural decision-making support service	a. Adding target crop to Island Taro b. Adding the information on agricultural decision-making support by using APCC seasonal forecast information - Adding a function to estimate the optimal time to sow - Adding the information to provide support such as water stress and nutrient stress c. Improving the user interface for agricultural decision-making based on the result of crop model (adding a service for GIS-based map search and improving graph design) - Comparing the productivity against that of the past (e.g., the year with the average yield, in the last 5/10 years) - Comparing the productivity among major islands d. Adding the information on crop model (e.g., background, restrictions, and applicability)
006	GIS-based soil map service for Vanuatu	a. Building digital data of Vanuatu's soil map in paper records in French b. Building a database of data on soil map's attributes into the OSCAR system c. Displaying the information of soil in Vanuatu on a GIS-based map d. Building to make download available ※ Whether to add the download function is to be determined in consultation with the implementation organization of Vanuatu (VMGD).
007	Service of recommendation in a decision-making tree format	a. Display in a decision-making tree format (e.g., a user selects a region, crop and sow date step by step); to be developed in a way that allows adding new entries or modifying prior entries b. Decision-making recommendations per scenario from expert consultants go into a database at the system ※ Decision-making recommendations per scenario may be updated based on the opinions of local people c. Providing a service of optimal farming decision-making recommendations by using seasonal forecast information and

		forecast agromet index ※ The recommended farming decision based on the decision-making tree must be added to Agromet bulletin (please see request ID 011).

C. Improving Function of Crop Climate Diary and Building App

Request ID	Request type	How to implement request
008	Android mobile app (improvement in offline map function)	a. Adding a new region to GIS-based offline map display function of Crop Climate Diary b. Adding a function to display map copyrights c. Improving a function to display the current location on offline map by using GPS embedded in mobile devices (e.g., symbol display, moving map center and moving zoom) d. Implementing a function to distribute offline map data when Crop Climate Diary is newly installed in a mobile device e. Implementing a function to move to a certain, pre-defined region (such as an island) on the offline map screen f. Improving a function to display the map by incorporating the opinions of users in Vanuatu if needed ※ How to display offline map and how to distribute the map will be implemented based on the discussion between overseeing organization and consignment organization; depending on the map distribution method, the web-based service OSCAR may need to have a separate function for distributing offline map
009	Android mobile app (implementing a function to calculate crop weight)	a. Implementing a function to photograph a crop with a mobile device camera b. Implementing a function to detect markers on the ground and perform distortion correction of camera lens and geometric correction by using computer vision technique c. Implementing a function which uses deep learning model to perform segmentation of final-processed crop images by computer vision d. Implementing a function to calculate the weight by using a correlation coefficient between the crop surface area and weight e. Implementing a function that enables setting up the data and parameters needed to implement the weight calculation function in Crop Climate Diary app f. Improving a function to sync data (interim and final output such as image data, parameters and Crop Climate Diary app setup can be selected)

		g. Improving a function to calculate the crop weight by incorporating the opinions of users in Vanuatu if needed ※ Computer vision algorithm and deep learning model are to be implemented based on the discussion between overseeing organization and consignment organization.
010	Augmenting the data management function of Crop Climate Diary in OSCAR system	a. Implementing a screen for managing crop images and estimated crop weight collected from Crop Climate Diary b. Implementing a screen for adding/deleting/modifying coefficients needed to calculate crop weight c. Improving a function to sync data (interim and final output such as image data, parameters and Crop Climate Diary app setup can be selected) d. Upgrading the system of Crop Climate Diary for statistical analysis and display e. It needs to be able to provide information to Agromet bulletin, if needed, via analysis in association with weather forecast information on the surrounding areas (by using agromet index). ※ Agromet bulletin (please see request ID 011)

D. Function to provide Agromet bulletin via OSCAR

Request ID	Name of request	Details on implementation
011	Service of making, searching and distributing Agromet bulletin	a. Adding recommended farming decisions based on the decision-making tree b. Building a system that semi-automatically makes monthly Agromet bulletin based on information on weather & climate and agro-climate service in OSCAR ※ The basic design of Agromet bulletin takes on a fixed framework based on the discussion with partners from Vanuatu; the system is designed in a way that enables administrators to edit some contents such as recommendations on farming decision-making. c. Developing Agromet bulletin print service in the web system (e.g., generating PDF files of Agromet bulletin used as a monthly bulletin) d. Developing a service that periodically sends Agromet bulletin via email and allows administrators to determine whom recipients will be e. Developing a service that displays Agromet bulletin optimized to mobile device screen

		※ Adding a Lite version option (e.g., information delivered mainly in text) in light of the telecommunications environment (please see request ID 012) f. Developing a two-way communication service capable of receiving user feedback (to be developed to allow users to send feedback via email or from the web, depending on the local conditions) ※ Development that integrates Q&A bulletin board (please see request ID 013)

E. Other requests made to OSCAR system development

Request ID	Name of request	Details on implementation
012	Mobile service	a. The contents of service for mobile devices are to be determined based on the discussion with overseeing organization; however, Agromet bulletin service must be included. b. Development covers a lite version that delivers information mainly in text in light of the telecommunications environment. c. It must allow downloading and printing graph and map in picture files (.jpg, .png formats) as well as sharing them over social media.
013	Q&A bulletin board service	a. Development of Q&A bulletin board service where users can ask questions and answer them about the system ※ Categorizing major functions for writing Q&A b. It must include a function that blocks spam posts. c. Only logged-in users can write Q&A posts, while login is not required for search.
014	Background map replacement	a. Replacing Google Map used by Crop Climate Diary in OSCAR system with an open source map b. Replacing Google Map used by Crop Climate Diary app with an open source map
015	Agro-climate information delivery service	a. Development of service that sends text messages delivering simplified information ※ The contents of information to be delivered are to be based on the discussion with overseeing organization. b. Building a system where administrators in Vanuatu determine whom recipients will be ※ Whether to provide the service is to be determined based on the discussion with the implementation organization of Vanuatu (VMGD).

F. General requests made to OSCAR development

Request ID	Name of request	Details on implementation
016	General requests	a. Overall improvement in user-friendly interface including menu tree adjustment and graphic in display, assisted by expert consultants b. System services are simultaneously provided in both English and Bislama languages (during the interim report meetings; also, documents translated into Bislama language are to be submitted as requested). c. System design allows providing a screen customized to the user's current access location information. d. The system performance (speed) needs to be optimized for easier access to and usability of OSCAR in consideration of the local internet environment. e. Putting in place a mechanism to prevent the loss of system data (DB) f. Respectively publishing user manual and guideline (technical manual) on OSCAR system (the number of copies to be printed will be determined based on discussion with overseeing organization) ※ If the organizations change how they provide data including VMGD 7-day forecast data and APCC MME data, appropriate updates will be followed. ※ With the help from a professional illustrator, a colorful brochure (e.g., leaflet) for promoting OSCAR system is to be published (within one quarter after a contract is signed). g. To hand over the developed OSCAR system, it will be installed in the server to be provided by Vanuatu. ※ The handover is to be carried out based on the discussion with overseeing organization as well as the VMGD and SPREP. h. Local administrators (VMGD and MALFFB) must be trained on the developed system to help them become able to operate the system on their own; the consignment organization must provide training materials and technical support. i. In the course of the project implementation, the opinions of local users in Vanuatu must be continuously incorporated into increasing the completion rate of OSCAR system; minor adjustments and changes to some system functions based on user opinion must be available via the discussion with overseeing organization. j. The logos and copyrights of implementation organizations and

		cooperation organizations must be inserted. k. Adding disclaimer on OSCAR system

G. Compiling software project information (information on software project implementation and performance)

Request ID	Name of request	Details on implementation
017	Compiling and submitting data on software project information storage	a. In accordance with article 46 of the Software Promotion Act, the project contractor must compile and submit data on software project information (information on implementation and performance of software project). b. For more details on compiling and submitting data on software project information, please see Guideline on Submission of Software Project Information Storage Data document in the data archive at www.spir.kr. c. The data on software project information must be clearly mentioned on the list of output per phase in the course of writing project implementation plan. d. To compile the data on scores of functions of the software project information, an expert specializing in scoring functions must be included in the project implementation personnel.

2. Result of Request Implementation

A. Function to provide weather and climate information via OSCAR

1) Weather/Climate forecast service (001)

Request	Implementation result
▪ Building VMGD's system for collecting information on today's weather forecast	Built the VMGD's system for collecting information on today's weather forecast
▪ Augmenting and improving the system for collecting data on APCC's MME seasonal forecast	The system has made it possible for database (DB) to manage route parts of APCC's seasonal forecast API URL, making it easier to modify its route when the route that provides data is changed .
▪ Building the systems for collecting and displaying data on APCC's ENSO forecast	ENSO images of APCC are displayed and automatically renewed on certain dates.
▪ Displaying the information on today's weather forecast on a GIS-based map	The information on today's weather forecast is displayed on a GIS-based map.
▪ Displaying the data on weekly weather forecast on a graph or table for each major island	Built the system that collects data on weekly weather forecast from the FTP server given by the VMGD, which displays it on a graph and table on the map
▪ Displaying the data on seasonal forecast on a GIS-based map and on a graph or table for each major island	The map server is used to generate seasonal forecast data map layer, which is displayed along with a graph and table.

2) Upgrading quality control (QC) of weather data (002)

Request	Implementation result
▪ Adding a function to check time consistency and internal consistency	Developed a function to run time consistency check and internal consistency check during the collection of weather data, and search the quality control result on the web
▪ Adding a function to roll post-QC data back to the original data	Added a function to roll back post-QC data
▪ Adding a function that fills the gap in omitted weather data (the gap filling technology to be provided by the APCC)	Added a function that fills the gap in omitted weather data

3) Adding climatological normal data (003)

Request	Implementation result
▪ Adding satellite-based, long-term, and high-resolution daily Tmax and Tmin data and updating climatology map	The APCC sends updated long-term, high-resolution weather data, which is used to renew the database and climatology map.
▪ Updating indexes and display data generated by climatological data	Renewed the indexes and display data generated by climatological data
▪ Calculating climatological normal of Vanuatu by using re-analyzed data and adding the functions of A and B mentioned above	Built a system that collects NASA power temporal daily data to calculate climatological normal per observation location and per island, and saves the values in the database

B. Function to provide agricultural service via OSCAR

1) Agromet index and climate extremes index information service (004)

Request	Implementation result
▪ Updating the agromet index service database by assembling the panel of expert consultants and seeking their consultation (including the provision of detailed information on decision-making based on crop growth timeline or changes in crop condition, and information on warning regarding agromet index ※ The information on decision-making and warning may be updated based on the opinions of local people.	A meeting of expert consultants has been held to be consulted on the advisory based on the warning level of agromet index; the consultation was incorporated into the updated database.
▪ Upgrading the agromet index display system (information on customized graph and map to be provided)	Improved the overall design and interface of the agromet index screen
▪ Adding user-friendly descriptions for each index (descriptions based on specific examples to be provided)	Added user-friendly descriptions for each index

2) Crop model-based agricultural decision-making support service (005)

Request	Implementation result
▪ Adding target crop to Island Taro	Added Taro model to crop model
▪ Adding the information on agricultural decision-making support by using APCC seasonal forecast information - Adding a function to estimate the optimal time to sow - Adding the information to provide support such as water stress and nutrient stress	Built a system that operates crop models with collected seasonal forecast data and soil input data Developed a function that estimates the optimal time to sow based on the result of model simulation Built an advisory database based on the values of water stress and nutrient stress
▪ Improving the user interface for agricultural decision-making based on the	Added a service for GIS-based map search and improved the design

result of crop model (adding a service for GIS-based map search and improving graph design) - Comparing the productivity against that of the past (e.g., the year with the average yield, in the last 5/10 years) - Comparing the productivity among major islands	Developed a function that can compare current yields against those of the past Developed a function that can compare yields of each major islands
▪ Adding the information on crop model (e.g., background, restrictions, and applicability)	Displays wording about the restrictions on crop model

3) GIS-based soil map service for Vanuatu (006)

Request	Implementation result
▪ Building digital data of Vanuatu's soil map in paper records in French	Built data on attributes by converting hardcopy data on soil information of Vanuatu in French into text and images
▪ Building a database of data on soil map's attributes into the OSCAR system	Built the database of data on soil map's attributes
▪ Displaying the information of soil in Vanuatu on a GIS-based map	Displays the information of soil in Vanuatu on the GIS-based map
▪ Building to make download available ※ Whether to add the download function is to be determined in consultation with the implementation organization of Vanuatu (VMGD).	Developed a function that downloads map images

4) Service of recommendation in a decision-making tree format (007)

Request	Implementation result
▪ Display in a decision-making tree format (e.g., a user selects a region, crop and sow date step by step; to be developed in a way that	Built the decision-making database Developed a screen where users can select a scenario step by step to obtain recommended decisions

allows adding new entries or modifying prior entries	Developed a function that allows administrators to input/modify recommendations per decision-making tree
▪ Decision-making recommendations per scenario from expert consultants go into a database at the system. ※ Decision-making recommendations per scenario may be updated based on the opinions of local people.	The panel of expert consultants convened to provide advices on supporting agricultural decision-making. The obtained advices have been incorporated into decision-making recommendations.
▪ Providing a service of optimal farming decision-making recommendations by using seasonal forecast information and forecast agromet index ※ The recommended farming decision based on the decision-making tree must be added to Agromet bulletin (please see request ID 011).	Agromet bulletin uses agromet index (EDI) to support the optimal farming decision-making. Added to Agromet bulletin recommended farming decisions based on the decision-making tree

C. Improving Function of Crop Climate Diary and Building App

1) Android mobile app (improvement in offline map function) (008)

Request	Implementation result
▪ Adding a new region to GIS-based offline map display function of Crop Climate Diary	The data on the map of new region provided by the APCC was transferred to SD cards. The personnel brought the SD cards when they visited Vanuatu and installed the data in devices.
▪ Adding a function to display map copyrights	Added a function to display copyrights on offline map
▪ Improving a function to display the current location on offline map by using GPS embedded in mobile devices (e.g., symbol display, moving map center and moving zoom)	Added the function to display user's current location on offline map by using GPS embedded in mobile devices Added the functions of moving the center of offline map and zoom
▪ Implementing a function to distribute offline map data when Crop Climate Diary is newly installed in a mobile device	The file size of the map was too big to be downloaded. Therefore, the data was transferred to SD cards. The personnel brought the SD cards when they visited Vanuatu, installed the data in devices, and provided the installation manual.

▪ Implementing a function to move to a certain, pre-defined region (such as an island) on the offline map screen	Developed the function of moving to an island on the offline map screen
▪ Improving a function to display the map by incorporating the opinions of users in Vanuatu if needed ※ How to display offline map and how to distribute the map will be implemented based on the discussion between overseeing organization and consignment organization; depending on the map distribution method, the web-based service OSCAR may need to have a separate function for distributing offline map.	Improved the function to display the map by incorporating the opinions of users in Vanuatu

2) Android mobile app (implementing a function to calculate crop weight) (009)

Request	Implementation result
▪ Implementing a function to photograph a crop with a mobile device camera	Added the camera function to photograph crops to Crop Climate Diary app
▪ Implementing a function to detect markers on the ground and perform distortion correction of camera lens and geometric correction by using computer vision technique	Developed the functions to detect image markers on the ground and run the programs for distortion correction of camera lens and geometric correction of images
▪ Implementing a function which uses deep learning model to perform segmentation of final-processed crop images by computer vision	Built the system for running image deep learning model to implement image segmentation Added the function for running segmentation on the images captured by mobile devices
▪ Implementing a function to calculate the weight by using a correlation coefficient between the crop surface area and weight	Developed the function to calculate the weight by using a correlation coefficient between the crop surface area and weight that was obtained from crop images captured by mobile devices
▪ Implementing a function that	Developed the function in Crop Climate Diary app that

enables setting up the data and parameters needed to implement the weight calculation function in Crop Climate Diary app	allows users to set up the data and parameters needed to calculate the crop weight Developed the function where the parameters set by users can be applied to the weight calculation function
▪ Improving a function to sync data (interim and final output such as image data, parameters and Crop Climate Diary app setup can be selected)	Improved the function to sync data
▪ Improving a function to calculate the crop weight by incorporating the opinions of users in Vanuatu if needed ※ Computer vision algorithm and deep learning model are to be implemented based on the discussion between overseeing organization and consignment organization.	Improved the function to calculate the crop weight by incorporating the opinions of users in Vanuatu

3) Augmenting the data management function of Crop Climate Diary in OSCAR system (010)

Request	Implementation result
▪ Implementing a screen for managing crop images and estimated crop weight collected from Crop Climate Diary	Developed the function for managing crop images and estimated crop weight collected from Crop Climate Diary
▪ Implementing a screen for adding/deleting/modifying coefficients needed to calculate crop weight	Developed the function for managing coefficients needed to calculate crop weight
▪ Improving a function to sync data (interim and final output such as image data, parameters and Crop Climate Diary app setup can be selected)	Improved the data sync speed of Crop Climate Diary app Developed the function for users to select interim and final output during data sync
▪ Upgrading the system of Crop Climate Diary for statistical analysis and display	Improved the statistical analysis function of Crop Climate Diary Improved the design of Crop Climate Diary for better visual effects

▪ It needs to be able to provide information to Agromet bulletin, if needed, via analysis in association with weather forecast information on the surrounding areas (by using agromet index). ※ Agromet bulletin (please see request ID 011)	EDI-associated graph and yields are displayed on Agromet bulletin. Developed the function for administrators to control whether to display yields

D. Function to provide Agromet bulletin via OSCAR

1) Service of making, searching and distributing Agromet bulletin (011)

Request	Implementation result
▪ Adding recommended farming decisions based on the decision-making tree	Agromet bulletin displays recommended farming decisions based on the decision-making tree.
▪ Building a system that semi-automatically makes monthly Agromet bulletin based on information on weather & climate and agro-climate service in OSCAR ※ The basic design of Agromet bulletin takes on a fixed framework based on the discussion with partners from Vanuatu; the system is designed in a way that enables administrators to edit some contents such as recommendations on farming decision-making.	Built the system that semi-automatically makes monthly Agromet bulletin Developed the function to generate Agromet bulletin Developed the function for administrators to manage recommendations on farming decision-making
▪ Developing Agromet bulletin print service in the web system (e.g., generating PDF files of Agromet bulletin used as a monthly bulletin)	Developed the function that automatically generates PDF files of Agromet bulletin every month
▪ Developing a service that periodically sends Agromet bulletin via email and allows administrators to determine whom recipients will be	Developed the function that can send Agromet bulletin by entering email Developed the function that sends regular pop-up notifications when Agromet bulletin is published and sent
▪ Developing a service that	Developed the service that displays Agromet bulletin on mobile

displays Agromet bulletin optimized to mobile device screen ※ Adding a lite version option (e.g., information delivered mainly in text) in light of the telecommunications environment (please see request ID 012)	device screen
▪ Developing a two-way communication service capable of receiving user feedback (to be developed to allow users to send feedback via email or from the web, depending on the local conditions) ※ Development that integrates Q&A bulletin board (please see request ID 013)	Developed the function that adds Q&A function to Agromet bulletin to integrate a registered user inquiry into the Q&A bulletin board

E. Other requests made to OSCAR system development

1) Mobile service (012)

Request	Implementation result
▪ The contents of service for mobile devices are to be determined based on the discussion with overseeing organization; however, Agromet bulletin service must be included.	The Best Crop Planting Week and Predicted Yield of Agromet bulletin have been included.
▪ Development covers a lite version that delivers information mainly in text in light of the telecommunications environment.	Mostly the developed contents are text-driven contents that do not contain images and library.
▪ It must allow downloading and printing graph and map in picture files (.jpg, .png formats) as well as sharing them over social media.	Developed the function to download and print graphs and maps Developed the function to share the graphs and maps on Facebook

2) Q&A bulletin board service (013)

Request	Implementation result
▪ Development of Q&A bulletin board service where users can ask questions and answer them about the system ※ Categorizing major functions for writing Q&A	Developed Q&A bulletin board service Added the function to select the category when writing Q&A
▪ It must include a function that blocks spam posts.	Developed capcha-based spam block function
▪ Only logged-in users can write Q&A posts, while login is not required for search.	Only logged-in users can write Q&A posts, while login is not required for search.

3) Background map replacement (014)

Request	Implementation result
▪ Replacing Google Map used by Crop Climate Diary in OSCAR system with an open source map	The Google Map that was used by Crop Climate Diary's web system was replaced with Leaflet and OpenLayers.
▪ Replacing Google Map used by Crop Climate Diary app with an open source map	The Google Map that was used by Crop Climate Diary app was replaced with Leaflet and OpenLayers.

4) Agro-climate information delivery service (015)

Request	Implementation result
▪ Development of service that sends text messages delivering simplified information ※ The contents of information to be delivered are to be based on the discussion with overseeing organization.	After a discussion with overseeing organization, it was decided not to include the function to send text messages.
▪ Building a system where administrators in Vanuatu determine whom recipients will be ※ Whether to provide the service is to be determined based on the discussion with the implementation	After a discussion with overseeing organization, it was decided not to include the function to send text messages.

organization of Vanuatu (VMGD).	

F. General requests made to OSCAR development

1) General requests (016)

Request	Implementation result
▪ Overall improvement in user-friendly interface including menu tree adjustment and graphic in display, assisted by expert consultants	The interface and graphic have been improved based on the feedback from the meeting of expert consultants.
▪ System services are simultaneously provided in both English and Bislama languages (during the interim report meetings; also, documents translated into Bislama language are to be submitted as requested).	Developed the function to switch to one of multiple languages
▪ System design allows providing a screen customized to the user's current access location information.	Developed the function to use GPS on the browser and mobile devices to be authorized to access user's access information and be provided with the location information Developed a function of the system to set up the region in advance depending on user's access location
▪ The system performance (speed) needs to be optimized for easier access to and usability of OSCAR in consideration of the local internet environment.	A performance optimization plan was devised and applied to the development.
▪ Putting in place a mechanism to prevent the loss of system data (DB)	A database recovery policy was applied to the development.
▪ Respectively publishing user manual and guideline (technical manual) on OSCAR system (the number of copies to be printed will be determined based on discussion with overseeing organization). ※ If the organizations	The user manual and guideline (technical manual) on OSCAR system have been published respectively. It has been made possible to change the route if the URL for receiving weather data is managed by the database and hence the organizations change how they provide data. The colorful brochure (e.g., leaflet) for promoting OSCAR system has been published with the help from a professional illustrator.

change how they provide data including VMGD 7-day forecast data and APCC MME data, appropriate updates will be followed. ※ With the help from a professional illustrator, a colorful brochure (e.g., leaflet) for promoting OSCAR system is to be published (within one quarter after a contract is signed).	
▪ To hand over the developed OSCAR system, it will be installed in the server to be provided by Vanuatu ※ The handover is to be carried out based on the discussion with overseeing organization as well as the VMGD and SPREP	The developed OSCAR system was installed in the server in Vanuatu as a part of the handover.
▪ Local administrators (VMGD and MALFFB) must be trained on the developed system to help them become able to operate the system on their own; the consignment organization must provide training materials and technical support.	Trained administrators of Vanuatu on the system twice Provided training materials and technical support to the administrators of Vanuatu
▪ In the course of the project implementation, the opinions of local users in Vanuatu must be continuously incorporated into increasing the completion rate of OSCAR system; minor adjustments and changes to some system functions based on user opinion must be available via the discussion with overseeing organization.	Minor adjustments and changes in accordance with users' opinions have been applied to system functions.
▪ The logos and copyrights of implementation organizations and cooperation organizations must be inserted	Inserted the logos and copyrights of implementation organizations and cooperation organizations
▪ Adding disclaimer on OSCAR	Added the disclaimer on OSCAR system

system	

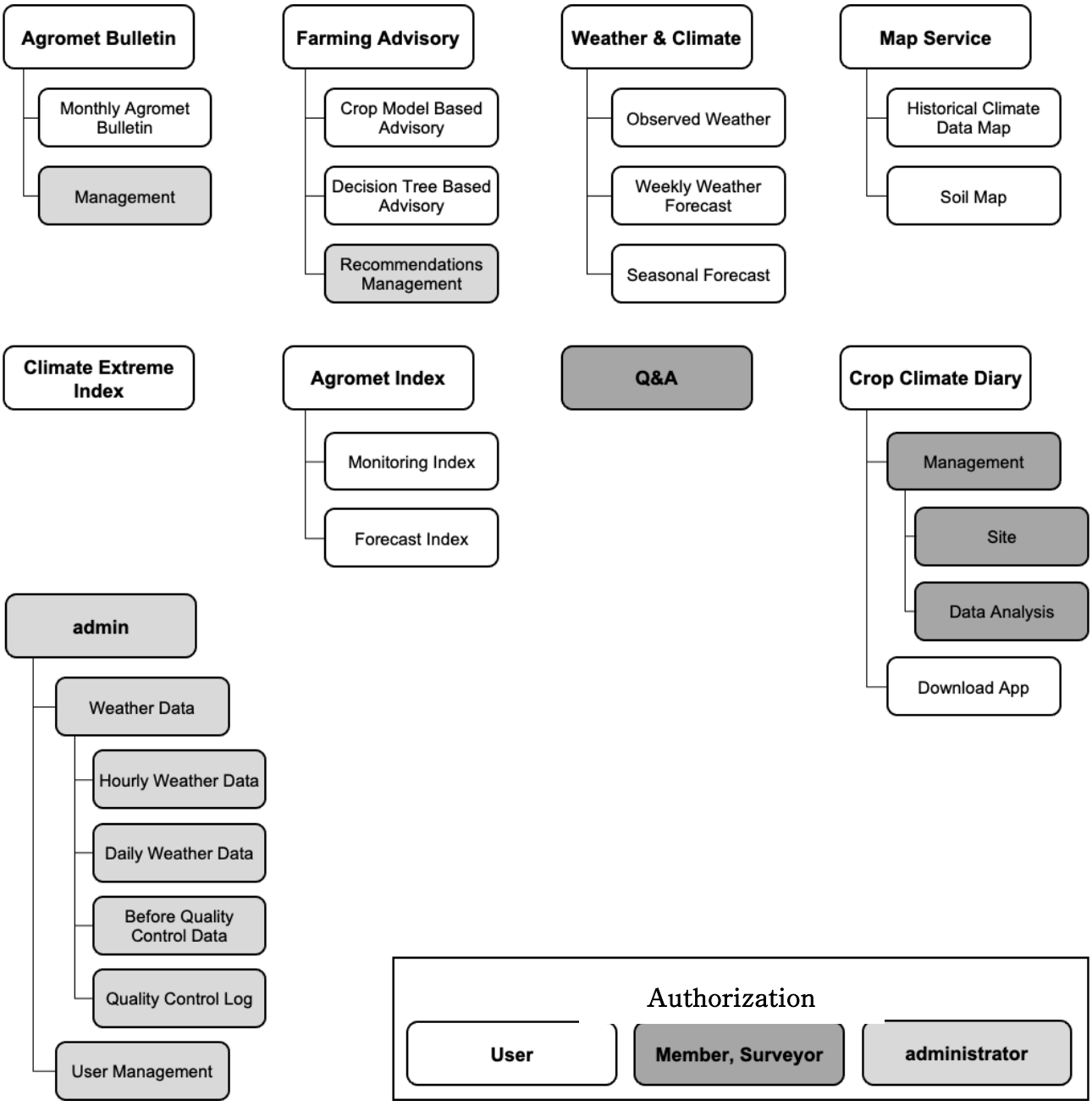
G. Compiling software project information (information on software project implementation and performance)

1) Compiling and submitting data on software project information storage (017)

Request	Implementation result
▪ In accordance with article 46 of the Software Promotion Act, the project contractor must compile and submit data on software project information (information on implementation and performance of software project).	In accordance with article 46 of the Software Promotion Act, the project contractor compiled and submitted data on software project information (information on implementation and performance of software project).
▪ For more details on compiling and submitting data on software project information, please see Guideline on Submission of Software Project Information Storage Data document in the data archive at www.spir.kr.	For more details on compiling and submitting data on software project information, please see Guideline on Submission of Software Project Information Storage Data document in the data archive at www.spir.kr.
▪ The data on software project information must be clearly mentioned on the list of output per phase in the course of writing project implementation plan.	The data on software project information must be clearly mentioned on the list of output per phase in the course of writing project implementation plan.
▪ To compile the data on scores of functions of the software project information, an expert specializing in scoring functions must be included in the project implementation personnel.	To compile the data on scores of functions of the software project information, an expert specializing in scoring functions has been included in the project implementation personnel.

