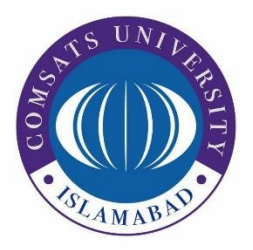



**COMSATS University, Islamabad Pakistan**

# AgroTech

***By***

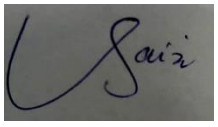
**Mohammad Ammar Ali** **CIIT/FA21-BSE-042/ISB**

**Muhammad Moiz** **CIIT/FA21-BSE-044/ISB**

**Muaaz Bin Mukhtar** **CIIT/FA21-BSE-045/ISB**

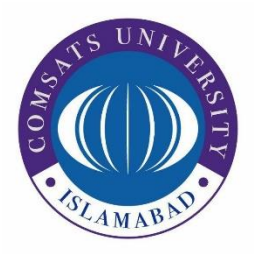
***Supervisor***

**Dr. Saira Beg**



***Bachelor of Science in Software Engineering (2021-2025)***

**The candidate confirms that the work submitted is their own and appropriate credit has been given where reference has been made to the work of others**.




**COMSATS University, Islamabad Pakistan**

# AgroTech

**A project presented to**

**COMSATS University, Islamabad**

**In partial fulfillment**

**of the requirement for the degree of**

***Bachelors of Science in Software Engineering (2021-2025)***

**By**

**Mohammad Ammar Ali** **CIIT/FA21-BSE-042/ISB**

**Muhammad Moiz** **CIIT/FA21-BSE-044/ISB**

**Muaaz Bin Mukhtar** **CIIT/FA21-BSE-045/ISB**

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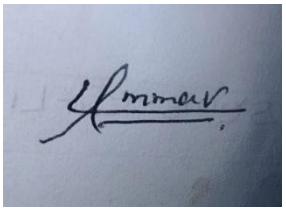
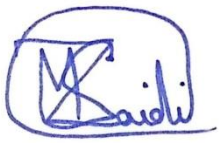
|  |  |  |
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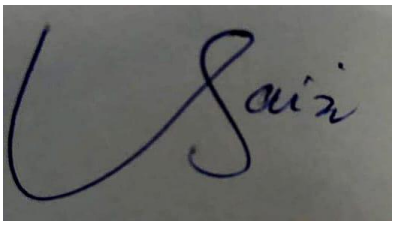
# CERTIFICATE OF APPROVAL

It is to certify that the final year project of BS (SE) "AgroTech" was developed by **MOHAMMAD AMMAR ALI (CIIT/FA21-BSE-042)**, **MUHAMMAD MOIZ (CIIT/FA21-BSE-044)** and **MUAAZ BIN MUKHTAR (CIIT/FA21-BSE-045)** under the supervision of "Dr. SAIRA BEG" and that in her opinion; it is fully adequate, in scope and quality for the degree of Bachelors of Science in Software Engineering.



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**Supervisor**

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**External Examiner**

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**Head of Department**

**(Department of Computer Science)**

# Executive Summary

In agriculture, farmers face numerous challenges in crop production, monitoring, and market accessibility, leading to inefficiencies and financial losses. Relying solely on traditional farming methods results in increased manual labor, suboptimal decision-making, and limited access to accurate data for optimizing yield and resource allocation. Additionally, conventional monitoring techniques are slow, reactive, and unable to provide early intervention for diseases, pests, and nutrient deficiencies. The lack of a structured marketplace further complicates selling and purchasing crops, creating difficulties in reaching potential buyers and securing fair prices.

To address these challenges, AgroTech is developed. It is a smart agricultural management system that provides innovative solutions to many of these problems. It is a web-based platform that leverages AI, machine learning, and image processing to assist farmers in making data-driven decisions. AgroTech integrates crop recommendation, health monitoring, yield estimation, and a digital marketplace, ensuring efficiency across the entire farming lifecycle.

AgroTech analyzes soil and climate data to recommend optimal crops, provides real-time crop health monitoring, and detects diseases and pests for proactive treatment. It also features harvesting and storage assistance, facilitating smooth post-harvest operations. Additionally, its online marketplace connects farmers with buyers, enabling secure transactions, bidding, and fair pricing.

The system is designed to be user-friendly, offering role-based access for admins, farmers, sellers, and customers**.** It ensures accessibility through a structured dashboard, allowing farmers to manage crops and sales efficiently. By integrating data-driven analytics and automated decision support, AgroTech empowers farmers, enhances productivity, and bridges the gap between agricultural supply and market demand.

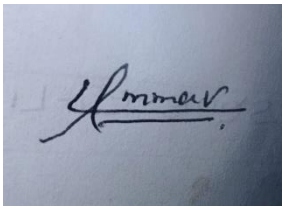
# Acknowledgement

All praise is to Almighty Allah who bestowed upon us a minute portion of His boundless knowledge by virtue of which we were able to accomplish this challenging task.

We are greatly indebted to our project supervisor “Dr. Saira Beg”. Without their personal supervision, advice and valuable guidance, completion of this project would have been doubtful. We are grateful to them for their encouragement and continual help during this work.

And we are also thankful to our parents and family who have been a constant source of encouragement for us and brought us with the values of honesty & hard work.

Mohammad Ammar Ali



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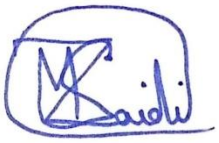
Muhammad Moiz



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Muaaz Bin Mukhtar

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# Abbreviations

| | |
|---|---|
| **SRS** | Software Require Specification |
| **PC** | Personal Computer |
| **SDS** | Software Design Specification |
| **STD** | State Transition Diagram |
| **DFD** | Data Flow Diagram |
| **UC** | Use Case |
| **FR** | Functional Requirement |
| **NFR** | Non-Functional Requirement |
| **AI** | Artificial Intelligence |
| **ML** | Machine Learning |

# Table of Contents

# List of Figures

# 1 Introduction

This chapter provides an overview of the AgroTech project, outlining its vision, comparative analysis with existing solutions, key deliverables, limitations, tools and technologies, and its relevance to course modules. AgroTech is designed to revolutionize modern farming through intelligent crop recommendations, real-time monitoring, and a digital marketplace, addressing critical challenges faced by farmers. The vision statement highlights its role in optimizing agricultural practices and enhancing market accessibility. A comparative analysis with existing systems demonstrates how AgroTech overcomes their limitations. The project deliverables detail its development timeline, while system limitations acknowledge constraints like connectivity and technological access. The chapter also outlines the tools and technologies used for implementation and explains how AgroTech integrates concepts from multiple academic courses, reinforcing its technical and practical significance.

## 1.1 Vision Statement

**For** farmers **who** want to optimize their agricultural practices, maximize yields sustainably and enhance their market access, **the** AgroTech **is** a web application **that** offers smart crop recommendation, monitoring, and marketing capabilities. **Unlike** traditional methods and outdated tools, **our product** revolutionizes crop recommendations, monitoring, and marketing by optimizing resource utilization, improving yield prediction accuracy, and facilitating market linkage. AgroTech aims to enhance agricultural productivity, sustainability, and profitability, contributing to food security and economic development.

## 1.2 Related System Analysis/Literature Review

**Table 1 Related System Analysis with proposed project solution**

| Application Name | Weakness | Proposed Project Solution |
|---|---|---|
| CropIn (Web and Mobile) https://www.cropin.com/ | Integration of comprehensive market access for farmers. | AgroTech will facilitate farmers with comprehensive market access like selling crops, pesticides and other agriculture products. |
| Folio3 AgTech (Desktop and Mobile) https://agtech.folio3.com/ | It gives a general-purpose approach for recommendation of crops. | AgroTech will recommend suitable crops keeping in view of soil type and history, climate conditions and budget. |
| Kheti Buddy https://khetibuddy.com/ca/ | It gives limited information on record keeping and crop/soil monitoring. | AgroTech will provide crop and soil monitoring using image processing and keeps detailed record of it for in-future analysis. |

## 1.3 Project Deliverables

**Table 2 Project Deliverables**

| Deliverable | Submitted on |
|---|---|
| Document 1: Scope | 12/5/2024 |
| Document 2: SRS (Software Requirement Specification) | 26/11/2024 |
| Document 3: SDS (Software Design Specification) | 23/11/2024 |
| Implementation: 40% | 23/11/2024 |
| Half Report | 28/2/2025 |
| Implementation: 60% | 28/2/2025 |
| Implementation: 100% | - |
| Document 4: Complete Project Report | - |
| Document 5: Hard Binding Project Report | - |

## 1.4 System Limitations/Constraints

LI-1: Limited Access to Technology: Some farmers may lack access to smartphones or computers, limiting their ability to use the software.
LI-2: Connectivity Issues: Rural areas may suffer from poor internet connectivity, affecting the crop monitoring and updating features of the software.
LI-3: Lack of familiarity with Technology: Farmers with limited literacy and familiarity with technology can significantly restrict their usage of software.

## 1.5 Tools and Technologies

**Table 3 Tools and Technologies for Proposed Project**

| | Tools | Version | Rationale |
|---|---|---|---|
| **Tools And Technologies** | MS Visual Studio Code | 1.88.1 | IDE |
| | MondoDb Compass | 7.0 | DBMS |
| | Adobe Photoshop | 25.6 | Design Work |
| | MS PowerPoint | 2016 | Presentation |
| | MS Word | 2016 | Documentation |
| | MS Project | 2016 | WBS and Gantt Chart |
| | Figma | 9.0 | Mockups |
| | **Technology** | **Version** | **Rationale** |
| | React JS | 17 | Front-end Development |
| | Java Script | ES 2023 | Client-side scripting |
| | MongoDB | 7.0 | Database |
| | Express JS | 4.18 | Web Development |
| | Python | 3.12 | AI and ML |
| | Node JS | 21 | Backend |

## 1.6 Relevance to Course Modules

### 1.6.1 Programming Fundamentals and Object-Oriented Programming

OOP principles were directly applied in various modules such as Crop Health Monitoring Recommendation etc.

### 1.6.2 Web Technologies and Topics in Software Engineering (Advance Web)

This course was crucial for AgroTech as our project is based on web. This course taught me how to design and build web apps, ensuring compatibility across platforms and other features synchronization.

### 1.6.3 Software Requirements Engineering, Software Design Analysis, Software Project Management

The skills gained helped in structuring the app's design, managing its development, and ensuring it is scalable and maintainable.

### 1.6.4 Artificial Intelligence

The knowledge from this course was applied in implementing AI based chatbot.

### 1.6.5 Database Systems

This course provided essential knowledge for managing data, allowing me to efficiently integrate MongoDB for real-time data storage.

# 2 Problem Definition

This chapter defines the core problem AgroTech aims to solve, along with its proposed solution, objectives, scope, and system modules. Farmers face multiple challenges in crop production, management, monitoring, and marketing, leading to inefficiencies, resource wastage, and reduced profitability. Traditional methods lack automation and predictive analytics, making decision-making difficult. AgroTech addresses these issues by leveraging artificial intelligence, machine learning, and image processing to provide smart crop recommendations, real-time monitoring, and an integrated marketplace. The chapter outlines the key objectives of the system, ensuring improved decision-making, yield optimization, and market accessibility. Additionally, it details the project's scope and the various modules that will contribute to its functionality, ensuring a comprehensive solution to modern agricultural challenges.

## 2.1 Problem Statement

Currently farmers are facing many challenges in crop production, management, monitoring and marketing which results in suboptimal yield production, resource wastage and limited market access. Traditional crop management methods require manual labor and rely on outdated tools and equipment which are inefficient and labor intensive. The agricultural sector and farmers face many challenges in making decisions about crop selection, planting schedule and agronomic practices because of lack of access to data and predictive analytics. Traditional monitoring processes cause delays in detecting diseases, pests or nutrient deficiency which results in lower yield production and increased costs. In physical markets, farmers face different challenges in selling their produce as well as customers finding their needs according to their budget.

## 2.2 Problem Solution

AgroTech will be a web application that will address all the problems and challenges mentioned in the problem statement. It will aim to revolutionize crop recommendations, management, monitoring, and marketing through streamlining the whole production lifecycle of crops using advanced technologies and data driven decision-making. It will provide recommendations about optimal crops based on soil and climate data monitoring crop health periodically, detect diseases and pests and recommend pesticides and insecticides, optimizing resource allocation, streamline harvest operations, facilitating access to market and pricing decisions. It will provide decision and recommendation support along with training for farmers to continuously improve to meet ever growing agricultural needs. By achieving these goals, the software aims to empower farmers, enhance productivity of crops, and facilitate comprehensive market linkage for both farmers and customers.

## 2.3 Objectives of the Proposed System

BO-1: Improve farmer decision-making by providing accurate crop recommendations by checking soil attributes and previous history.
BO-2: Increase crop yield through optimized resource allocation and disease prevention.
BO-3: Reduce post-harvest losses through improved harvest planning and quality control measures.
BO-4: Increase farmer adoption and satisfaction with the software by providing user-friendly interfaces and comprehensive training materials, enhancing user engagement.
BO-5: Enhance market access and profitability for farmers by facilitating sales at competitive prices, resulting in a great increase in revenue.
BO-6: Reducing the effort of farmers by providing automated software to manage and control crop production

## 2.4 Scope

AgroTech is a web-based application. It revolutionizes agricultural practices by empowering farmers with advanced tools and data driven decision making capabilities along with streamlining soil and crop monitoring process, utilization of resources and marketplace

availability. AgroTech includes crop recommendation, monitoring, and marketing. It uses artificial intelligence, machine learning, and image processing to provide efficient crop recommendations based on soil and climate data. The system facilitates crop health monitoring, disease detection, and pest prevention to optimize resource allocation and prevent yield loss. AgroTech includes four main users, Admin, Farmers, Sellers and Customers. **Admin** holds the highest level of authority and access and can easily add, remove and view anything at any time. **Farmers** can access the recommendation and monitoring functionalities along with the option to buy and sell crops. **Customers** only have access to the marketplace for buying agricultural products and reviewing them. They can also participate in bidding. However, they must register for Seller profile to provide services. **Sellers** have access to the marketplace to sell their products/services. They can bid on their products. Moreover, they can view reviews and reports.

