e-Tayoga focuses on helping farmers optimize water management, make informed decisions about crop selection, and foster community collaboration, all while leveraging **NASA's Earth observation data**. This platform consists of four core components: a virtual assistant, a real-time dashboard, an alert system, and a community forum.

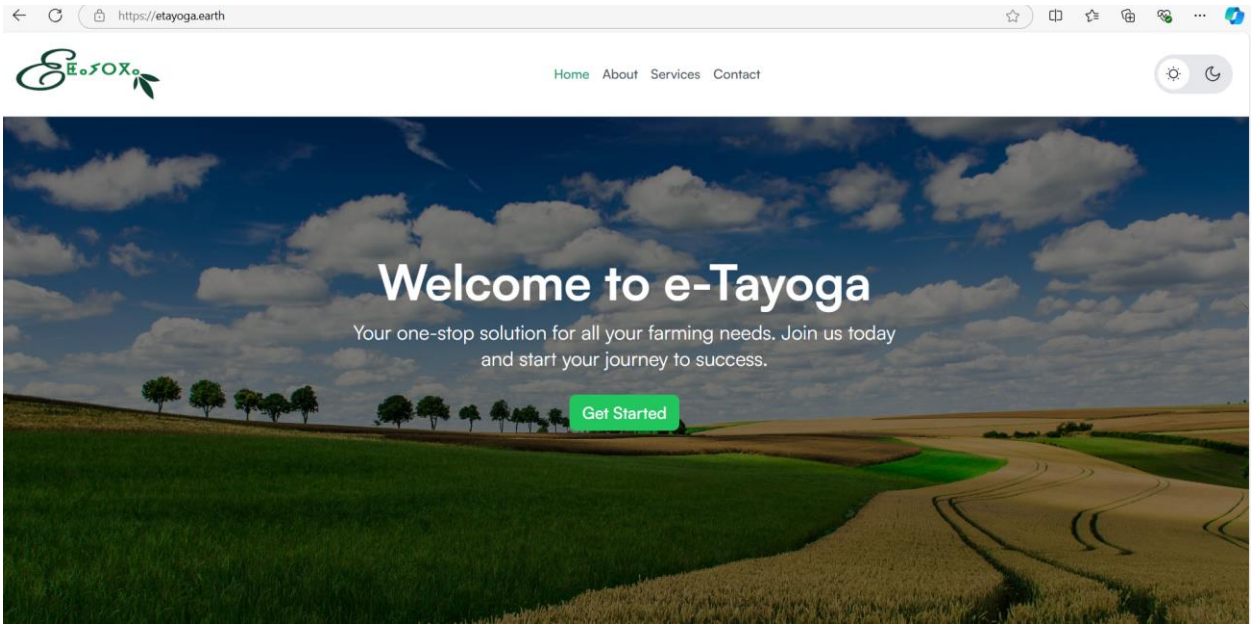

Figure 1: Home page

How It Works:

1. **Sign-Up and User Registration:**

Sign-Up Process:

Step 1: Account Creation: Farmers can create an account by providing basic information such as name, email, and location. They can sign up using their email or a phone number (with SMS verification).