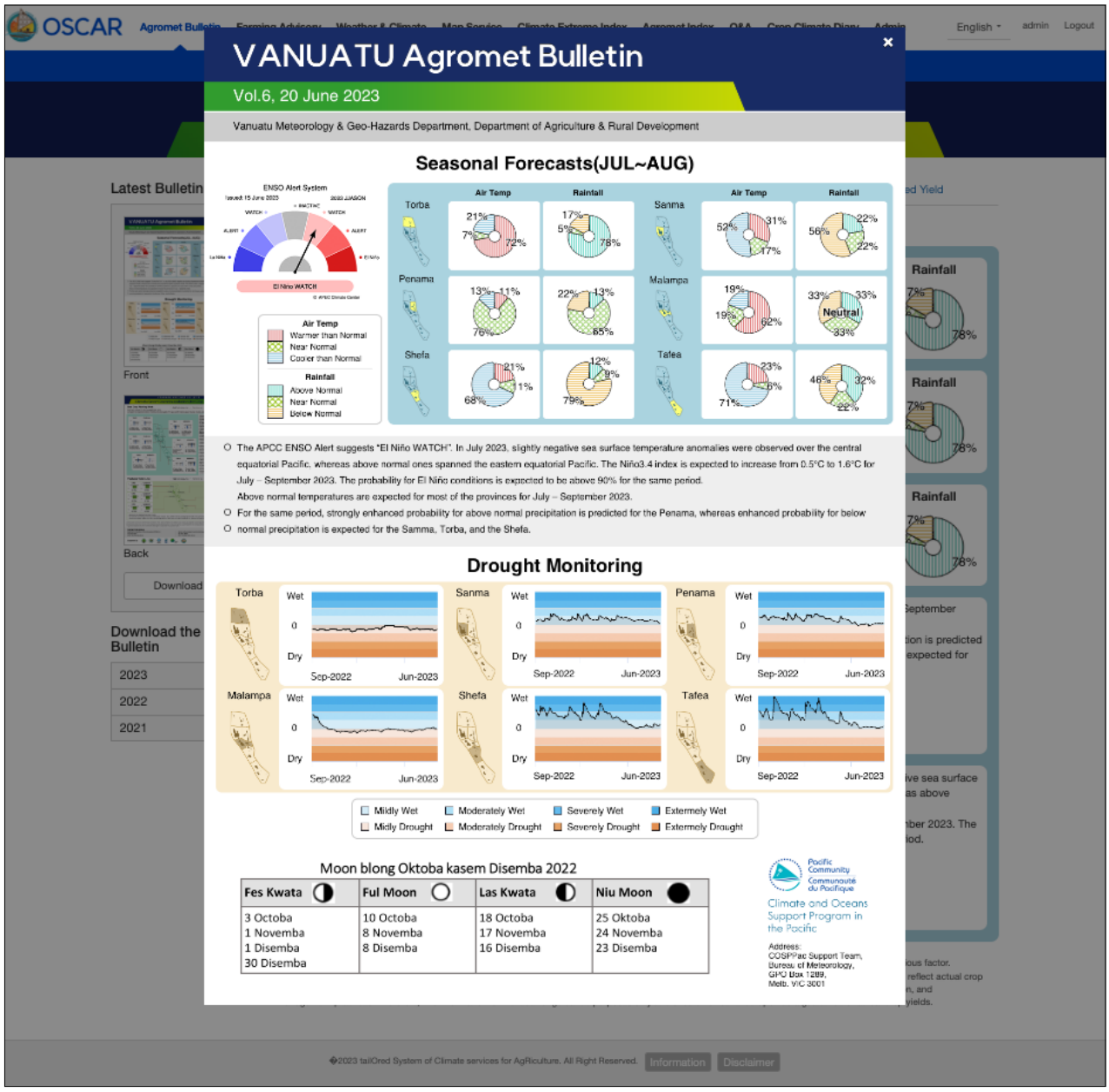
3. Details on System Development

A. Menu composition diagram



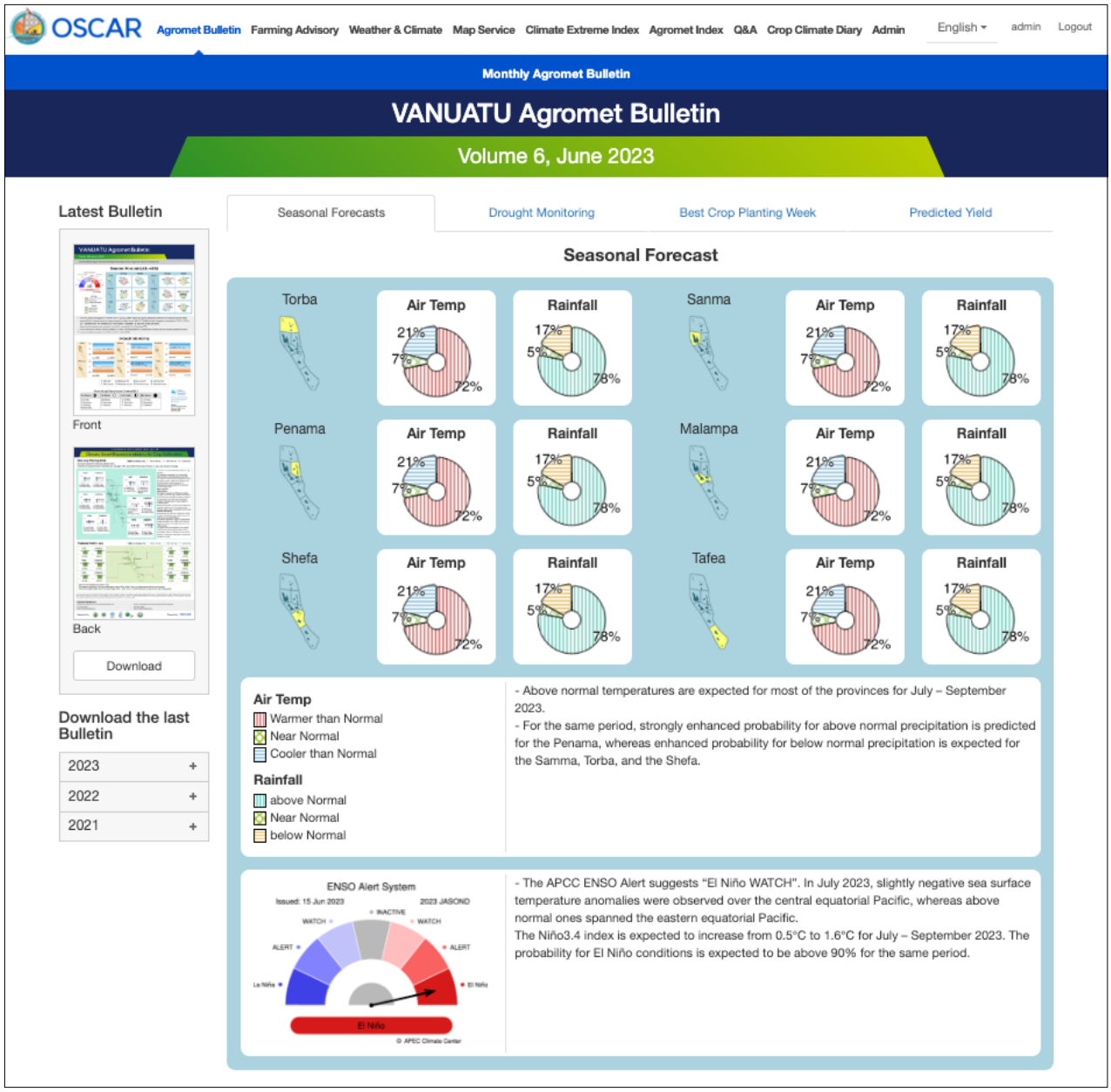
B. Result of implementing the service of making, searching and distributing Agromet bulletin

1) Service of making Agromet bulletin



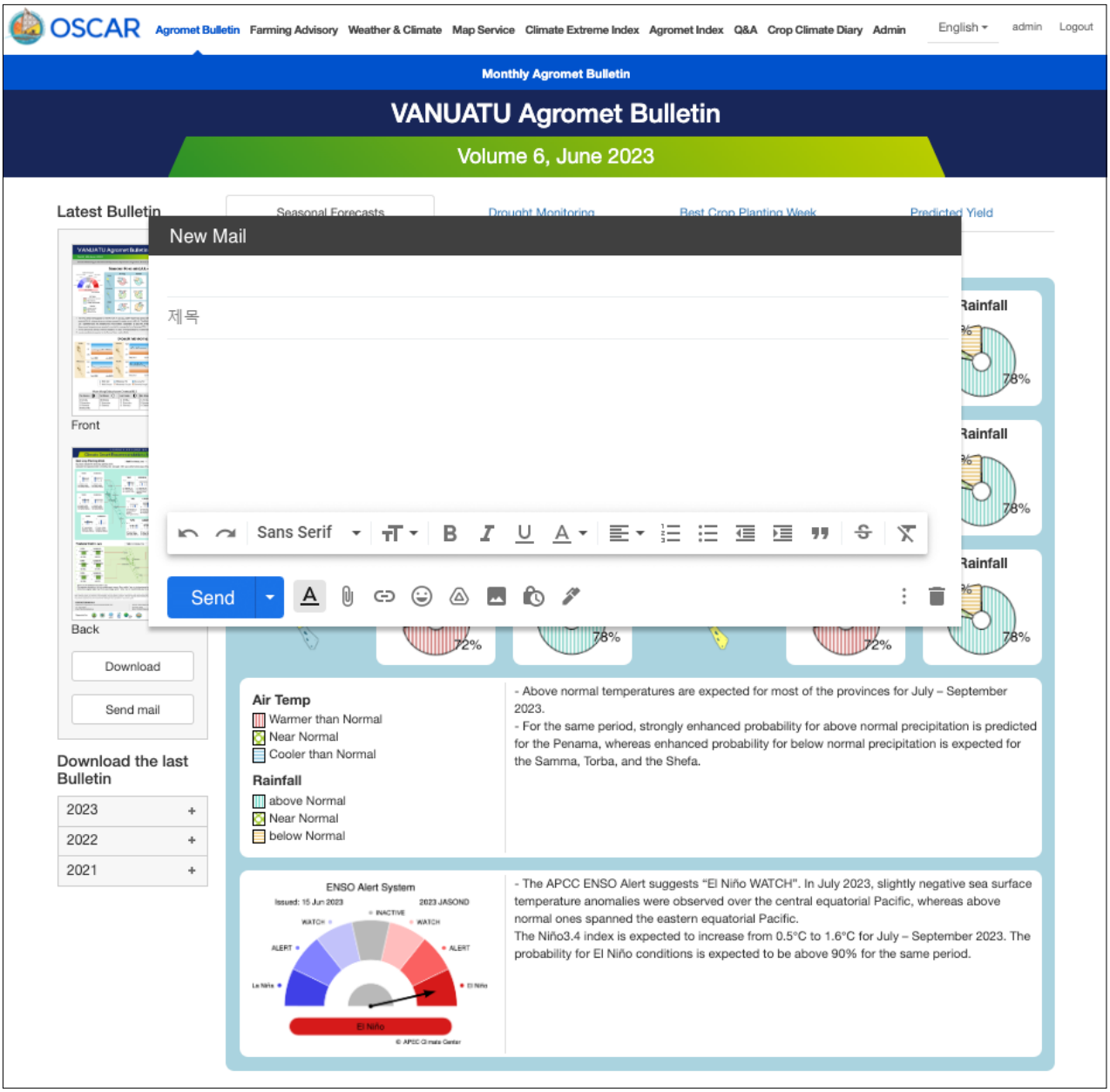
- It provides a function to print out and download in PDF the data generated based on weather and climate and agro-climate service information in OSCAR.

2) Service of searching Agromet bulletin



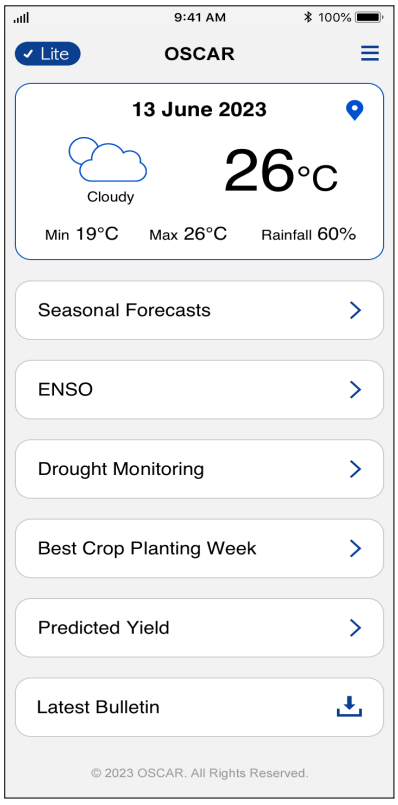
- **It displays on the web screen the data generated based on weather and climate and agro-climate service information in OSCAR.**

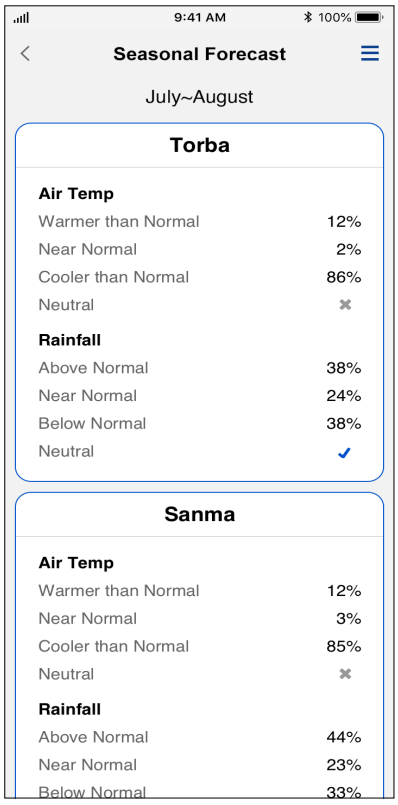
3) Service of distributing Agromet bulletin

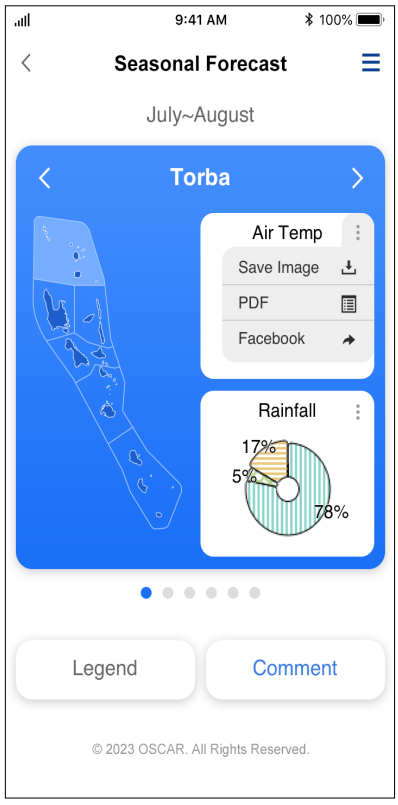


- **Agromet bulletin is sent via email function.**

4) Agromet bulletin mobile service





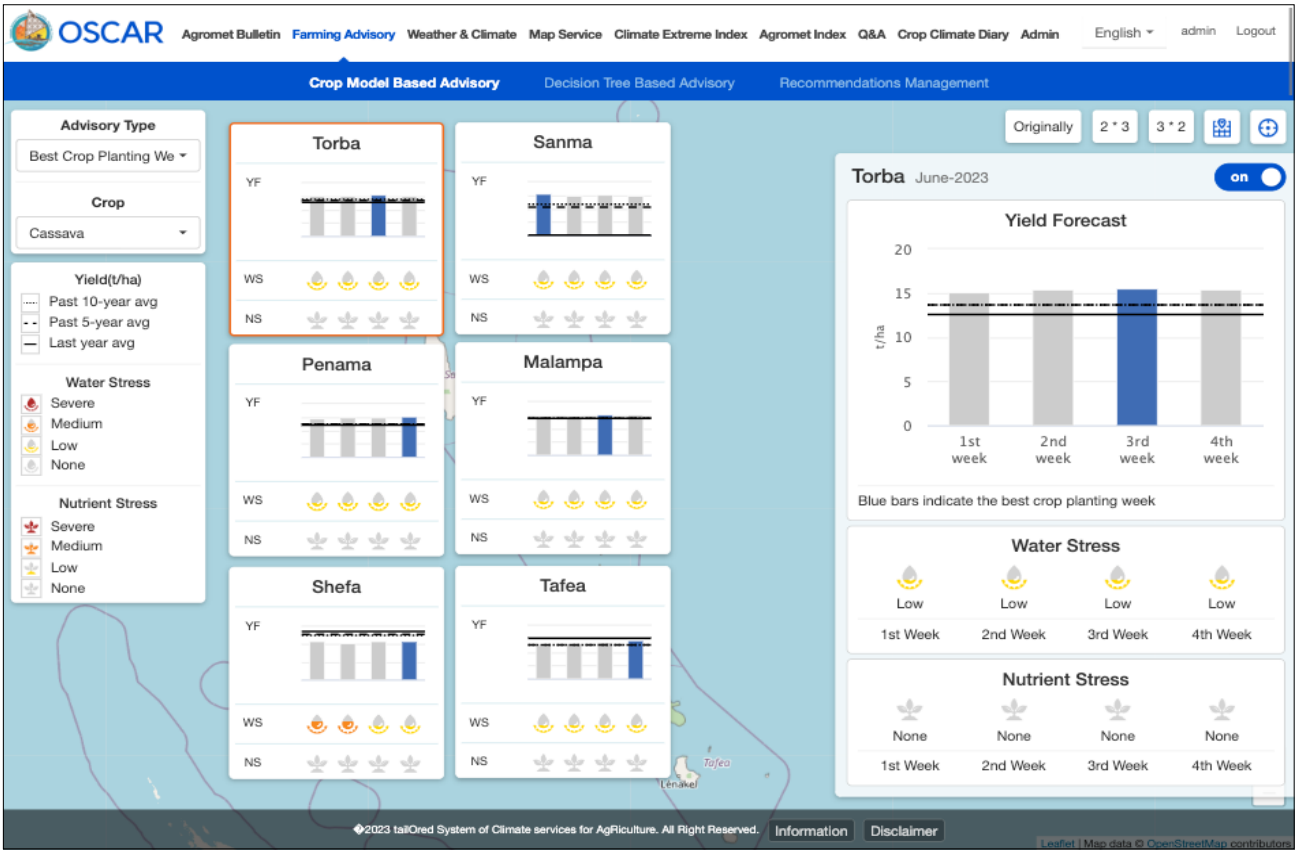


<Figure 1. Lite version, Figure 2. Lite version, Figure 3. Regular version>

- **We provide a mobile service for mobile users. We offer a lite version and a regular version, and graphs can be saved in images and PDF, and can also be shared on social media.**

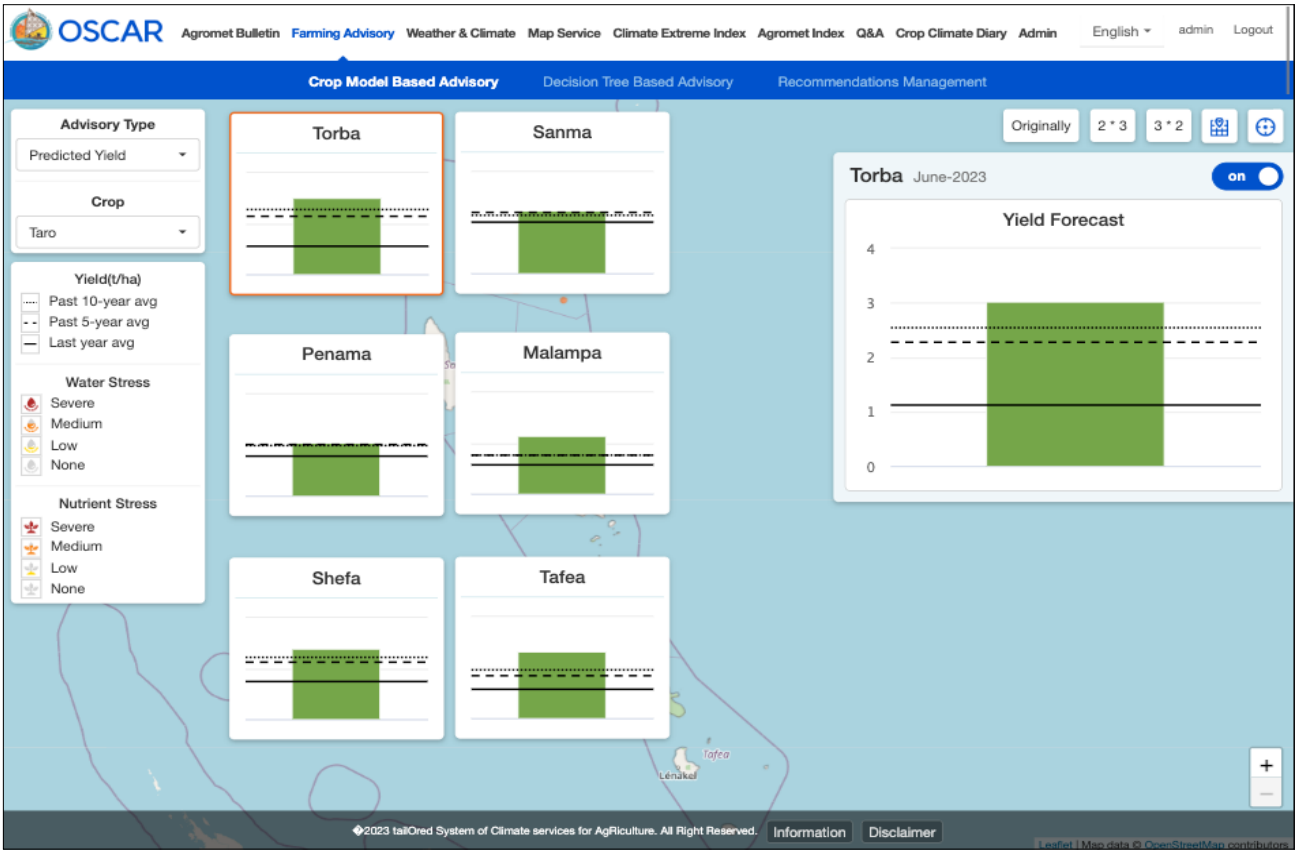
C. Crop model-based agricultural decision-making support service

1) Service that estimates the optimal time to sow crops



- It uses the result from crop model to compare the productivity of each major island against that of the past (the year with the average yield, in the last 5/10 years), which then is presented in a graph.
- It provides the information on the optimal time to sow as well as water stress and nutrient stress support.

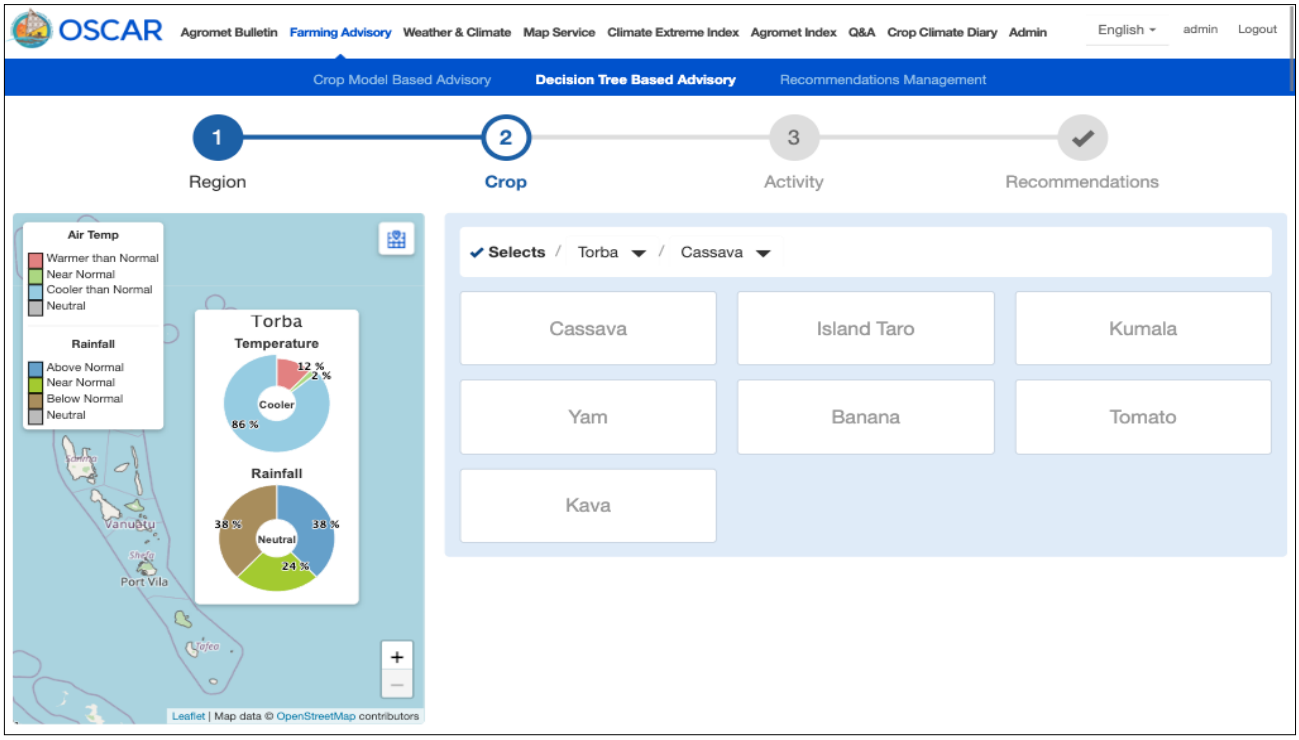
2) Yield prediction service

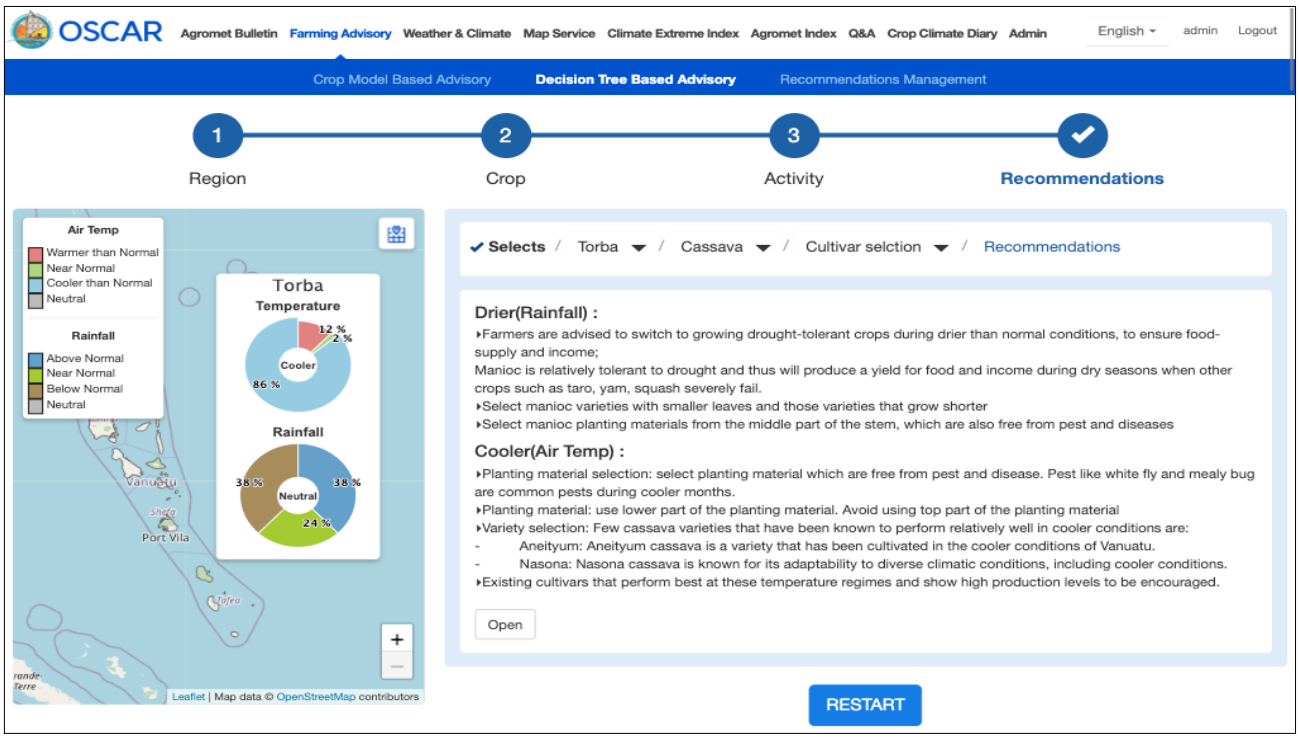


- It uses the result from crop model to compare the yield of each major island against that of the past (the year with the average yield, in the last 5/10 years), which then is presented in a graph.