## 2.5 Modules

Modules of AgroTech are as follows:

### 2.5.1 Module 1: User Profiling

FE-1: Sign-up (Select User Type (Ecommerce Admin, Farmer and customer)).
FE-2: Sign-in.
FE-3: Manage Profile (Edit, View, Deactivate Account, Change Password).
FE-4: Recover Account.
FE-5: Social Sign-in (Gmail etc.).

### 2.5.2 Module 2: Soil Analysis

FE-1: Analyzes Nitrogen, Phosphorus. Potassium content in soil.
FE-2: Analyzes previous soil record.
FE-3: Farmers can give input according to specific needs to analyze the soil.

### 2.5.3 Module 3: Climate Analysis

FE-1: Analyzes seasonal weather.
FE-2: Analyzes climate according to specific location.

### 2.5.4 Module 4: Crop Recommendation

FE-1: Using the reports of soil and climate analysis to recommend crops.
FE-2: Provides different options according to budget.
FE-3: provides pros and cons of different crops on that soil.
FE-4: Provides tutorials for the methods for planting crops.

### 2.5.5 Module 5: AgroTech Chatbot

FE-1: Provides assistance according to user queries.
FE-2: Provides educational content, tutorials to help users learn about the system.
FE-3: Provides facility of different channels like email and phone support.

### 2.5.6 Module 6: Crop Health Monitoring

FE-1: Identify stress in crops including water, nutrients and pest infestations stress etc.
FE-2: Identify visual symptoms of diseases in crops and classify them against databases.
FE-3: Provides information about crop health periodically using images for timely intervention to minimize damage.

### 2.5.7 Module 7: Yield Estimation and Prediction

FE-1: Utilizes ML models on factors such as temperature, rainfall, soil moisture, and nutrient availability to estimate crop yield.

FE-2: Provides accurate yield prediction for planning and resource allocation.
FE-3: Assesses yield risk factors such as drought, disease outbreaks, and pest infestations, allowing farmers to implement risk mitigation measures.

### 2.5.8 Module 8: Crop Maturity Assessment

FE-1: Using image recognition (IR) to assess crop maturity and readiness for harvesting.
FE-2: Determines optimal time for harvesting based on crop growth and maturity indicators.
FE-3: Provides feedback to farmers on crop readiness to optimize harvest scheduling.
FE-4: Assess the Quality of crops based on factors such as sugar content, starch levels, size, color, and overall visual appearance.

### 2.5.9 Module 9: Harvesting Assist

FE-1: Provides a scheduling tool to plan and manage harvesting activities, specifying crop types, quantities and preferred dates.
FE-2: Recommends tools and techniques for harvesting
FE-3: Provides access to a catalog of harvesting equipment for rent and purchasing.
FE-4: Provides detailed guidelines for proper handling of tools and freshly harvested crops, helping farmers maintain quality of crops.

### 2.5.10 Module 10: Transport Assist

FE-1: Provides a facility of transportation to farmers directly from platform, specifying pickup and delivery locations.
FE-2: Provides option of different recycling and biodegradable packaging material for sustainable transportation practices.
FE-3: Provide the shortest route to desired location for fuel efficient transportation, minimizing emissions and transportation costs.
FE-4: Provides facility of logistic planning for scheduling time and routes to deliver.
FE-5: Provides facility of different delivery options based on types and quantity of crops
FE-6: Provides facility of guide lining to farmers for packaging crops securely for better transportation.

### 2.5.11 Module 11: Storage Assist

FE-1: Provides facility to reserve climate-controlled storage facilities through this platform.
FE-2: Provides an option to assess crop quality and assign grades providing buyers accurate information.
FE-3: Provides different training suggestions to improve farmer’s grading skills.
FE-4: Provides guidelines for the complete process of storage and handling techniques for each quality grade.

### 2.5.12 Module 12: Online Marketplace

FE-1: Provides facility to list items with their name, description, price, quality grade and image.
FE-2: Provides facility to manage inventory, track orders through single dashboard.
FE-3: Provides facility to perform digital marketing campaigns directly through platform.
FE-4: Provides description of farming practices used to harvest these crops to highlight their eco-friendly processes.
FE-5: Provides facility to customers directly buy crops at listed prices.
FE-6: Provides facility for customers to participate in the bidding process.
FE-7: Provides facility to farmers to manage inventory levels.
FE-8: Provides secure online payment gateways.

### 2.5.13 Module 13: Reports and Analytics

FE-1: System will provide comparative reports and analytics about user engagement (before and after using our tool)
FE-2: System will provide reports containing various terms of webpage (visits, web pages visited at max etc.)
FE-3: System will provide reports about sales and revenues. (total crop sale, total pesticides and fertilizers sale, total renting equipment).
FE-4: System will provide user with various filters for user to filter out required data.

# 3 Requirement Analysis

This chapter intends to describe the functionalities of the system on a deeper level. To do so we have designed case diagrams for graphical representation. Moreover, the finer details via detailed use cases, functional requirements. Lastly, this chapter will clarify the non-functional needs; qualitative and quantitative standards and interface requirements (UI, Software, and communication)

## 3.1 User classes and characteristics

**Table 4 User Classes and Description**

| User Class | Description |
|---|---|
| **Admin** | Admin is the super user who oversees the AgroTech system. They can manage user profiles and actions. They monitor the system's performance, manage complaints and subscriptions. Admin can also generate reports and analytics for analysis of system, users, performance etc. |
| **Farmer** | Farmer is facilitated with recommendations and assistance throughout the lifecycle of a crop. He can get recommendations, monitoring and techniques for his crops. Also, he can access AgroTech chatbot for knowledge and queries. He can get reports and analytics for the whole process. |
| **Seller** | Seller can offer his products according to the pricing guidelines of the system based on quality. He can upload pictures, descriptions and process of how the product was made available. If the seller wants to sell a large stock, he can put it in bidding. He can view reviews and feedback from users and reports and analytics from system. |
| **Customer** | Customers have access to the marketplace. He can view, review and buy any product. He can also join on going biddings if he is looking for a large stock. |

