A socio-ecological approach to combat desertification for a sustainable future

(EcoFuture)

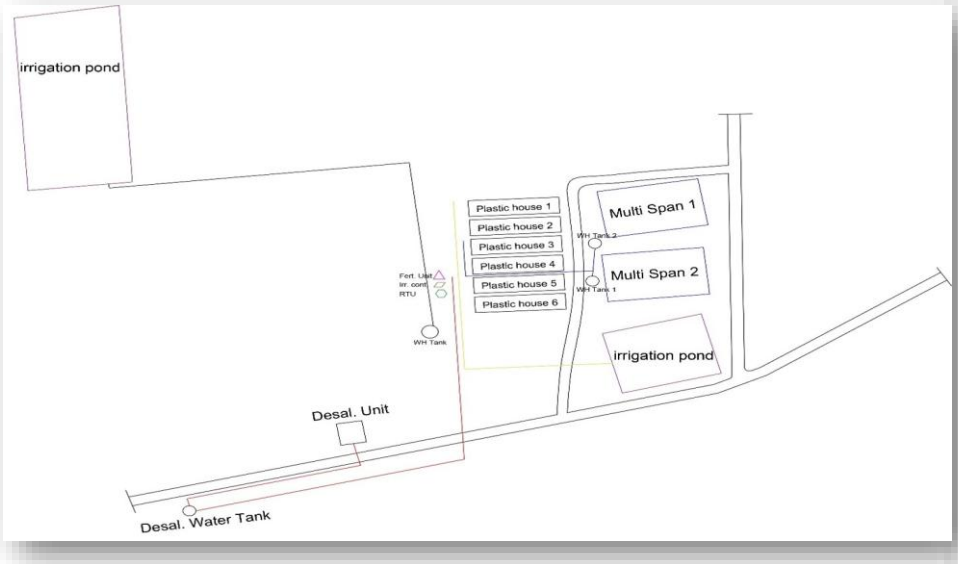
A Guide to EcoFuture Platforms for Smart Irrigation Management

2025

Introduction:

The EcoFuture project, funded by PRIMA, uses the Jordan Valley (JV) as a pilot case to develop a climate-change adaptation program that aims to improve the socio-economic welfare of communities in the Mediterranean region. This project is based on Water-Energy-Food-Ecosystem (WEFE) nexus methodologies, which highlight the interconnection between these critical resources and promote sustainable management practices to enhance resilience against climate-related challenges.

As part of the project, a pilot site has been established in Deir Alla, Jordan, to implement WEFE nexus technologies through innovative approaches. The following figure illustrates the layout of this pioneering site and its multiple components.



At the Deir Alla station, six plastic houses were constructed, each pair receiving the same irrigation treatment. Tomatoes were planted in all six houses, and the irrigation treatments were organized as follows:

- **Desalinated Water Treatment (RO V1 and RO V2)**: Two plastic houses are irrigated with desalinated water. Water from a large pond, supplied by the Jordan Valley Authority, is treated using a reverse osmosis (RO) desalination unit. The treated water is stored in a tank and used to irrigate these houses.
- **Rainwater Harvesting (WH V1 and WH V2)**: Another pair of plastic houses is irrigated using rainwater harvested from the roofs of two multi-span greenhouses. The rainwater is collected and transferred via pipelines to a storage tank for irrigation.
- **Control Houses (Control V1 and Control V2)**: The final pair serves as control units and is irrigated directly with water supplied by Jordan Valley Authority. These houses follow traditional farming practices, providing a basis for comparison with the other irrigation methods.

This setup allows for a comprehensive comparison of different irrigation strategies, particularly evaluating the effectiveness of rainwater harvesting and desalinated water against traditional irrigation methods.

To effectively monitor and manage the irrigation systems in the Deir Alla station, two advanced platforms are utilized. These platforms provide real-time data and insights, enabling users to optimize water usage and ensure healthy crop growth. Below is an explanation of how each platform functions and how they contribute to smart irrigation management in the EcoFuture project.