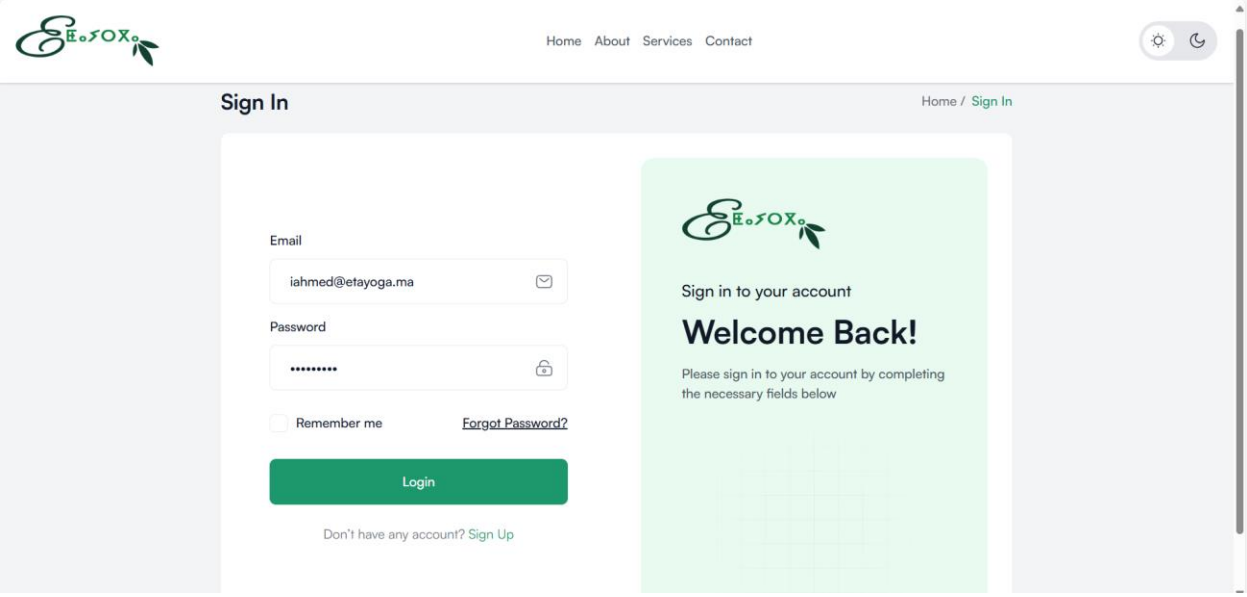

Figure 2: Sign In page

Step 2: Land Information: After registration, the user is prompted to mark their land on a map using Google Earth Engine integration. The system allows users to draw a rectangle around their fields, which defines the area for which e-Tayoga will collect and analyze data.

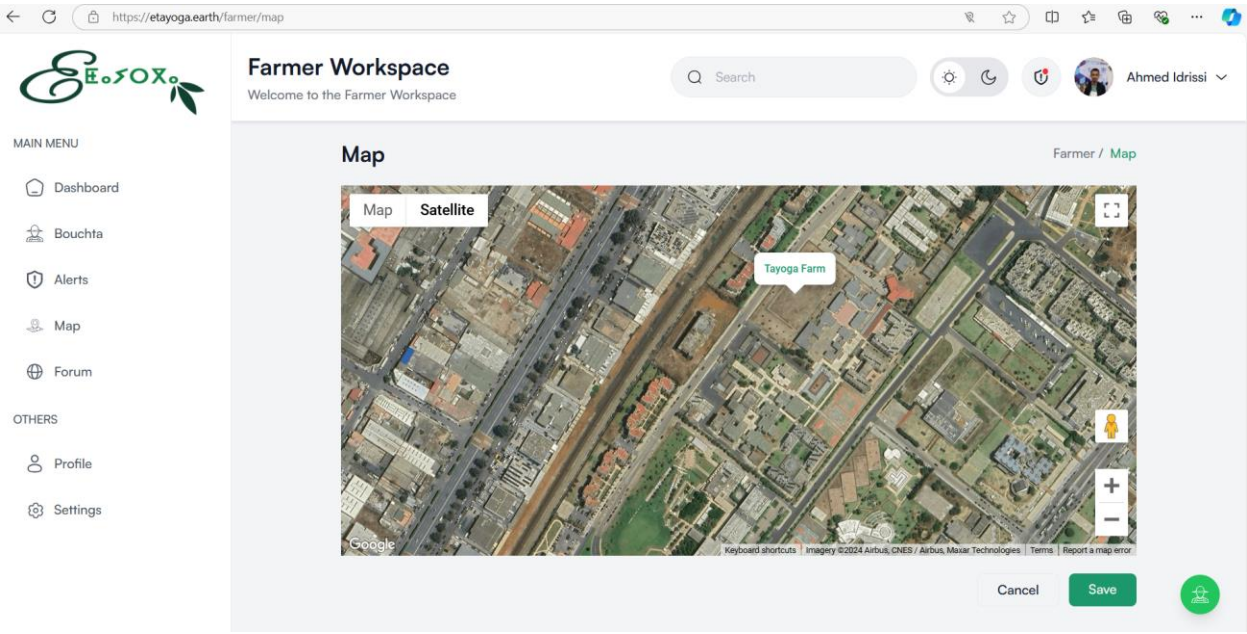

Figure 3: Farmer workspace

Step 3: Language and Input Mode: The user selects their preferred language (Darija, English, etc.) and chooses the interaction mode: voice or text. This enhances accessibility for both tech-savvy and traditional farmers.

Account Setup:

- The platform collects specific data about the farmer's land (such as size, crops, water sources) based on the drawn area and integrates it with geospatial data (NASA datasets).
- It saves user preferences for future interactions and provides personalized alerts and advice based on the farm's location and land conditions.

2. Components of e-Tayoga:

2.1 BOUCHTA

This is the heart of the e-Tayoga system. The assistant interacts with farmers through voice or text, offering three main services:

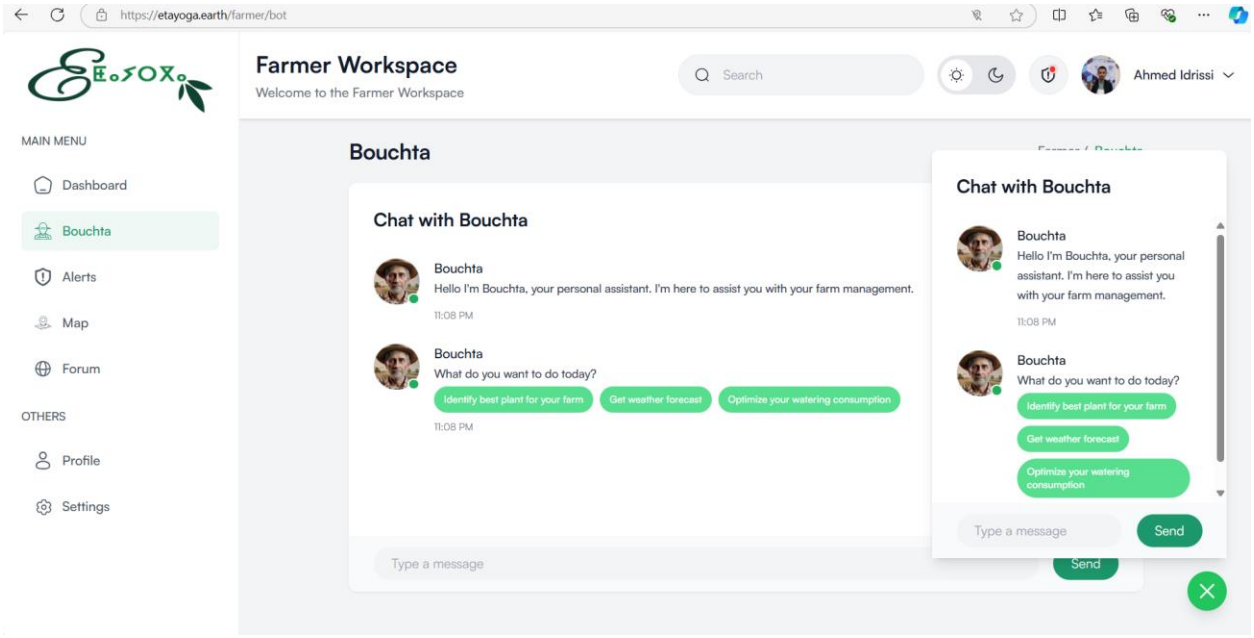

Figure 4: Bouchta

- **Option 1: Crop Identification and Recommendation**:
    - The assistant analyzes the water challenges in the user's area, soil type, and historical weather data to recommend the best crops to grow. For

example, in areas with water scarcity, it might suggest drought-resistant crops.

- Justification is provided based on the data collected, such as local rainfall, soil type (based on NASA's soil moisture data), and historical yield statistics.
- The farmer can choose to view a detailed report of each recommendation and interact by asking for more information through voice commands or text queries.

NB:

By utilizing **data from FRO and crop characteristics** alongside **generative AI techniques**, we create a well-structured dataset that informs the training of an **XGBoost model**. This model ultimately serves as a decision-support tool, enabling farmers to select the best crops for their specific water and soil conditions, thereby promoting efficient resource use and maximizing agricultural productivity.