## 3.2 Requirement Identifying Technique

### 3.2.1 Use Case Diagrams

**Admin**

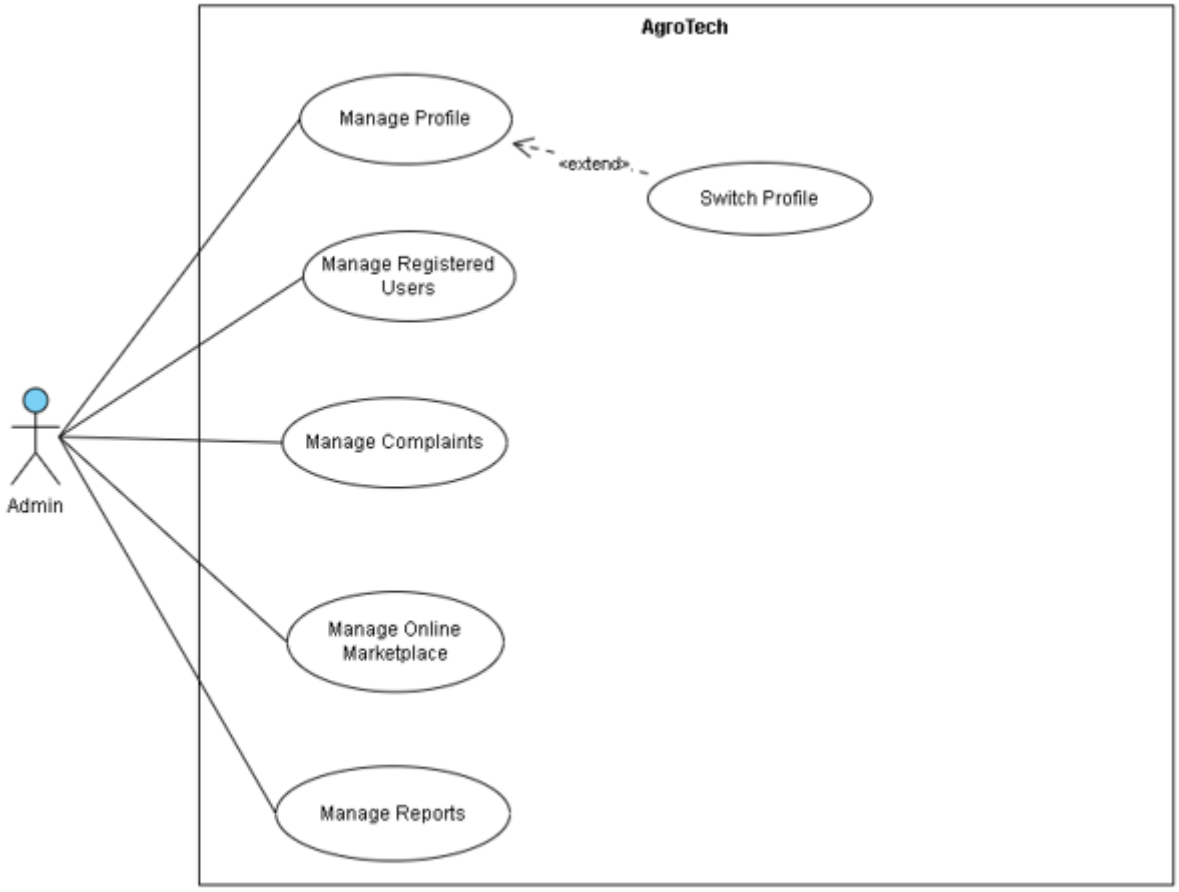


**Figure 1 Admin Use Case Diagram**

# Farmer


**Figure 2 Farmer Use Case Diagram**


**Figure 3 Farmer Use Case Diagram**

# Customer

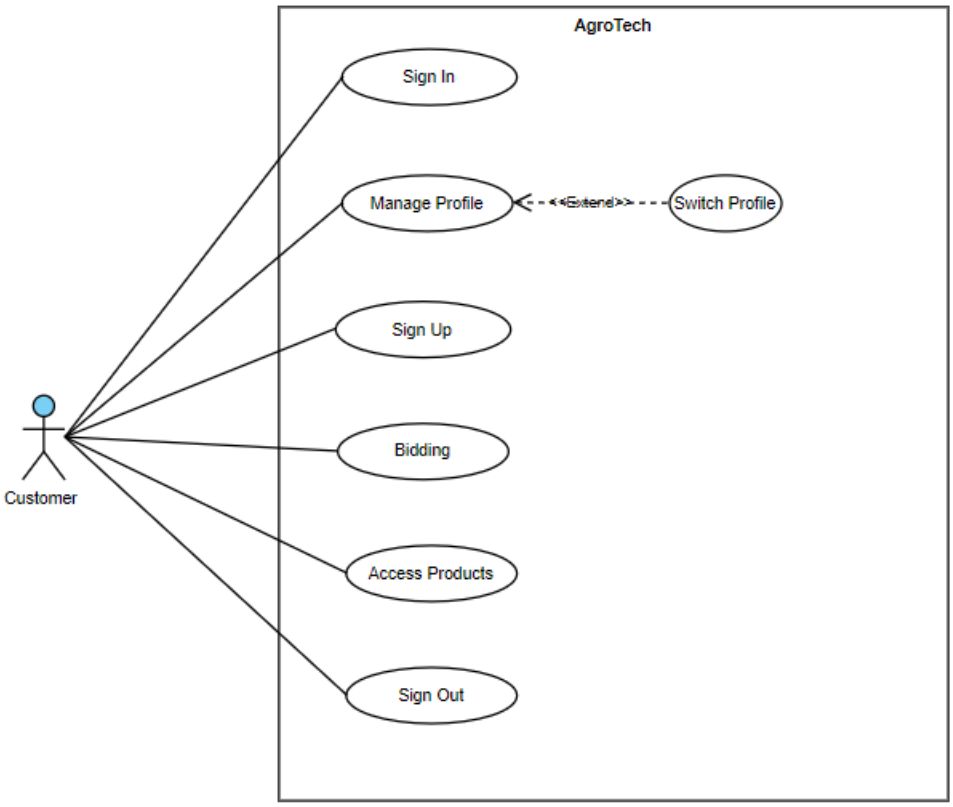


**Figure 4 Customer Use Case Diagram**

# Seller

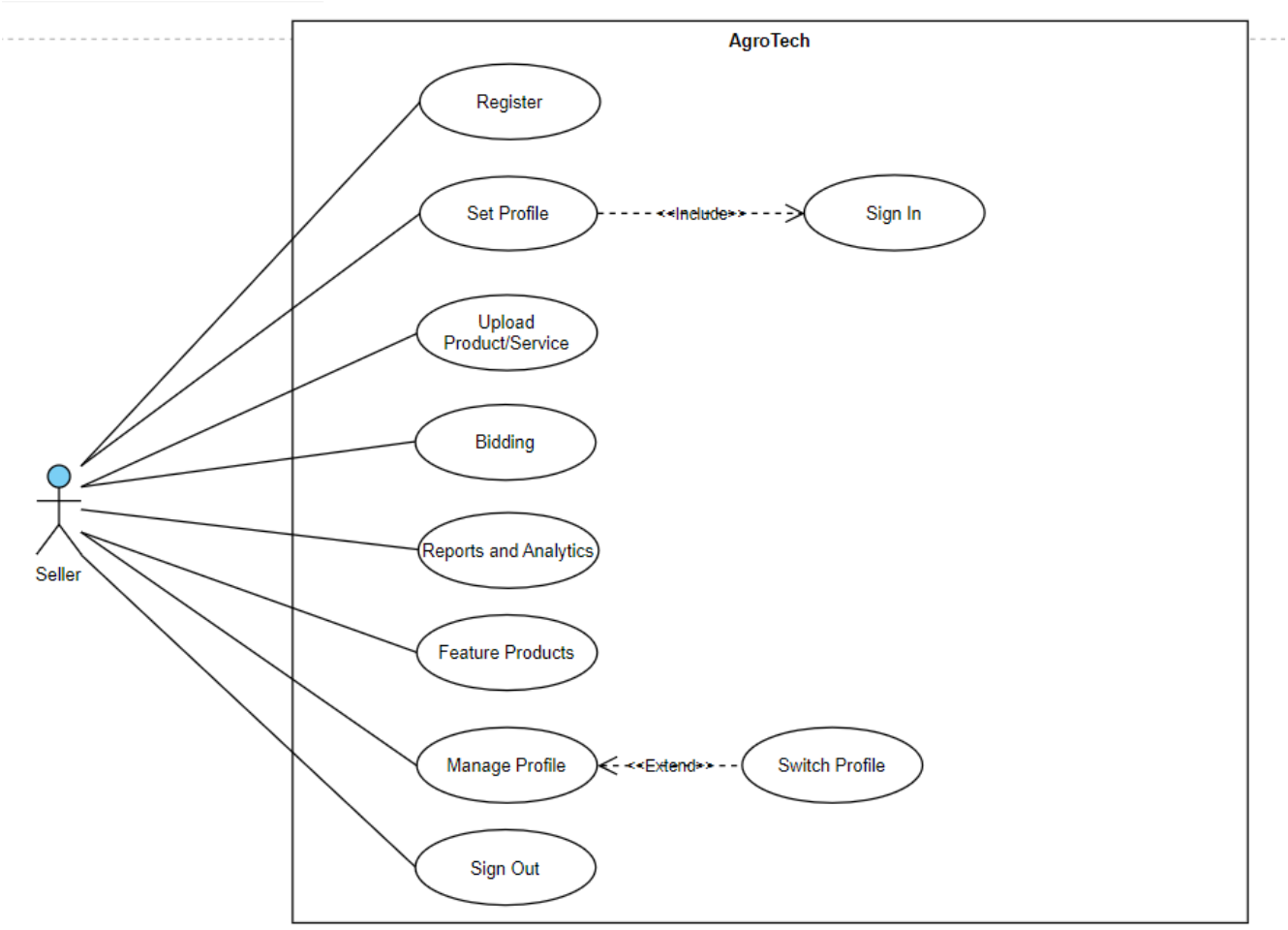


**Figure 5 Seller Use Case Diagram**

### 3.2.2 Admin Detail Use Cases

#### *3.2.2.1 Sign-Up*

**Use Case ID:** UC-1.1
**Use Case Name:** Sign-Up
**Description:** This use case explains the creation of admin account within the system.

**Table 3 Sign-Up detailed use case**

| | |
|---|---|
| **Actors:** | Admin |
| **Trigger:** | User initiates registration process by clicking sign-up button |
| **Preconditions:** | PRE-1: Attempting user must not have an existing account in the system. |
| **Postconditions:** | POST-1: Successful creation of user's account within the system. |
| **Normal Flow:** | 1. User clicks Sign-Up button.<br>2. User enters email address.<br>3. User creates a strong password.<br>4. User enters their username.<br>5. System reviews the provided information for completeness and correctness.<br>6. User clicks on Register button.<br>7. System confirms the successful registration and navigates to Sign-In page. |
| **Alternative Flows:** | 5A. If entered information is detected incomplete or invalid, system highlights the errors or mistakes.<br>5B. User re-enters the details.<br>5C. Continues from 5$^{th}$ step of normal flow. |
| **Exceptions:** | 7A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | 1. User is not registered in the system. |

#### *3.2.2.2 Sign-In*

**Use Case ID:** UC-1.2
**Use Case Name:** Sign-In
**Description:** This use case explains how admin access his account within the system.

**Table 4 Sign-In detailed use case**

| | |
|---|---|
| **Actors:** | Admin |
| **Trigger:** | User initiates sign-in process by clicking sign-in button |
| **Preconditions:** | PRE-1: Attempting user must have an existing account in the system. |
| **Postconditions:** | POST-1: Successful logging in and granting access to the system. |
| **Normal Flow:** | 1. User clicks Sign-In button.<br>2. User enters email address and password.<br>3. User clicks on Sign-In button.<br>4. System reviews the provided information for its correct format, and checks credentials against the stored data.<br>5. System confirms the successful sign-in and grants access to their personal dashboard. |
| **Alternative Flows:** | 1A. User opts for third party sign-in (Google).<br>1B. System navigates to respective third party's service page.<br>1C. Third party authenticates the user.<br>1D. Continues from 5th step of normal flow.<br><br>4A. If entered information is detected incomplete or invalid, system highlights the errors or mistakes.<br>4B. User re-enters the details.<br>4C. Continues from 3rd step of normal flow. |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | 1. User is registered in the system to avail services. |

#### *3.2.2.3 Manage Registered Users*

**Use Case ID:** UC-1.3
**Use Case Name:** Manage Registered Users
**Description:** This use case explains how admin is able to view and manage registered users' accounts.

**Table 5 Manage Registered Users detailed use case**

| | |
|---|---|
| **Actors:** | Admin |
| **Trigger:** | Admin selects user management from admin dashboard. |
| **Preconditions:** | PRE-1: Admin is logged into the system. |
| **Postconditions:** | POST-1: Successful monitoring/modification of user accounts as required. |
| **Normal Flow:** | 1. Admin selects user management option.<br>2. System displays a list of registered users.<br>3. Admin selects a particular user.<br>4. System shows user activity and gives various options.<br>5. Admin chooses to edit, deactivate or delete user's account.<br>6. System proceeds the request and confirms the updates. |
| **Alternative Flows:** | None |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Admin must have proper authorization to manage user accounts. |
| **Assumptions:** | None |

#### *3.2.2.4 Manage User Complaints*

**Use Case ID:** UC-1.4
**Use Case Name:** Manage User Complaints
**Description:** This use case explains how admin is able to view and manage complaints by users.

**Table 6 Manage User Complaints detailed use case**

| | |
|---|---|
| **Actors:** | Admin |
| **Trigger:** | Admin selects complaint management from admin dashboard. |
| **Preconditions:** | PRE-1: Admin is logged into the system. |
| **Postconditions:** | POST-1: Successful addressing/solution of user complaints as required. |
| **Normal Flow:** | 1. Admin selects complaint management option.<br>2. System displays a list of registered complaints.<br>3. Admin selects a particular complaint to view details.<br>4. Admin takes suitable action against the complaint to resolve or address the issue.<br>5. System confirms the action and updates the complaint status. |
| **Alternative Flows:** | None |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Admin must have proper authorization to manage user complaints. |
| **Assumptions:** | None |

### *3.2.2.5 Manage Reports*

**Use Case ID:** UC-1.5
**Use Case Name:** Manage Reports
**Description:** This use case explains how admin is able to view and analyze reports.

**Table 7 Manage Reports detailed use case**

| | |
|---|---|
| **Actors:** | Admin |
| **Trigger:** | Admin selects reports and analytics from admin dashboard. |
| **Preconditions:** | PRE-1: Admin is logged into the system. |
| **Postconditions:** | POST-1: System successfully generates and shows accurate reports. |
| **Normal Flow:** | 1. Admin selects reports and analytics option.<br>2. System displays a list of available reports.<br>3. Admin selects a particular report to view details and applies filters as needed.<br>4. System generates the required reports according to the filters. |
| **Alternative Flows:** | None |
| **Exceptions:** | 3A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Admin must have proper authorization to manage reports. |
| **Assumptions:** | None |

### *3.2.2.6 Switch Profile*

**Use Case ID:** UC-1.6
**Use Case Name:** Switch Profile
**Description:** This use case explains how admin is able to switch profiles.

**Table 8 Switch Profile detailed use case**

| | |
|---|---|
| **Actors:** | Admin |
| **Trigger:** | Admin selects switch profile from admin dashboard. |
| **Preconditions:** | PRE-1: Admin is logged into the system. |
| **Postconditions:** | POST-1: System successfully switches the profile. |
| **Normal Flow:** | 1. Admin selects switch profile option.<br>2. System shows available profiles (farmer, seller, customer).<br>3. Admin selects the profile he wants to switch to.<br>4. System switches to the requested profile and give access to its dashboard. |
| **Alternative Flows:** | None |
| **Exceptions:** | 4A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | 1. Admin has registered each profile available for switching. |

### *3.2.2.7 Manage Profile*

**Use Case ID:** UC-1.7
**Use Case Name:** Manage Profile
**Description:** This use case explains how admin is able to manage and modify his profile.

**Table 9 Manage Profile detailed use case**

| | |
|---|---|
| **Actors:** | Admin |
| **Trigger:** | Admin selects switch profile from admin dashboard. |
| **Preconditions:** | PRE-1: Admin is logged into the system. |
| **Postconditions:** | POST-1: System successfully modifies the profile. |
| **Normal Flow:** | 1. Admin selects manage profile option.<br>2. System loads the user profile.<br>3. Admin selects the field (picture, number, password etc.) and modifies it.<br>4. System verifies.<br>5. System updates the database. |
| **Alternative Flows:** | 5A. System notifies the user about unsuccessful verification.<br>6A. Continues from 3rd step of Normal Flow |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | None |

#### *3.2.2.8 Sign-Out*

**Use Case ID:** UC-1.8
**Use Case Name:** Sign-Out
**Description:** This use case explains how admin is able to sign-out from system.

**Table 10 Sign-Out detailed use case**

| | |
|---|---|
| **Actors:** | Admin |
| **Trigger:** | Admin selects sign-out from dashboard. |
| **Preconditions:** | PRE-1: Admin is logged into the system. |
| **Postconditions:** | POST-1: System successfully logs out the user. |
| **Normal Flow:** | 1. Admin selects sign-out option.<br>2. System terminates the session and loads the sign-in page. |
| **Alternative Flows:** | None |
| **Exceptions:** | 2A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | None |

### 3.2.3 Farmer Detail Use Cases

#### *3.2.3.1 Sign-Up*

**Use Case ID:** UC-2.1
**Use Case Name:** Sign-Up
**Description:** This use case explains the creation of farmer account within the system.

**Table 11 Sign-Up detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User initiates registration process by clicking sign-up button |
| **Preconditions:** | PRE-1: Attempting user must not have an existing account in the system. |
| **Postconditions:** | POST-1: Successful creation of user's account within the system. |
| **Normal Flow:** | 1. User clicks Sign-Up button.<br>2. User enters email address.<br>3. User creates a strong password.<br>4. User enters their username.<br>5. System reviews the provided information for completeness and correctness.<br>6. User clicks on Register button.<br>7. System confirms the successful registration and navigates to Sign-In page. |
| **Alternative Flows:** | 5D. If entered information is detected incomplete or invalid, system highlights the errors or mistakes.<br>5E. User re-enters the details.<br>5F. Continues from 5$^{th}$ step of normal flow. |
| **Exceptions:** | 7A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | 1. User is not registered in the system. |

### *3.2.3.2 Sign-In*

**Use Case ID:** UC-2.2
**Use Case Name:** Sign-In
**Description:** This use case explains how admin access his account within the system.