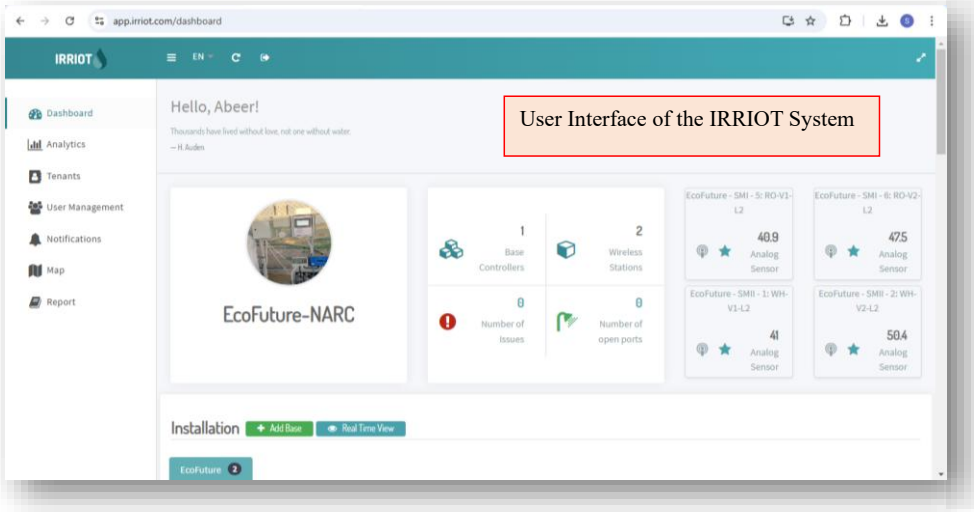
1- **IRRIOT Platform:**
   IRRIOT is a wireless irrigation automation platform that uses sensors and radio technology to optimize water usage. It offers solar-powered, maintenance-free units that control water valves without the need for cables. The system is expected to help farmers save up to 50% of water and increase crop yields by 30%, according to https://www.irriot.com/, while enabling remote irrigation management via a cloud-based mobile app. Additionally, it sends alerts in case of malfunctions. IRRIOT is designed to support efficient, sustainable agriculture, saving both time and resources.

Accessing the IRRIOT Platform:

1. Website Link: Open your web browser and visit https://app.irriot.com/.
2. Login Credentials: Enter the username and password provided by the platform administrator to access your account.
3. Dashboard Overview: Once logged in, you will be directed to the platform's main dashboard, where you can view a summary of your site's data.

At the core of the IRRIOT system is the Control Unit, which links the platform to the physical irrigation infrastructure. The Control Unit regulates water flow by receiving data from soil moisture sensors installed in the plastic houses at the pilot site and managing irrigation valves and pumps based on preset thresholds. When soil moisture falls below the set level, the system activates irrigation, stopping once optimal moisture is restored. This ensures efficient water management, minimizes waste, and improves crop productivity.

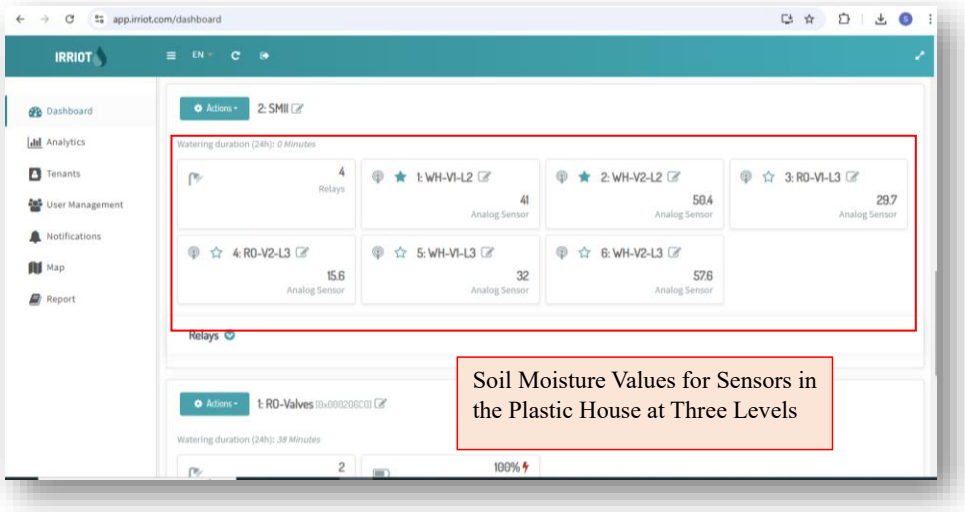
The following figure shows the interface of the IRRIOT system, demonstrating how the EcoFuture project at NARC utilizes the platform.