D. Service of recommendation in a decision-making tree format

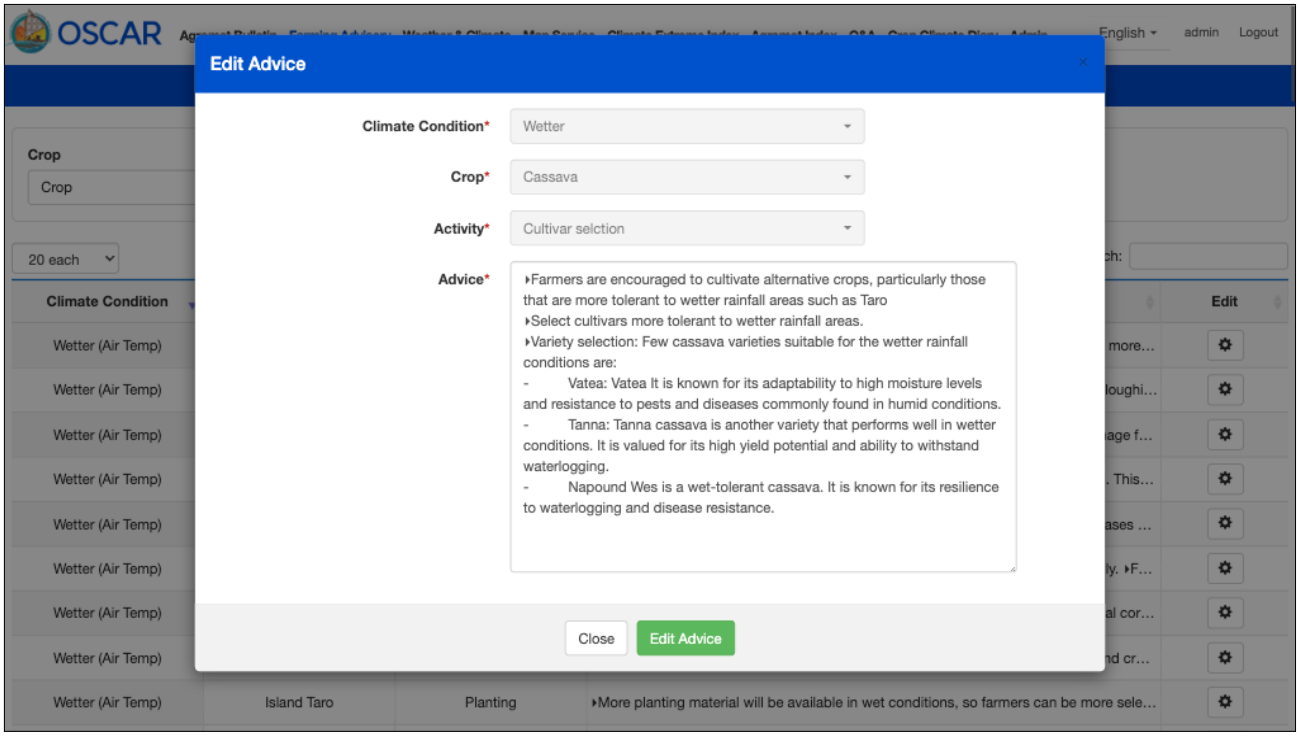
1) Farming decision-making recommendation service





- **It offers optimal farming decision-making recommendations based on seasonal forecast information.**

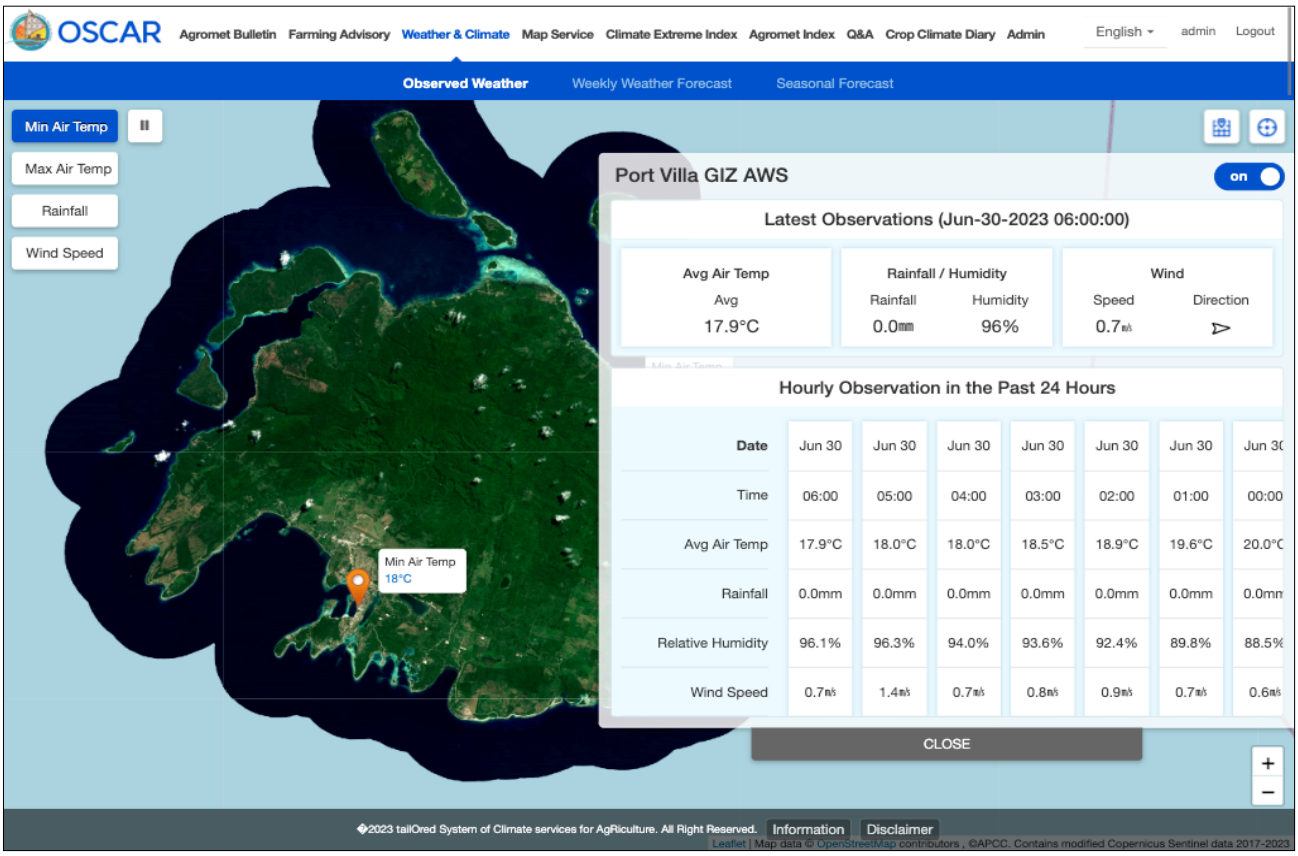
2) Service of editing farming decision-making recommendations



- **It provides a function for administrators to edit the advices about optimal farming decisions based on seasonal forecast information.**

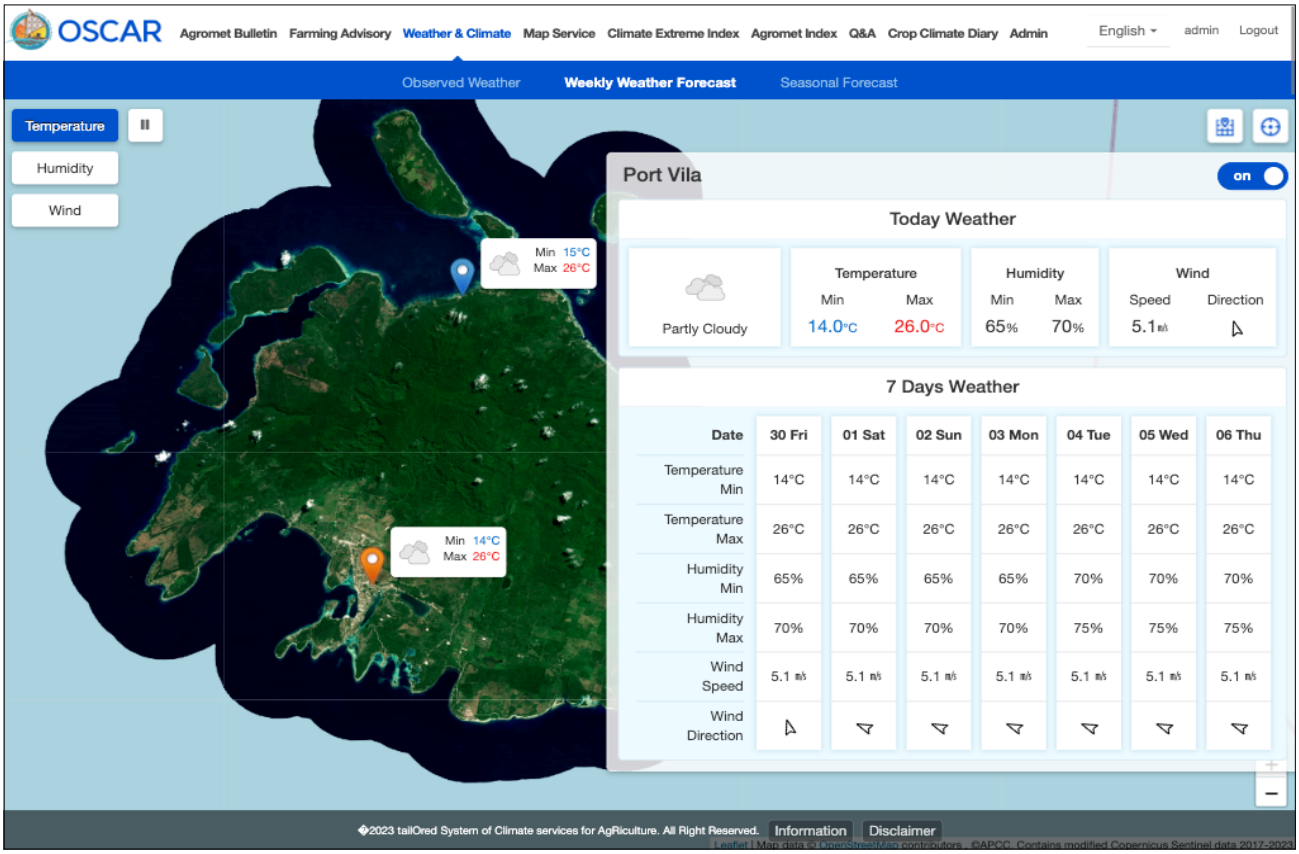
E. Weather & climate information service

1) Today's weather information service



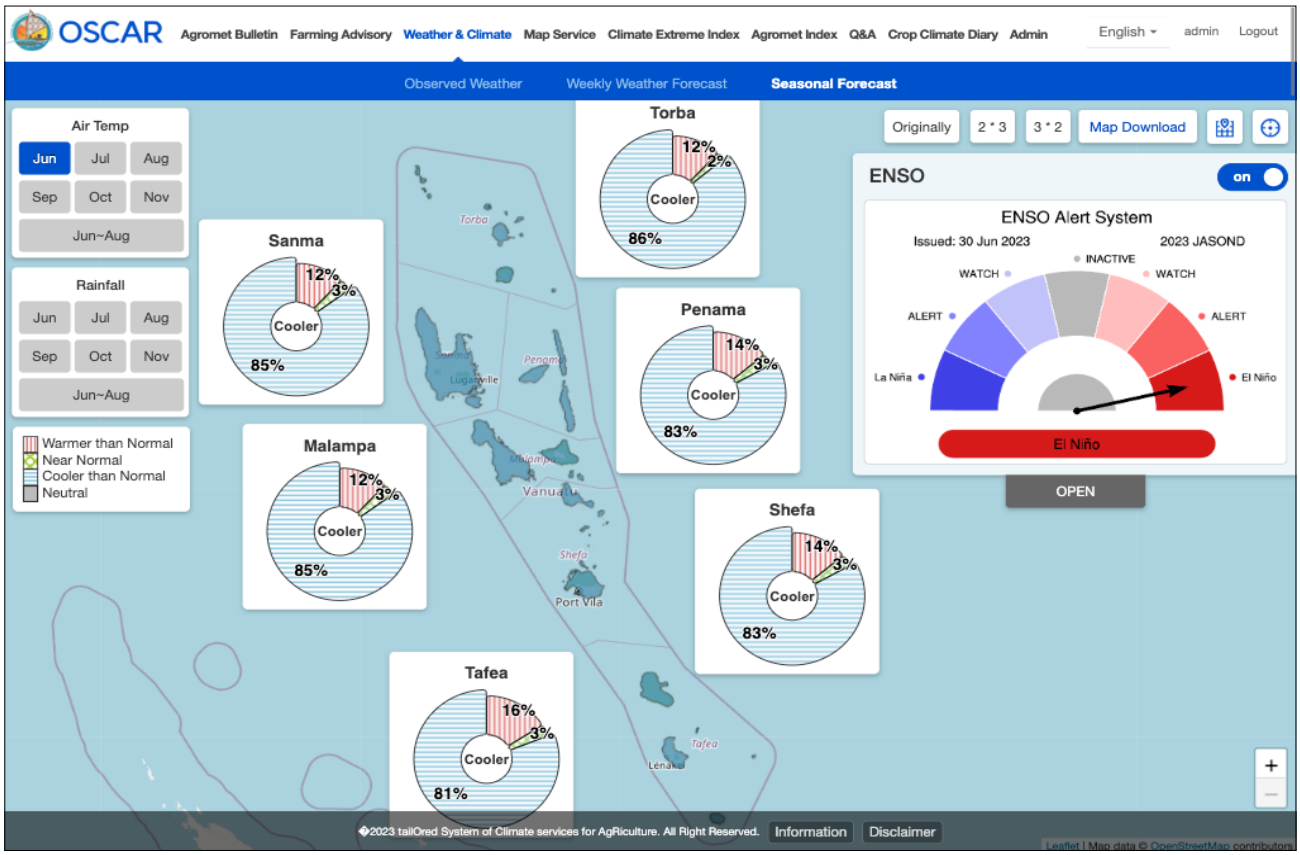
- **It displays on the map the weather data collected from 10 observation points across Vanuatu.**
- **Data in observation: temperature, rainfall, humidity, wind speed and wind direction**

2) Weekly weather forecast service



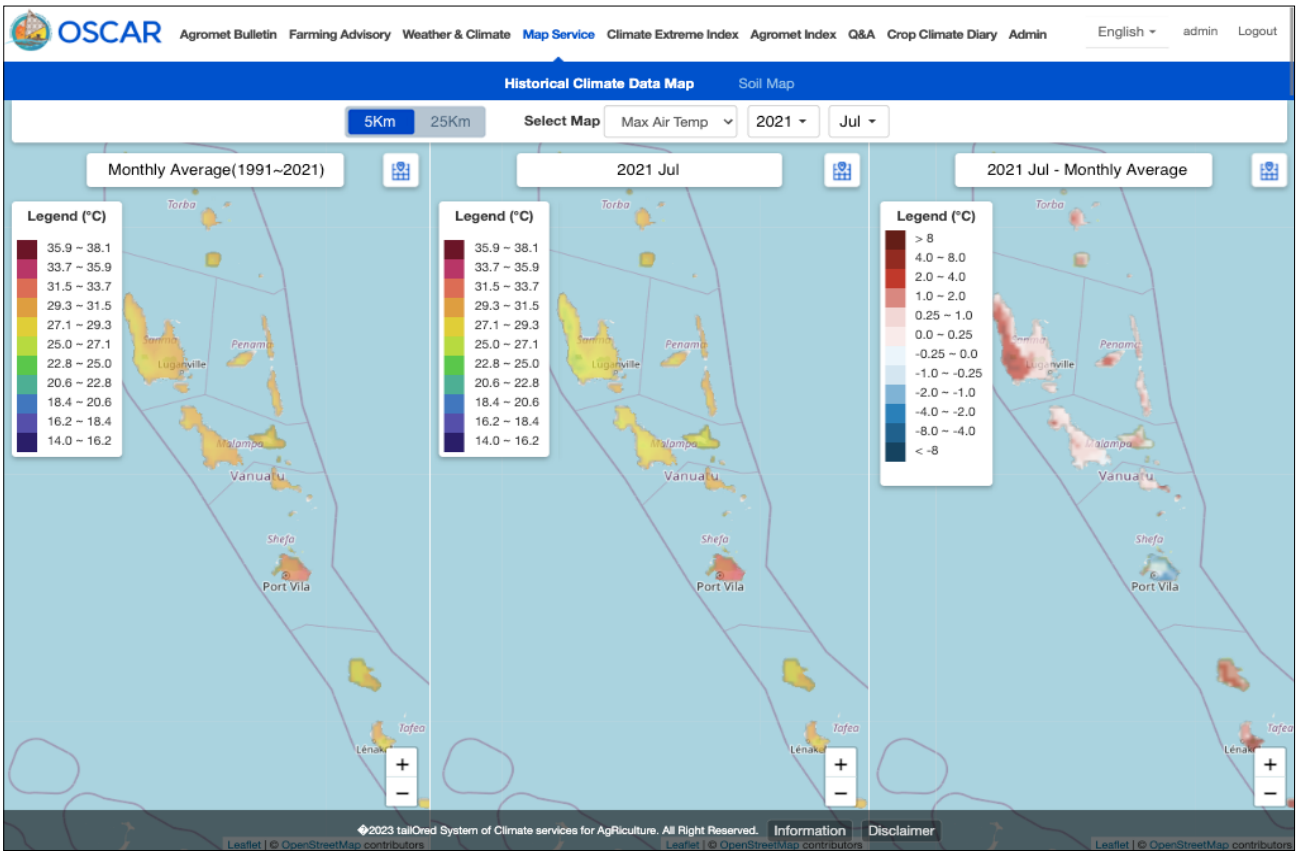
- **It displays on the map of Vanuatu the data on weather of the week, including today, for each of the 10 observation points.**
- **Forecast items: weather, temperature (the highest/lowest), rainfall, humidity (the highest/lowest), wind speed and wind direction**

2) Seasonal forecast service



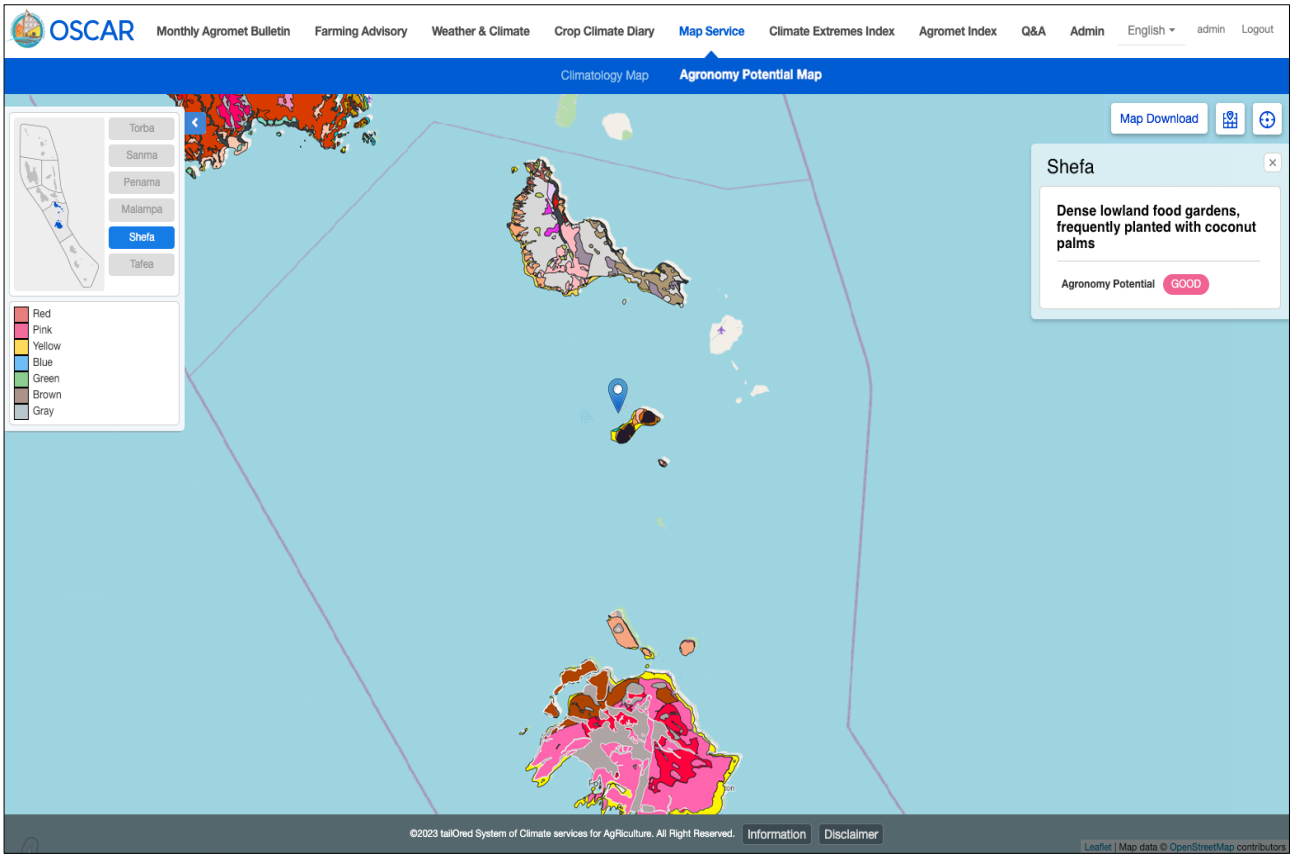
- It presents seasonal forecast information in a chart on 6 Vanuatu islands along with ENSO forecast information.
- Forecast items: temperature, rainfall and ENSO

F. Climatological normal information service



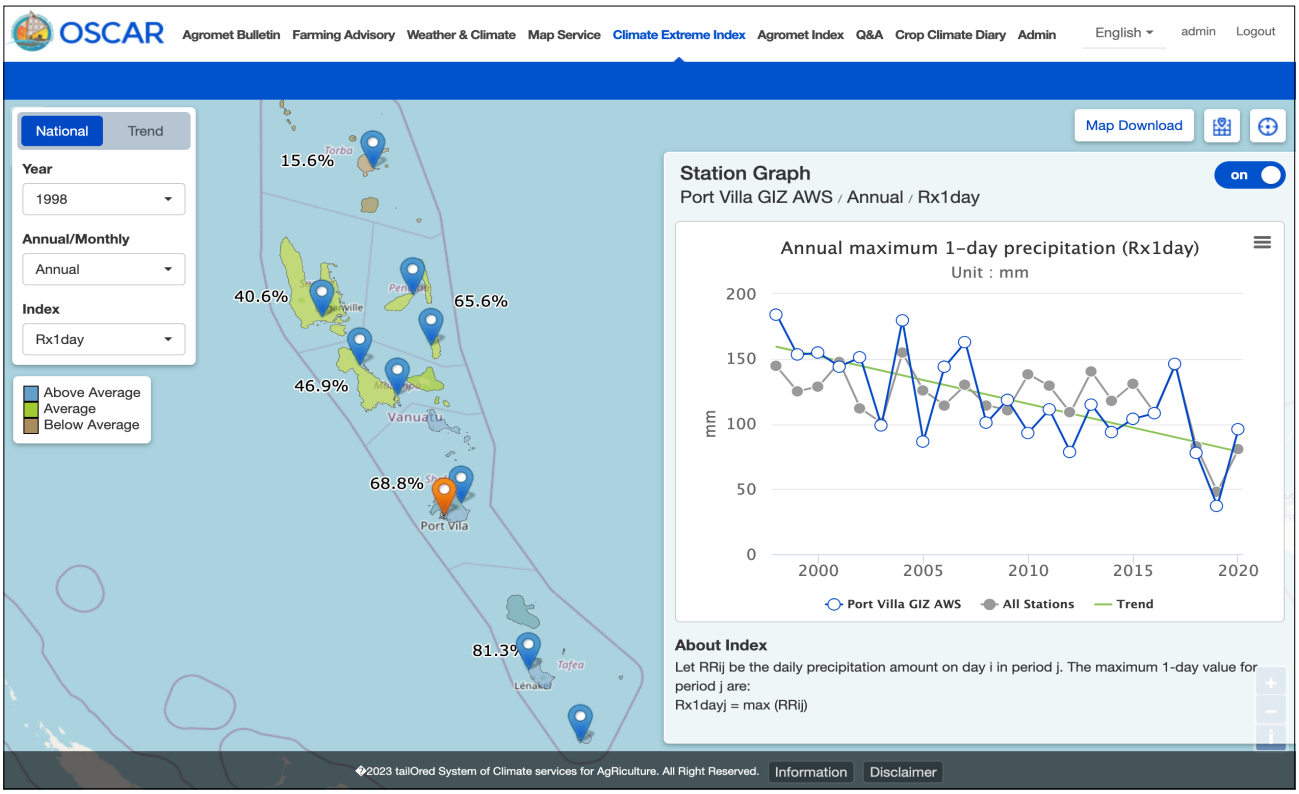
- It presents the maps of the index data generated based on daily climate data for a selected month, of climatological normal, and of the differences between the two.

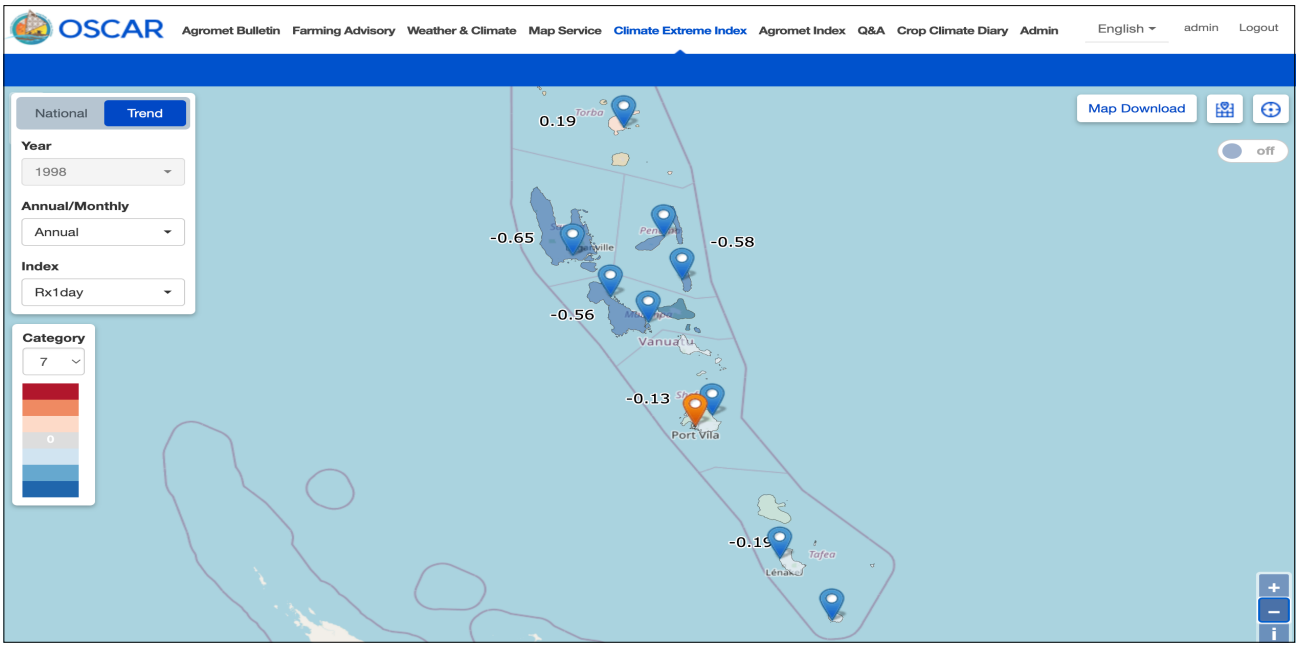
G. Vanuatu soil map service



- **It displays the images of soil attributes in Vanuatu on the GIS-based map.**
- **Attribute information: depth of the earth, soil organic matter and soil inorganic matter**

H. Climate extreme index information service

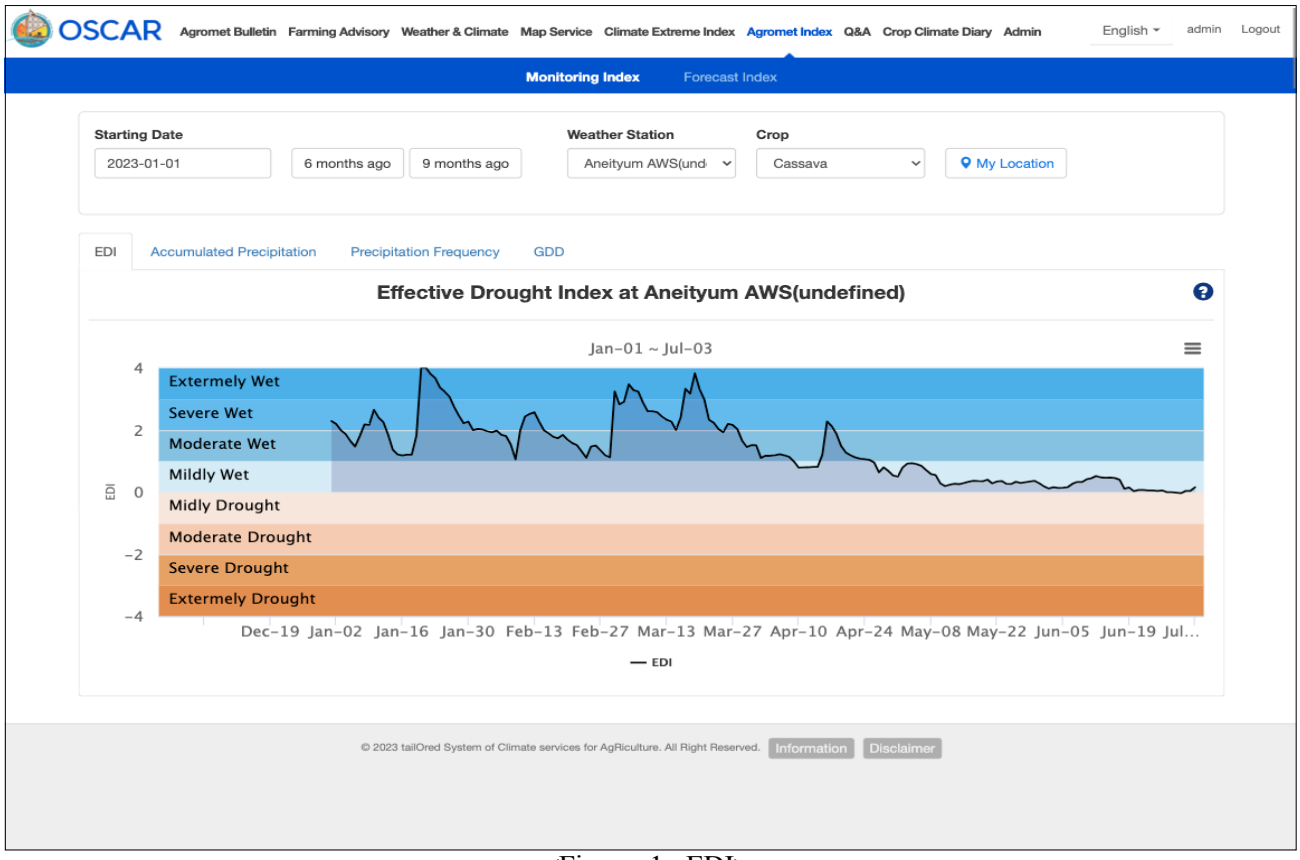




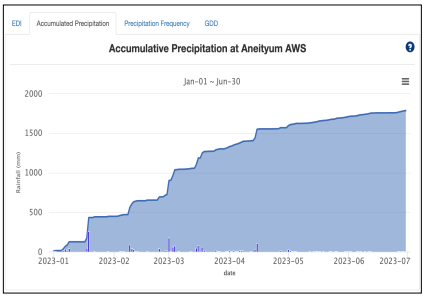
- It calculates the climate extreme index with the data on the weather observed in Vanuatu for the last 30 years, and runs statistical analysis per observation point, per region and per trend, which is then displayed on the map.
- Weather element information: precipitation, maximum/minimum temperature