**Table 12 Sign-In detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User initiates sign-in process by clicking sign-in button |
| **Preconditions:** | PRE-1: Attempting user must have an existing account in the system. |
| **Postconditions:** | POST-1: Successful logging in and granting access to the system. |
| **Normal Flow:** | 1. User clicks Sign-In button.<br>2. User enters email address and password.<br>3. User clicks on Sign-In button.<br>4. System reviews the provided information for its correct format, and checks credentials against the stored data.<br>5. System confirms the successful sign-in and grants access to their personal dashboard. |
| **Alternative Flows:** | 1A. User opts for third party sign-in (Google).<br>1B. System navigates to respective third party's service page.<br>1C. Third party authenticates the user.<br>1D. Continues from 5th step of normal flow.<br><br>4D. If entered information is detected incomplete or invalid, system highlights the errors or mistakes.<br>4E. User re-enters the details.<br>4F. Continues from 3rd step of normal flow. |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | 1. User is registered in the system |

#### *3.2.3.3 Current Soil Analysis*

**Use Case ID:** UC-2.3
**Use Case Name:** Current Soil Analysis
**Description:** This use case explains how farmer gives soil information to system for analysis

**Table 13 Current Soil Analysis detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects soil analysis option from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have an existing account in the system. |
| **Postconditions:** | POST-1: Successful analysis of soil. |
| **Normal Flow:** | 1. User clicks soil analysis button.<br>2. User enters soil information from tests (Nitrogen, Phosphorus, Potassium).<br>3. User clicks on OK button.<br>4. System reviews the provided information for its correctness.<br>5. System gives a confirmation to user. |
| **Alternative Flows:** | None |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | 1. User has accurate and valid soil test data for analysis. |

### *3.2.3.4 Previous Soil Analysis*

**Use Case ID:** UC-2.4
**Use Case Name:** Previous Soil Analysis
**Description:** This use case explains how farmer gives soil information to system for analysis

**Table 14 Previous Soil Analysis detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects previous soil analysis option from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have an existing soil record in the system. |
| **Postconditions:** | POST-1: Successful analysis of previous soil. |
| **Normal Flow:** | 1. User clicks previous soil analysis button.<br>2. System checks if previous soil data is available and views it to user.<br>3. User clicks on OK button.<br>4. System reviews the provided information for its correctness.<br>5. System gives a confirmation to user. |
| **Alternative Flows:** | 2A. System notifies user that there is no previous record.<br>3A. Farmer enters the previous record manually and presses OK.<br>4A. Continues from $4^{th}$ step of normal flow. |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | 1. System has stored previous soil data for analysis. |

### *3.2.3.5 Weather Analysis*

**Use Case ID:** UC-2.5
**Use Case Name:** Weather Analysis
**Description:** This use case explains how farmer gives weather information to system for analysis

**Table 15 Weather Analysis detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects weather analysis option from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have performed soil analysis. |
| **Postconditions:** | POST-1: Successful analysis of weather. |
| **Normal Flow:** | 1. User clicks weather analysis button.<br>2. User enters current weather of the area.<br>3. User clicks on OK button.<br>4. System reviews the provided information for its correctness.<br>5. System gives a confirmation to user. |
| **Alternative Flows:** | None |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.6 Climate Analysis*

**Use Case ID:** UC-2.6
**Use Case Name:** Climate Analysis
**Description:** This use case explains how farmer is able to do climate analysis

**Table 16 Climate Analysis detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects climate analysis option from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have performed soil analysis. |
| **Postconditions:** | POST-1: Successful analysis of climate. |
| **Normal Flow:** | 1. User clicks climate analysis button.<br>2. User selects the location from search bar.<br>3. User clicks on OK button.<br>4. System fetches the climate of selected area from third party.<br>5. System gives a confirmation to user. |
| **Alternative Flows:** | None |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.7 Crop Recommendation*

**Use Case ID:** UC-2.7
**Use Case Name:** Crop Recommendation
**Description:** This use case explains how farmer is able to get crop recommendations.

**Table 17 Crop Recommendation detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects crop recommendation option from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have performed soil, weather and climate analysis. |
| **Postconditions:** | POST-1: Successful crop recommendations. |
| **Normal Flow:** | 1. User clicks crop recommendation button.<br>2. System gives multiple recommendations using the analysis (soil, weather, climate).<br>3. User selects a crop to view its characteristics.<br>4. System shows the pros and cons of selected crop.<br>5. User clicks OK to confirm crop.<br>6. System updates database and notifies the user. |
| **Alternative Flows:** | None |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | System provides valid crop recommendation according to the inputs. |

#### *3.2.3.8 Tutorials*

**Use Case ID:** UC-2.8
**Use Case Name:** Tutorials
**Description:** This use case explains how farmer is able to get tutorials for various techniques.

**Table 18 Tutorials detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects tutorials option from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must be logged into the system. |
| **Postconditions:** | POST-1: User is able to view requested tutorial selected. |
| **Normal Flow:** | 1. User clicks tutorials button.<br>2. System gives a list of available tutorials.<br>3. System views the requested tutorial. |
| **Alternative Flows:** | None |
| **Exceptions:** | 3A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

#### *3.2.3.9 AI Chatbot*

**Use Case ID:** UC-2.9
**Use Case Name:** AI Chatbot
**Description:** This use case explains how farmer interacts able with chatbot for assistance.

**Table 19 AI Chatbot detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects AgroTech chatbot from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must be logged into the system. |
| **Postconditions:** | POST-1: User is able to get assistance from AI chatbot. |
| **Normal Flow:** | 1. User clicks AgroTech chatbot button.<br>2. System opens the chatbot window.<br>3. Chatbot greets the user and provides options for Frequently Asked Questions (FAQs).<br>4. User interacts with chatbot by selecting an option or giving prompts.<br>5. Chatbot generates responses against the given prompts. |
| **Alternative Flows:** | None |
| **Exceptions:** | 2A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | AI Chatbot is trained on relevant data and provide accurate information to the user. |

### *3.2.3.10 Register Complaints*

**Use Case ID:** UC-2.10
**Use Case Name:** Register Complaints
**Description:** This use case explains how farmer is able to get register complaints.

**Table 20 Register Complaints detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects register complaint from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must be logged into the system. |
| **Postconditions:** | POST-1: User is able to register complaint and view its status successfully. |
| **Normal Flow:** | 1. User clicks register complaint button.<br>2. System displays domains for complaints.<br>3. User selects appropriate option and writes and submits the complaint.<br>4. System updates the complaint register and views complaint status to user. |
| **Alternative Flows:** | None |
| **Exceptions:** | 4A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.11 Feedback and Reviews*

**Use Case ID:** UC-2.11
**Use Case Name:** Feedback and Reviews
**Description:** This use case explains how farmer is able to view and submit feedback and reviews.

**Table 21 Feedback and Reviews detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects feedback and reviews from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must be logged into the system. |
| **Postconditions:** | POST-1: User is able to view and submit feedback and reviews successfully. |
| **Normal Flow:** | 1. User clicks feedbacks and reviews button.<br>2. System displays reviews from users and gives option for feedback.<br>3. User selects feedback option.<br>4. System shows domains for feedbacks.<br>5. User selects appropriate option and submits feedback.<br>6. System updates the feedback register. |
| **Alternative Flows:** | None |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.12 Identify Crop Stresses*

**Use Case ID:** UC-2.12
**Use Case Name:** Identify Crop Stresses
**Description:** Identifies stresses in crops, including water, nutrient and pest infestations.

**Table 22 Identify Crop Stresses detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects identify crop stress from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have crops in growing stage. |
| **Postconditions:** | POST-1: User is able to view report on crop stress rate successfully. |
| **Normal Flow:** | 1. User clicks on "Identify Crop Stress" button<br>2. User selects the crop from the list of registered crops.<br>3. System analyzes the data about the crop like water, nutrient and pest stress<br>4. System generates and presents a detailed report about crop stresses to the user |
| **Alternative Flows:** | 2a. User clicks on "Unregistered Crops" option.<br>2b. System prompts user to enter details of the crops.<br>2c. User enter details of the crops and process continues from step-3. |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | It is assumed that the System will have up-to-date list of crops. |

### *3.2.3.13 Identification of Crop Diseases*

**Use Case ID:** UC-2.13
**Use Case Name:** Identification of Crop Diseases
**Description:** Identifies visual symptoms of diseases and classify them against diseases in the database

**Table 23 Identification of Crop Diseases detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects identify crop diseases from dashboard. |
| **Preconditions:** | PRE-1: System has a database containing list of diseases including symptoms. |
| **Postconditions:** | POST-1: User is able to view diagnosis report generated by the system. |
| **Normal Flow:** | 1. User clicks "Identify crop diseases" button.<br>2. User enter details about crop including images of the affected crop or symptoms.<br>3. System uses image recognition technology and machine learning to identify the symptoms of disease in the crop.<br>4. System compares symptoms with its database.<br>5. System generates and presents a detailed report about diseases to the user. |
| **Alternative Flows:** | 2a. User submits invalid images or symptoms.<br>2b. System notifies the user to reenter the details.<br>2c. User reenters the details and process continues from step-3. |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.14 Periodic Crop Health Monitoring*

**Use Case ID:** UC-2.14
**Use Case Name:** Provide periodic crop health monitoring
**Description:** Periodically provides crop health monitoring to minimize crop damage.

**Table 24 Periodic Crop Health Monitoring detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects periodic crop health from dashboard. |
| **Preconditions:** | PRE-1: User must be logged in to the system.<br>PRE-2: User must have crops in growing stage. |
| **Postconditions:** | POST-1: The system provides periodic crop health report to the user. |
| **Normal Flow:** | 1. User selects the schedule to periodically monitor crops.<br>2. System prompts user to collect the data about the crops at given intervals.<br>3. User provides the data at the defined intervals<br>4. System uses ML model and Image Recognition Technology to assess the health of crops.<br>5. System generates and provides the crop health report to the user. |
| **Alternative Flows:** | None |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.15 Estimate Crop Yield*

**Use Case ID:** UC-2.15
**Use Case Name:** Estimate Crop Yield
**Description:** Utilizes ML model to estimate and predict crop yield using factors such as temperature, rainfall, soil nutrient etc.

**Table 25 Crop Yield detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects estimate crop yield from dashboard. |
| **Preconditions:** | PRE-1: User has logged in to the system.<br>PRE-2: The User has entered relevant crop data. |
| **Postconditions:** | POST-1: System generates estimated yield report. |
| **Normal Flow:** | 1. User clicks 'Estimate Crop Yield' button.<br>2. User selects a crop from the list of crops.<br>3. User selects the values of factors such as temperature, rainfall, soil nutrient.<br>4. System utilizes ML model on factors.<br>5. System generates and presents the detailed yield report to the user. |
| **Alternative Flows:** | None |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | User has entered valid crop data for estimation. |

### *3.2.3.16 Assess Yield Risk Factors*

**Use Case ID:** UC-2.16
**Use Case Name:** Assess yield risk factors
**Description:** Assesses yield risk factors (such as disease outbreaks, pest infestation) and suggest mitigation strategies to deal with these risks.

**Table 26 Assess Yield Risk Factors detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects assess yield risk from dashboard. |
| **Preconditions:** | PRE-1: The user is logged in to the system.<br>PRE-2: The system has up-to-date yield data. |
| **Postconditions:** | POST-1: User is able to view report on risk assessment. |
| **Normal Flow:** | 1. User clicks “Assess Yield Risk” button.<br>2. System collects data about drought, pest infestation and disease outbreaks.<br>3. System generates and presents the risk assessment report to the user.<br>4. User clicks on “Provide Recommendations” button.<br>5. System provides risk mitigation strategies to deal with these risks. |
| **Alternative Flows:** | None |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | System will have up-to-date crop yield data for risk assessment. |

### *3.2.3.17 Crop Maturity Assessment*

**Use Case ID:** UC-2.17
**Use Case Name:** Crop Maturity Assessment
**Description:** Assesses crop maturity and readiness for harvesting

**Table 27 Crop Maturity Assessment detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects assess crop maturity from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have grown crops. |
| **Postconditions:** | POST-1: User is able to view report on crop maturity successfully. |
| **Normal Flow:** | 1. User clicks "Assess Crop Maturity" button.<br>2. User uploads the images of the crop.<br>3. System uses Image Recognition technology to determine the crop maturity.<br>4. System generates and provides a detailed crop maturity report to the user.<br>5. User assesses whether the crop is ready for harvesting or not. |
| **Alternative Flows:** | None |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.18 Crop Quality Assessment*

**Use Case ID:** UC-2.18
**Use Case Name:** Crop Quality Assessment
**Description:** Assesses crop quality for harvesting

**Table 28 Crop Quality Assessment detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects assess crop quality from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have grown crops. |
| **Postconditions:** | POST-1: User is able to view report on crop quality report successfully. |
| **Normal Flow:** | 1. User clicks "Assess Crop Quality" button.<br>2. System prompts the user to enter factors such as starch, sugar content, size, color etc.<br>3. User enter the factors in to the system.<br>4. System analyzes the factors and generates a crop quality report.<br>5. System provides the report to the user to assess crop quality. |
| **Alternative Flows:** | None |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.19 Optimal Harvesting Schedule*

**Use Case ID:** UC-2.19
**Use Case Name:** Optimal Harvesting Schedule
**Description:** Develop an optimal schedule for harvesting the crop.

**Table 29 Optimal Harvesting Schedule detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects harvesting schedule from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have mature crops. |
| **Postconditions:** | POST-1: User is able to get optimal schedule for harvesting the crop. |
| **Normal Flow:** | 1. User clicks harvesting schedule button.<br>2. System retrieves the crop maturity reports and develops an optimal schedule for best timing of harvesting.<br>3. User makes changes in schedule as needed and update it after finalized.<br>4. System keeps track of the schedule. |
| **Alternative Flows:** | None |
| **Exceptions:** | 2A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.20 Harvesting Tools and Techniques*

**Use Case ID:** UC-2.20
**Use Case Name:** Harvesting Tools and Techniques
**Description:** Recommends suitable tools and techniques for the crop grown by farmer.

**Table 30 Harvesting Tools and Techniques detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects harvesting tools and techniques from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have his crop details in system. |
| **Postconditions:** | POST-1: User is able to get suitable recommendations for tools and techniques for his crop. |
| **Normal Flow:** | 1. User clicks harvesting tools and techniques button.<br>2. System retrieves the crop details and recommends suitable tools and techniques for harvesting. |
| **Alternative Flows:** | None |
| **Exceptions:** | 2A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | System has adequate information about the crop type to suggest appropriate harvesting tools and techniques. |

### *3.2.3.21 Harvesting Tools Catalog*

**Use Case ID:** UC-2.21
**Use Case Name:** Harvesting Tools Catalog
**Description:** Shows catalog of available harvesting tools for rent and sale.