User Interface of the IRRIOT System

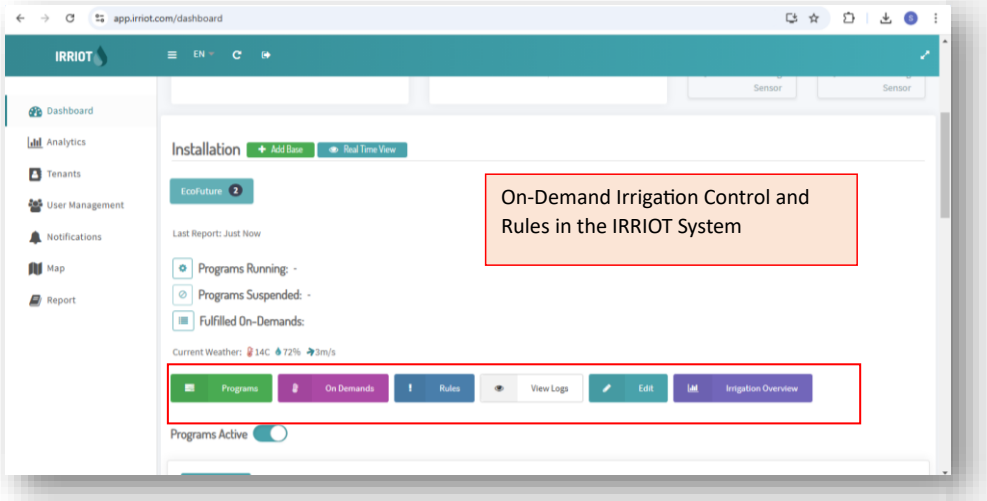
Through this user-friendly interface, the user can monitor and control irrigation activities across multiple plastic houses, with real-time data on soil moisture at three levels for each house, enabling the detection of water movement from the upper to the lower levels. All information is displayed in an intuitive dashboard, which provides a comprehensive, real-time overview of key metrics such as soil moisture, temperature, and irrigation status for all connected zones. The dashboard's visual representation allows users to quickly assess the health of their crops and the efficiency of their irrigation system, while also providing details on current water usage, active irrigation schedules, and system malfunctions. This tool enables farmers to make informed decisions, manage irrigation remotely, and ensure optimal watering conditions while conserving water resources.

- **Sensor Modules (SMs)** in the IRRIOT system are devices used to measure soil moisture at different depths within the soil. The system employs sensors at three levels to monitor moisture content, providing a more accurate understanding of how water moves through the soil and ensuring optimal irrigation. By collecting real-time data, SMs help manage water usage efficiently, prevent over-irrigation, and improve crop health by maintaining ideal moisture levels at each soil depth.