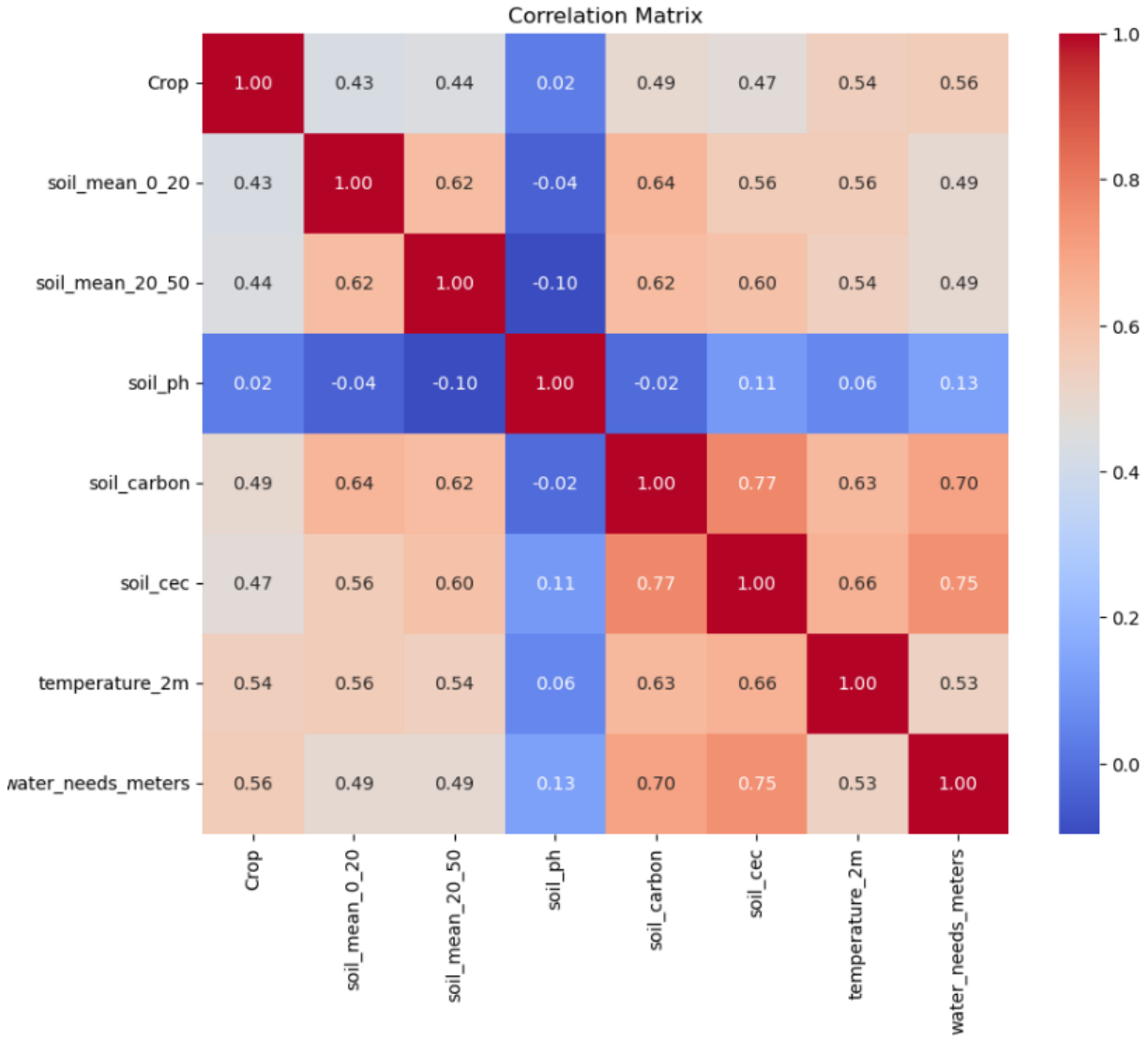

Figure 5:Correlation matrix

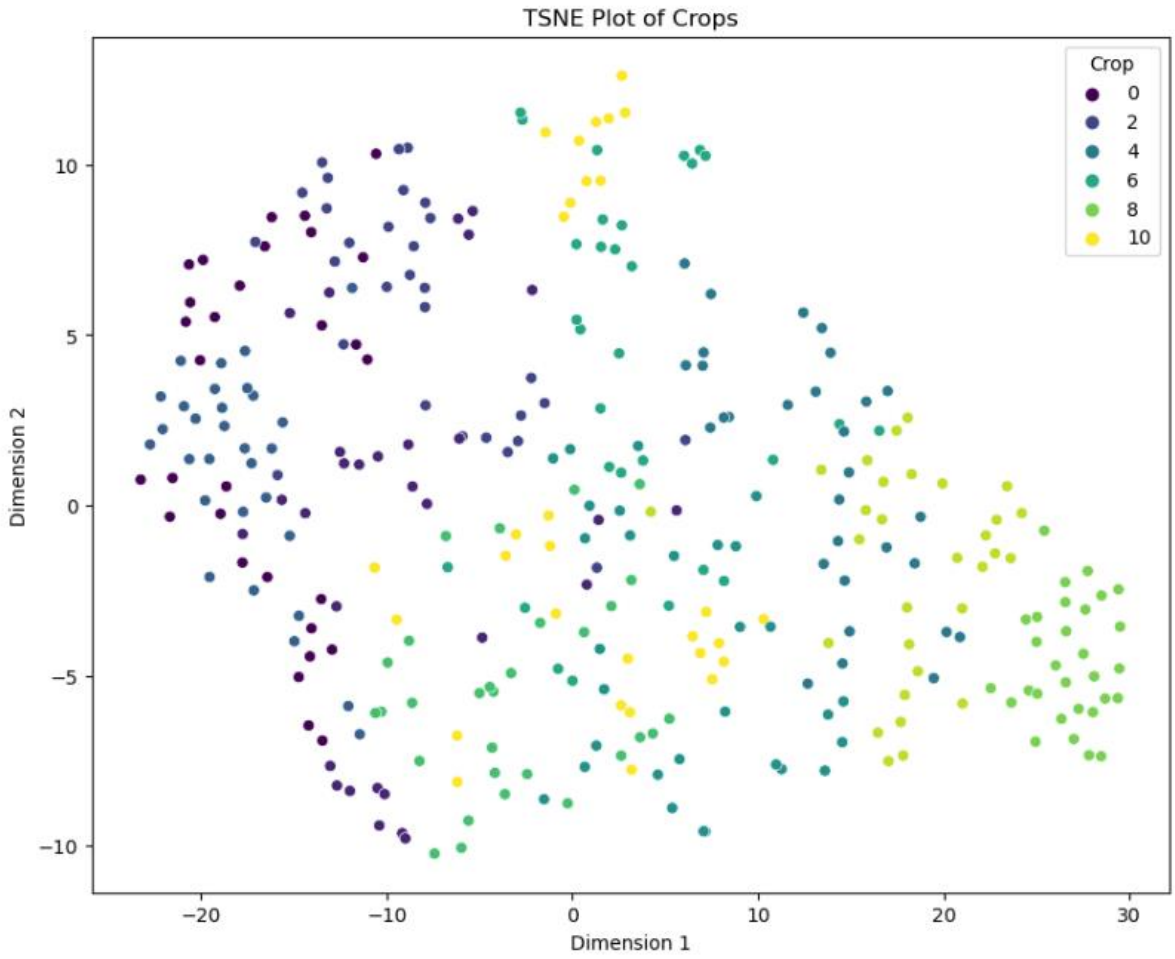

Figure 6: TSNE Plot of crops

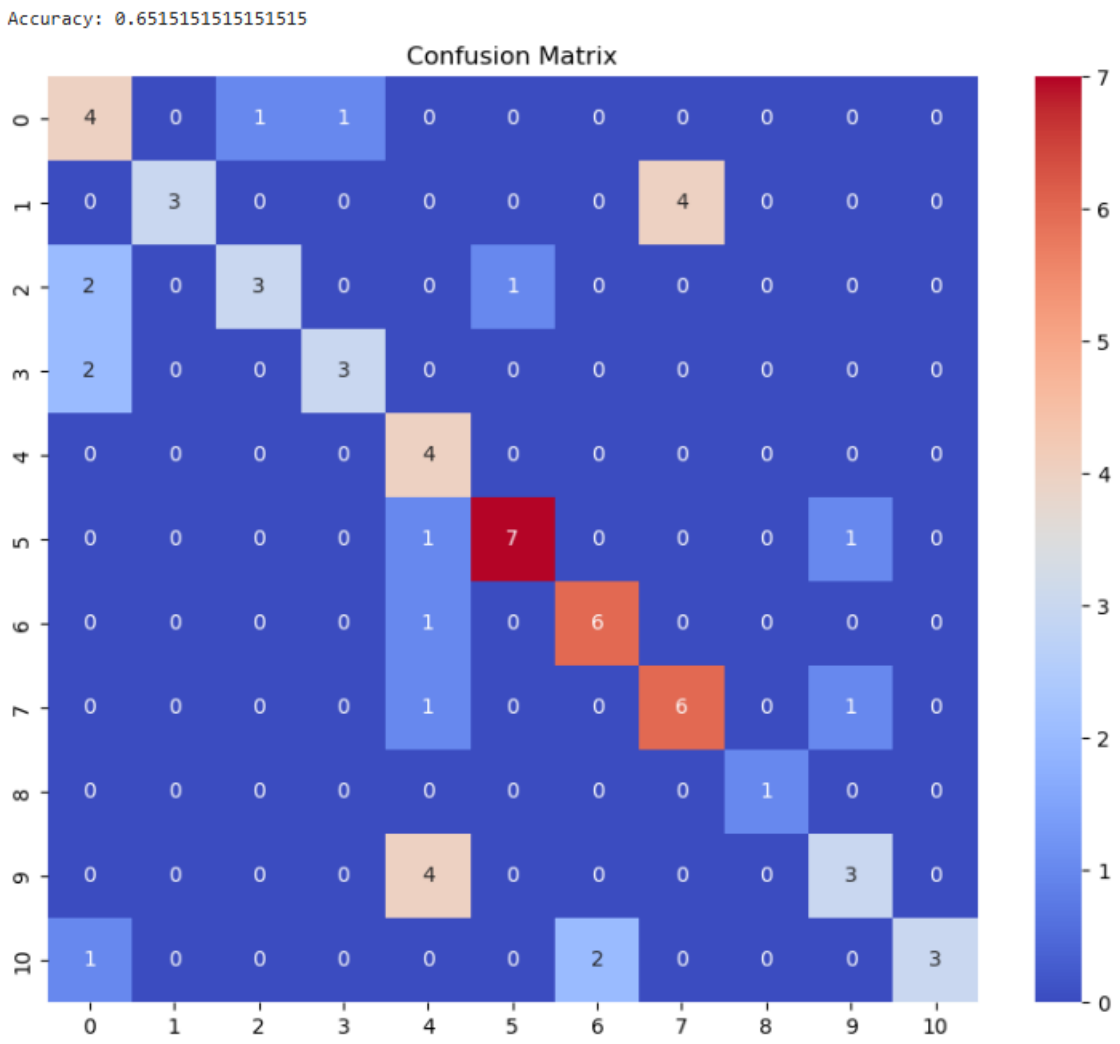

Figure 7: Confusion Matrix

- **Option 2: Prediction and Monitoring**:
    - This feature offers predictive analysis of the user's crops based on real-time data. It uses temperature forecasts, water availability, and evapotranspiration rates to predict the growth rate, water consumption, and possible risks (diseases, droughts).
    - The assistant provides a future projection for crop health, optimal irrigation schedules, and upcoming weather alerts, giving the farmer proactive advice.
    - The system also warns users about upcoming high-temperature days or changes in water levels that might affect crop yield.
- **Option 3: Optimization of Resources**:

- This option helps farmers optimize their water usage by recommending efficient irrigation strategies (such as drip irrigation) and best practices for planting, fertilizing, and plowing.
- The assistant also analyzes equipment usage and suggests ways to improve efficiency, from tractors to water pumps. For example, the system could recommend the best time to water crops to minimize evaporation loss, saving water and energy costs.