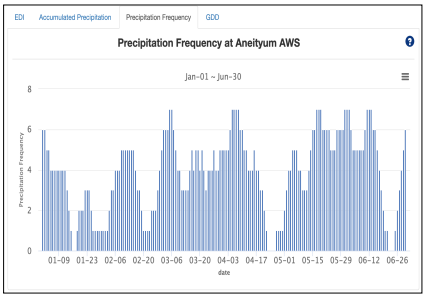
I. Agromet index service

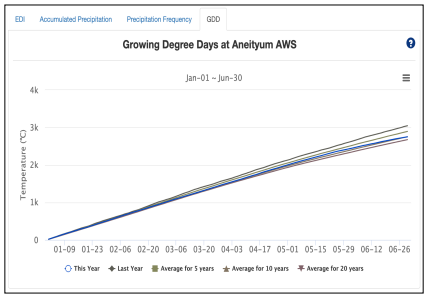
1) Agromet index based on the observed weather data



<Figure 1. EDI>



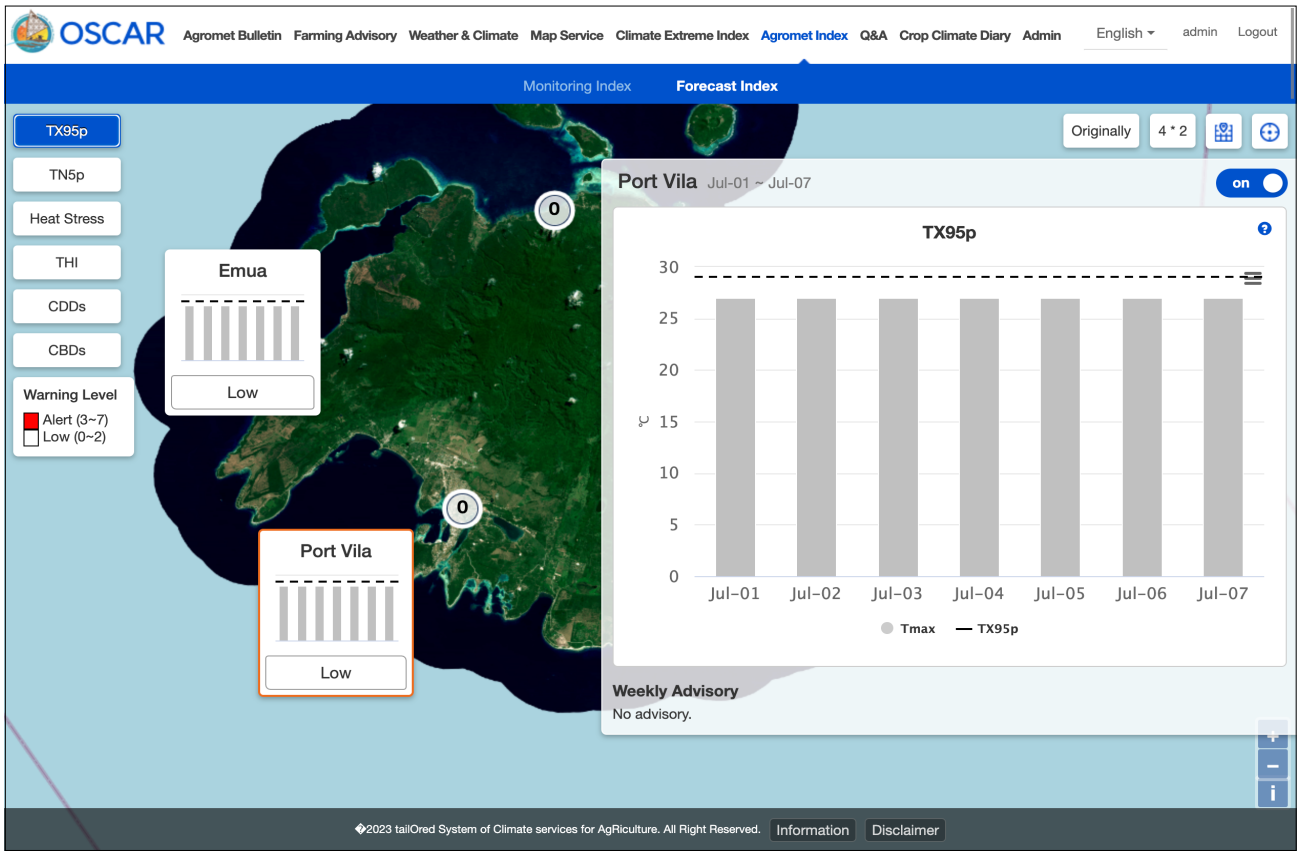




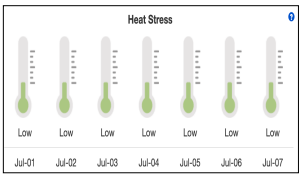
<Figure 2. Accumulated Precipitation, Figure 3. Precipitation Frequency, Figure 4. GDD>

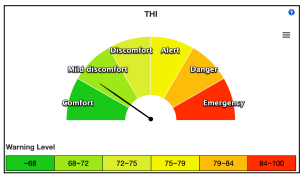
- **It provides EDI, accumulated precipitation, precipitation frequency, and GDD as agromet index that uses the observed weather data.**

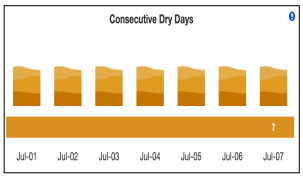
2) Weather forecast data-based agromet index

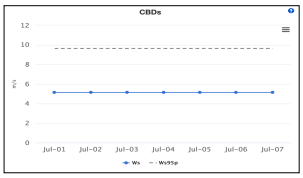


<Figure 1. TX95p>





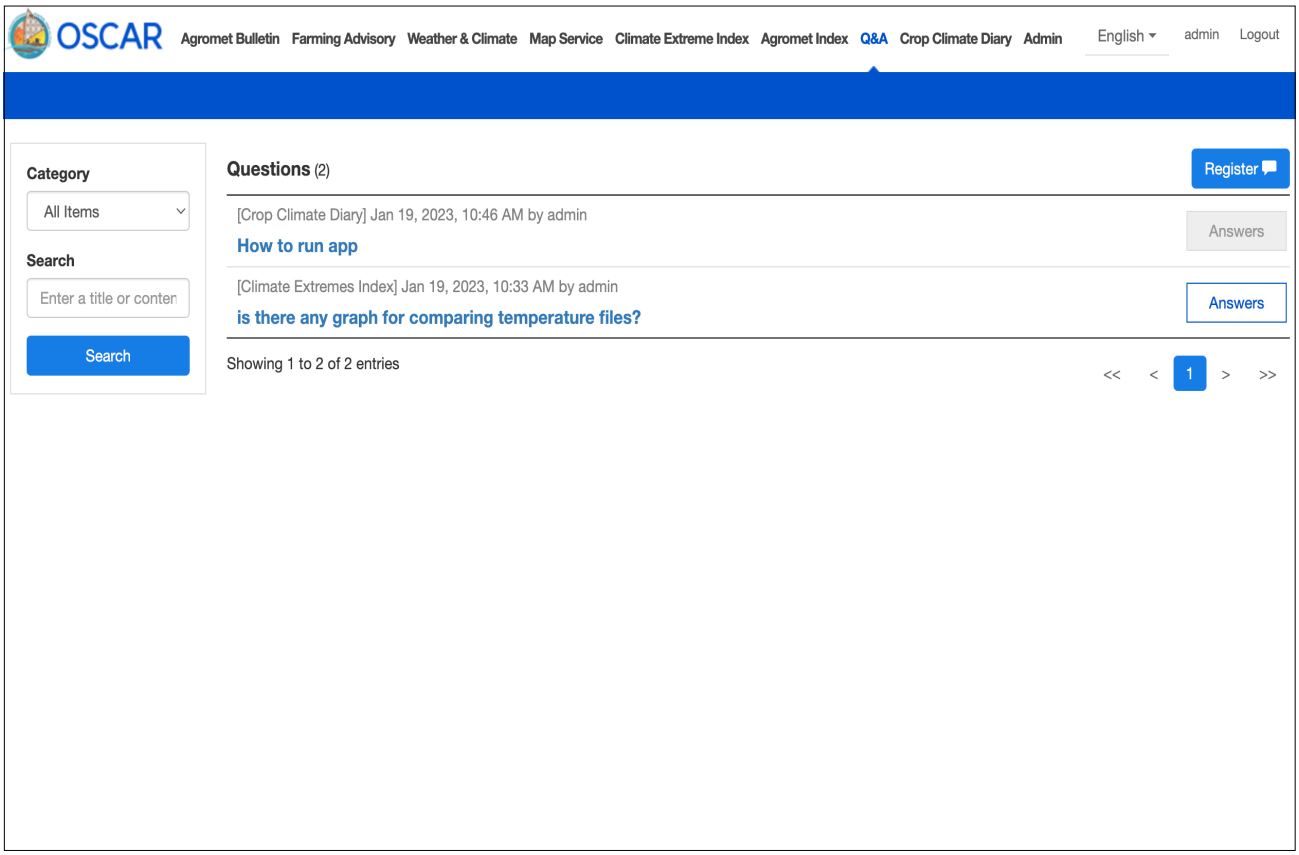




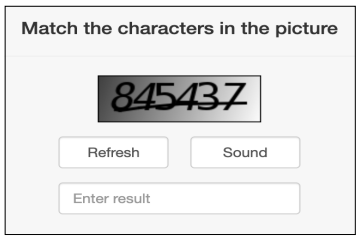
<Figure 2. Heat Stress, figure 3. THI, figure 4. CCDs, figure 5. CBDs>

- **It presents agromet index in maps and charts per observation point with VMGD's 7-day forecast data.**
- **Provided items: TX95p, TN5p, heat stress, THI, CCDs, and CBDs**

J. Q&A bulletin board service



<Figure 1. A list on the bulletin board>

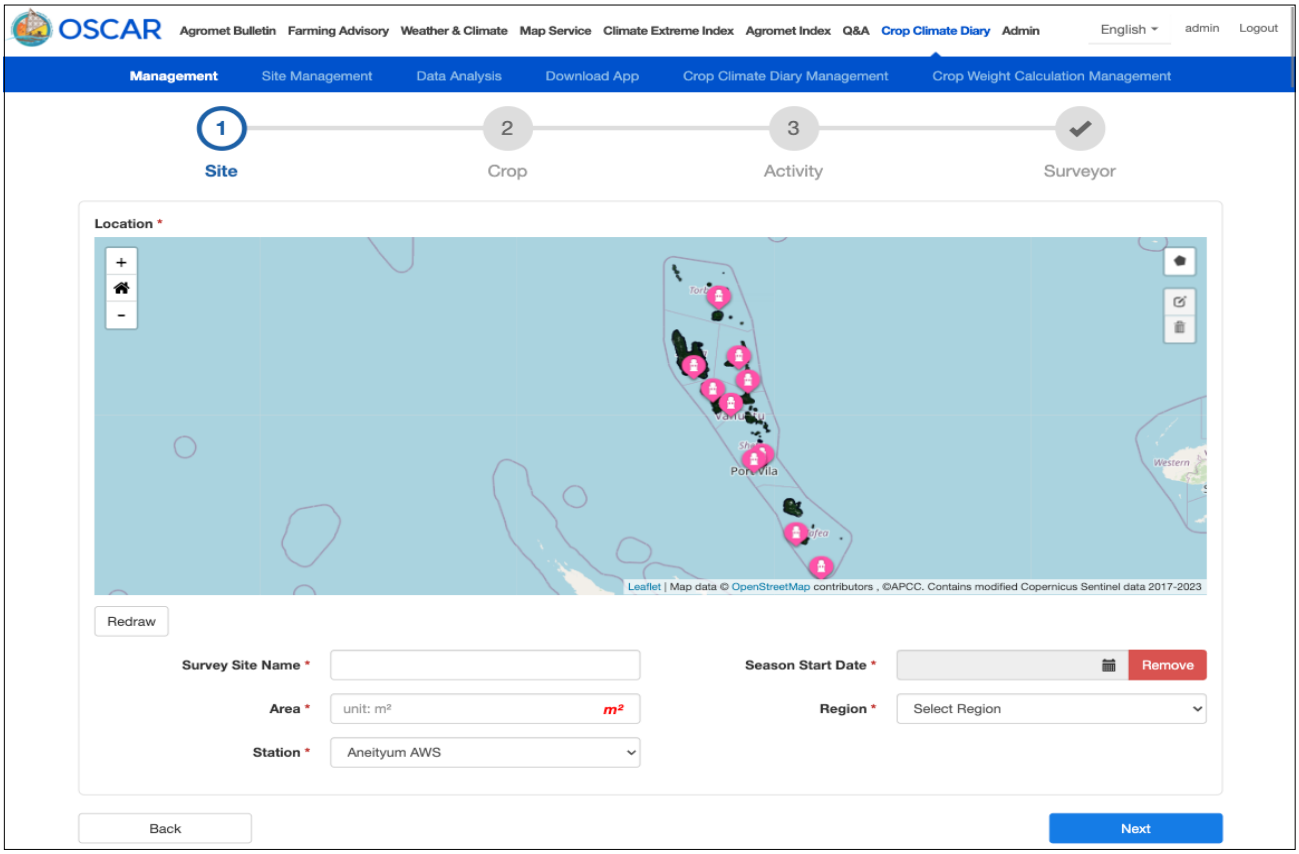


<Figure 2. Spam block function>

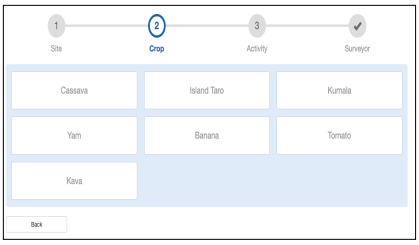
- **It provides a Q&A bulletin board where users can ask and answer questions on the system.**
- **It uses CAPTCHA code to prevent spam and automatic registration.**

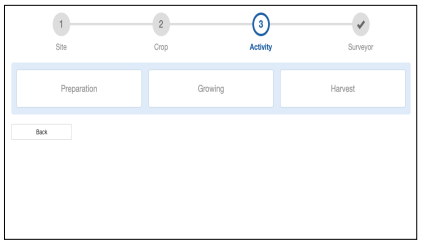
K. Crop Climate Diary service

1) Agricultural produce survey site management service



<Figure 1. Screens for entering site information>

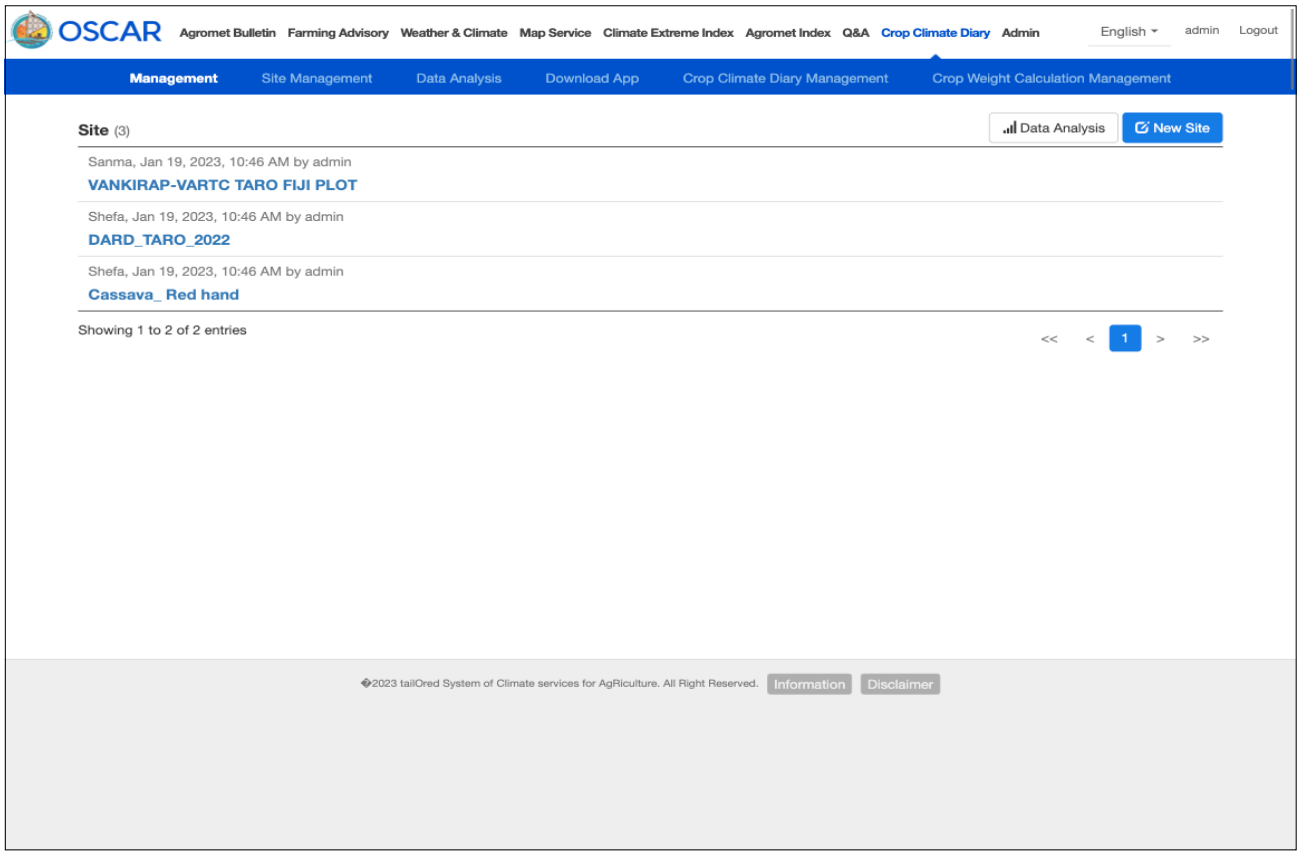




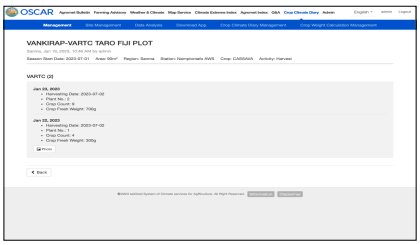
<Figure 2. Screens for selecting a crop, Figure 3. Screens for selecting an activity, Figure 4. Screens for selecting a surveyor>

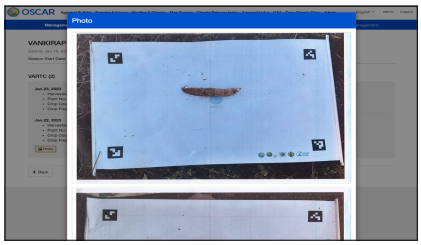
- **It provides a function to register a site for surveying agricultural produce and select a surveyor for the site.**

2) Registered survey management service



<Figure 1. Screens with the list of sites>



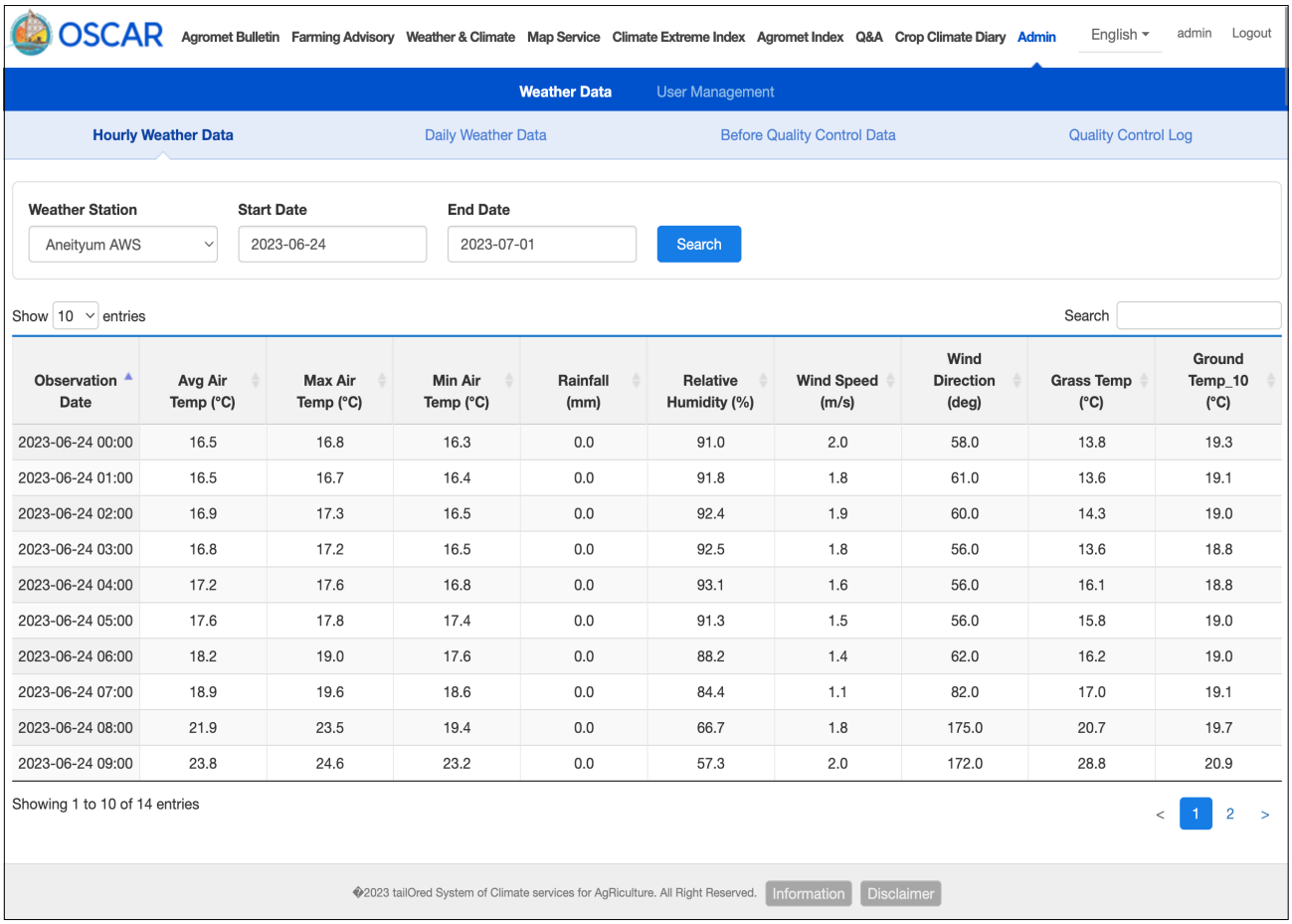


<Figure 2. Screens with the information on survey activities, Figure 3. Screens with photos of survey activity>

- **It provides a function to check the details of the survey registered on-site by a surveyor on Crop Climate Diary app.**

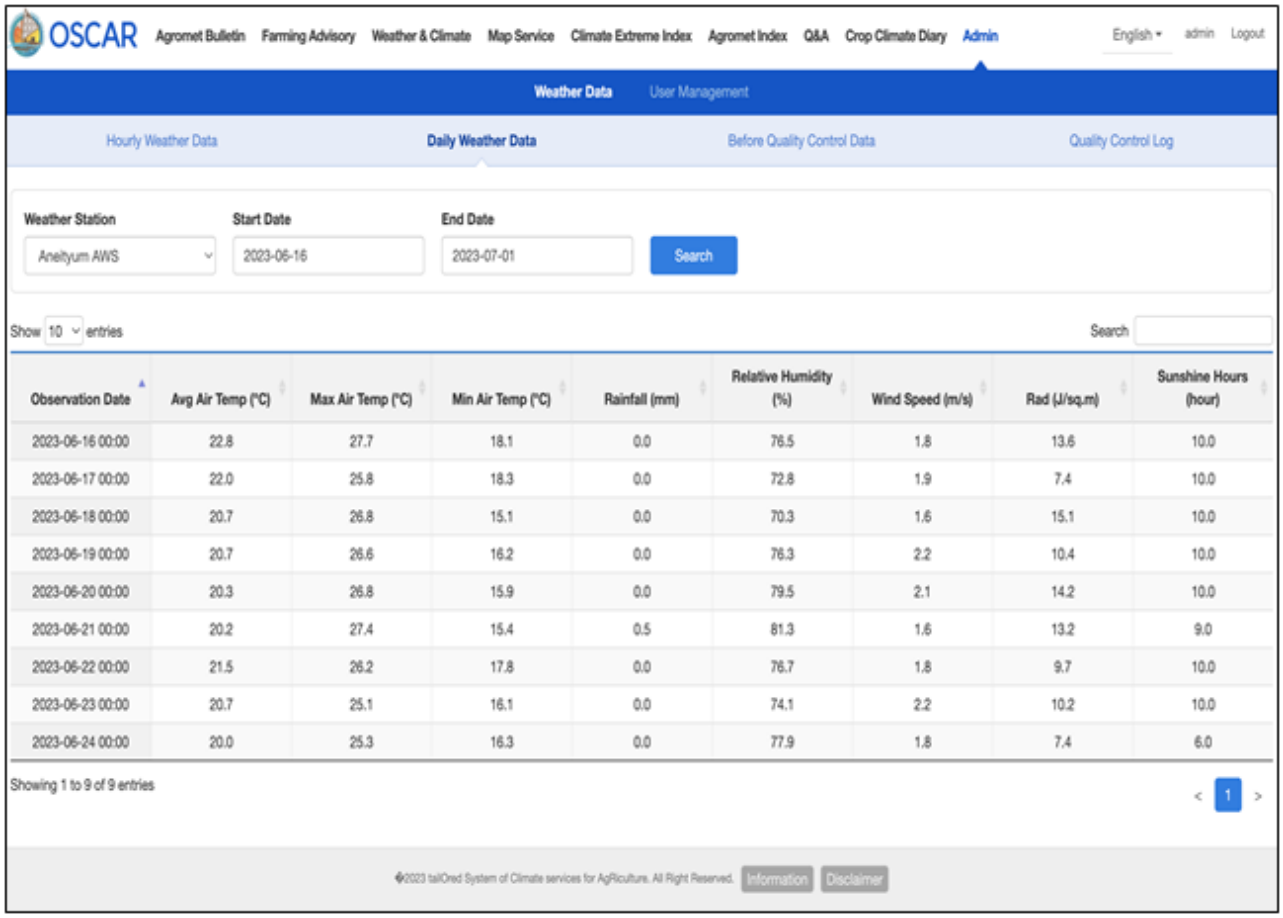
L. Administrator service

1) Weather data per time point



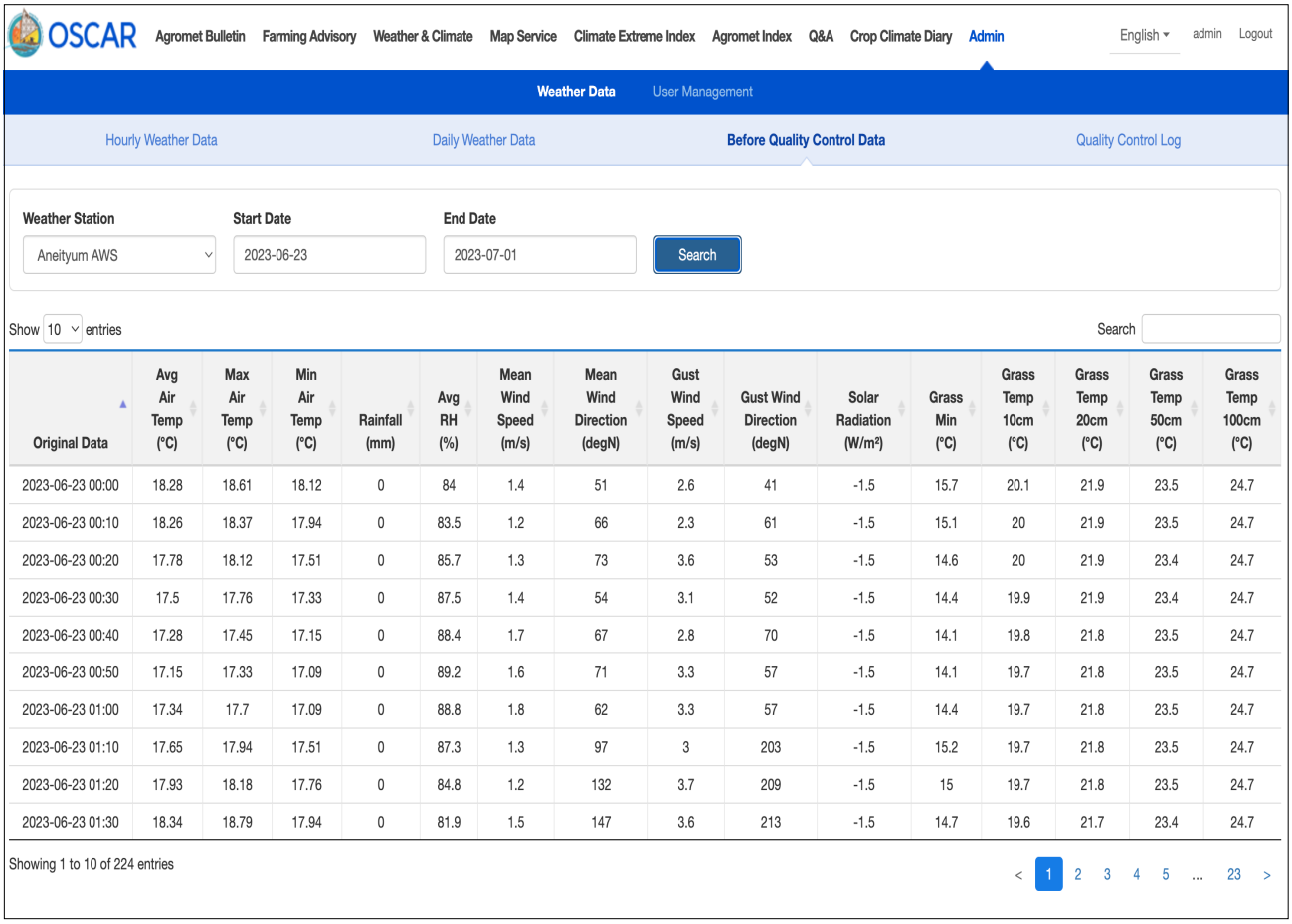
- **It is possible to search weather data collected per time point by place of observation and weather.**