**Table 31 Harvesting Tools Catalog detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects harvesting tools catalog from catalogs from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have performed tools and techniques recommendation. |
| **Postconditions:** | POST-1: User is able to view, purchase and review products. |
| **Normal Flow:** | 1. User clicks harvesting tools catalog from catalogs.<br>2. System retrieves the tools and techniques recommendation details and shows catalog for suitable tools.<br>3. User selects a particular product and proceeds to view, purchase or review product.<br>4. System updates the database and marketplace. |
| **Alternative Flows:** | 2A. User uses search bar to find tools.<br>3A. System shows results for searched product.<br>4A. Continues from 3rd step of Normal Flow. |
| **Exceptions:** | 4A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.22 Transport Recommendation*

**Use Case ID:** UC-2.22
**Use Case Name:** Transport Recommendation
**Description:** Recommends transport type according to crop type and weight.

**Table 32 Transport Recommendation detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects transport recommendation from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have harvested the crops. |
| **Postconditions:** | POST-1: User is able to get transport recommendation. |
| **Normal Flow:** | 1. User clicks transport recommendation from dashboard.<br>2. System retrieves the crop and harvesting details and shows suitable transport types.<br>3. User can select a particular transportation type from there. |
| **Alternative Flows:** | None |
| **Exceptions:** | 2A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

#### *3.2.3.23 Transportation*

**Use Case ID:** UC-2.23
**Use Case Name:** Transportation
**Description:** User can book transportation for crops and track it.

**Table 33 Transportation detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects book ride from transportation in dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have harvested crops. |
| **Postconditions:** | POST-1: User is able to get transport and track it. |
| **Normal Flow:** | 1. User clicks book ride from transport recommendation<br>2. User enters pickup and drop off location.<br>3. System searches for available service providers for recommended transport and shows it to user.<br>4. User selects the suitable ride.<br>5. System starts the ride and provides live location to user and best routes to driver till the ride ends. |
| **Alternative Flows:** | 1A. User searches for any transportation type and selects it.<br>2A. Continues from 2nd step of Normal Flow. |
| **Exceptions:** | 3A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.24 Packaging Assist*

**Use Case ID:** UC-2.24
**Use Case Name:** Packaging Assist
**Description:** User gets recommendations for suitable, sustainable and biodegradable packaging materials.

**Table 34 Packaging Assist detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects packaging assist from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have harvested crops. |
| **Postconditions:** | POST-1: User is able to get suitable packaging material recommendation. |
| **Normal Flow:** | 1. User clicks packaging assist from dashboard.<br>2. System retrieves the harvesting and crops details.<br>3. System recommends sustainable and biodegradable packaging materials which is suitable for crop type and size.<br>4. User can view pros and cons of any material by selecting it. |
| **Alternative Flows:** | 2A. User enters any crop type and size.<br>3A. Continues from 3rd step of Normal Flow. |
| **Exceptions:** | 3A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.25 Climate-Controlled Storage Reservation*

**Use Case ID:** UC-2.25
**Use Case Name:** Climate-Controlled Storage Assist
**Description:** User can get suitable temperature and storage recommendations. User can view, review and reserve any storage place.

**Table 35 Climate-Controlled Storage Reservation detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects Climate-Controlled Storage from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have harvested crops. |
| **Postconditions:** | POST-1: User is able to get climate-controlled storage reservations. |
| **Normal Flow:** | 1. User clicks climate-controlled storage from dashboard.<br>2. System retrieves the harvesting and crops details.<br>3. System recommends suitable temperature and storage recommendations for crop.<br>4. System shows storage providers.<br>5. User can view, review and reserve storage.<br>6. System updates the database. |
| **Alternative Flows:** | None |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.26 Crop Quality Grading*

**Use Case ID:** UC-2.26
**Use Case Name:** Crop Quality Grading
**Description:** User can get assistance to grade his crops and make groups.

**Table 36 Crop Quality Grading detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | User selects Crop Quality Grading from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must have harvested crops. |
| **Postconditions:** | POST-1: User is able to group crops based on quality and get a quality index. |
| **Normal Flow:** | 1. User clicks crop quality grading from dashboard.<br>2. System retrieves the harvesting and crops details.<br>3. System recommends various grading tips according to standards and crop characteristics.<br>4. User can make a table for information about different grades of crop.<br>5. System makes a report of quality index showing crop quality and quantity.<br>6. User can use this index in marketplace to show customers. |
| **Alternative Flows:** | None |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

### *3.2.3.27 Switch Profile*

**Use Case ID:** UC-2.27
**Use Case Name:** Switch Profile
**Description:** This use case explains how farmer is able to switch profiles.

**Table 37 Switch Profile detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | Farmer selects switch profile from dashboard. |
| **Preconditions:** | PRE-1: Farmer is logged into the system. |
| **Postconditions:** | POST-1: System successfully switches the profile. |
| **Normal Flow:** | 1. Farmer selects switch profile option.<br>2. System shows available profiles (seller, customer).<br>3. Farmer selects the profile he wants to switch to.<br>4. System switches to the requested profile and give access to its dashboard. |
| **Alternative Flows:** | None |
| **Exceptions:** | 4A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | None |

### *3.2.3.28 Manage Profile*

**Use Case ID:** UC-2.28
**Use Case Name:** Manage Profile
**Description:** This use case explains how Farmer is able to manage and modify his profile.

**Table 38 Manage Profile detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | Farmer selects switch profile from dashboard. |
| **Preconditions:** | PRE-1: Farmer is logged into the system. |
| **Postconditions:** | POST-1: System successfully modifies the profile. |
| **Normal Flow:** | 1. Farmer selects manage profile option.<br>2. System loads the user profile.<br>3. Admin selects the field (picture, number, password etc.) and modifies it.<br>4. System verifies.<br>5. System updates the database. |
| **Alternative Flows:** | 5A. System notifies the user about unsuccessful verification.<br>6A. Continues from 3rd step of Normal Flow |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | None |

### *3.2.3.29 Sign-Out*

**Use Case ID:** UC-2.29
**Use Case Name:** Sign-Out
**Description:** This use case explains how farmer is able to sign-out from system.

**Table 39 Sign-Out detailed use case**

| | |
|---|---|
| **Actors:** | Farmer |
| **Trigger:** | Farmer selects sign-out from dashboard. |
| **Preconditions:** | PRE-1: Farmer is logged into the system. |
| **Postconditions:** | POST-1: System successfully logs out the user. |
| **Normal Flow:** | 1. Farmer selects sign-out option.<br>2. System terminates the session and loads the sign-in page. |
| **Alternative Flows:** | None |
| **Exceptions:** | 2A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | User is logged in the system. |

### 3.2.4 Customer Detail Use Cases

#### *3.2.4.1 Sign-Up*

**Use Case ID:** UC-3.1
**Use Case Name:** Sign-Up
**Description:** This use case explains the creation of customer account within the system.

**Table 40 Sign-Up detailed use case**

| | |
|---|---|
| **Actors:** | Customer |
| **Trigger:** | User initiates registration process by clicking sign-up button |
| **Preconditions:** | PRE-1: Attempting user must not have an existing account in the system. |
| **Postconditions:** | POST-1: Successful creation of user's account within the system. |
| **Normal Flow:** | 1. User clicks Sign-Up button.<br>2. User enters email address.<br>3. User creates a strong password.<br>4. User enters their username.<br>5. System reviews the provided information for completeness and correctness.<br>6. User clicks on Register button.<br>7. System confirms the successful registration and navigates to Sign-In page. |
| **Alternative Flows:** | 5A. If entered information is detected incomplete or invalid, system highlights the errors or mistakes.<br>5B. User re-enters the details.<br>5C. Continues from 5$^{th}$ step of normal flow. |
| **Exceptions:** | 7A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | User is not registered in the system |

#### *3.2.4.2 Sign-In*

**Use Case ID:** UC-3.2
**Use Case Name:** Sign-In
**Description:** This use case explains how admin access his account within the system.

**Table 41 Sign-In detailed use case**

| | |
|---|---|
| **Actors:** | Customer |
| **Trigger:** | User initiates sign-in process by clicking sign-in button |
| **Preconditions:** | PRE-1: Attempting user must have an existing account in the system. |
| **Postconditions:** | POST-1: Successful logging in and granting access to the system. |
| **Normal Flow:** | 1. User clicks Sign-In button.<br>2. User enters email address and password.<br>3. User clicks on Sign-In button.<br>4. System reviews the provided information for its correct format, and checks credentials against the stored data.<br>5. System confirms the successful sign-in and grants access to their personal dashboard. |
| **Alternative Flows:** | 1A. User opts for third party sign-in (Google).<br>1B. System navigates to respective third party's service page.<br>1C. Third party authenticates the user.<br>1D. Continues from 5th step of normal flow.<br><br>4A. If entered information is detected incomplete or invalid, system highlights the errors or mistakes.<br>4B. User re-enters the details.<br>4C. Continues from 3rd step of normal flow. |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | User is registered in the system. |

### *3.2.4.3 Access Products*

**Use Case ID:** UC-3.3
**Use Case Name:** Access Products
**Description:** User can view, review and buy products.

**Table 42 Access Products detailed use case**

| | |
|---|---|
| **Actors:** | Customer |
| **Trigger:** | User opens catalog from dashboard. |
| **Preconditions:** | PRE-1: Attempting user must be signed in. |
| **Postconditions:** | POST-1: User should be able to view, review and buy products. |
| **Normal Flow:** | 1. User opens catalog from dashboard.<br>2. System shows a list of products to user.<br>3. User can search for a particular product.<br>4. User clicks on a product.<br>5. System shows product details.<br>6. User can give reviews about it or add to cart to buy.<br>7. System updates the database |
| **Alternative Flows:** | None |
| **Exceptions:** | 7A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | None |

#### *3.2.4.4 Bidding*

**Use Case ID:** 3.4
**Use Case Name:** Bidding
**Description:** If user wants to buy large number of crops, he can join bidding.

**Table 43 Bidding detailed use case**

| | |
|---|---|
| **Actors:** | Customer |
| **Trigger:** | User clicks on bidding in dashboard. |
| **Preconditions:** | PRE-1: Attempting user must be signed in. |
| **Postconditions:** | POST-1: User should be able to bid and buy products. |
| **Normal Flow:** | 1. User opens bidding from dashboard.<br>2. System shows a list of ongoing bids.<br>3. User can search for a particular product.<br>4. User clicks on a product.<br>5. System shows bidding details.<br>6. User can bid his price.<br>7. System notifies the user when farmer accepts any bid.<br>8. User then performs payment if his bid is accepted and can give reviews.<br>9. System updates the database. |
| **Alternative Flows:** | None |
| **Exceptions:** | 7A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Users must be registered to avail services provided by the system. |
| **Assumptions:** | Users understand the payment process and is ready to complete it once the bid is accepted. |

### *3.2.4.5 Switch Profile*

**Use Case ID:** UC-3.5
**Use Case Name:** Switch Profile
**Description:** Customer can switch to other profiles if registered.

**Table 44 Switch Profile detailed use case**

| | |
|---|---|
| **Actors:** | Customer |
| **Trigger:** | Customer selects switch profile from dashboard. |
| **Preconditions:** | PRE-1: Customer is logged into the system. |
| **Postconditions:** | POST-1: System successfully switches the profile. |
| **Normal Flow:** | 1. Farmer selects switch profile option.<br>2. System shows available profiles (seller, others if registered).<br>3. Farmer selects the profile he wants to switch to.<br>4. System switches to the requested profile and give access to its dashboard. |
| **Alternative Flows:** | None |
| **Exceptions:** | 4A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | The user is already registered for multiple profiles. |

### *3.2.4.6 Manage Profile*

**Use Case ID:** UC-3.6
**Use Case Name:** Manage Profile
**Description:** This use case explains how customer is able to manage and modify his profile.

**Table 45 Manage Profile detailed use case**

| | |
|---|---|
| **Actors:** | Customer |
| **Trigger:** | Customer selects switch profile from dashboard. |
| **Preconditions:** | PRE-1: Customer is logged into the system. |
| **Postconditions:** | POST-1: System successfully modifies the profile. |
| **Normal Flow:** | 1. Customer selects manage profile option.<br>2. System loads the user profile.<br>3. Customer selects the field (picture, number, password etc.) and modifies it.<br>4. System verifies.<br>5. System updates the database. |
| **Alternative Flows:** | 5A. System notifies the user about unsuccessful verification.<br>6A. Continues from 3rd step of Normal Flow |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | Users are familiar with profile management. |

#### *3.2.4.7 Sign-Out*

**Use Case ID:** UC-3.7
**Use Case Name:** Sign-Out
**Description:** This use case explains how customer is able to sign-out from system.

**Table 46 Sign-Out detailed use case**

| | |
|---|---|
| **Actors:** | Customer |
| **Trigger:** | Customer selects sign-out from dashboard. |
| **Preconditions:** | PRE-1: Customer is logged into the system. |
| **Postconditions:** | POST-1: System successfully logs out the user. |
| **Normal Flow:** | 1. Customer selects sign-out option.<br>2. System terminates the session and loads the sign-in page. |
| **Alternative Flows:** | None |
| **Exceptions:** | 2A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | None |

### 3.2.5 Seller Detail Use Cases

#### *3.2.5.1 Set Profile*

**Use Case ID:** 4.1
**Use Case Name:** Set Profile
**Description:** This use case explains how a user can register to be a seller.

**Table 47 Set Profile detailed use case**

| | |
|---|---|
| **Actors:** | Seller |
| **Trigger:** | User switches to seller profile. |
| **Preconditions:** | PRE-1: Attempting user has already registered account.<br>PRE-2: Attempting user must not have registered to be a seller already. |
| **Postconditions:** | POST-1: User should be able to access seller dashboard. |
| **Normal Flow:** | 1. User switches to seller profile.<br>2. User enters details about type of products he would sell.<br>3. User enters his bank details.<br>4. User presses register.<br>5. System validates data<br>6. System gives access to seller dashboard. |
| **Alternative Flows:** | 6A. System notifies user for incorrect data.<br>7A. User re-enters data.<br>8A. Continues from 4$^{th}$ step of Normal Flow. |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | The user is registered in the system. |

### *3.2.5.2 Upload Product/Service*

**Use Case ID:** 4.2
**Use Case Name:** Upload Product/Service
**Description:** This use case explains how a user is able to upload his product in marketplace.