2.2 Dashboard Component

The dashboard provides a comprehensive view of the farmer's land and its current state. It includes:

- **Land Overview**: A map view of the farm with real-time temperature, soil moisture, and water levels displayed on an interactive map.
- **Weather Data**: Displays daily weather conditions, water availability, and risk alerts (e.g., drought or floods).
- **Crop Health Tracking**: Shows crop status with predictive insights on growth stages, irrigation needs, and potential disease risks.
- **Water Management Insights**: Provides data on water usage, reservoir levels, and recommendations for optimizing water supply based on daily predictions.

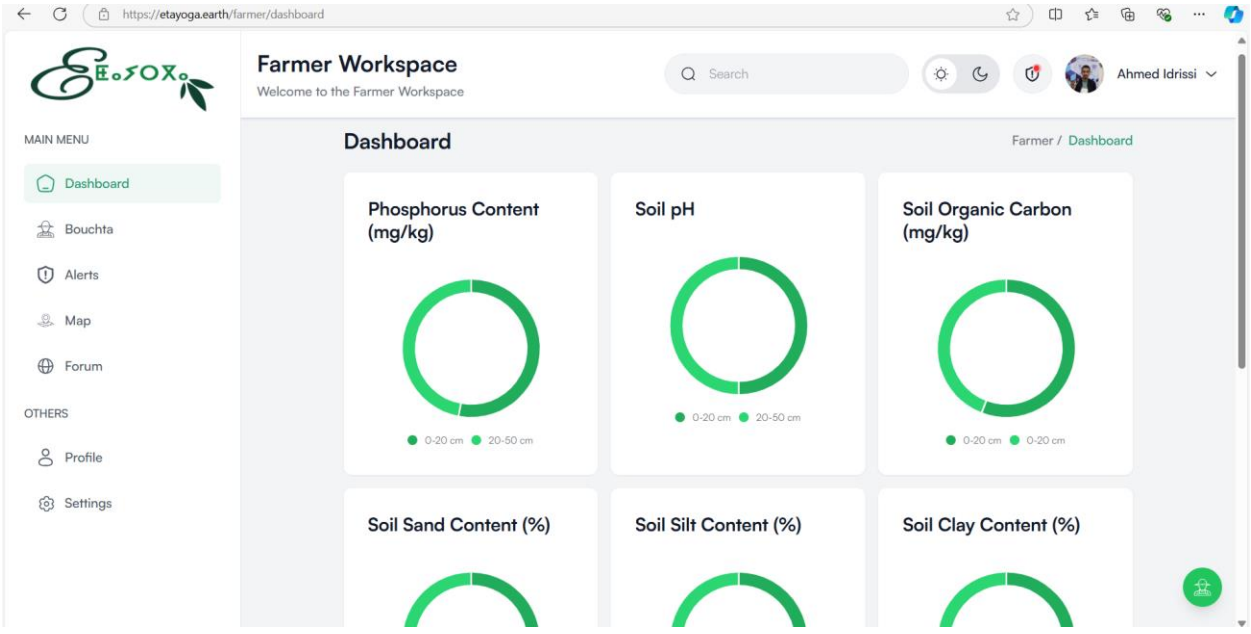

Figure 8: Dashboard

2.3 Forum Component

The **Forum** allows users to interact with other farmers, agronomists, and experts in the agricultural community. This component works like a knowledge-sharing hub:

- **Knowledge Exchange**: Farmers can post questions, share experiences, or ask for advice regarding water management, crop diseases, irrigation systems, or new technologies.
- **Expert Contributions**: Experts (e.g., agronomists) can provide answers, and participants earn points for contributions, building a community of knowledge exchange.
- **Problem Solving**: Through discussion, farmers can help one another solve common agricultural issues, improving their practices by learning from others.