2) Daily weather data



- **It is possible to search daily collected weather data by place of observation and weather.**

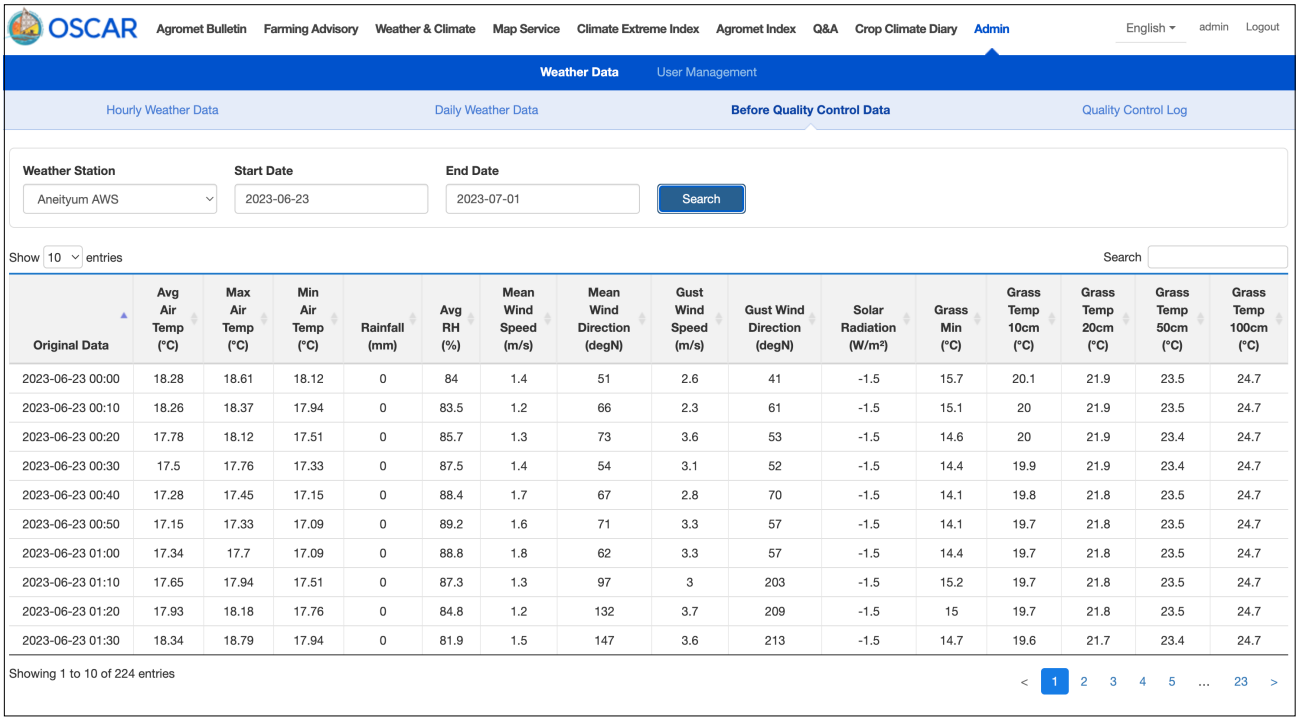
3) Original weather data



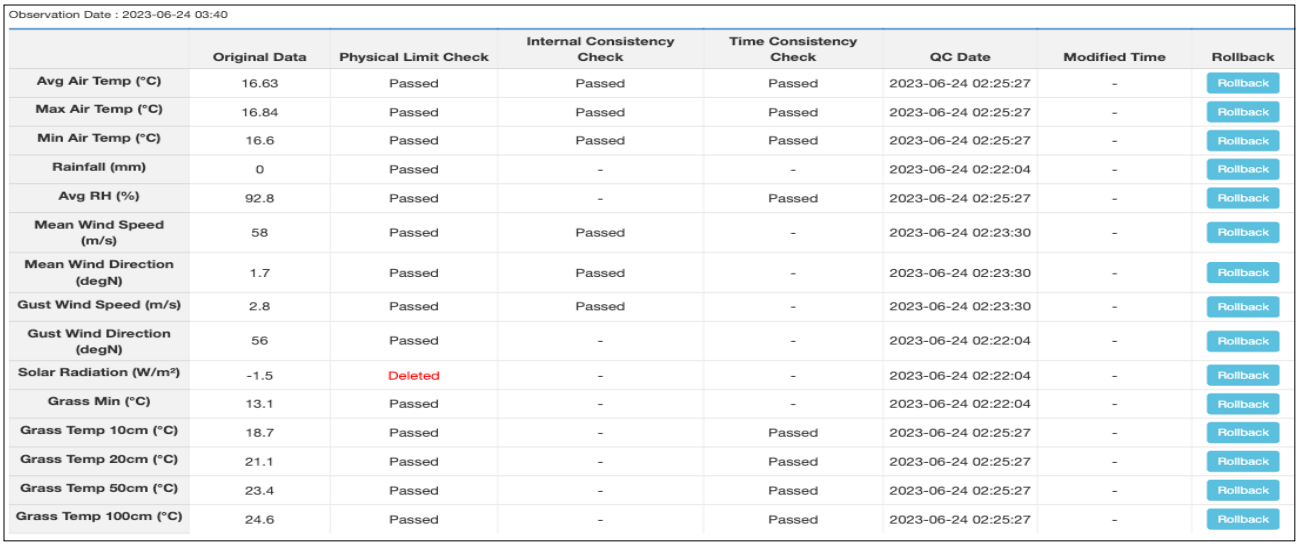
Original Data	Avg Air Temp (°C)	Max Air Temp (°C)	Min Air Temp (°C)	Rainfall (mm)	Avg RH (%)	Mean Wind Speed (m/s)	Mean Wind Direction (degN)	Gust Wind Speed (m/s)	Gust Wind Direction (degN)	Solar Radiation (W/m²)	Grass Min (°C)	Grass Temp 10cm (°C)	Grass Temp 20cm (°C)	Grass Temp 50cm (°C)	Grass Temp 100cm (°C)
2023-06-23 00:00	18.28	18.61	18.12	0	84	1.4	51	2.6	41	-1.5	15.7	20.1	21.9	23.5	24.7
2023-06-23 00:10	18.26	18.37	17.94	0	83.5	1.2	66	2.3	61	-1.5	15.1	20	21.9	23.5	24.7
2023-06-23 00:20	17.78	18.12	17.51	0	85.7	1.3	73	3.6	53	-1.5	14.6	20	21.9	23.4	24.7
2023-06-23 00:30	17.5	17.76	17.33	0	87.5	1.4	54	3.1	52	-1.5	14.4	19.9	21.9	23.4	24.7
2023-06-23 00:40	17.28	17.45	17.15	0	88.4	1.7	67	2.8	70	-1.5	14.1	19.8	21.8	23.5	24.7
2023-06-23 00:50	17.15	17.33	17.09	0	89.2	1.6	71	3.3	57	-1.5	14.1	19.7	21.8	23.5	24.7
2023-06-23 01:00	17.34	17.7	17.09	0	88.8	1.8	62	3.3	57	-1.5	14.4	19.7	21.8	23.5	24.7
2023-06-23 01:10	17.65	17.94	17.51	0	87.3	1.3	97	3	203	-1.5	15.2	19.7	21.8	23.5	24.7
2023-06-23 01:20	17.93	18.18	17.76	0	84.8	1.2	132	3.7	209	-1.5	15	19.7	21.8	23.5	24.7
2023-06-23 01:30	18.34	18.79	17.94	0	81.9	1.5	147	3.6	213	-1.5	14.7	19.6	21.7	23.4	24.7

- **It provides original weather data that has not gone through quality control. It is possible to search the data by place of observation and weather.**

4) Quality-controlled weather observation data

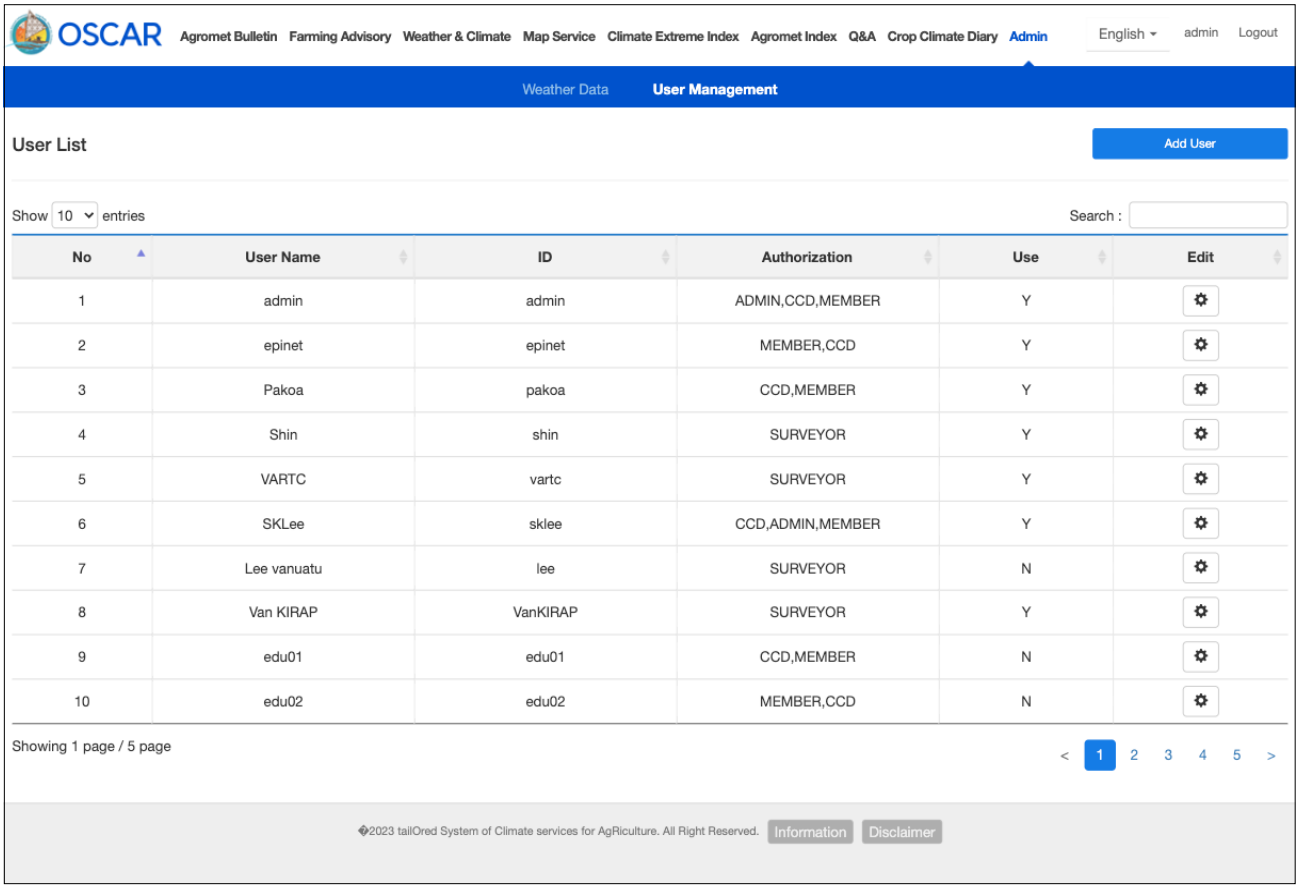


- Quality-controlled weather observation data is available for search. The quality control is provided based on the range check (physical limit check, internal consistency check and time consistency check) of quality control techniques of the World Meteorological Organization (WMO).



- It is possible to verify the details of quality-controlled data with a function to reverse it to the original data.

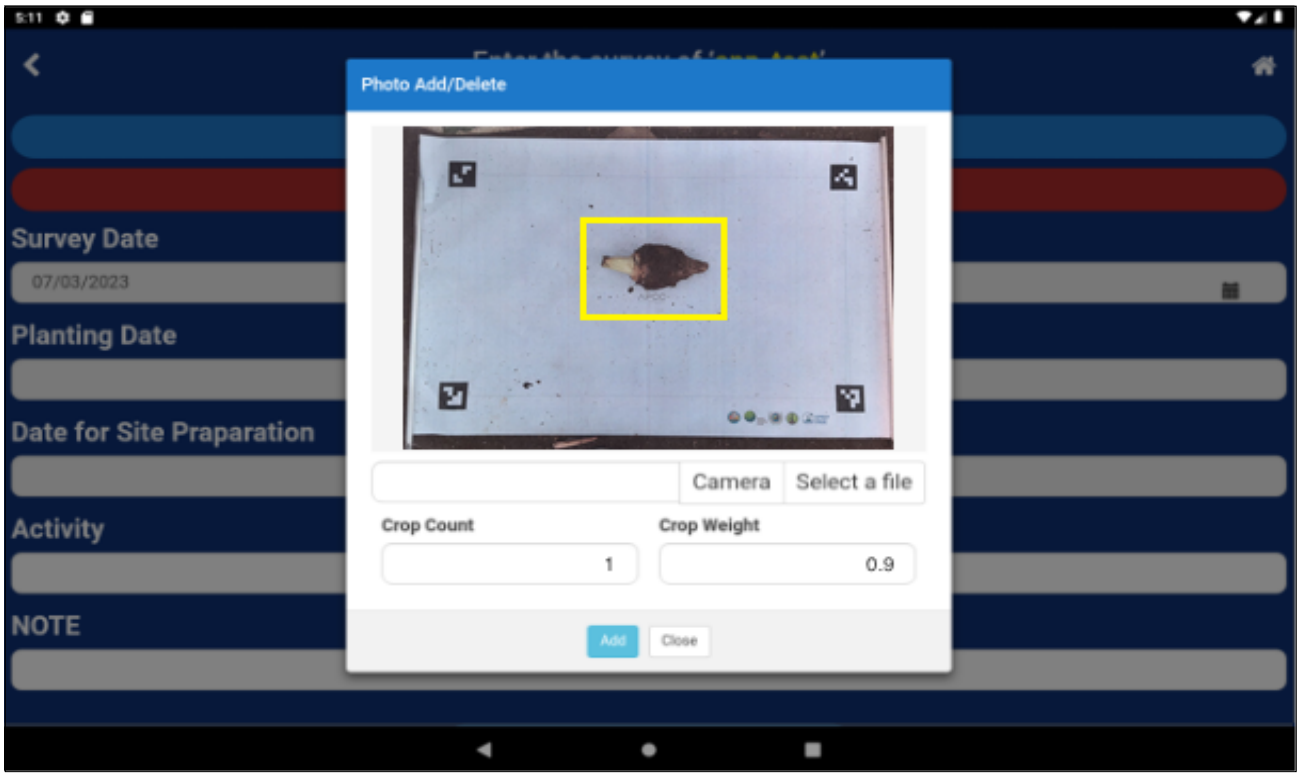
5) User management service

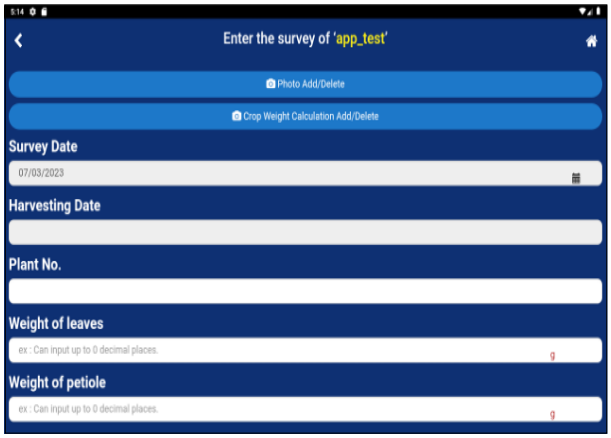


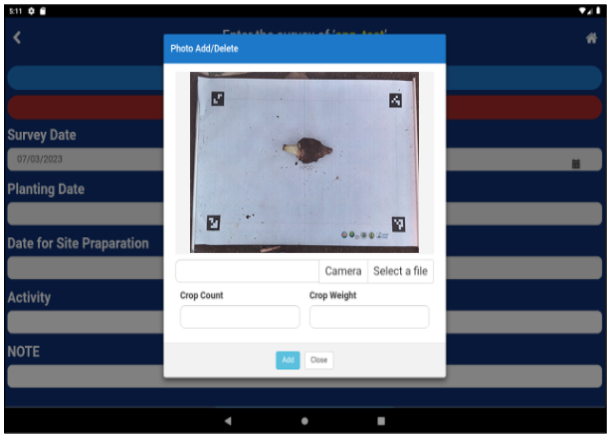
- It provides a function to add, edit and delete users who use OSCAR system.
- Authorization: member, surveyor, CCD, and administrator

M. Crop climate diary App service

1) Crop Weight Measurement







<Figure 1. Result screen, Figure 2. Input screen, Figure 3. Photo screen>

- **This is a function to calculate the weight of crops that has been added to the Crop-Climate Diary app**
- **It provides the number and weight of crops using computer vision techniques.**

2) Off-line Map Update

<Figure 1. Off-line Map>

- **Updated map that can be checked offline.**

4. Information on Database

A. Basic information on database

Organization name	Vanuatu Meteorology and Geohazards Department	Department name	(Insert)
Applicable task	Building agro-climate information service system in Vanuatu		

DB name	OSCAR	The number of tables	98 (Including the tables on environmental data)
DB identification name	oscar	Date of completion	July 2023
Topic area	Agricultural weather and climate, and agriculturally applicable information		
DB description	Vanuatu's agro-climate information service data		
Database server specifications			
Type of DBMS	PostgreSQL		
DBMS version	12.2		
Operating system	Linux (CentOS 7)		