**Table 48 Upload Product/Service detailed use case**

| | |
|---|---|
| **Actors:** | Seller |
| **Trigger:** | User clicks upload product in marketplace. |
| **Preconditions:** | PRE-1: User must have registered seller account. |
| **Postconditions:** | POST-1: User must be able to upload his product. |
| **Normal Flow:** | 1. User clicks upload product in marketplace.<br>2. User enters product type, details and pictures.<br>3. User uploads quality index document if available.<br>4. User clicks upload.<br>5. System checks data and rates for correctness.<br>6. System uploads it. |
| **Alternative Flows:** | 6A. System notifies user for incorrect data.<br>7A. User re-enters data.<br>8A. Continues from 4$^{th}$ step of Normal Flow. |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | None |

### *3.2.5.3 Bidding*

**Use Case ID:** 4.3
**Use Case Name:** Bidding
**Description:** This use case explains how a seller can upload his product and receive bids for it.

**Table 49 Bidding detailed use case**

| | |
|---|---|
| **Actors:** | Seller |
| **Trigger:** | User clicks on bidding in dashboard. |
| **Preconditions:** | PRE-1: User must have registered seller account. |
| **Postconditions:** | POST-1: User must be able to bid his product. |
| **Normal Flow:** | 1. User clicks upload product in bidding.<br>2. User enters product type, details, time limit and pictures.<br>3. User uploads quality index document if available.<br>4. User clicks upload.<br>5. System checks data and rates for correctness.<br>6. System uploads it.<br>7. System notifies whenever a new price is received.<br>8. User can select the best bid after given time and sell it to that customer.<br>9. System updates database accordingly. |
| **Alternative Flows:** | 6A. System notifies user for incorrect data.<br>7A. User re-enters data.<br>8A. Continues from 4$^{th}$ step of Normal Flow. |
| **Exceptions:** | 9A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | The system will provide notifications to user if a bid is made. |

### *3.2.5.4 Reports and Analytics*

**Use Case ID:** 4.4
**Use Case Name:** Reports and Analytics
**Description:** This use case explains how a seller can view his reports (revenue, profits etc.) and progress.

**Table 50 Reports and Analytics detailed use case**

| | |
|---|---|
| **Actors:** | Seller |
| **Trigger:** | Seller selects reports and analytics from dashboard. |
| **Preconditions:** | PRE-1: Seller is logged into the system. |
| **Postconditions:** | POST-1: System successfully generates and shows accurate reports. |
| **Normal Flow:** | 1. User selects reports and analytics option.<br>2. System displays a list of available reports.<br>3. User selects a particular report to view details and applies filters as needed.<br>4. System generates the required reports according to the filters. |
| **Alternative Flows:** | None |
| **Exceptions:** | 3A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | None |

### *3.2.5.5 Feature Products*

**Use Case ID:** 4.5
**Use Case Name:** Feature Products
**Description:** This use case explains how a seller can promote his products.

**Table 51 Feature Products detailed use case**

| | |
|---|---|
| **Actors:** | Seller |
| **Trigger:** | Seller selects promotion from dashboard. |
| **Preconditions:** | PRE-1: Seller is logged into the system.<br>PRE-2: Seller must have active gig. |
| **Postconditions:** | POST-1: Seller must get his product featured. |
| **Normal Flow:** | 1. User selects promotion option.<br>2. System displays a list of promotion rates.<br>3. User selects suitable promotion.<br>4. System asks to select the gigs to be featured.<br>5. User selects required gigs and proceeds to payment<br>6. System updates the database. |
| **Alternative Flows:** | None |
| **Exceptions:** | 6A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | None |

### *3.2.5.6 Manage Profile*

**Use Case ID:** UC-4.6
**Use Case Name:** Manage Profile
**Description:** This use case explains how seller is able to manage and modify his profile.

**Table 52 Manage Profile detailed use case**

| | |
|---|---|
| **Actors:** | Seller |
| **Trigger:** | Seller selects switch profile from admin dashboard. |
| **Preconditions:** | PRE-1: Seller is logged into the system. |
| **Postconditions:** | POST-1: System successfully modifies the profile. |
| **Normal Flow:** | 1. Seller selects manage profile option.<br>2. System loads the user profile.<br>3. Seller selects the field (picture, number, password etc.) and modifies it.<br>4. System verifies.<br>5. System updates the database. |
| **Alternative Flows:** | 5A. System notifies the user about unsuccessful verification.<br>6A. Continues from 3rd step of Normal Flow |
| **Exceptions:** | 5A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | The user is familiar with profile management. |

### *3.2.5.7 Sign-Out*

**Use Case ID:** UC-4.7
**Use Case Name:** Sign-Out
**Description:** This use case explains how seller is able to sign-out from system.

**Table 53 Sign-Out detailed use case**

| | |
|---|---|
| **Actors:** | Seller |
| **Trigger:** | Seller selects sign-out from dashboard. |
| **Preconditions:** | PRE-1: Seller is logged into the system. |
| **Postconditions:** | POST-1: System successfully logs out the user. |
| **Normal Flow:** | 1. Seller selects sign-out option.<br>2. System terminates the session and loads the sign-in page. |
| **Alternative Flows:** | None |
| **Exceptions:** | 2A. If technical error occurs, system notifies the user and advise them to retry or seek help from support assistance. |
| **Business Rules** | Requested profile must be registered to get access. |
| **Assumptions:** | The user is logged in the system. |

## 3.3 Functional Requirements

## Admin Functional Requirements

### 3.3.1 UC-1.1: Sign Up

#### *3.3.1.1 FR-1: Initiate.Registration*

**Table 54: Initiate.Registration FR**

| | |
|---|---|
| **Identifier** | FR-1 |
| **Title** | Initiate.Registration |
| **Requirement** | The user shall be able to initiate registration by clicking on Sign up button |
| **Source** | UC-1.1 |
| **Rationale** | Provide users an option to register in to the system |
| **Business Rule** | None |
| **Dependencies** | FR-2, FR-3, FR-4, FR-5 |
| **Priority** | High |

#### *3.3.1.2 FR-2: Input.Credentials*

**Table 55: Input.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-2 |
| **Title** | Input.Credentials |
| **Requirement** | The user shall be able to input credentials to register in the system. |
| **Source** | UC-1.1 |
| **Rationale** | Allow users to enter credentials to register as a Admin. |
| **Business Rule** | None |
| **Dependencies** | FR-3 |
| **Priority** | High |

#### *3.3.1.3 FR-3: Validate.Credentials*

**Table 56: Validate.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-3 |
| **Title** | Validate.Information |
| **Requirement** | The system should validate the correctness and accuracy of user entered email, password and username before proceeding with registration |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | The system ensure that the user entered credentials are correct and accurate and could be used as a valid email and password. |
| **Business Rule** | None |
| **Dependencies** | FR-4 |
| **Priority** | High |

#### *3.3.1.4 FR-4: Confirm.Registration*

**Table 57: Confirm.Registration FR**

| | |
|---|---|
| **Identifier** | FR-4 |
| **Title** | Confirm.Registration |
| **Requirement** | The system shall confirm the successful registration of user's account and display a message that user account is created. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the user's account is successfully created and allow them to sign in to his account. |
| **Business Rule** | The user must be directed to the login page after successful sign up. |
| **Dependencies** | FR-5, FR-6 |
| **Priority** | High |

#### *3.3.1.5 FR-5: Handle.Invalid.Input*

**Table 58: Handle.Invalid.Input FR**

| | |
|---|---|
| **Identifier** | FR-5 |
| **Title** | Handle.Invalid.Input |
| **Requirement** | The system shall display a message that information is invalid if the user enters invalid input. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the user enters valid data so that sign up is successful. |
| **Business Rule** | The system must validate each field and notifies user if there is any error or missing field. |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.2 UC-1.2 Sign In

#### *3.3.2.1 FR-6: Initiate.SignIn.Process*

**Table 59: Initiate.SignIn.Process FR**

| | |
|---|---|
| **Identifier** | FR-6 |
| **Title** | Initiate.SignIn.Process |
| **Requirement** | The user shall be able to initiate the sign in process by clicking on “Sign In” button. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | Provide users an option to access their accounts and services. |
| **Business Rule** | The user must be registered to initiate sign in process. |
| **Dependencies** | FR-7 |
| **Priority** | High |

#### *3.3.2.2 FR-7: Input.Credentials*

**Table 60: Enter.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-7 |
| **Title** | Input.Credentials |
| **Requirement** | The system shall prompt the user to input their registered credentials to authenticate their identity. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the user enters registered credentials to successfully log in to the system |
| **Business Rule** | Email and password must match the one stored in database. |
| **Dependencies** | FR-8 |
| **Priority** | High |

#### *3.3.2.3 FR-8: Verify.Credentials*

**Table 61: Verify.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-8 |
| **Title** | Verify.Credentials |
| **Requirement** | The system shall verify credentials against database to authenticate the user. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the user enter credentials to successfully to log in to the system |
| **Business Rule** | The system must verify the user-entered credentials against database and directs the user to admin dashboard upon successful verification. |
| **Dependencies** | FR-9 |
| **Priority** | High |

#### *3.3.2.4 FR-9: Handle.Invalid.Credentials*

**Table 62: Handle.Invalid.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-9 |
| **Title** | Handle.Invalid.Credentials |
| **Requirement** | The system should display the message “Invalid Credentials” if the user enters invalid credentials. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the user does not enter invalid credentials. |
| **Business Rule** | The system must limit invalid login attempts to the maximum of five consecutive failures. |
| **Dependencies** | FR-10 |
| **Priority** | Medium |

### 3.3.3 UC-1.3 Manage Registered Users

#### *3.3.3.1 FR-10: Access.User.Management*

**Table 63: Access.User.Management FR**

| | |
|---|---|
| **Identifier** | FR-10 |
| **Title** | Access.User.Management |
| **Requirement** | The admin shall be able to access the user management section by clicking the “User Management” button from the dashboard |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the admin manage registered users. |
| **Business Rule** | Only users with admin privileges are authorized to access the user management section. |
| **Dependencies** | FR-11, FR-12, FR-13, FR-14, FR-15 |
| **Priority** | High |

#### *3.3.3.2 FR-11: Display.Registered.Users*

**Table 64: Display.Registered.Users FR**

| | |
|---|---|
| **Identifier** | FR-11 |
| **Title** | Display.Registered.Users |
| **Requirement** | The system shall display all the users that are registered when the user accesses the user management section. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that system display all the registered users to the admin. |
| **Business Rule** | None |
| **Dependencies** | FR-12 |
| **Priority** | High |

#### *3.3.3.3 FR-12: Select.Registered.User*

**Table 65: Select.Registered.User FR**

| | |
|---|---|
| **Identifier** | FR-12 |
| **Title** | Select.Registered.User |
| **Requirement** | The user shall be able to select a user from the list of registered users. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the admin to select a particular user. |
| **Business Rule** | None |
| **Dependencies** | FR-13 |
| **Priority** | High |

#### *3.3.3.4 FR-13: Manage.User.Account*

**Table 66: Manage.User.Account FR**

| | |
|---|---|
| **Identifier** | FR-13 |
| **Title** | Manage.User.Account |
| **Requirement** | The user shall be able to modify, deactivate or delete a user account upon selecting the user. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the admin to manage and modify user accounts. |
| **Business Rule** | None |
| **Dependencies** | FR-14 |
| **Priority** | High |

#### *3.3.3.5 FR-14: Process.User.Account.Changes*

**Table 67: Process.User.Account.Changes FR**

| | |
|---|---|
| **Identifier** | FR-14 |
| **Title** | Process.User.Account.Changes |
| **Requirement** | The system shall process all modifications, deletions or deactivations requested by the admin. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the system to execute all the changes requested by the admin. |
| **Business Rule** | None |
| **Dependencies** | FR-15 |
| **Priority** | High |

#### *3.3.3.6 FR-15: Notify.Admin.About.Issues*

**Table 68: Notify.Admin.about.Issues FR**

| | |
|---|---|
| **Identifier** | FR-15 |
| **Title** | Notify.Admin.About.Issues |
| **Requirement** | The system shall update admin in case of any errors during the processing of changes to the user account and suggests retrying. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | The system shall update admin in case of any errors during the processing of changes to the user account and suggest retrying. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.4 UC-1.4: Manage User Complaints

#### *3.3.4.1 FR-16: Access.Complaint.Management*

**Table 69: Access.Complaint.Management FR**

| | |
|---|---|
| **Identifier** | FR-16 |
| **Title** | Access.Complaint.Management |
| **Requirement** | The admin shall be able to access the complaint management section by clicking on “Access Complaint Management” button from the dashboard. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the admin to manage and resolve user complaints. |
| **Business Rule** | Only users with admin privileges are authorized to access the complaint management section. |
| **Dependencies** | FR-17, FR-18, FR-19, FR-20, FR-21 |
| **Priority** | High |

### *3.3.4.2 FR-17: Display.Complaint.List*

**Table 70: Display.Complaint.List FR**

| | |
|---|---|
| **Identifier** | FR-17 |
| **Title** | Display.Complaint.List |
| **Requirement** | The system shall display a list of registered complaints when the admin accesses the complaint management section. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the system to display a list of registered complaints. |
| **Business Rule** | None |
| **Dependencies** | FR-18 |
| **Priority** | High |