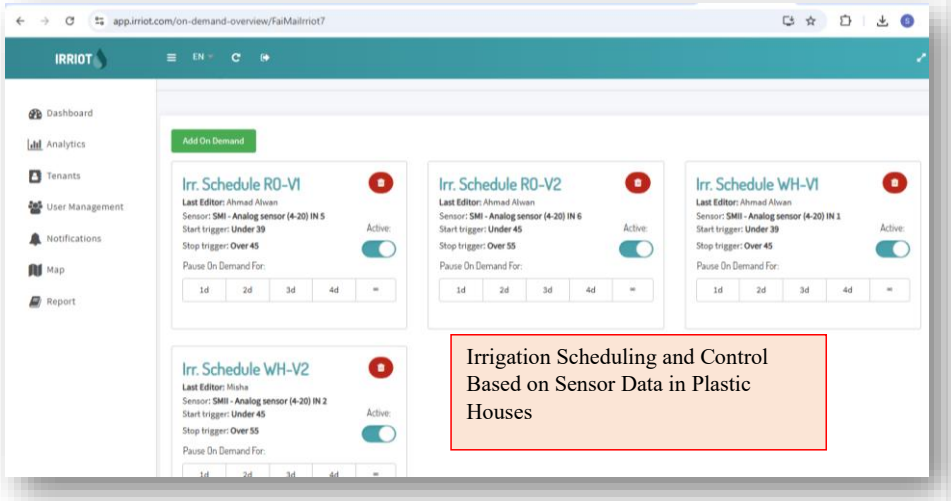


Soil Moisture Values for Sensors in the Plastic House at Three Levels

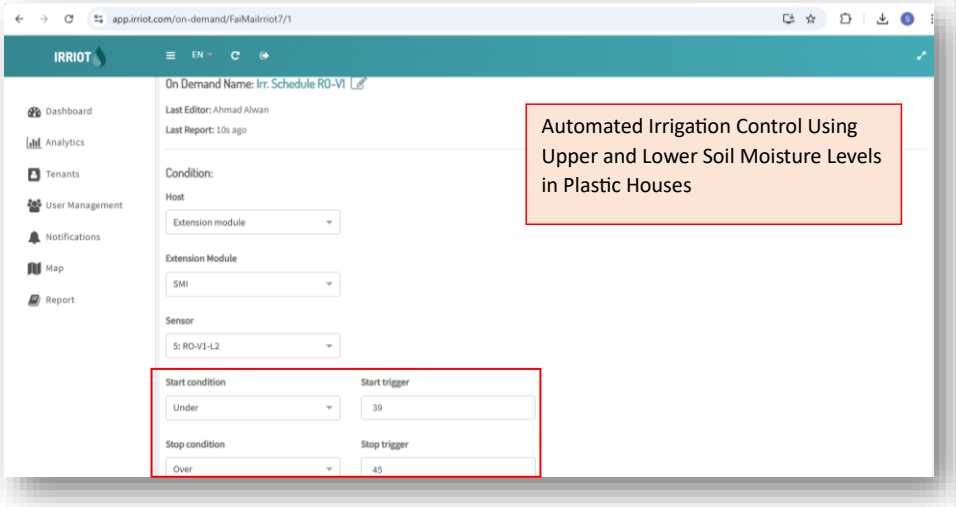
- The **On-Demand** feature in the IRRIOT system allows users to manually control irrigation when needed, offering flexibility beyond the automated schedules. Users can instantly activate or stop irrigation through the platform's interface, which is particularly useful when crops require immediate attention or when unexpected weather changes occur. This feature enables users to initiate irrigation in specific zones, ensuring that water is applied exactly where and when it's needed. With this level of control, water usage is optimized, plant health is maintained, and over-irrigation is avoided.



- **Control Valves** are used to regulate the flow of water to different areas of the irrigation system. In the IRRIOT system, control valves can be linked to the soil moisture levels at various depths (e.g., upper, middle, and lower levels) to determine when irrigation should start and stop. For instance, if the moisture level at the upper level of the soil reaches the minimum threshold, the control valve will activate to start irrigation, ensuring water is supplied to the crops as needed. This system of automated control helps ensure that water is delivered in an efficient manner, conserving resources while promoting optimal growth conditions.



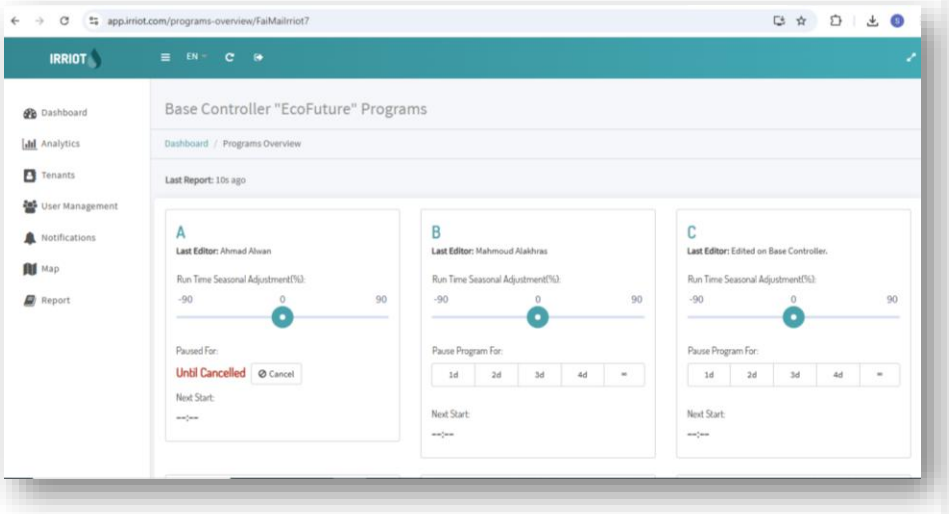
Irrigation Scheduling and Control Based on Sensor Data in Plastic Houses



Automated Irrigation Control Using Upper and Lower Soil Moisture Levels in Plastic Houses

- **The Programs** feature in the IRRIOT system allows users to create and customize automated irrigation schedules based on the specific needs of their crops. Users can set up multiple irrigation programs based on soil moisture levels, time intervals, or weather conditions. Each program can be tailored to the requirements of different zones on the farm, ensuring that water is applied efficiently and only when needed.