B. Logic ERD information

☐ **Common**

배치_에러_로그

날짜시간 배치_이름 로그

외부_url

url_코드
url 비고 텍스트_url

배치_상태

배치_아이디
시작_dttm 종료_dttm 현재_구동_여부 비고

코드_공통

코드_번호
코드_이름

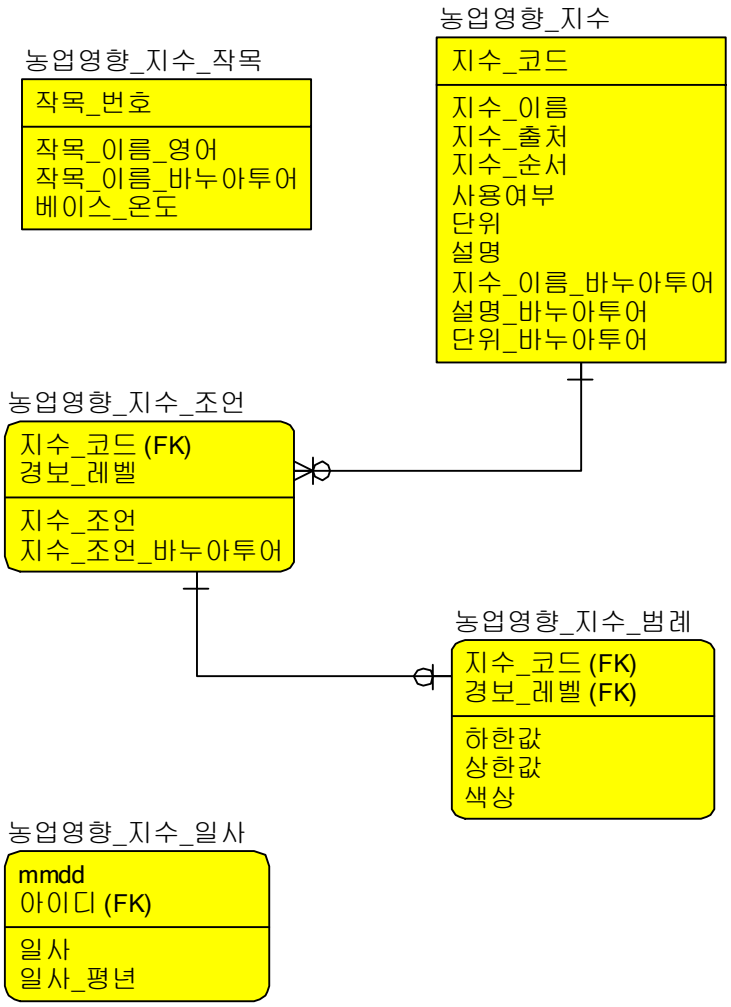
코드_하위

메인_번호 하위_번호
하위_이름

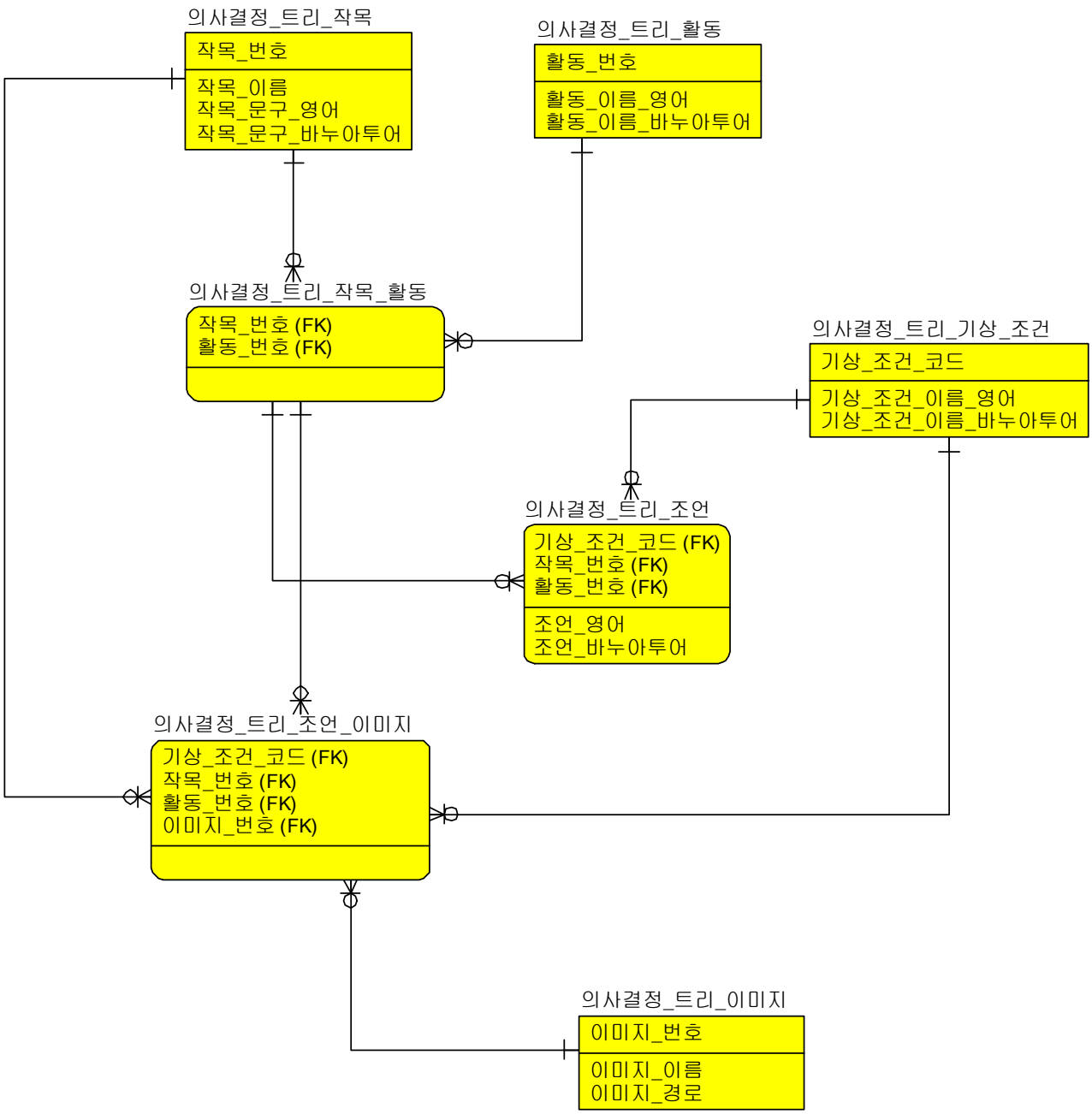
지역

지역_번호
지역_이름 지역_깊이 상위_지역_번호 활성화 폴리곤_지오메트리

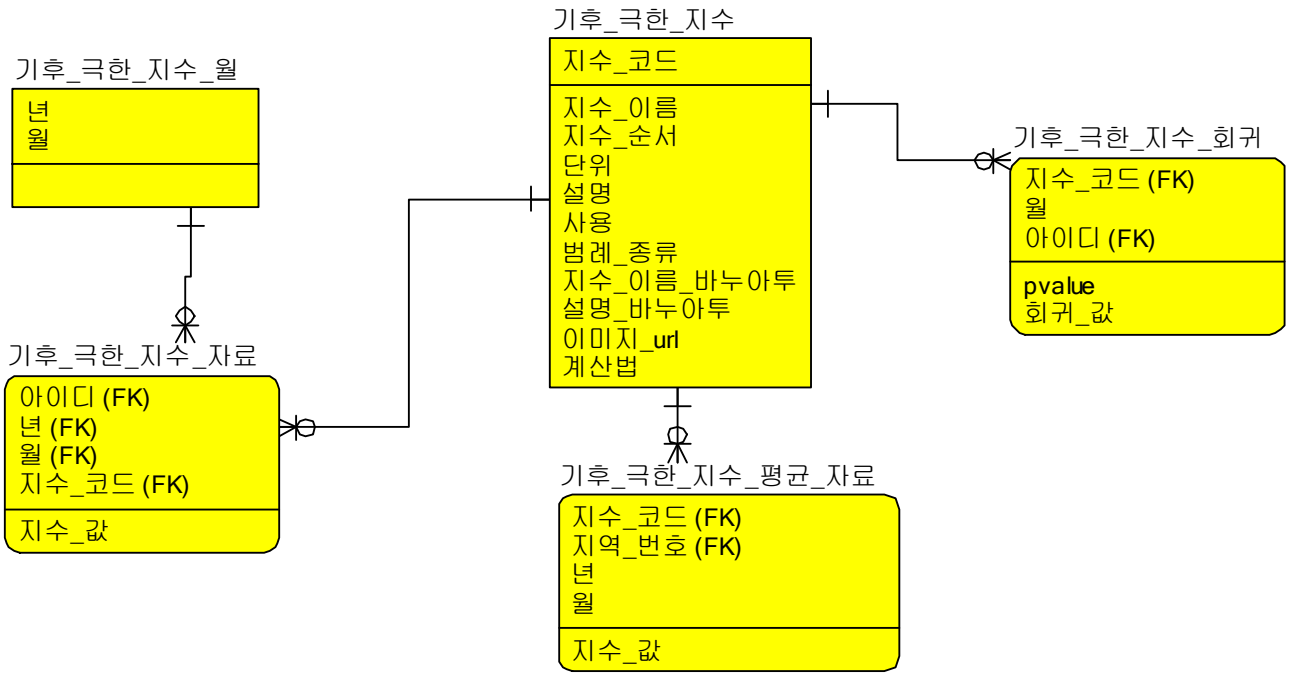
□ Agromet index data



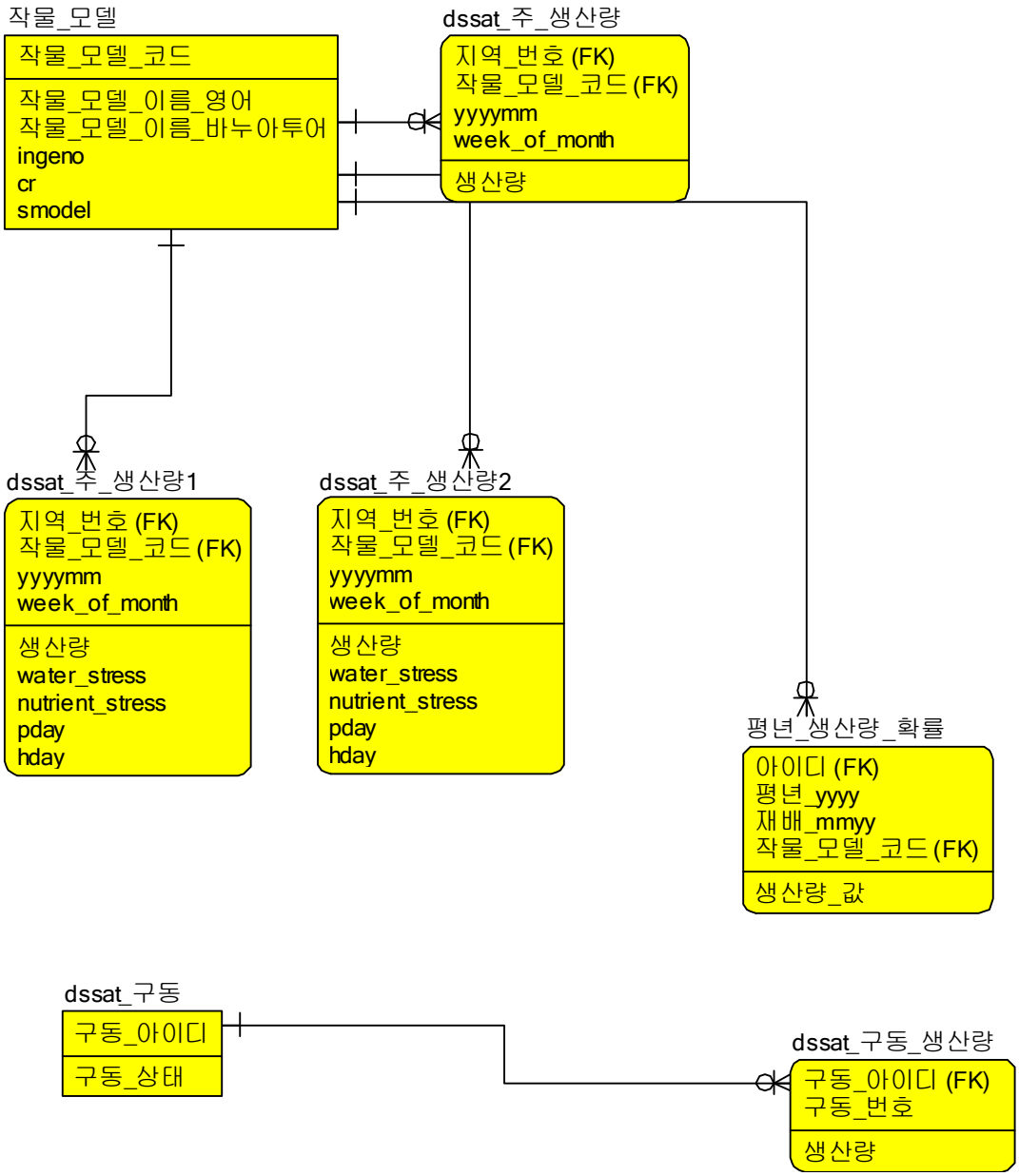
□ Decision-making tree data



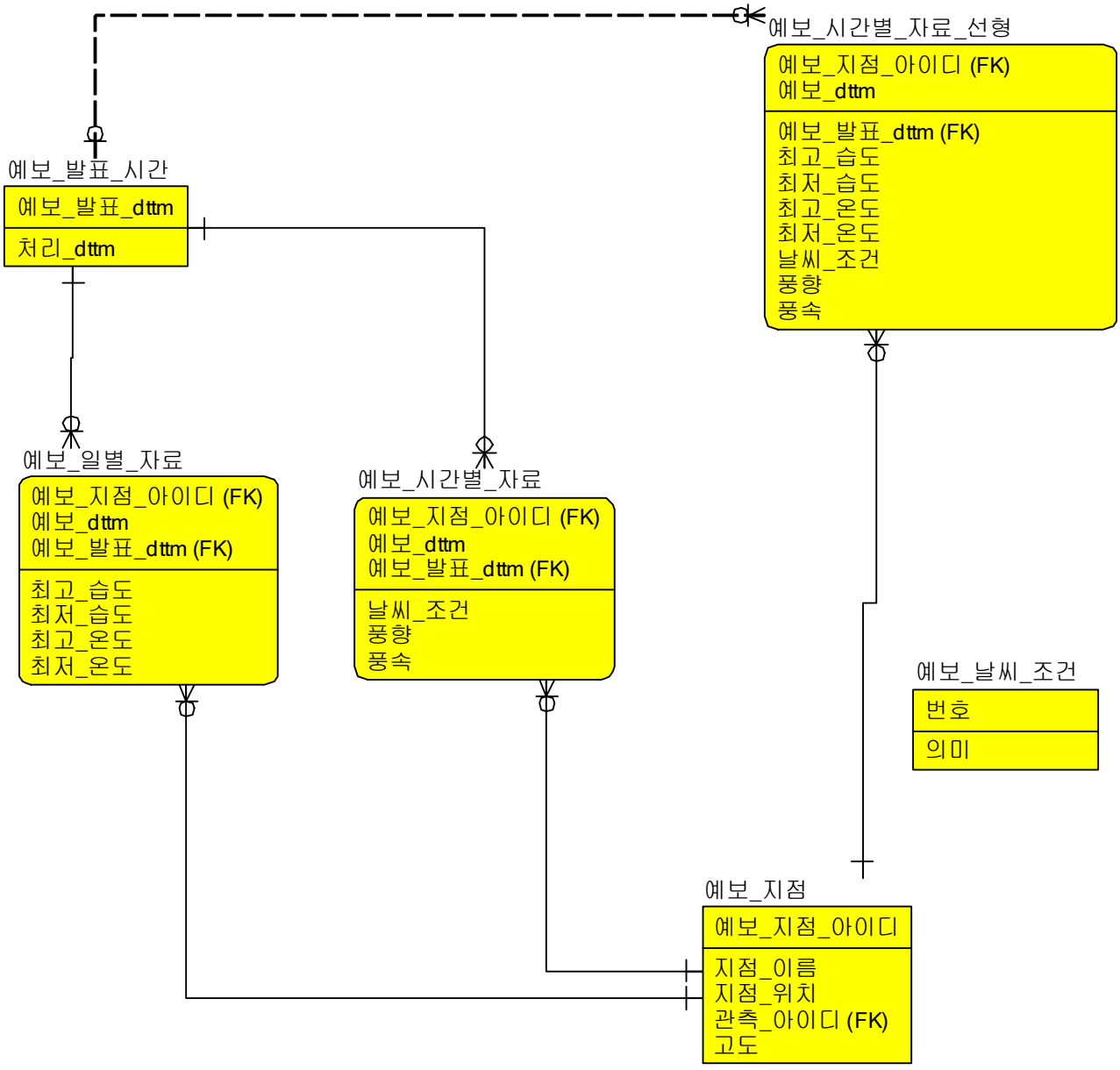
□ Climate extreme index data



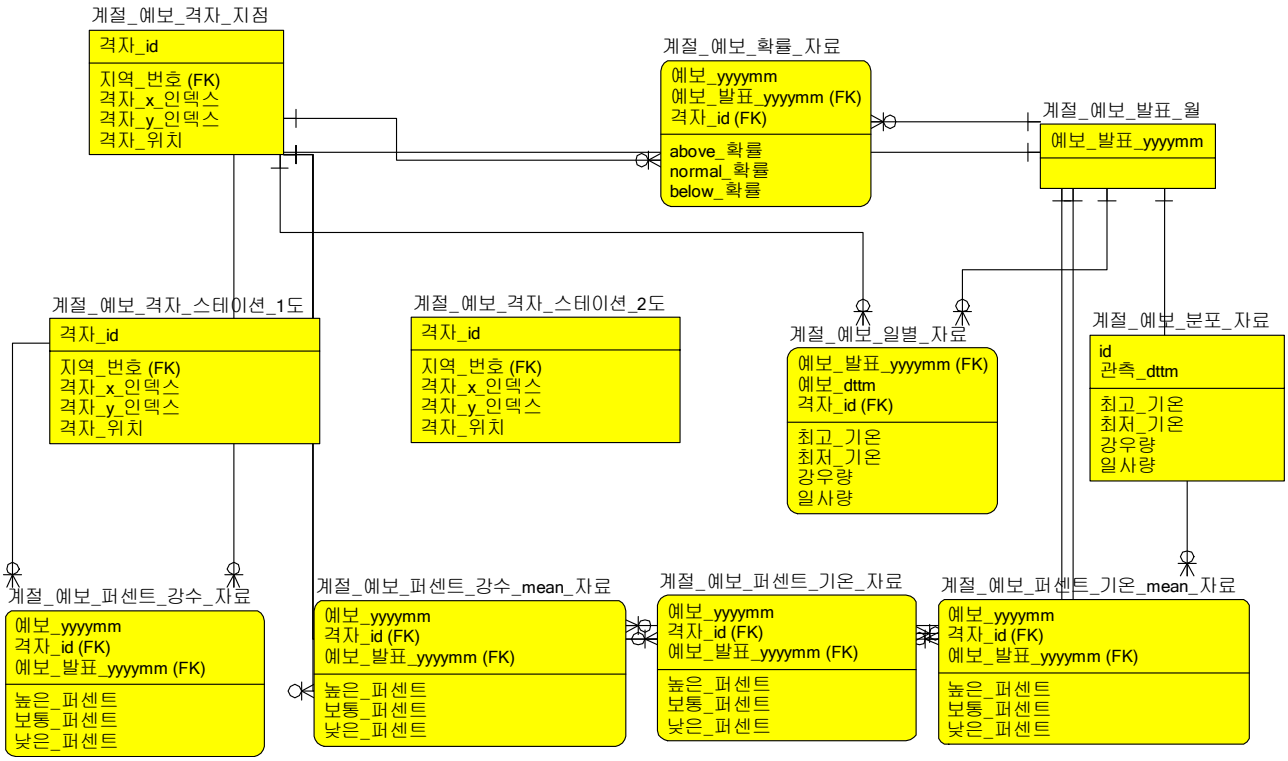
☐ Crop model operation data



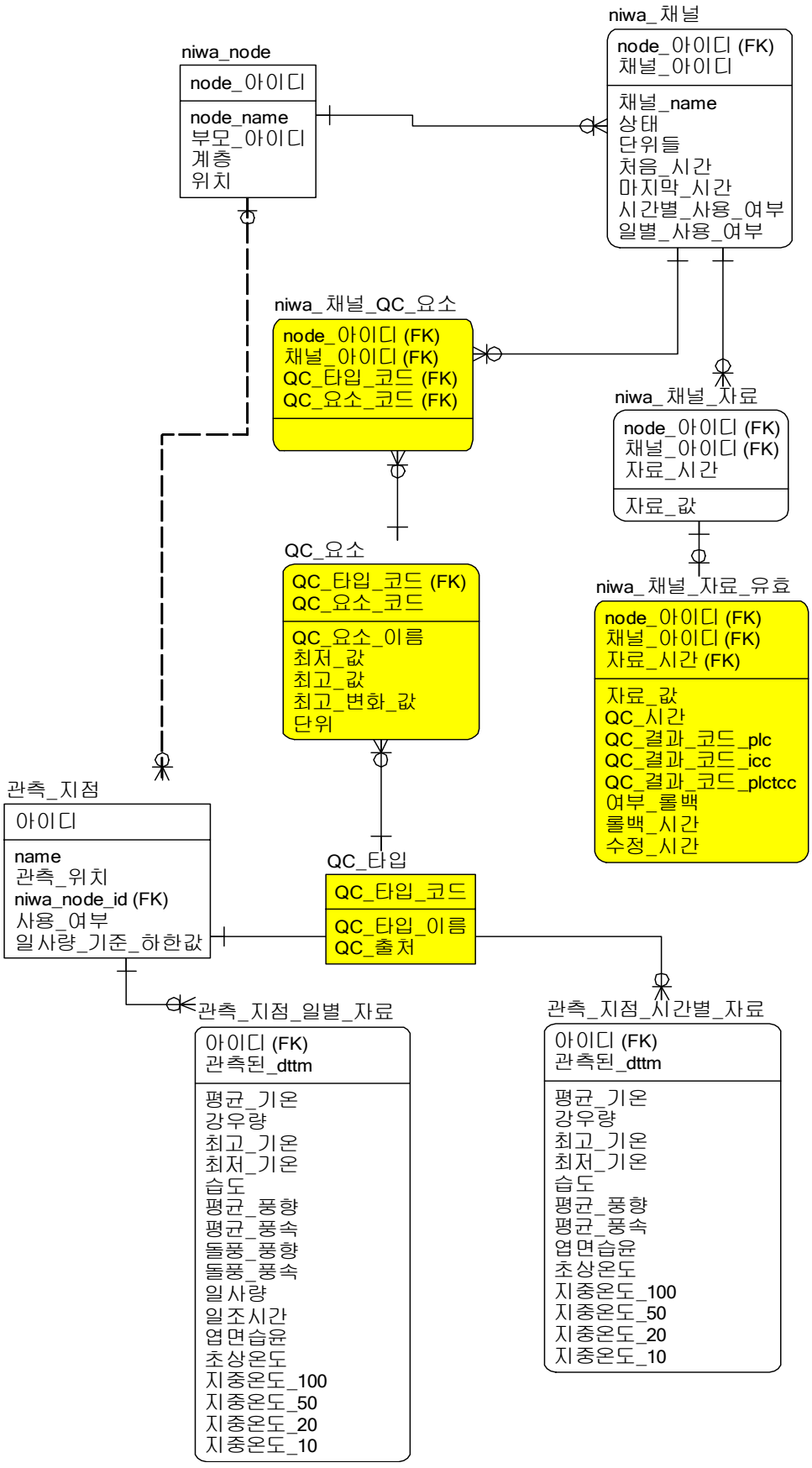
□ 7-day forecast data



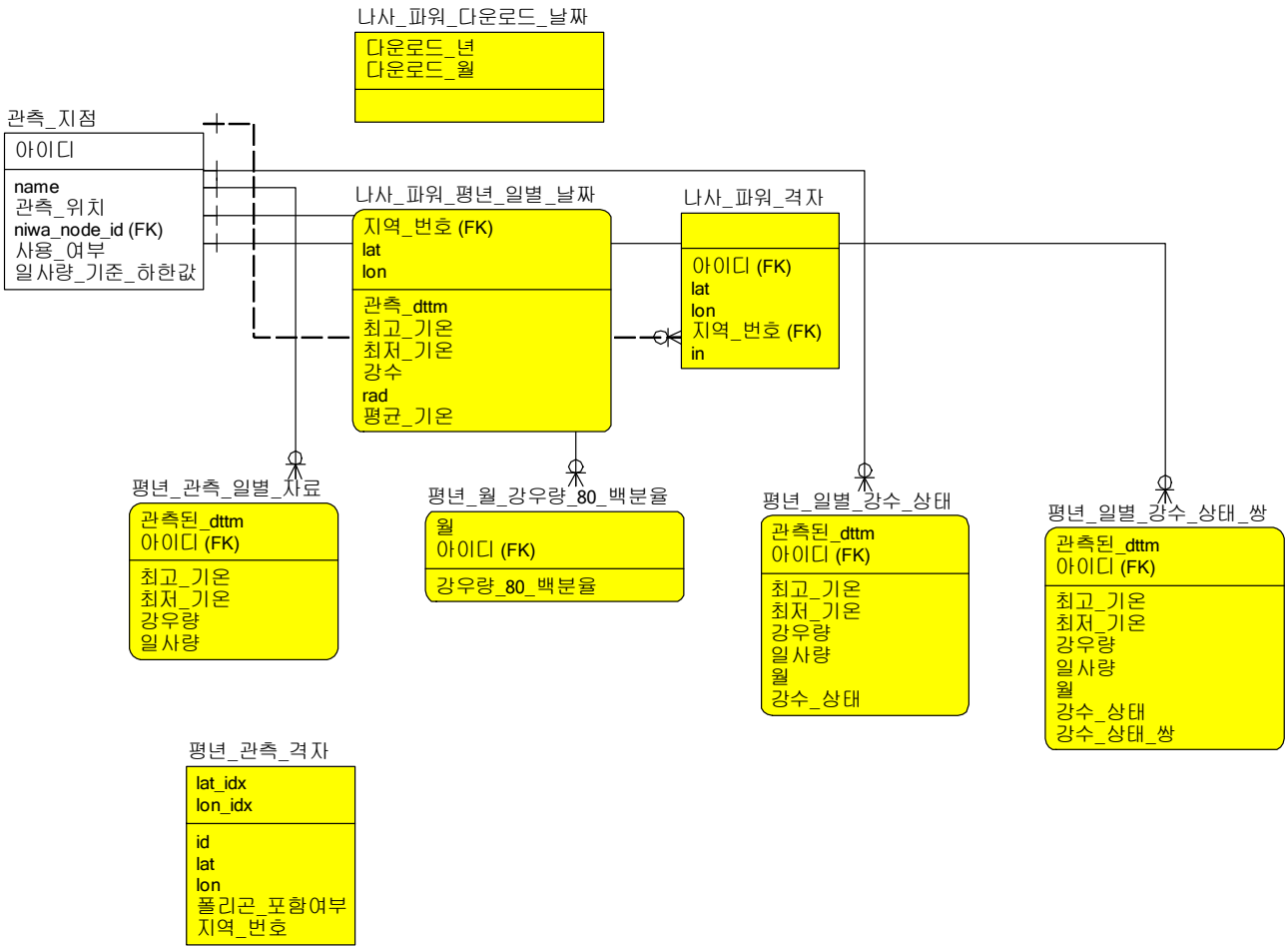
☐ Seasonal forecast data



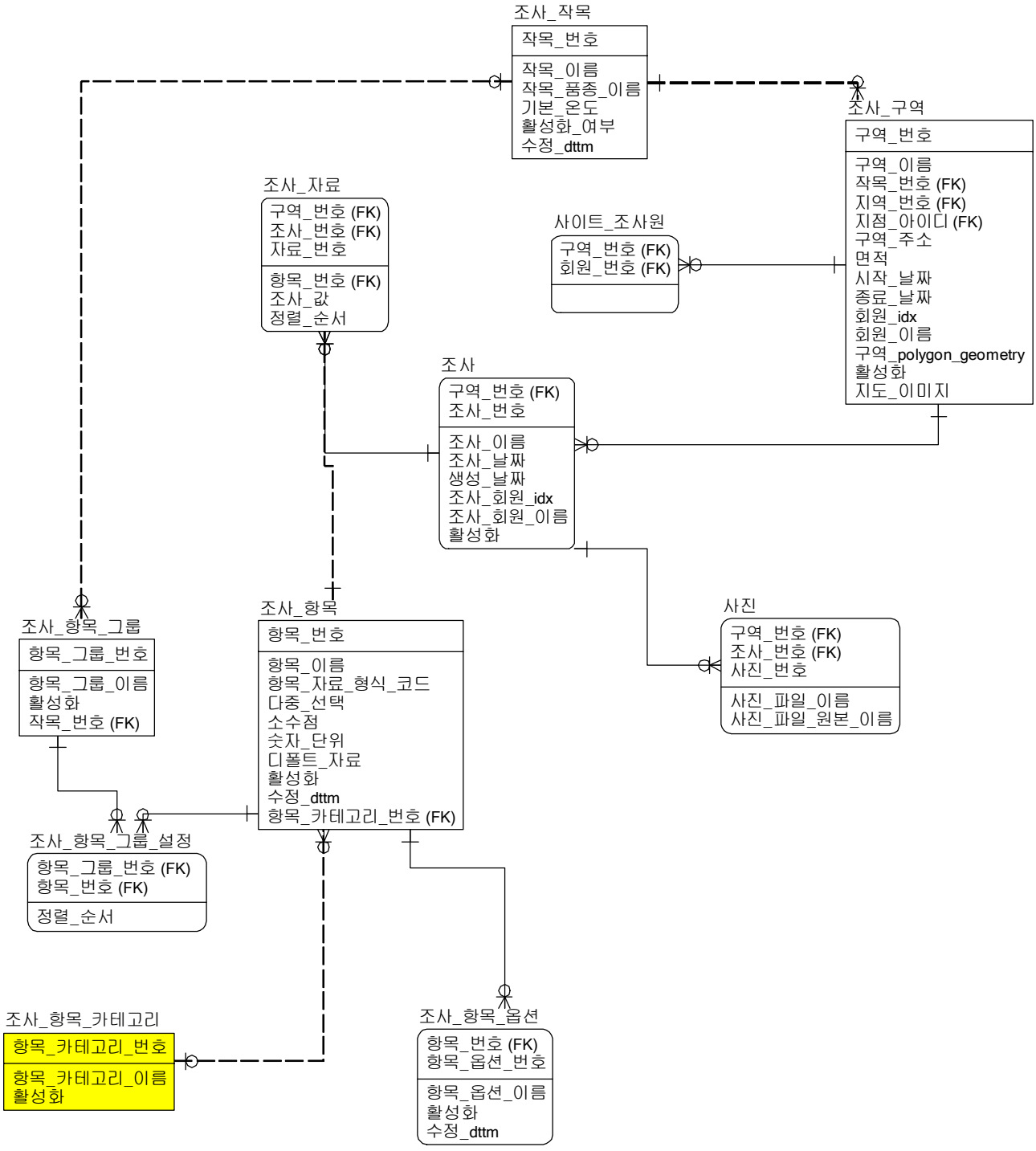
☐ Observed weather data



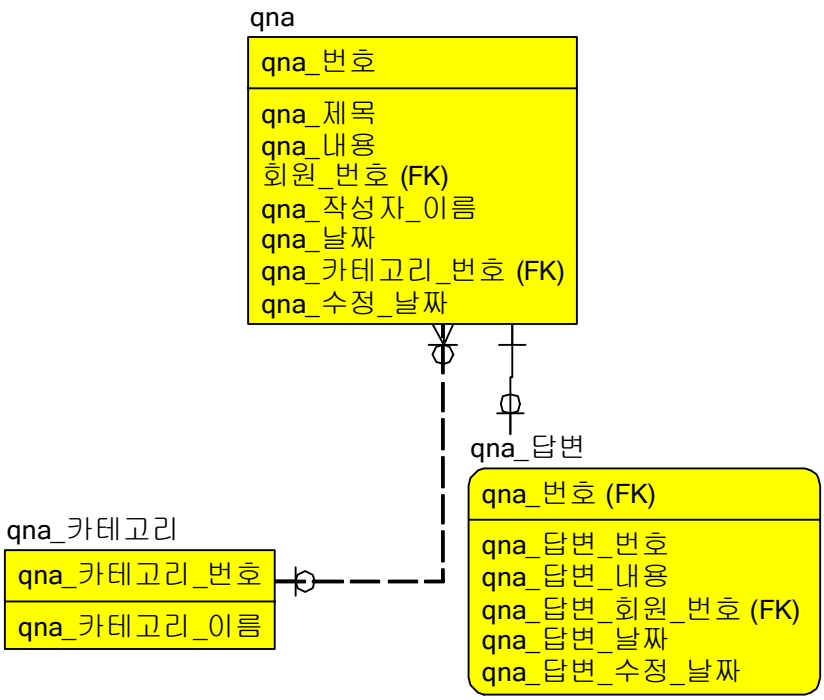
□ Climatological normal data



□ CCD data


조사_작목
작목_번호
작목_이름
작목_품종_이름
기본_온도
활성화_여부
수정_dttm
조사_구역
구역_번호
구역_이름
작목_번호 (FK)
지역_번호 (FK)
지점_아이디 (FK)
구역_주소
면적
시작_날짜
종료_날짜
회원_idx
회원_이름
구역_polygon_geometry
활성화
지도_이미지
조사_자료
구역_번호 (FK)
조사_번호 (FK)
자료_번호
항목_번호 (FK)
조사_값
정렬_순서
사이트_조사원
구역_번호 (FK)
회원_번호 (FK)
조사
구역_번호 (FK)
조사_번호
조사_이름
조사_날짜
생성_날짜
조사_회원_idx
조사_회원_이름
활성화
조사_항목_그룹
항목_그룹_번호
항목_그룹_이름
활성화
작목_번호 (FK)
조사_항목
항목_번호
항목_이름
항목_자료_형식_코드
다중_선택
소수점
숫자_단위
디폴트_자료
활성화
수정_dttm
항목_카테고리_번호 (FK)
사진
구역_번호 (FK)
조사_번호 (FK)
사진_번호
사진_파일_이름
사진_파일_원본_이름
조사_항목_그룹_설정
항목_그룹_번호 (FK)
항목_번호 (FK)
정렬_순서
조사_항목_카테고리
항목_카테고리_번호
항목_카테고리_이름
활성화
조사_항목_옵션
항목_번호 (FK)
항목_옵션_번호
항목_옵션_이름
활성화
수정_dttm

□ Q&A data


qna
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qna_제목
qna_내용
회원_번호 (FK)
qna_작성자_이름
qna_날짜
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qna_수정_날짜
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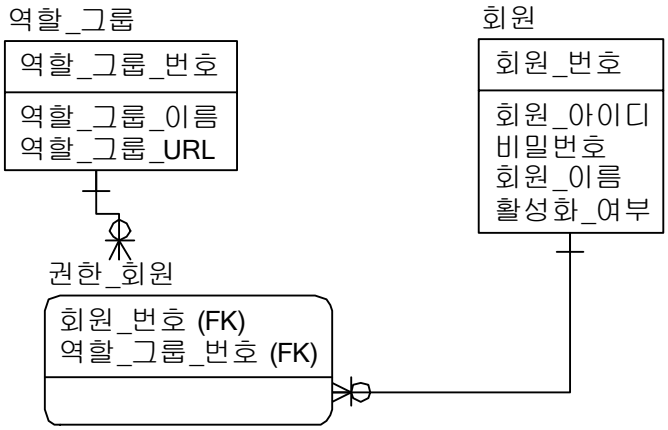
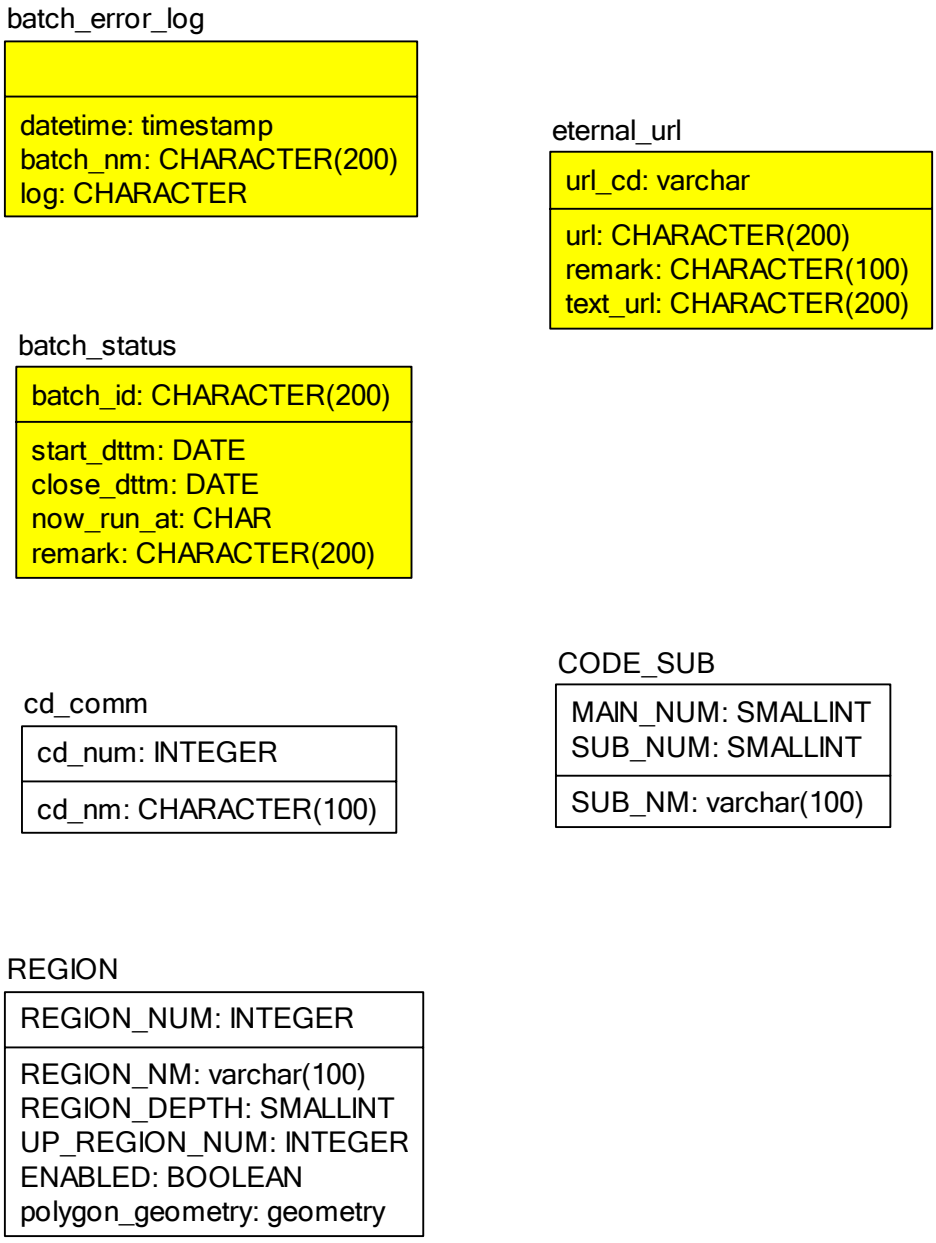
qna_답변_수정_날짜
qna_카테고리
qna_카테고리_번호
qna_카테고리_이름