### *3.3.4.3 FR-18: Select.A.Particular.Complaint*

**Table 71: Select.A.Particular.Complaint FR**

| | |
|---|---|
| **Identifier** | FR-18 |
| **Title** | Select.A.Particular.Complaint |
| **Requirement** | The user shall be able to select a particular complaint from the list of registered complaints. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the admin to select a particular user complaint. |
| **Business Rule** | None |
| **Dependencies** | FR-19 |
| **Priority** | High |

#### *3.3.4.4 FR-19: Review.Complaint.Details*

**Table 72: Review.Complaint.Details FR**

| | |
|---|---|
| **Identifier** | FR-19 |
| **Title** | Review.Complaint.Details |
| **Requirement** | The admin shall be able to review the details of a selected complaint from the displayed list. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the admin to review a particular complaint. |
| **Business Rule** | None |
| **Dependencies** | FR-20 |
| **Priority** | High |

#### *3.3.4.5 FR-20: Address.Complaint*

**Table 73: Address.Complaint FR**

| | |
|---|---|
| **Identifier** | FR-20 |
| **Title** | Address.Complaint |
| **Requirement** | The user shall be able to resolve or address the selected complaint by taking appropriate actions. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the admin to take appropriate actions to resolve a complaint. |
| **Business Rule** | None |
| **Dependencies** | FR-21 |
| **Priority** | High |

#### *3.3.4.6 FR-21: Update.Complaint.Status*

**Table 74: Update.Complaint.Status FR**

| | |
|---|---|
| **Identifier** | FR-21 |
| **Title** | Update.Complaint.Status |
| **Requirement** | The system shall update the complaint status and confirm the action taken by the user. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the system to accurately reflect the current status of complaints. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.5 UC-1.5: Manage Reports

#### *3.3.5.1 FR-22: Access.Reports.Management*

**Table 75: Access.Reports.Management FR**

| | |
|---|---|
| **Identifier** | FR-22 |
| **Title** | Access.Reports.Management |
| **Requirement** | The admin shall be able to access the reports management section by clicking on “Reports Management” button on the dashboard. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the admin to manage and generate various reports. |
| **Business Rule** | Only users with admin privileges are authorized to access the reports management section. |
| **Dependencies** | FR-23, FR-24, FR-25, FR-26 |
| **Priority** | High |

#### *3.3.5.2 FR-23: Display.Reports.List*

**Table 76: Display.Reports.List FR**

| | |
|---|---|
| **Identifier** | FR-23 |
| **Title** | Display.Reports.List |
| **Requirement** | The system shall display a list of reports when admin access the reports management section |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the admin to generate a specific report from the list. |
| **Business Rule** | None |
| **Dependencies** | FR-24 |
| **Priority** | High |

#### *3.3.5.3 FR-24: Select.And.Apply.Filters.To.The.Report*

**Table 77: Select.And.Apply.Filters.To.The.Report FR**

| | |
|---|---|
| **Identifier** | FR-24 |
| **Title** | Select.And.Apply.Filters.To.the.Report |
| **Requirement** | The user selects a particular report from the list and apply filters as needed. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the admin to select and apply filter to the report. |
| **Business Rule** | None |
| **Dependencies** | FR-25 |
| **Priority** | High |

#### *3.3.5.4 FR-25: Generate.Required.Reports*

**Table 78: Generate.Required.Reports FR**

| | |
|---|---|
| **Identifier** | FR-25 |
| **Title** | Generate.Required.Reports |
| **Requirement** | The system shall generate required reports according to the filters. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the system to generate reports according to the filters applied. |
| **Business Rule** | None |
| **Dependencies** | FR-26 |
| **Priority** | High |

#### *3.3.5.5 FR-26: Notifies.Admin.About.Issues*

**Table 79: Notifies.Admin.About.Issues FR**

| | |
|---|---|
| **Identifier** | FR-26 |
| **Title** | Notifies.Admin.About.Issues |
| **Requirement** | The system shall notify admin in case of any errors during the generation of reports and suggests retrying. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | The system shall notify admin in case of any errors during the generation of reports and suggests retrying. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.6 UC-1.6: Switch Profile

#### *3.3.6.1 FR-27: Access.Switch.Profile*

**Table 80: Access.Switch.Profile FR**

| | |
|---|---|
| **Identifier** | FR-27 |
| **Title** | Access.Switch.Profile |
| **Requirement** | The admin shall access switch profile by clicking on “Switch Profile” option on the dashboard |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the admin to switch profile. |
| **Business Rule** | Only users with admin privileges are authorized to access the switch profile section. |
| **Dependencies** | FR-28, FR-29, FR-30 |
| **Priority** | High |

#### *3.3.6.2 FR-28: Displays.Available.Profiles*

**Table 81: Displays.Available.Profiles FR**

| | |
|---|---|
| **Identifier** | FR-28 |
| **Title** | Displays.Available.Profiles |
| **Requirement** | The system shall display the available profiles when user access switch profile. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable admin to select a specific profile from the available profiles. |
| **Business Rule** | None |
| **Dependencies** | FR-29 |
| **Priority** | High |

#### *3.3.6.3 FR-29: Selects.Profile*

**Table 82: Selects.Profile FR**

| | |
|---|---|
| **Identifier** | FR-29 |
| **Title** | Selects.Profile |
| **Requirement** | The admin selects a desired profile from the available profiles. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the admin switch to desired profile. |
| **Business Rule** | None |
| **Dependencies** | FR-30 |
| **Priority** | High |

#### *3.3.6.4 FR-30: Switch.To.Selected.Profile*

**Table 83: Switch.To.Selected.Profile FR**

| | |
|---|---|
| **Identifier** | FR-30 |
| **Title** | Switches.To.Selected.Profile |
| **Requirement** | The system shall switch to the profile selected by the admin and provide access to the corresponding dashboard. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the admin to switch between profiles (e.g. farmer, seller, customer) and manage actions. |
| **Business Rule** | Requested profile must be registered to gain access. |
| **Dependencies** | None |
| **Priority** | High |

## Farmer Functional Requirements

### 3.3.7 UC-2.1: Sign Up

#### *3.3.7.1 FR-31: Initiate.Registration*

**Table 84: Initiate.Registration FR**

| | |
|---|---|
| **Identifier** | FR-31 |
| **Title** | Initiate.Registration |
| **Requirement** | The user shall be able to initiate registration by clicking on Sign up button |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | Provide user an option to register in to the system |
| **Business Rule** | None |
| **Dependencies** | FR-32, FR-33, FR-34, FR-35 |
| **Priority** | High |

#### *3.3.7.2 FR-32: Enter.Credentials*

**Table 85: Enter.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-32 |
| **Title** | Enter.Credentials |
| **Requirement** | The user shall be able to enter credentials. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | Allow users to enter credentials to register as a Farmer. |
| **Business Rule** | None |
| **Dependencies** | FR-33 |
| **Priority** | High |

### *3.3.7.3 FR-33: Validate.Credentials*

**Table 86: Validate.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-33 |
| **Title** | Validate.Credentials |
| **Requirement** | The system should validate the correctness and accuracy of user entered email, password and username before proceeding with registration |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | The system ensure that the user entered credentials are correct and accurate and could be used as a valid email and password. |
| **Business Rule** | None |
| **Dependencies** | FR-34 |
| **Priority** | High |

### *3.3.7.4 FR-34: Confirm.Registration*

**Table 87: Confirm.Registration FR**

| | |
|---|---|
| **Identifier** | FR-34 |
| **Title** | Confirm.Registration |
| **Requirement** | The system shall confirm the successful registration of user's account and display a message that user account is created. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the user's account is successfully created and allow them to sign in to his account. |
| **Business Rule** | The user must be directed to the login page after successful sign up. |
| **Dependencies** | FR-35, FR-36 |
| **Priority** | High |

#### *3.3.7.5 FR-35: Handle.Invalid.Input*

**Table 88: Handle.Invalid.Input FR**

| | |
|---|---|
| **Identifier** | FR-35 |
| **Title** | Handle.Invalid.Input |
| **Requirement** | The system shall display a message that information is invalid if the user enters invalid input. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the user enters valid data so that sign up is successful. |
| **Business Rule** | The system must validate each field and notifies user if there is any error or missing field. |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.8 UC-2.2: Sign In

#### *3.3.8.1 FR-36: Initiate.SignIn.Process*

**Table 89: Initiate.SignIn.Process FR**

| | |
|---|---|
| **Identifier** | FR-36 |
| **Title** | Initiate.Sign.In.Process |
| **Requirement** | The user shall be able to initiate the sign in process by clicking on “Sign In” button. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | Provide users an option to access their accounts and services. |
| **Business Rule** | None |
| **Dependencies** | FR-37, FR-38, FR-39 |
| **Priority** | High |

#### *3.3.8.2 FR-37: Enter.Credentials*

**Table 90: Enter.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-37 |
| **Title** | Enter.Credentials |
| **Requirement** | The system shall prompt the user to enter their registered credentials to authenticate their identity. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the user enters registered credentials to successfully log in to the system |
| **Business Rule** | Email and password must match the one stored in database. |
| **Dependencies** | FR-38 |
| **Priority** | High |

#### *3.3.8.3 FR-38: Verify.Credentials*

**Table 91: Verify.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-38 |
| **Title** | Verify.Credentials |
| **Requirement** | The system shall verify credentials against database to authenticate the user. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the user enter credentials to successfully to log in to the system |
| **Business Rule** | None |
| **Dependencies** | FR-39 |
| **Priority** | High |

#### *3.3.8.4 FR-39: Handle.Invalid.Credentials*

**Table 92: Handle.Invalid.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-39 |
| **Title** | Handle.Invalid.Credentials |
| **Requirement** | The system shall display the message “Invalid Credentials” if the user enters invalid credentials. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the user does not enter invalid credentials. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.9 UC-2.3: Current Soil Analysis

#### *3.3.9.1 FR-40: Access.Soil.Analysis*

**Table 93: Access.Soil.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-40 |
| **Title** | Access.Soil.Analysis |
| **Requirement** | The system shall allow users to access soil analysis by clicking on “Soil Analysis” button on the dashboard. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the user to initiate the soil analysis process. |
| **Business Rule** | Users must have appropriate permissions to access soil analysis services. |
| **Dependencies** | FR-41, FR-42, FR-43 |
| **Priority** | High |

### *3.3.9.2 FR-41: Input.SoilData.for.Analysis*

**Table 94: Input.SoilData.for.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-41 |
| **Title** | Input.SoilData.for.Analysis |
| **Requirement** | The system shall allow the user to input soil information (Nitrogen, Phosphorus, Potassium). |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the user to input soil data for analysis. |
| **Business Rule** | None |
| **Dependencies** | FR-42, FR-44 |
| **Priority** | High |

### *3.3.9.3 FR-42: Validate.Soil.Information*

**Table 95: Validate.Soil.Information FR**

| | |
|---|---|
| **Identifier** | FR-42 |
| **Title** | Validate.Soil.Information |
| **Requirement** | The system shall validate the correctness of provided information (Nitrogen, Phosphorus, Potassium) provided by the user |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure that the user enters valid information for soil analysis. |
| **Business Rule** | None |
| **Dependencies** | FR-43 |
| **Priority** | High |

#### *3.3.9.4 FR-43: Confirm.Soil.Analysis*

**Table 96: Confirm.Soil.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-43 |
| **Title** | Confirm.Soil.Analysis |
| **Requirement** | The system shall provide a confirmation message to the user on the successful submission and validation of soil information. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | The system provides information to user that soil information is submitted and validated successfully. |
| **Business Rule** | None |
| **Dependencies** | FR-44, FR-62 |
| **Priority** | Medium |

#### *3.3.9.5 FR-44: Error.Notification.For.Soil.Analysis*

**Table 97: Error.Notification.For.Soil.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-44 |
| **Title** | Error.Notification.For.Soil.Analysis |
| **Requirement** | The system shall notify user in case of any errors during the process of soil analysis and suggests retrying. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | The system shall notify user in case of any errors during the process of soil analysis and suggests retrying. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.10 UC-2.4: Previous Soil Analysis

#### *3.3.10.1 FR-45 Access.Previous.Soil.Analysis*

**Table 98: Access.Previous.Soil.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-45 |
| **Title** | Access.Previous.Soil.Analysis |
| **Requirement** | The system shall allow users to access previous soil analysis by clicking on "Previous Soil Analysis" button on the dashboard. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the user to initiate the previous soil analysis process. |
| **Business Rule** | Users must have appropriate permissions to access previous soil analysis services. |
| **Dependencies** | FR-46, FR-47, FR-48, FR-49 |
| **Priority** | High |

#### *3.3.10.2 FR-46 Retrieve.Previous.Soil.Analysis.Data*

**Table 99: Retrieve.Previous.Soil.Analysis.Data FR**

| | |
|---|---|
| **Identifier** | FR-46 |
| **Title** | Retrieve.Previous.Soil.Analysis.Data |
| **Requirement** | The system shall retrieve previous soil analysis data if it is available and displays it to the user. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the system retrieve the previous soil analysis data and displays it to the user. |
| **Business Rule** | None |
| **Dependencies** | FR-47 |
| **Priority** | High |

### *3.3.10.3 FR-47: Handle.Missing.Previous.Data*

**Table 100: Handle.Missing.Previous.Data FR**

| | |
|---|---|
| **Identifier** | FR-47 |
| **Title** | Handle.Missing.Previous.Data |
| **Requirement** | The system shall notify the user that there is no previous data available. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To inform the user that there is no previous data available. |
| **Business Rule** | None |
| **Dependencies** | FR-48 |
| **Priority** | High |