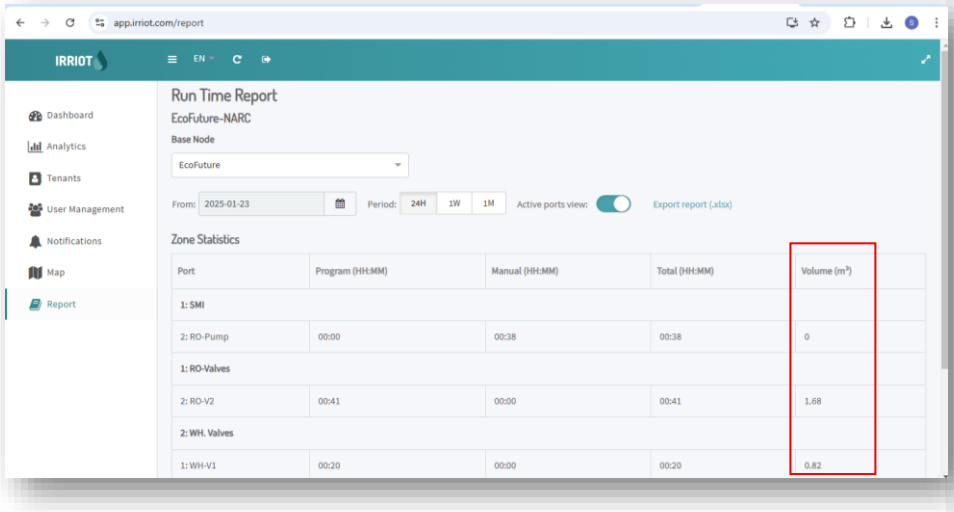
  This feature helps farmers reduce water waste, save time, and optimize crop growth by maintaining ideal moisture levels. By automating irrigation management, users can focus on other important tasks while ensuring their irrigation system operates smoothly and efficiently.



- **The Report** feature in the IRRIOT system provides detailed insights into irrigation activities and system performance over time. Users can access historical data for different time periods—24 hours, one week, or one month—related to water usage, irrigation schedules, and soil moisture levels across various zones. Reports are generated in an easy-to-read format, allowing farmers to analyze the efficiency of their irrigation practices and make informed decisions to optimize water management.

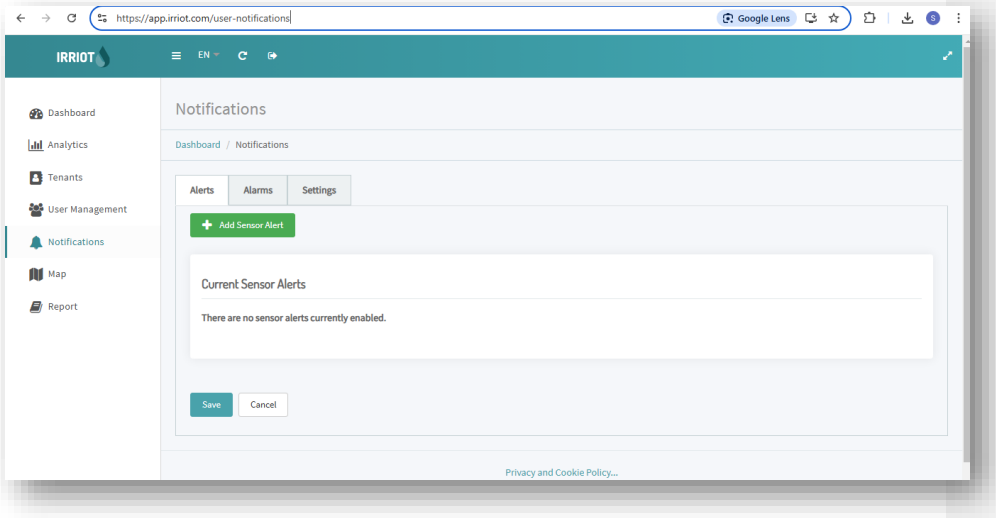
The IRRIOT system also enables users to export these reports into Excel files for further analysis or sharing. This feature offers flexibility in data management, allowing users to create custom charts, compare different time periods, and integrate the data into larger reports or presentations for deeper analysis.