□ User data

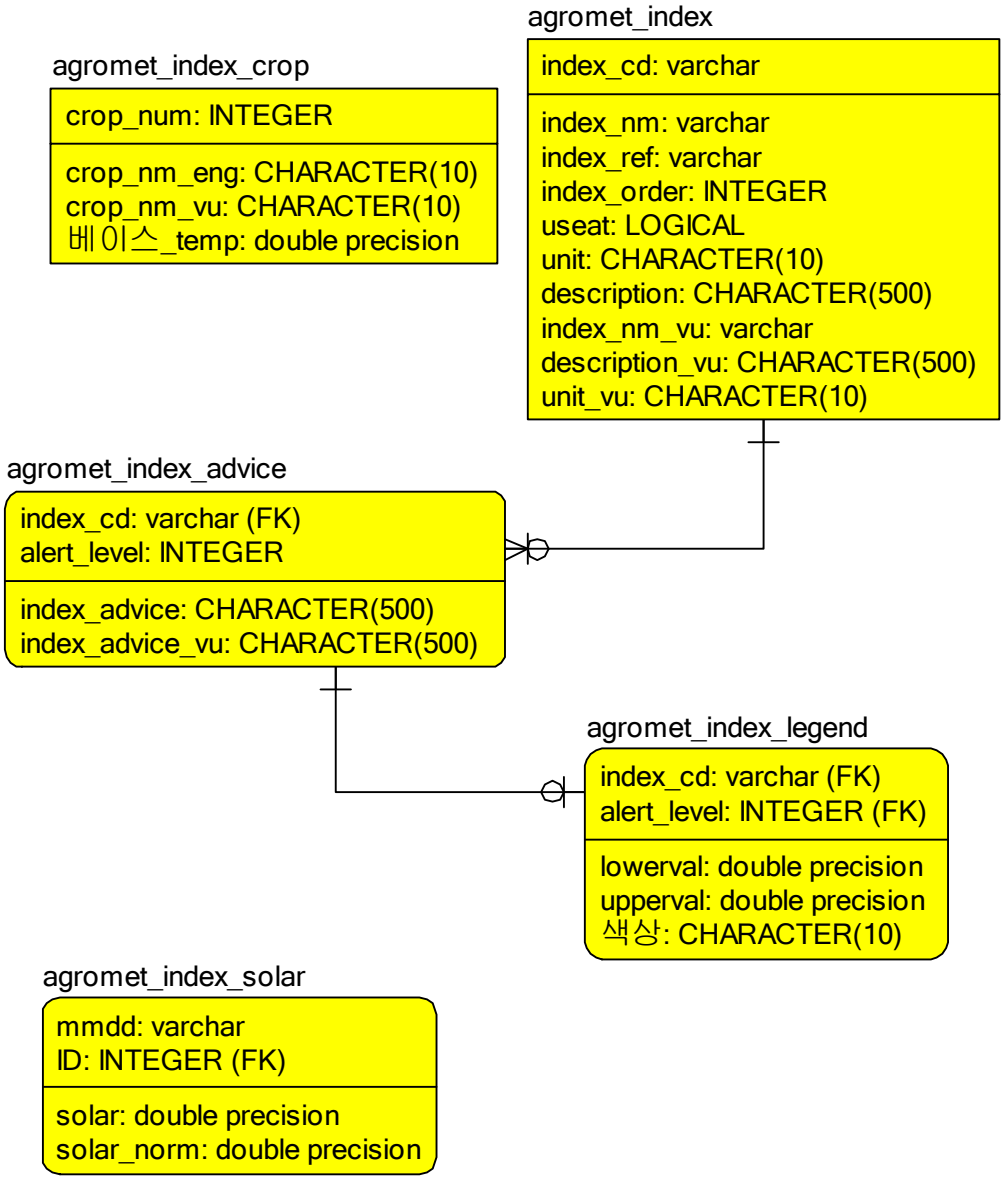

역할_그룹
역할_그룹_번호
역할_그룹_이름
역할_그룹_URL
회원
회원_번호
회원_아이디
비밀번호
회원_이름
활성화_여부
권한_회원
회원_번호 (FK)
역할_그룹_번호 (FK)