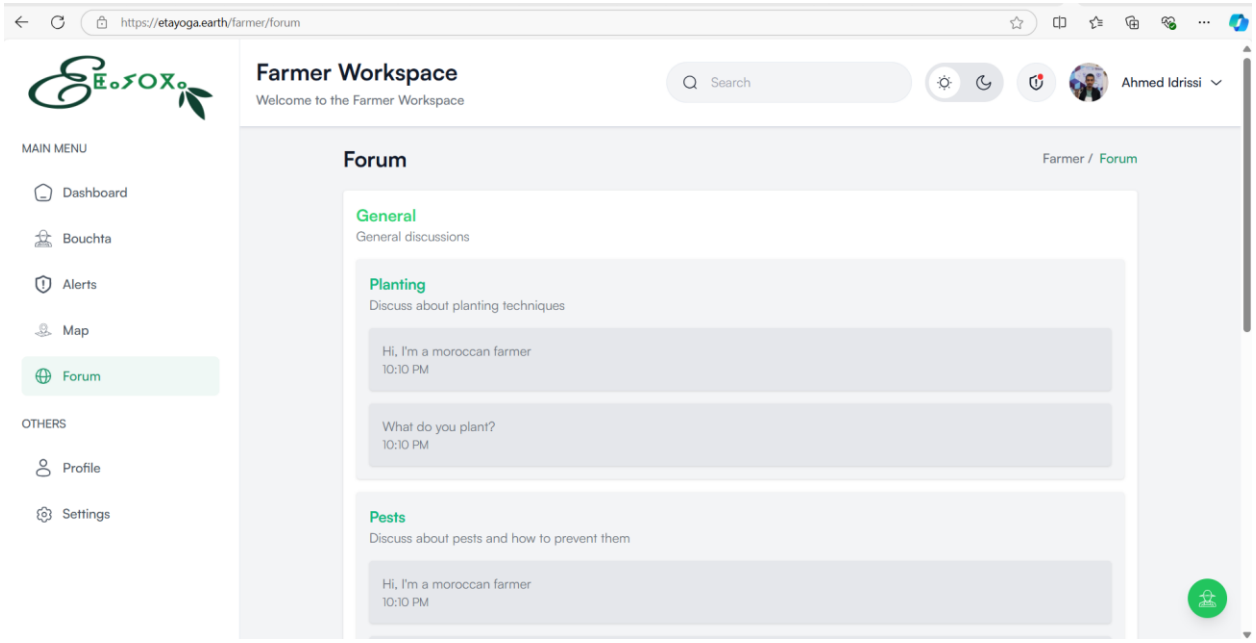

Figure 9: Forum page

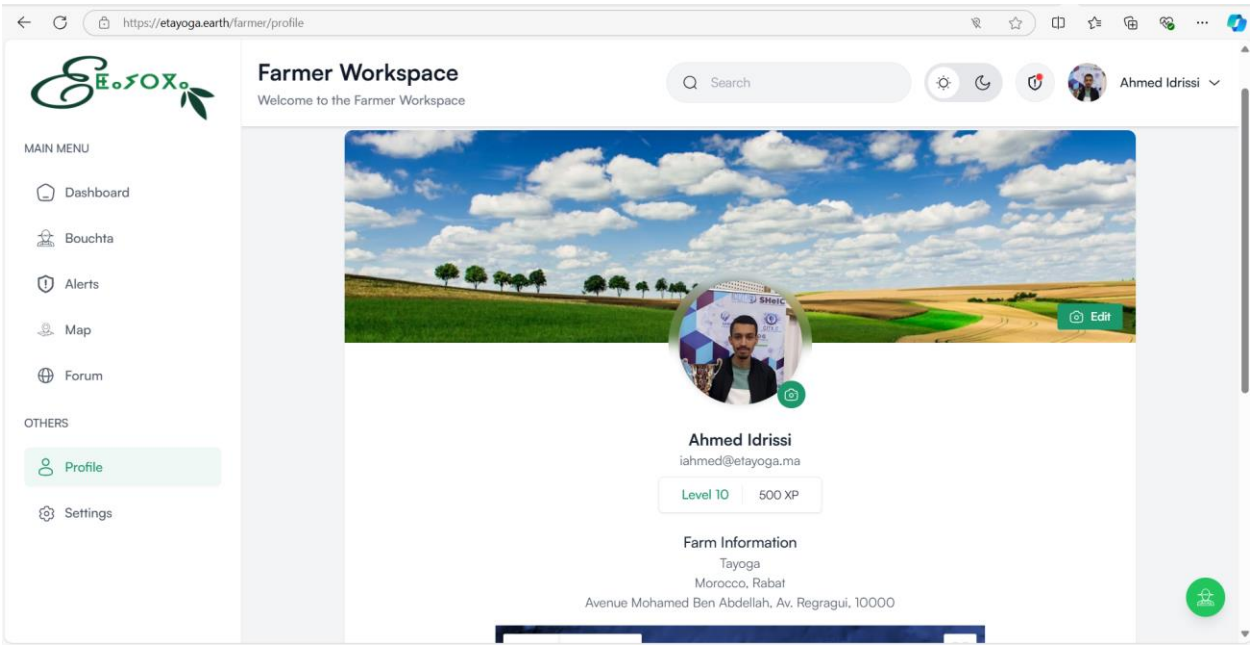

Figure 10: Points for contribution

2.4 Alert System Component

The alert system acts as a notification center for the farmer:

- **Real-Time Alerts**: Farmers receive notifications regarding water scarcity, crop diseases, or environmental hazards.
    - For instance, if there's a sudden drop in reservoir levels or a high chance of crop disease due to humidity, the system will alert the farmer.
- **Personalized Alerts**: These alerts are based on real-time monitoring of the farmer’s specific land, ensuring that they receive highly relevant and actionable warnings.