By reviewing these reports, users can track trends, identify areas for improvement, and ensure that irrigation is managed sustainably and cost-effectively. Accessing and analyzing this data helps enhance productivity, conserve resources, and improve overall farm management.



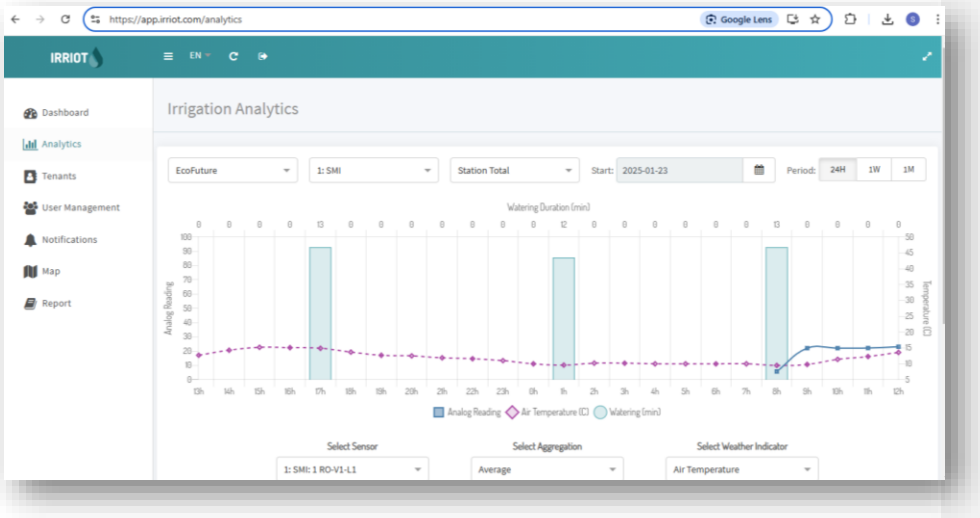
- **The User Notifications** feature in the IRRIOT system ensures users are always informed about their irrigation system's status. It sends real-time alerts regarding system performance, such as when irrigation starts or stops, or if there are issues with the sensors or water valves.

  These notifications enable users to take immediate action in case of irregularities, such as system failures, water shortages, or abnormal soil moisture levels. By keeping users updated, the system helps prevent potential crop damage, reduce water waste, and ensure efficient irrigation management. Notifications can be received through the mobile app or other preferred communication channels, allowing users to stay connected to their irrigation system at all times.



- **The Analytics** feature in the IRRIOT system offers users advanced tools for monitoring and optimizing irrigation performance. This feature allows users to visualize and interpret data on water usage, soil moisture levels, and other key irrigation metrics over time. Through interactive graphs and charts, users can analyze trends, identify inefficiencies, and make data-driven decisions to enhance irrigation management.

  The Analytics tool helps users track the effectiveness of their irrigation programs, compare performance across different zones, and determine the most effective strategies for water conservation. With access to this comprehensive data, farmers can ensure efficient water use, maintain crop health, and boost overall productivity.



2- Experimental Data Platform

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- Accessing the Platform:

1. Website Link: Open your web browser and visit http://www.ideasgroceries.com/.
2. Login Credentials: Enter your username and password provided by the platform administrator.
3. Dashboard Overview: After logging in, you'll be directed to the platform's main dashboard, where you can view the summarized data of your site.

The platform organizes the collected data into several critical parameters that play a vital role in farming success:

- **Electrical Conductivity (EC)**: indicates the concentration of ions, particularly dissolved salts, within the soil solution. High salt concentrations can negatively influence plant development, disrupt the soil-water balance, and consequently affect biological processes and nutrient cycling.
- **pH Levels**: The pH level indicates the acidity or alkalinity of the soil. Different crops have specific pH requirements, and regular monitoring allows you to make adjustments that promote optimal plant health.