C. Physical ERD information

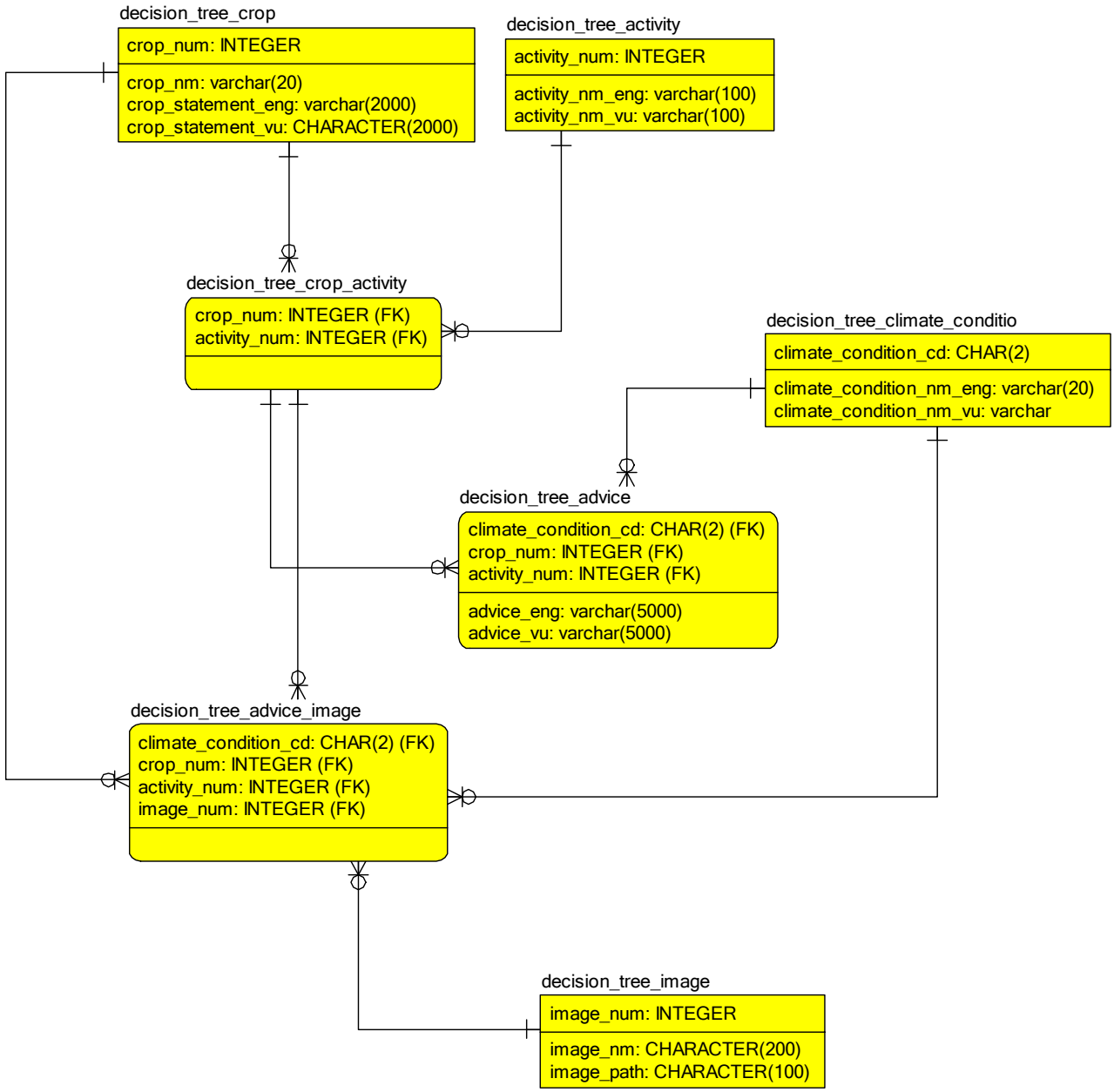
☐ Common



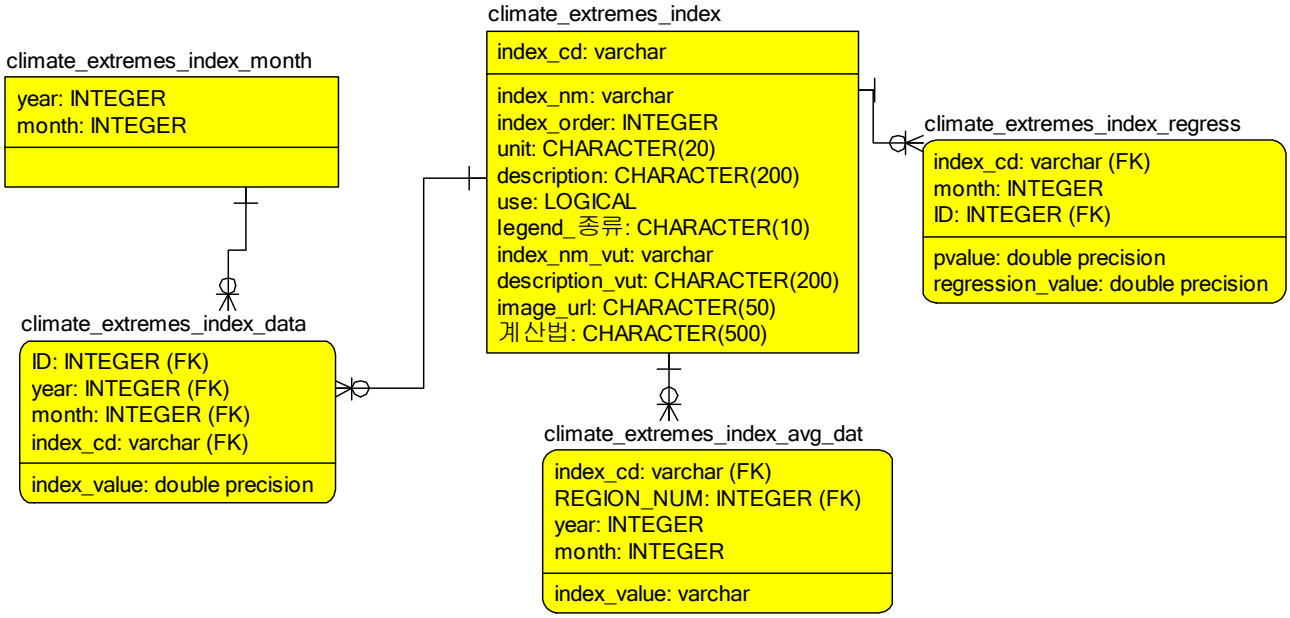
☐ Agromet index data



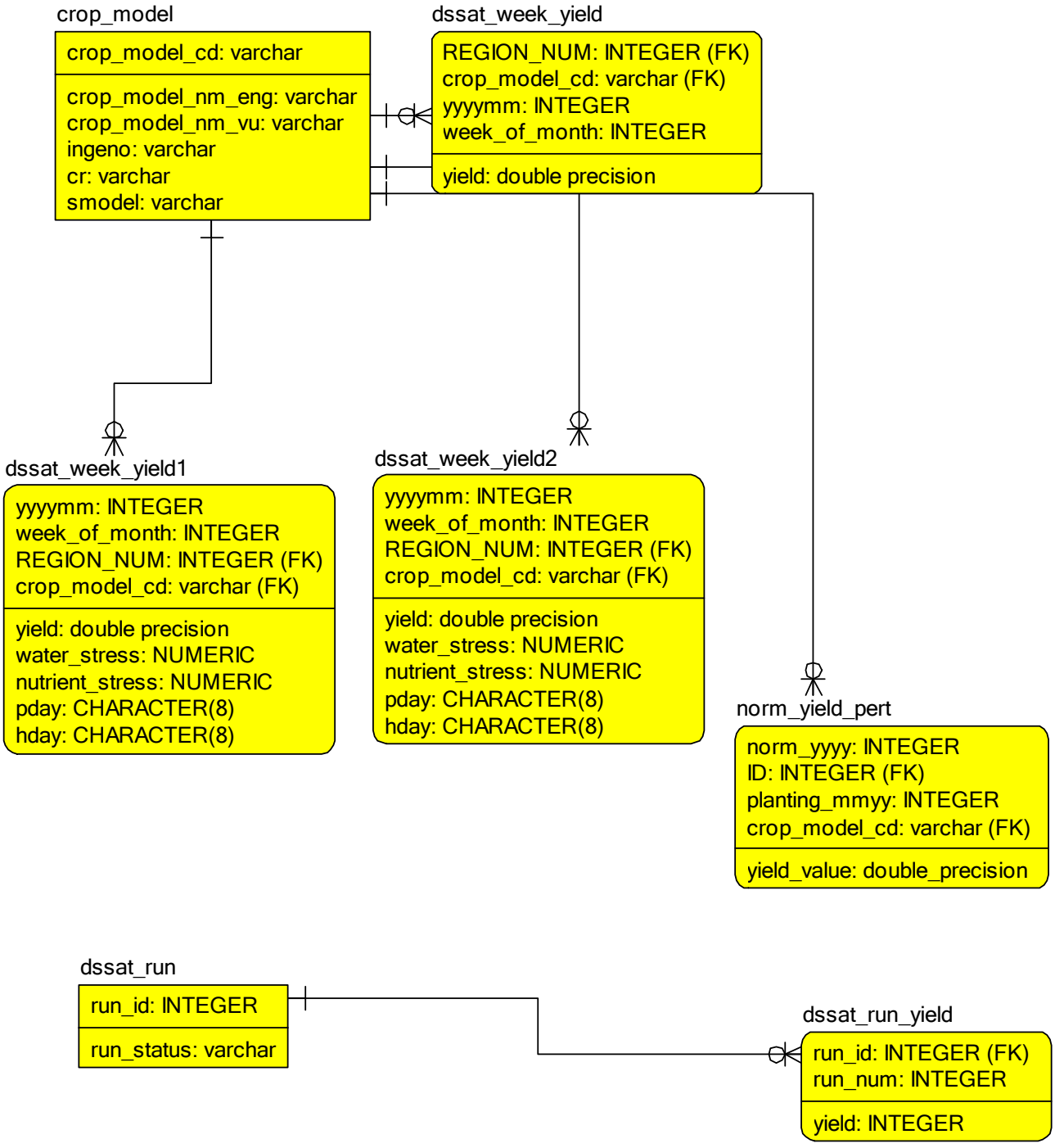
☐ Decision-making tree data



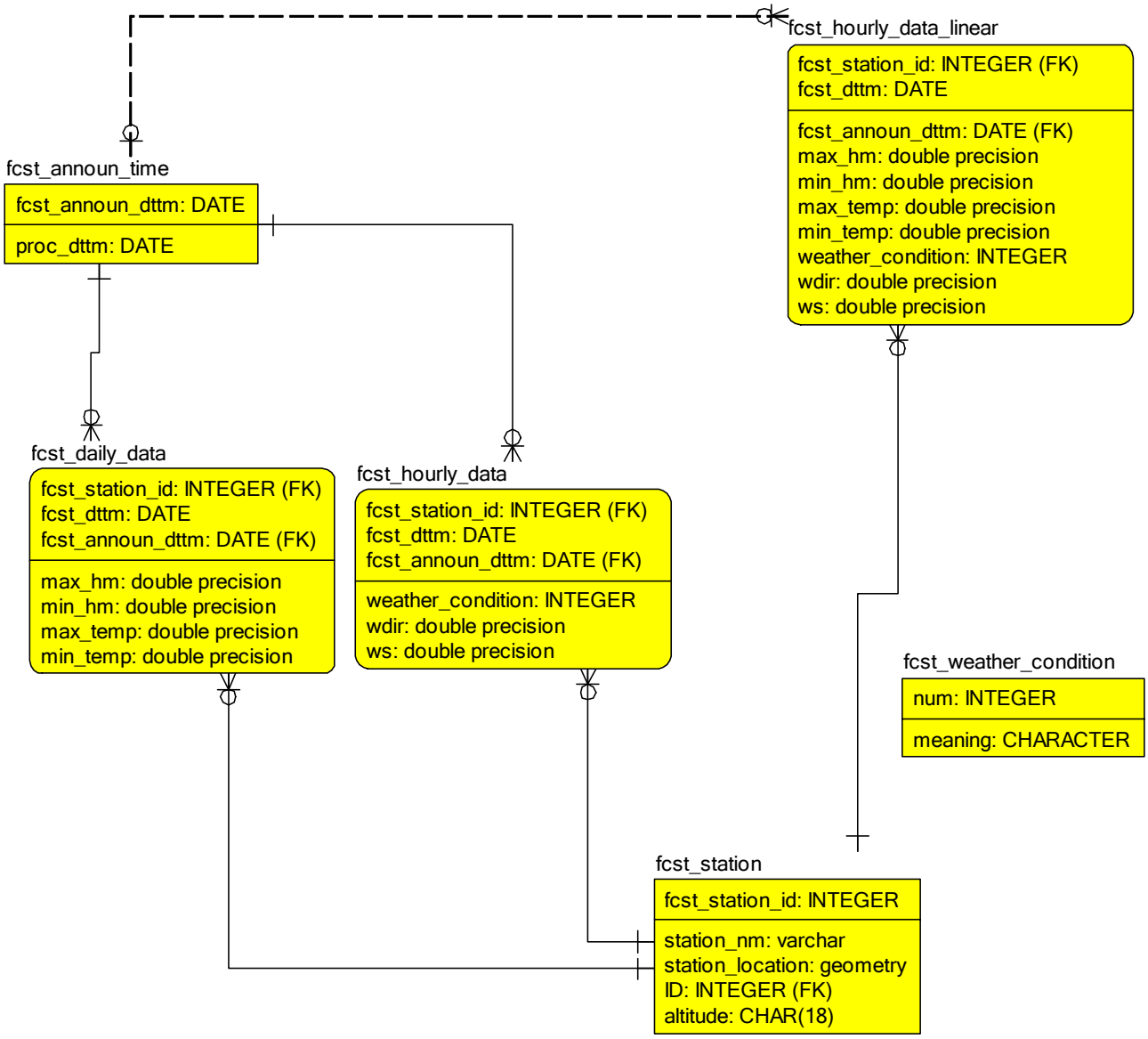
□ Climate extreme index data



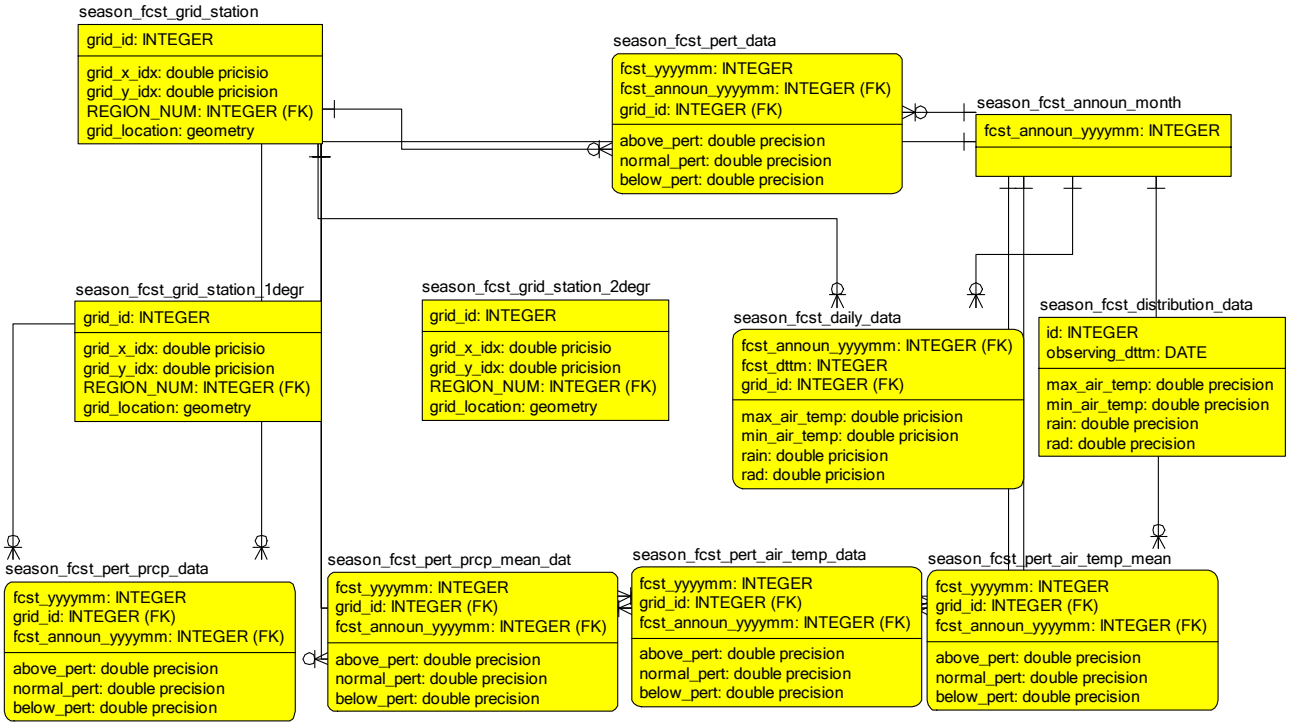
☐ Crop model operation data



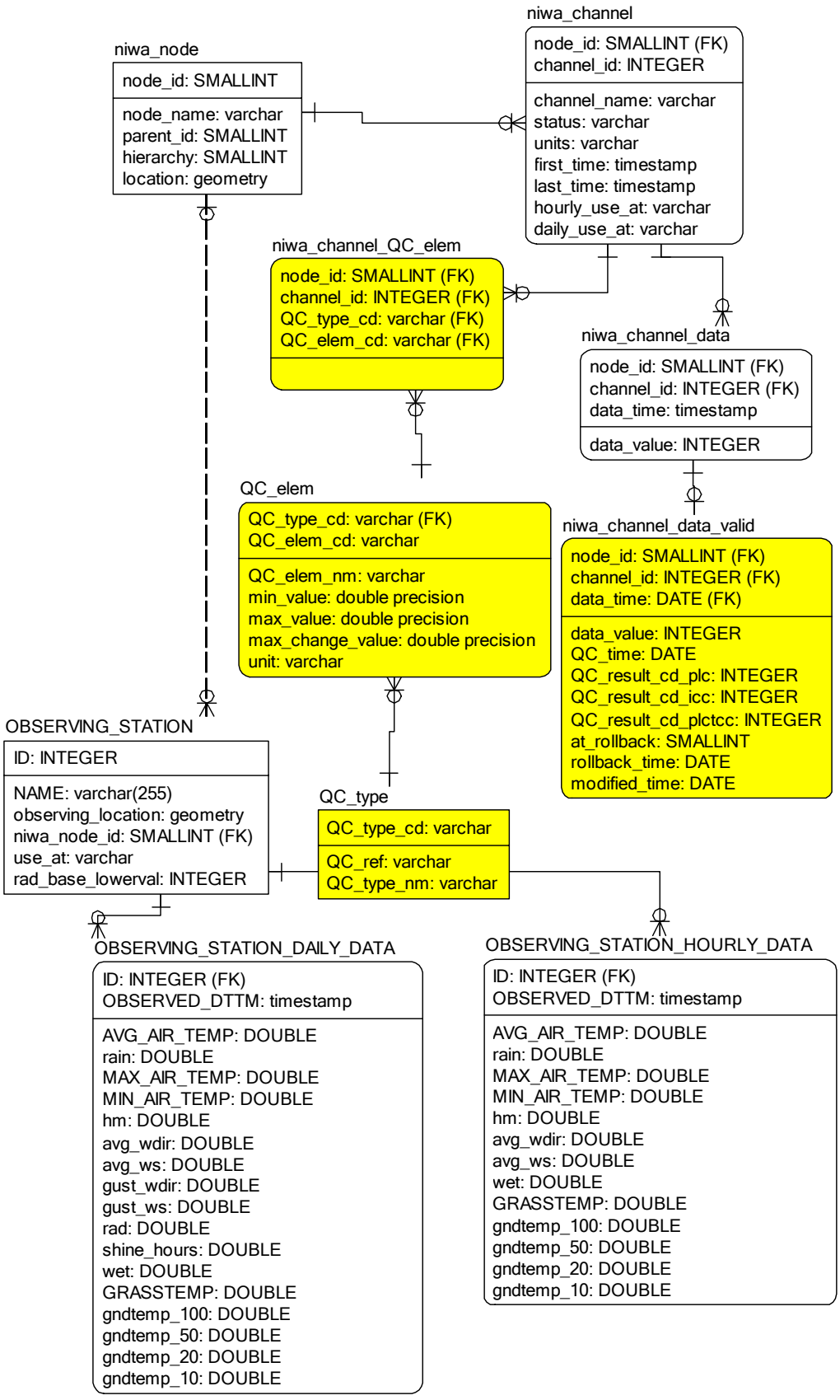
☐ 7-day forecast data



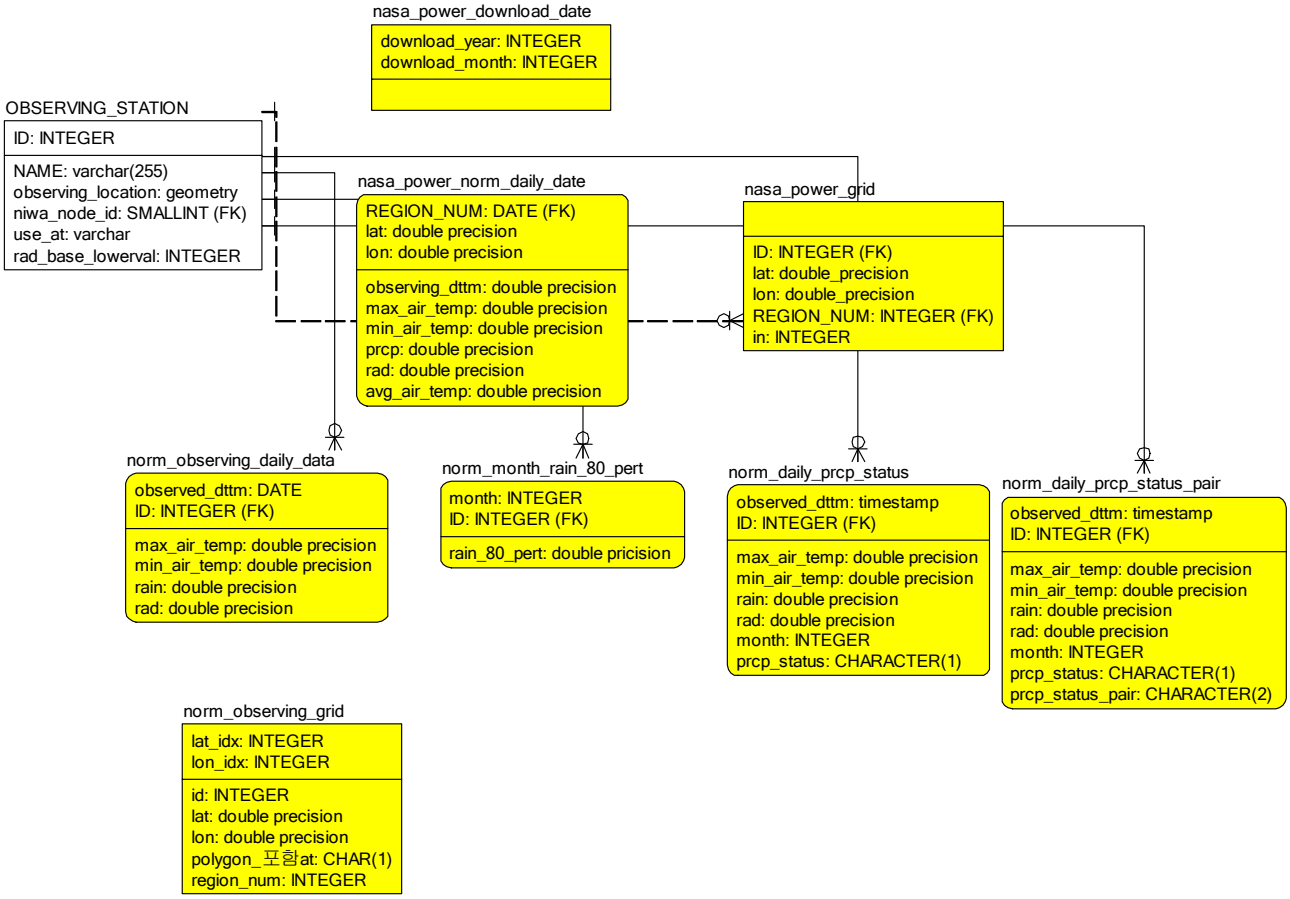
☐ Seasonal forecast data



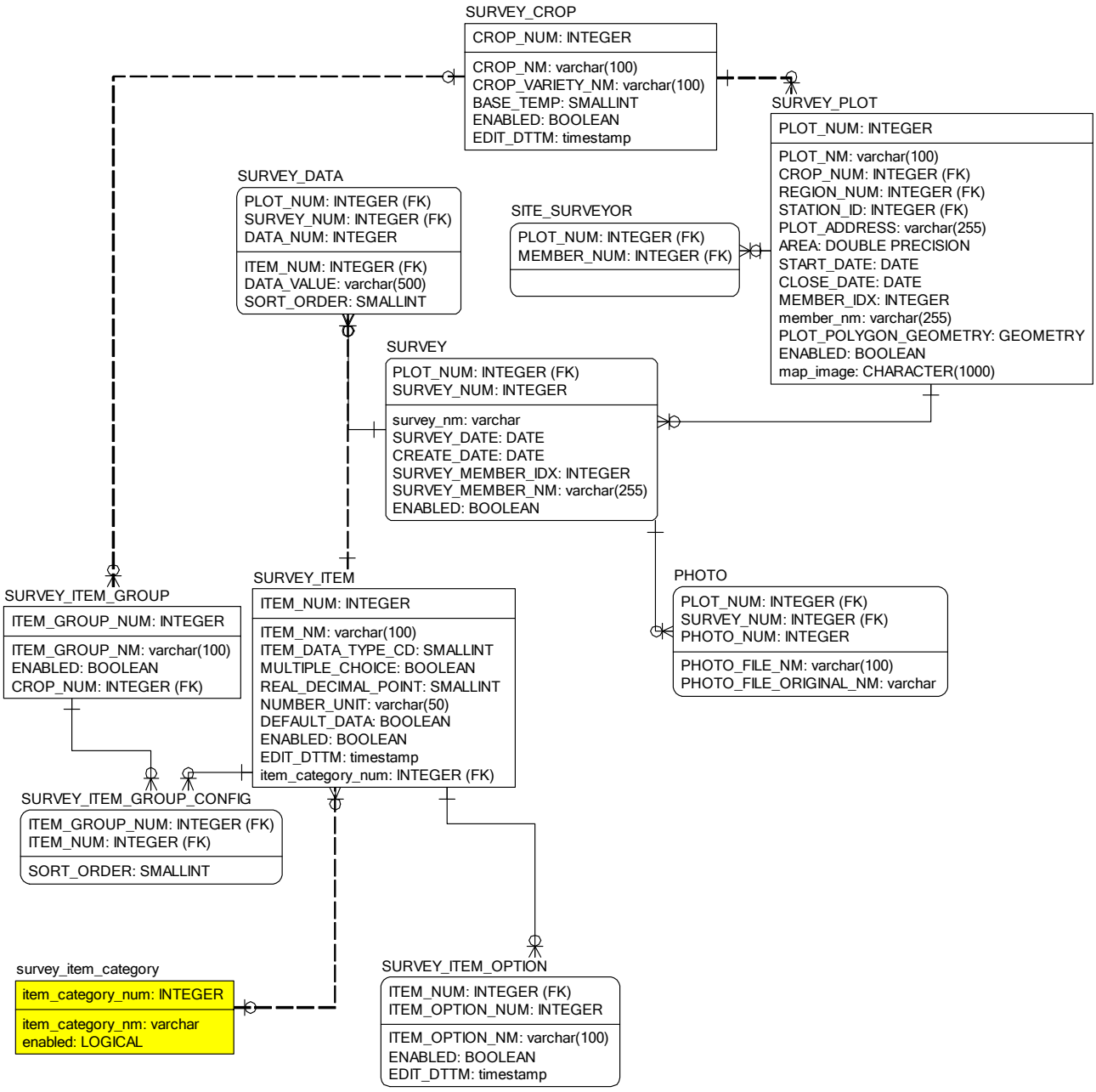
☐ Observed weather data



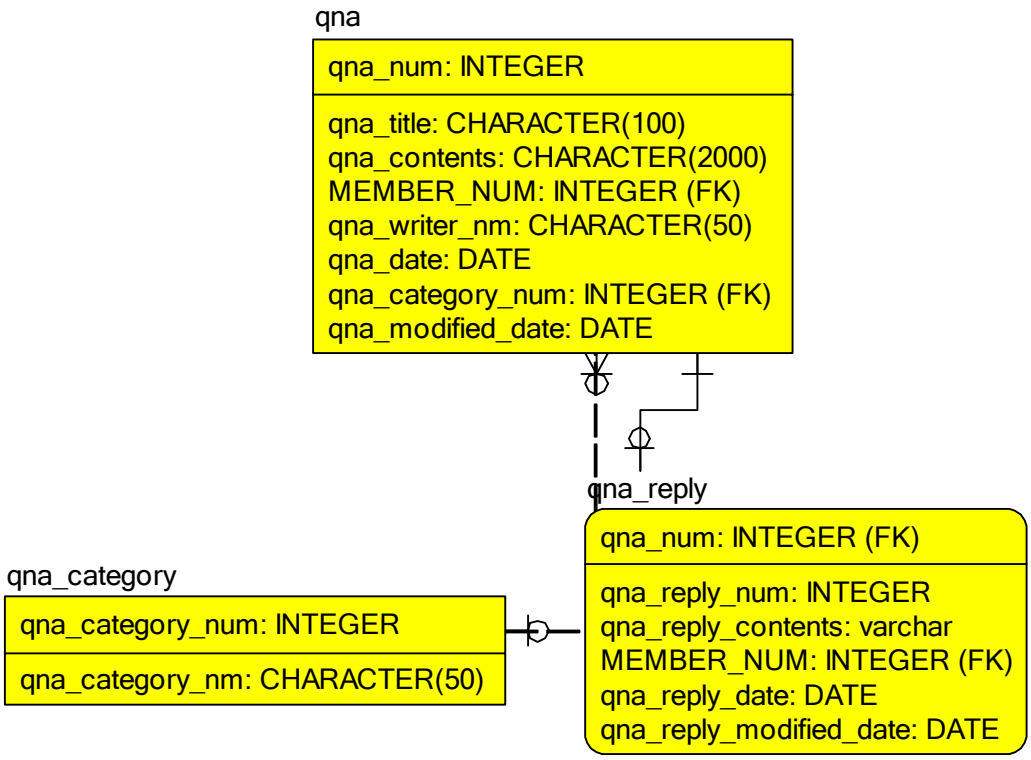
□ Climatological normal data



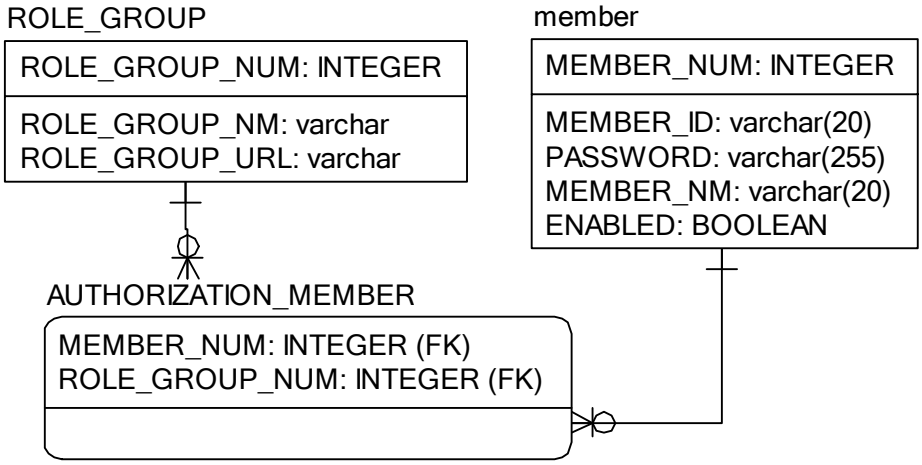
□ CCD data


SURVEY_CROP
CROP_NUM: INTEGER
CROP_NM: varchar(100)
CROP_VARIETY_NM: varchar(100)
BASE_TEMP: SMALLINT
ENABLED: BOOLEAN
EDIT_DTTM: timestamp
SURVEY_PLOT
PLOT_NUM: INTEGER
PLOT_NM: varchar(100)
CROP_NUM: INTEGER (FK)
REGION_NUM: INTEGER (FK)
STATION_ID: INTEGER (FK)
PLOT_ADDRESS: varchar(255)
AREA: DOUBLE PRECISION
START_DATE: DATE
CLOSE_DATE: DATE
MEMBER_IDX: INTEGER
member_nm: varchar(255)
PLOT_POLYGON_GEOMETRY: GEOMETRY
ENABLED: BOOLEAN
map_image: CHARACTER(1000)
SURVEY_DATA
PLOT_NUM: INTEGER (FK)
SURVEY_NUM: INTEGER (FK)
DATA_NUM: INTEGER
ITEM_NUM: INTEGER (FK)
DATA_VALUE: varchar(500)
SORT_ORDER: SMALLINT
SITE_SURVEYOR
PLOT_NUM: INTEGER (FK)
MEMBER_NUM: INTEGER (FK)
SURVEY
PLOT_NUM: INTEGER (FK)
SURVEY_NUM: INTEGER
survey_nm: varchar
SURVEY_DATE: DATE
CREATE_DATE: DATE
SURVEY_MEMBER_IDX: INTEGER
SURVEY_MEMBER_NM: varchar(255)
ENABLED: BOOLEAN
SURVEY_ITEM_GROUP
ITEM_GROUP_NUM: INTEGER
ITEM_GROUP_NM: varchar(100)
ENABLED: BOOLEAN
CROP_NUM: INTEGER (FK)
SURVEY_ITEM
ITEM_NUM: INTEGER
ITEM_NM: varchar(100)
ITEM_DATA_TYPE_CD: SMALLINT
MULTIPLE_CHOICE: BOOLEAN
REAL_DECIMAL_POINT: SMALLINT
NUMBER_UNIT: varchar(50)
DEFAULT_DATA: BOOLEAN
ENABLED: BOOLEAN
EDIT_DTTM: timestamp
item_category_num: INTEGER (FK)
PHOTO
PLOT_NUM: INTEGER (FK)
SURVEY_NUM: INTEGER (FK)
PHOTO_NUM: INTEGER
PHOTO_FILE_NM: varchar(100)
PHOTO_FILE_ORIGINAL_NM: varchar
SURVEY_ITEM_GROUP_CONFIG
ITEM_GROUP_NUM: INTEGER (FK)
ITEM_NUM: INTEGER (FK)
SORT_ORDER: SMALLINT
survey_item_category
item_category_num: INTEGER
item_category_nm: varchar
enabled: LOGICAL
SURVEY_ITEM_OPTION
ITEM_NUM: INTEGER (FK)
ITEM_OPTION_NUM: INTEGER
ITEM_OPTION_NM: varchar(100)
ENABLED: BOOLEAN
EDIT_DTTM: timestamp

□ Q&A data


qna
qna_num: INTEGER
qna_title: CHARACTER(100)
qna_contents: CHARACTER(2000)
MEMBER_NUM: INTEGER (FK)
qna_writer_nm: CHARACTER(50)
qna_date: DATE
qna_category_num: INTEGER (FK)
qna_modified_date: DATE
qna_reply
qna_num: INTEGER (FK)
qna_reply_num: INTEGER
qna_reply_contents: varchar
MEMBER_NUM: INTEGER (FK)
qna_reply_date: DATE
qna_reply_modified_date: DATE
qna_category
qna_category_num: INTEGER
qna_category_nm: CHARACTER(50)

□ **User data**


ROLE_GROUP
ROLE_GROUP_NUM: INTEGER
ROLE_GROUP_NM: varchar
ROLE_GROUP_URL: varchar
member
MEMBER_NUM: INTEGER
MEMBER_ID: varchar(20)
PASSWORD: varchar(255)
MEMBER_NM: varchar(20)
ENABLED: BOOLEAN
AUTHORIZATION_MEMBER
MEMBER_NUM: INTEGER (FK)
ROLE_GROUP_NUM: INTEGER (FK)

C. List of tables

Number	Table name	Table name in Korean	Attribute
1	QC_elem	QC_요소	New
2	QC_type	QC_타입	New
3	dssat_run	dssat_구동	New
4	dssat_run_yield	dssat_구동_생산량	New
5	dssat_week_yield	dssat_주_생산량	New
6	niwa_node	niwa_node	-
7	niwa_channel	niwa_채널	-
8	niwa_channel_QC_elem	niwa_채널_QC_요소	New
9	niwa_channel_data	niwa_채널_자료	-
10	niwa_channel_data_valid	niwa_채널_자료_유효	New
11	qna	qna	New
12	qna_reply	qna_답변	New
13	qna_category	qna_카테고리	New
14	drought_index_ep	가뭄_지수_ep	New
15	drought_index_sd_dep	가뭄_지수_sd_dep	New
16	season_fcst_grid_station_1degr	계절_예보_격자_스테이션_1도	New
17	season_fcst_grid_station_2degr	계절_예보_격자_스테이션_2도	New
18	season_fcst_grid_station	계절_예보_격자_지점	New
19	season_fcst_announ_month	계절_예보_발표_월	New
20	season_fcst_distribution_data	계절_예보_분포_자료	New
21	season_fcst_daily_data	계절_예보_일별_자료	New
22	season_fcst_pert_prcp_mean_dat	계절_예보_퍼센트_강수_mean_자료	New
23	season_fcst_pert_prcp_data	계절_예보_퍼센트_강수_자료	New
24	season_fcst_pert_air_temp_mean	계절_예보_퍼센트_기온_mean_자료	New
25	season_fcst_pert_air_temp_data	계절_예보_퍼센트_기온_자료	New
26	season_fcst_pert_data	계절_예보_확률_자료	New
27	OBSERVING_STATION	관측_지점	-
28	OBSERVING_STATION_HOURLY_DATA	관측_지점_시간별_자료	-
29	OBSERVING_STATION_DAILY_DATA	관측_지점_일별_자료	-
30	AUTHORIZATION_MEMBER	권한_회원	-
31	climate_extremes_index	기후_극한_지수	New
32	climate_extremes_index_month	기후_극한_지수_월	New
33	climate_extremes_index_data	기후_극한_지수_자료	New
34	climate_extremes_index_avg_dat	기후_극한_지수_평균_자료	New
35	climate_extremes_index_regress	기후_극한_지수_회귀	New
36	nasa_power_grid	나사_파워_격자	New
37	nasa_power_download_date	나사_파워_다운로드_날짜	New

38	nasa_power_norm_daily_date	나사_파워_평년_일별_날짜	New
39	agromet_index	농업영향_지수	New
40	agromet_index_legend	농업영향_지수_범례	New
41	agromet_index_solar	농업영향_지수_일사	New
42	agromet_index_crop	농업영향_지수_작목	New
43	agromet_index_advice	농업영향_지수_조언	New
44	batch_status	배치_상태	New
45	batch_error_log	배치_에러_로그	New
46	SITE_SURVEYOR	사이트_조사원	-
47	PHOTO	사진	-
48	ROLE_GROUP	역할_그룹	-
49	fcst_weather_condition	예보_날씨_조건	New
50	fcst_announ_time	예보_발표_시간	New
51	fcst_hourly_data	예보_시간별_자료	New
52	fcst_hourly_data_linear	예보_시간별_자료_선형	New
53	fcst_daily_data	예보_일별_자료	New
54	fcst_station	예보_지점	New
55	fcst_station_daily_data_linear	예보_지점_일별_자료_선형	New
56	eternal_url	외부_url	New
57	decision_tree	의사결정_트리	New
58	decision_tree_climate_conditio	의사결정_트리_기상_조건	New
59	decision_tree_image	의사결정_트리_이미지	New
60	decision_tree_crop	의사결정_트리_작목	New
61	decision_tree_crop_activity	의사결정_트리_작목_활동	New
62	decision_tree_advice	의사결정_트리_조언	New
63	decision_tree_advice_image	의사결정_트리_조언_이미지	New
64	decision_tree_activity	의사결정_트리_활동	New
65	crop_model	작목_모델	-
66	SURVEY	조사	-
67	SURVEY_PLOT	조사_구역	-
68	SURVEY_DATA	조사_자료	-
69	SURVEY_CROP	조사_작목	-
70	SURVEY_ITEM	조사_항목	-
71	SURVEY_ITEM_GROUP	조사_항목_그룹	-
72	SURVEY_ITEM_GROUP_CONFIG	조사_항목_그룹_설정	-
73	SURVEY_ITEM_OPTION	조사_항목_옵션	-
74	survey_item_category	조사_항목_카테고리	-
75	REGION	지역	-
76	cd_comm	코드_공통	-
77	CODE_SUB	코드_하위	-
78	norm_prcp_status_pair	평년_강수_상태_쌍	New
79	norm_observing_grid	평년_관측_격자	New
80	norm_observing_daily_data	평년_관측_일별_자료	New
81	norm_yield_pert	평년_생산량_확률	New
82	norm_month_rain_80_pert	평년_월_강우량_80_백분율	New
83	norm_daily_prcp_status	평년_일별_강수_상태	New

84	norm_daily_prcp_status_pair	평년_일별_강수_상태_쌍	New
85	member	회원	-
86	dssat_week_yield	dssat_주_생산량/1	New
87	dssat_week_yield/1	dssat_주_생산량/2	New
88	crop_model	작물_모델	New
89	norm_month_rain_80_pert	평년_월_강수량_80_확률	New

Ⅲ Project Achievements and Direction of Advancement

1. Project Achievements

○ Built the service to make, search and distribute agromet bulletin
- Built the system that semi-automatically makes monthly Agromet bulletin
- Built the function that periodically sends it via email
- Developed the Agromet bulletin service optimized to mobile devices
- Built the communication function that allows receiving feedback from users

○ Built the service that provides recommendations in a decision-making tree format
- Built the database of recommendations per scenario with the help from the panel of expert consultants
- Built the database of recommendations that have incorporated opinions of the local people for each scenario
- Built the function to add a new recommendation
- Built the function for the service of recommendations in a decision-making tree format

○ Built the GIS-based Vanuatu soil map service
- Built digital data of Vanuatu soil map in French
- Built the database of data on soil map's attributes in OSCAR system
- The GIS-based map displays information on soil in Vanuatu

○ Upgraded the service of supporting agricultural decision-making based on crop model
- Added service target crops to Island Taro
- Added the information for supporting agricultural decision-making by using seasonal forecast information
- Improved the user interface for agricultural decision-making by using the result of crop model

○ Upgraded the weather and climate service and agricultural index service
- Added weather and climate forecast service and improved its functions
- Upgraded quality control (QC) of weather data

- Added the data on Vanuatu's climatological normal as well as the data renewal function
- Agromet index and climate extreme index information

○ Upgraded the web/app-based Crop Climate Diary service

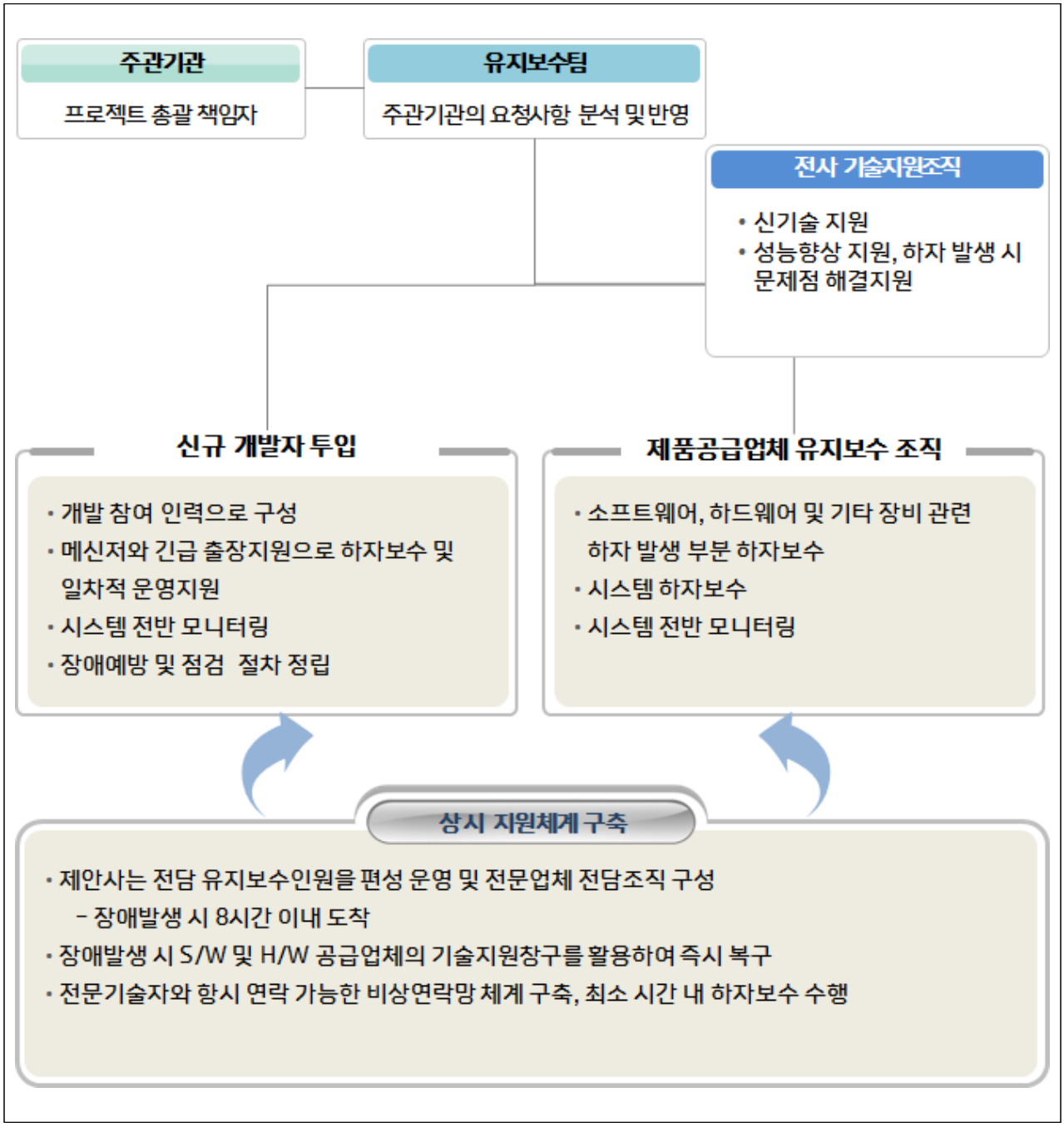
- Added a new region on the offline map of Android app
- Added functions to Android app and improved them
- Added the function that uses deep learning technique to calculate crop weight
- Added and improved web-based functions of Crop Climate Diary

2. System Stabilization and Maintenance Plan

○ Goals of repair and maintenance

- To ensure continuity and stability in the system operation, EPINET Co., Ltd. provides recovery support in case of a problem or failure, offers effective preventive service to proactively resolve potential risk factors, and performs repair and maintenance for comprehensive resolution

○ Organizational chart for repair and maintenance



○ Contents and scope of repair and maintenance

Item		Contents
Fault repair target		• Any hardware, software or developed application that has been supplied/installed in this project
Duration of free fault repair		• For 12 months after the date on which the final inspection was completed
Repair and maintenance	Fault repair	• This repair looks for a cause of the discovered defect and addresses the problem. It is free of charge during the free warranty period; once the period is over, the service is provided at a cost.
	Functional improvement	• This improvement, which is offered at a fee in principle, adds a new function and upgrades the system based on the discussion with overseeing organization.
	Adaptation to the environment	• Offered at a fee for a transfer to a new operating system or new hardware environment
	Recovery after failure	• Committed to identifying a cause and performing recovery as immediately as possible • Committed to arriving on site and performing recovery in the shortest time possible if failure occurs during the free fault repair period
	Preventive inspection	• To be provided free of charge for easier repair and maintenance or higher system reliability
Scope of repair and maintenance	Free fault repair	• Repair of defects is to be provided free of charge if the supplied system is not consistent with the system proposal or if it has a defect.
	Paid repair and maintenance	• Any repair and maintenance after the end of free warranty period • Paid repair and maintenance is to be provided by a separate contract.
	Others	• Emergency contact details and flowchart are in place to facilitate repair and maintenance support. • When a failure of operation task is reported, recovery is to be attempted to restore the system in the shortest time possible. • The confidentiality is ensured for client's information obtained during the repair and maintenance. • Paid repair and maintenance is to be provided upon signing a contract with overseeing organization after the free fault repair period expires. • Limited to existing system functions even during the free fault repair period • The company that proposed the system is not to be held liable for a failure clearly caused by the client or natural disaster.

		• The company that proposed the system is to be held liable for compensation for damages if the company's negligence during the repair and maintenance causes damages to overseeing organization including equipment breakdown. • Repair will be provided at a cost if the system is affected significantly after a person other than the repair and maintenance personnel modifies, applies addition to, adjusts or repairs the system.

○ Free repair and maintenance period

Item	Contents
Target	Any hardware, software or developed application that has been supplied/installed in this project
Duration	For 12 months after the date on which the final inspection was completed
Others	Repair of defects is to be provided free of charge if the supplied system is not consistent with the system proposal or if it has a defect. The fault repair support is provided within 24 hours after the request is.

○ Target of free repair and maintenance

Item	Contents
Supplied hardware	▪ System improvement and stabilization ▪ Handling inquiries regarding system operation ▪ Resolving a failure ▪ Checking thoroughly and taking actions against a problem discovered while logging system error ▪ To be determined based on the discussion with overseeing organization in the absence of supplied hardware
Supplied software	▪ Handling inquiries about software operation (technical consultation) ▪ Resolving software failure and decreased functional performance ▪ Providing support for running patch software ▪ Re-installing software if it breaks or fails ▪ To be determined based on the discussion with overseeing organization in the absence of supplied software
Application	▪ Resolving a functional problem of developed application

○ How to perform free repair and maintenance

Item	Contents
Preventive repair	▪ Continuously perform preventive repair at a pre-determined interval (once a month) during the free fault repair period

	▪ The ad hoc inspection in the preventive repair must be performed if system failure is predicted. ▪ Set up a regular inspection report to record and store the dates and details of inspection ▪ Training and technical support will continue to be provided.
Addressing failure	▪ A failure that occurs during the free fault repair period will be handled in the shortest time possible. ▪ Once a failure is resolved, a thorough analysis will be performed to investigate its cause to prevent the repeat of the same failure.

○ How paid repair and maintenance will be performed

Item	Contents
Basic policy	▪ Paid repair and maintenance will be provided if a contract is signed before the free fault repair period expires. ▪ How to apply the upgrade of adding more functions is to be determined based on the discussion with overseeing organization. ▪ Adding a new function or improving the system in the free fault repair period will depend on the mutual discussion. ▪ Any repair and maintenance following the end of the free fault repair period will be based on a separate contract.
Compensation determination	▪ The compensation rate for paid repair and maintenance will be determined at the time of planning repair and maintenance based on relevant regulations and an agreement reached with overseeing organization before the free fault repair expires. ▪ The repair and maintenance rate agreed with overseeing organization remains unchanged until the end of contract.
Scope of support	▪ The scope of paid repair and maintenance is identical to that of the free fault repair.

○ Target and method of paid repair and maintenance

Item	Contents	Cost compensation
Application	▪ Regular system inspection and system performance excluding re-development ▪ Other details to be defined by contract terms	▪ To be determined based on mutual discussion in accordance with standard compensation rates for software repair and maintenance
Software	▪ Upgrade ▪ Version management ▪ Other details to be defined by contract terms	▪ To be determined via discussion
Hardware	▪ Regular system inspection ▪ Other details to be defined by contract terms	▪ To be determined via discussion

○ Personnel in charge of repair and maintenance

Task	Affiliation	PIC	Duration	On-site presence
Supervision	EPINET Co., Ltd.	Sang Hyun Park (Deputy Manager)	Until the end of free repair and maintenance	Not to be present on-site
System stabilization	EPINET Co., Ltd.	Sung Won Choi (Senior Manager)	The end of August 2023 - the end of October 2023 (2 months)	Not to be present on-site
Free repair and maintenance	EPINET Co., Ltd.	Sung Won Choi (Senior Manager)	August 2023. - August 2024 (12 months)	Not to be present on-site