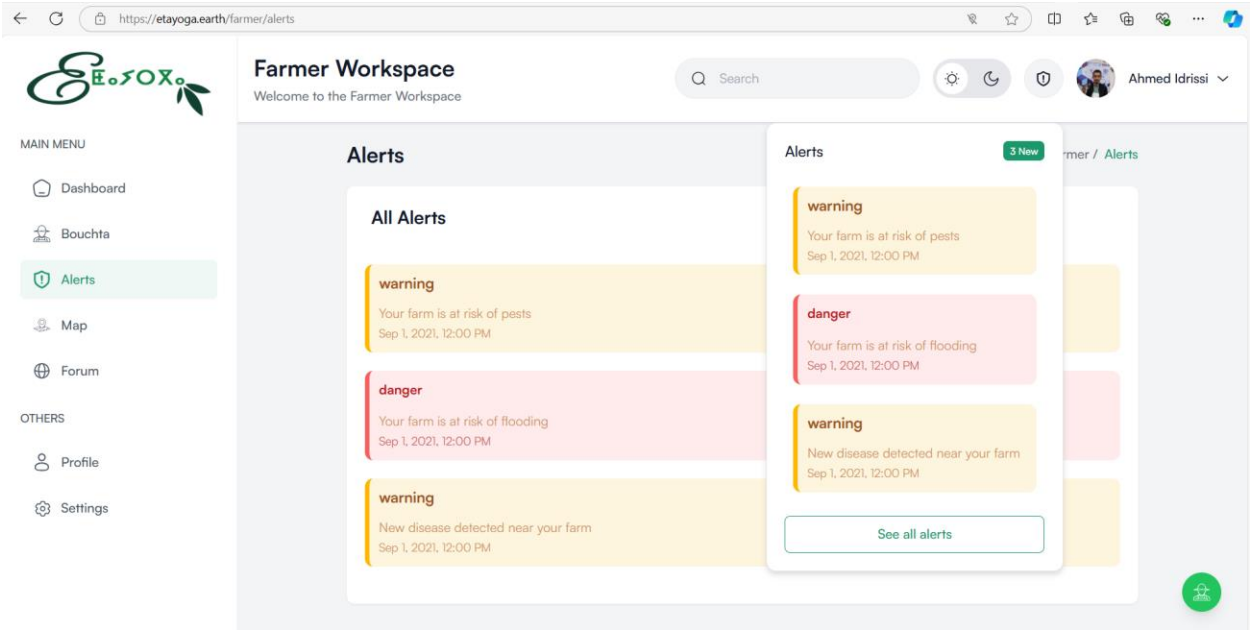

Figure 11: Alert page

Backend Technologies

Google Earth Engine API

NASA Datasets (NASA Earth Observations (NEO))

Python: Fo AI : GitHub Copilot and OpenAI

API: Google Maps API

Domain name: Porkbun

Hosting: Netlify

Frontend: NextJS and Tailwind CSS

Icons: https://iconsvg.co/

Template: https://github.com/NextAdminHQ/nextjs-admin-dashboard/

Backend: Spring Boot

Benefits of e-Tayoga

Real-Time Insights: e-Tayoga provides farmers with up-to-date information on weather patterns, soil moisture, and crop health, enabling timely decision-making regarding irrigation and crop management.

Optimized Water Management: By leveraging advanced data analytics and geospatial information, e-Tayoga helps farmers use water more efficiently, crucial in an era of increasing drought conditions and water scarcity.

User-Friendly Interface: The application is designed with farmers in mind, ensuring easy navigation and accessibility of complex data, which enhances user adoption and engagement.

Disease Prediction and Management: e-Tayoga incorporates predictive analytics to identify potential crop diseases, allowing farmers to take preventative measures and reduce crop loss.

Community Empowerment: The platform encourages collaboration among farmers, agronomists, and local communities by facilitating knowledge sharing and collective decision-making.

Sustainability Focus: e-Tayoga promotes sustainable farming practices by enabling precision agriculture, reducing resource waste, and encouraging environmentally friendly practices.

Enhanced Productivity: By providing actionable insights and support for efficient farming practices, e-Tayoga helps increase crop yields and overall agricultural productivity.

Integration with NASA Data: Utilizing NASA's extensive Earth observation data, e-Tayoga ensures that the information provided is scientifically accurate and relevant to current agricultural challenges.