- **Soil Temperature**: Soil temperature affects seed germination, root development, and nutrient absorption. By tracking soil temperature, you can ensure that conditions are ideal for crop growth.
- **Relative Humidity (RH)**: Relative humidity affects transpiration and water retention in crops. Monitoring RH helps assess the moisture levels in the air, which can impact plant hydration and overall growth.
- **Air Temperature**: Air temperature plays a crucial role in crop development, influencing photosynthesis and transpiration rates. Keeping track of air temperature ensures that the environment remains favorable for optimal crop growth.

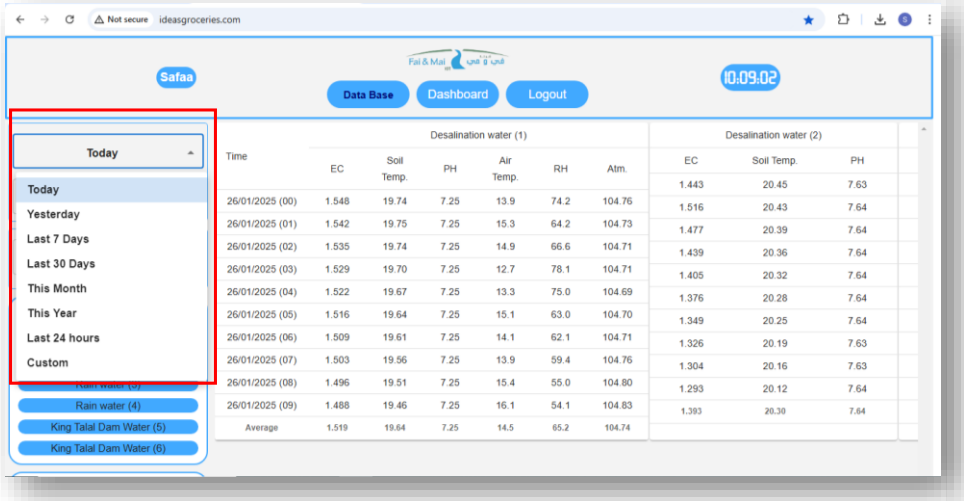
- **Navigating and Viewing Data:**

  The platform provides users with the flexibility to customize their data views for EC, pH, Soil Temperature, and other parameters, allowing them to analyze trends over varying time periods and across different zones. The options available help users track changes in parameters based on their specific needs:

  1. Time Selections:

  The platform offers various **data export options**, allowing users to download information based on different time periods, including **Hourly**, **3-hourly**, **6-hourly**, and **Daily** options, as well as **Today**, **Yesterday**, **This Month**, or **This Year**. This flexibility enables users to analyze data over both short and extended time frames, making it easier to observe trends and monitor conditions over time.

  These intervals help users track how environmental conditions evolve throughout the day or across longer periods, making it easier to adjust irrigation and farming practices based on real-time insights.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King Talal Dam Water (5)
King Talal Dam Water (6)
Desalination water (1)
Desalination water (2)
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Soil Temp.
PH
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RH
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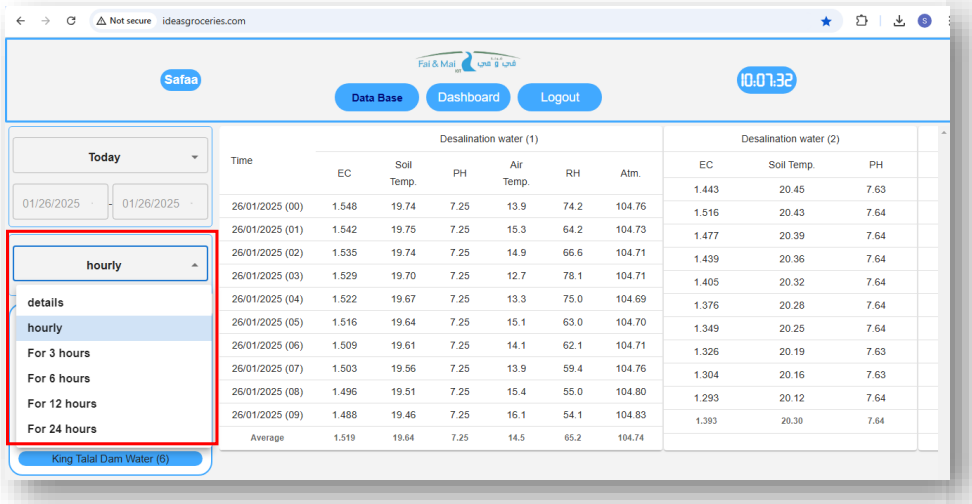
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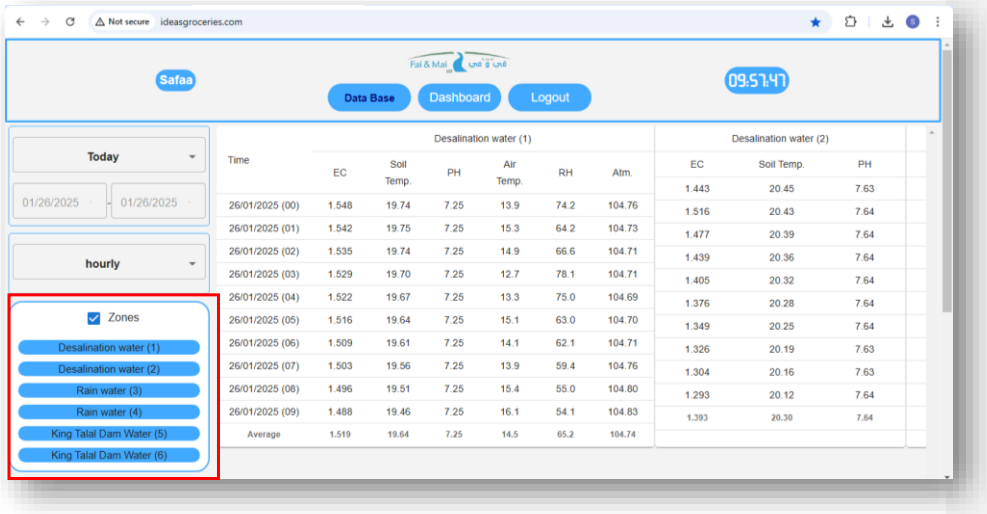
2. Zone Selection:

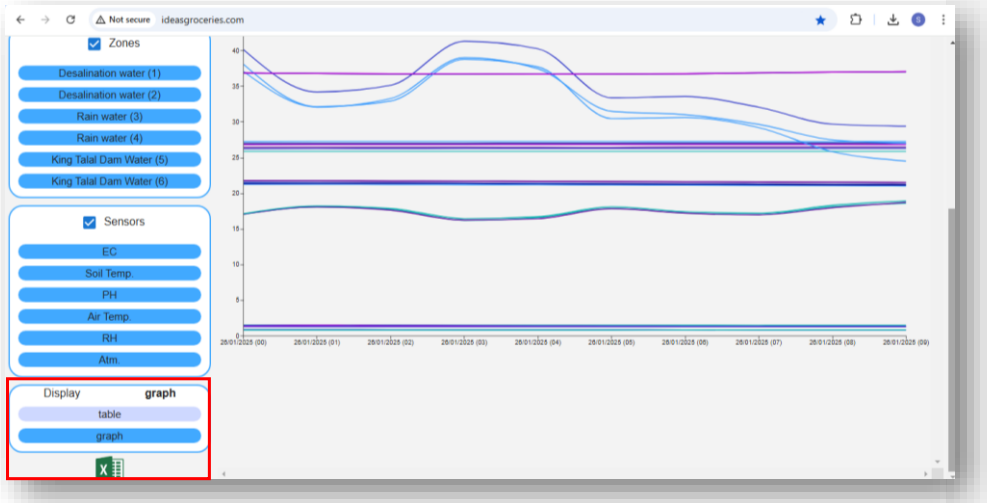
- Users can choose the relevant Zone (e.g., plastic house) to view or export data. This customization allows for targeted data analysis, enabling farmers to assess conditions specific to each zone.

  By selecting individual zones, farmers can identify how different areas of the farm may require distinct irrigation strategies or adjustments, ensuring optimal resource management across the entire farm.



3. Data Download Options and Display:

- The platform offers **flexible data export options**, allowing users to download data based on specific time periods. This flexibility helps users analyze data from various timeframes, providing valuable insights into trends over both short and long periods. Users can display data in **both tables and graphs**, making it easier to visualize patterns and compare conditions. Graphical representations allow for quick identification of trends and anomalies, while tables provide precise numerical data for more detailed analysis.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Zones
Desalination water (1)
Desalination water (2)
Rain water (3)
Rain water (4)
King Talal Dam Water (5)
King Talal Dam Water (6)
Sensors
EC
Soil Temp.
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Display
graph
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