### *3.3.10.4 FR-48: Validate.Previous.Soil.Data*

**Table 101: Validate.Previous.Soil.Data FR**

| | |
|---|---|
| **Identifier** | FR-48 |
| **Title** | Validate.Previous.Soil.Data |
| **Requirement** | The system shall validate the correctness of retrieved previous soil data. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure the accuracy of previous soil data before further analysis. |
| **Business Rule** | The system must validate the correctness and accuracy of retrieved soil data. |
| **Dependencies** | FR-49 |
| **Priority** | High |

### *3.3.10.5 FR-49 Confirm.Previous.Soil.Analysis*

**Table 102: Confirm.Previous.Soil.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-49 |
| **Title** | Confirm.Previous.Soil.Analysis |
| **Requirement** | The system shall provide a confirmation message to the user after the successful retrieval and validation of previous soil data. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To inform the farmer about successful analysis of previous soil data. |
| **Business Rule** | None |
| **Dependencies** | FR-50, FR-62 |
| **Priority** | High |

### *3.3.10.6 FR-50 Error.Notification.For.Previous.Soil.Analysis*

**Table 103: Error.Notification.For.Previous.Soil.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-50 |
| **Title** | Error.Notificationo.For.Previous.Soil.Analysis |
| **Requirement** | The system shall notify user in case of any errors during the process of previous soil analysis and suggests retrying. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | The system shall notify user in case of any errors during the process of previous soil analysis and suggests retrying. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.11 UC-2.5: Weather Analysis

#### *3.3.11.1 FR-51: Access.Weather.Analysis*

**Table 104: Access.Weather.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-51 |
| **Title** | Access.Weather.Analysis |
| **Requirement** | The system shall allow users to access weather analysis by clicking on "Weather Analysis" button on the dashboard. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the user to initiate the weather analysis process. |
| **Business Rule** | Users must have appropriate permissions to access weather analysis services. |
| **Dependencies** | FR-52, FR-53, FR-54 |
| **Priority** | High |

#### *3.3.11.2 FR-52: Input.Current.Weather.Data*

**Table 105: Input.Current.Weather.Data FR**

| | |
|---|---|
| **Identifier** | FR-52 |
| **Title** | Input.Current.Weather.Data |
| **Requirement** | The system shall allow the user to input current weather data for analysis |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the user to input weather data for analysis. |
| **Business Rule** | None |
| **Dependencies** | FR-53, FR-55 |
| **Priority** | High |

### *3.3.11.3 FR-53: Validate.Weather.Data*

**Table 106: Validate.Weather.Data FR**

| | |
|---|---|
| **Identifier** | FR-53 |
| **Title** | Validate.Weather.Data |
| **Requirement** | The system shall validate the correctness of provided weather data. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To ensure the accuracy of weather data before analysis. |
| **Business Rule** | None |
| **Dependencies** | FR-54, FR-55 |
| **Priority** | High |

### *3.3.11.4 FR-54: Confirm.Weather.Analysis*

**Table 107: Confirm.Weather.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-54 |
| **Title** | Confirm.Weather.Analysis |
| **Requirement** | The system shall provide a confirmation message to the user on the successful submission and validation of weather data |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To inform the user of successful analysis of weather data. |
| **Business Rule** | None |
| **Dependencies** | FR-55, FR-62 |
| **Priority** | High |

#### *3.3.11.5 FR-55: Error.Notification.For.Weather.Analysis*

**Table 108: Error.Notification.For.Weather.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-55 |
| **Title** | Error.Notification.For.Weather.Analysis |
| **Requirement** | The system shall notify user in case of any errors during the process of weather analysis and suggests retrying. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | The system shall notify user in case of any errors during the process of weather analysis and suggests retrying. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.12 UC-2.6: Climate Analysis

#### *3.3.12.1 FR-56: Access.Climate.Analysis*

**Table 109: Access.Climate.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-56 |
| **Title** | Access.Climate.Analysis |
| **Requirement** | The system shall allow users to access climate analysis by clicking on “Climate Analysis” button on the dashboard. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the user to initiate the climate analysis process. |
| **Business Rule** | Users must have appropriate permissions to access climate analysis services. |
| **Dependencies** | FR-57, FR-58, FR-59 |
| **Priority** | High |

#### *3.3.12.2 FR-57: Select.Location.From.Search.Bar*

**Table 110: Select.Location.From.Search.Bar FR**

| | |
|---|---|
| **Identifier** | FR-57 |
| **Title** | Select.Location.From.Search.Bar. |
| **Requirement** | The system shall allow the user to select particular location from search bar for climate analysis. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the user to select a location for climate analysis. |
| **Business Rule** | None |
| **Dependencies** | FR-58, FR-60 |
| **Priority** | High |

#### *3.3.12.3 FR-58: Retrieve.Climate.Of.Selected.Location.Via.ThirdParty*

**Table 111: Retrieve.Climate.Of.Selected.Location.Via.ThirdParty FR**

| | |
|---|---|
| **Identifier** | FR-58 |
| **Title** | Retrieve.Climate.Of.Selected.Location.Via.ThirdParty |
| **Requirement** | The system shall retrieve the climate of selected location. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the user to select a location for climate analysis, aiding in informed decision-making for farming activities. |
| **Business Rule** | None |
| **Dependencies** | FR-59, FR-60 |
| **Priority** | High |

### *3.3.12.4 FR-59: Confirm.Climate.Analysis*

**Table 112: Confirm.Climate.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-59 |
| **Title** | Confirm.Climate.Analysis |
| **Requirement** | The system shall provide a confirmation message to the user on the successful analysis and validation of climate data. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To inform the user of successful analysis of climate data. |
| **Business Rule** | None |
| **Dependencies** | FR-60, FR-62 |
| **Priority** | High |

### *3.3.12.5 FR-60: Error.Notification.For.Climate.Analysis*

**Table 113: Error.Notification.For.Climate.Analysis FR**

| | |
|---|---|
| **Identifier** | FR-60 |
| **Title** | Error.Notification.For.Climate.Analysis |
| **Requirement** | The system shall notify user in case of any errors during the process of climate analysis and suggests retrying. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | The system shall notify user in case of any errors during the process of climate analysis and suggests retrying. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.13 UC-2.7: Crop Recommendation

#### *3.3.13.1 FR-61: Access.Crop.Recommendation*

**Table 114: Access.Crop.Recommendation FR**

| | |
|---|---|
| **Identifier** | FR-61 |
| **Title** | Access.Crop.Recommendation |
| **Requirement** | The system shall allow users to access crop recommendation by clicking on “Crop Recommendation” button on the dashboard. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the user to initiate the crop recommendation process. |
| **Business Rule** | User must have completed soil, weather and climate analysis |
| **Dependencies** | FR-62, FR-63, FR-64 |
| **Priority** | High |

#### *3.3.13.2 FR-62: Provide.Crop.Recommendations*

**Table 115: Provide.Crop.Recommendations FR**

| | |
|---|---|
| **Identifier** | FR-62 |
| **Title** | Provide.Crop.Recommendations |
| **Requirement** | The system shall provide multiple crop recommendation based on soil, weather and climate analysis. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the system to provide recommendation based on soil, weather and climate analysis. |
| **Business Rule** | None |
| **Dependencies** | FR-63, FR-65 |
| **Priority** | High |

### *3.3.13.3 FR-63: View.Crop.Characteristics*

**Table 116: View.Crop.Characteristics FR**

| | |
|---|---|
| **Identifier** | FR-63 |
| **Title** | View.Crop.Characteristics |
| **Requirement** | The user selects a crop from the recommended list of crops to view its characteristics, including pros and cons |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To enable the user to make informed decisions by understanding the benefits and drawbacks of each crop |
| **Business Rule** | None |
| **Dependencies** | FR-64, FR-65 |
| **Priority** | High |

### *3.3.13.4 FR-64: Confirm.Crop.Selection*

**Table 117: Confirm.Crop.Selection FR**

| | |
|---|---|
| **Identifier** | FR-64 |
| **Title** | Confirm.Crop.Selection |
| **Requirement** | The system shall allow the user to confirm the selected crop after viewing its characteristics. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | To allow the user to confirm the selected crop based on analysis and personal preference. |
| **Business Rule** | None |
| **Dependencies** | FR-65 |
| **Priority** | High |

#### *3.3.13.5 FR-65 Error.Notification.For.Crop.Recommendation*

**Table 118: Error.Notification.For.Crop.Recommendation FR**

| | |
|---|---|
| **Identifier** | FR-65 |
| **Title** | Error.Notification.For.Crop.Recommendation |
| **Requirement** | The system shall notify user in case of any errors during the process of crop recommendation and suggests retrying. |
| **Source** | Muaaz Bin Mukhtar |
| **Rationale** | The system shall notify user in case of any errors during the process of crop recommendation and suggests retrying. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.14 UC-2.8: Tutorials

#### *3.3.14.1 FR-66: Access.Tutorials*

**Table 119: Access.Tutorials FR**

| | |
|---|---|
| **Identifier** | FR-66 |
| **Title** | Access.Tutorials |
| **Requirement** | The system shall allow the user to access tutorials by clicking on “Tutorials” option on the dashboard. |
| **Source** | Muaaz Bin Mukhtar, Ammar Ali, Muhammad Moiz |
| **Rationale** | To allow the user to access learning materials provided by the system. |
| **Business Rule** | None |
| **Dependencies** | FR-67 |
| **Priority** | High |

### *3.3.14.2 FR-67: Display.Tutorials.List*

**Table 120: Display.Tutorials.List FR**

| | |
|---|---|
| **Identifier** | FR-67 |
| **Title** | Display.Tutorials.List |
| **Requirement** | The system shall display a list of tutorials when user access the Tutorials section. |
| **Source** | Muaaz Bin Mukhtar, Ammar Ali, Muhammad Moiz |
| **Rationale** | To enable the user to access and choose a specific tutorial from the list. |
| **Business Rule** | None |
| **Dependencies** | FR-68 |
| **Priority** | High |

### *3.3.14.3 FR-68: View.Selected.Tutorial*

**Table 121: View.Selected.Tutorial FR**

| | |
|---|---|
| **Identifier** | FR-68 |
| **Title** | View.Selected.Tutorial |
| **Requirement** | The system shall display the selected tutorial when user selects one from the list of tutorials. |
| **Source** | Muaaz Bin Mukhtar, Ammar Ali, Muhammad Moiz |
| **Rationale** | To ensure the user can view the selected tutorial. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.15 UC-2.9: AI Chatbot

#### *3.3.15.1 FR-69: Initiate.Chatbot.Interaction*

**Table 122: Initiate.Chatbot.Interaction FR**

| | |
|---|---|
| **Identifier** | FR-69 |
| **Title** | Initiate.Chatbot.Interaction |
| **Requirement** | The system shall allow users to initiate interaction with the Chabot by clicking on "AgroTech Chatbot" button on the dashboard. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To provide user a simple way to seek help about the system. |
| **Business Rule** | None |
| **Dependencies** | FR-70, FR-71, FR-72, FR-73, FR-74 |
| **Priority** | High |

#### *3.3.15.2 FR-70: Display.FAQ.Options*

**Table 123: Display.FAQ.Options FR**

| | |
|---|---|
| **Identifier** | FR-70 |
| **Title** | Display.FAQ.Options |
| **Requirement** | The system shall greet the user and display a list of Frequently Asked Questions (FAQs) options when user clicks "AgroTech Chatbot" button on the dashboard |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To provide user with guidance and help quickly by display Frequently Asked Questions (FAQs) options. |
| **Business Rule** | FAQ options should be up-to-date and covers a broad range of issues |
| **Dependencies** | FR-71 |
| **Priority** | High |

### *3.3.15.3 FR-71: Option.Selection.Or.Query.Prompt*

**Table 124: Option.Selection.Or.Query.Prompt FR**

| | |
|---|---|
| **Identifier** | FR-71 |
| **Title** | Option.Selection.Or.Query.Prompt |
| **Requirement** | The user selects an option from provided FAQs or prompt a query. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To provide user options to convey its problems to the system. |
| **Business Rule** | None |
| **Dependencies** | FR-72 |
| **Priority** | High |

### *3.3.15.4 FR-72: Process.Queries*

**Table 125: Process.Queries FR**

| | |
|---|---|
| **Identifier** | FR-72 |
| **Title** | Process.Queries |
| **Requirement** | The user shall process user queries and provide response based on the query |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To ensure that the system can understand and address user queries efficiently, providing responses to help users resolve issues or access information. |
| **Business Rule** | None |
| **Dependencies** | FR-73 |
| **Priority** | High |

#### *3.3.15.5 FR-73: Manage.Unrecognized.Queries*

**Table 126: Manage.Unrecognized.Queries FR**

| | |
|---|---|
| **Identifier** | FR-73 |
| **Title** | Manage.Unrecognized.Queries |
| **Requirement** | If the chatbot does not recognize a user's query, it shall request clarification or provide general assistance. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To ensure that the user's queries are processed properly without any confusion. |
| **Business Rule** | None |
| **Dependencies** | FR-74 |
| **Priority** | High |

#### *3.3.15.6 FR-74: Provide.Responses*

**Table 127: Provide.Responses FR**

| | |
|---|---|
| **Identifier** | FR-74 |
| **Title** | Provide.Responses |
| **Requirement** | The system shall provide responses to user queries within a few seconds to ensure optimal user experience. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To enhance user satisfaction by offering prompt and helpful responses to their queries or issues. |
| **Business Rule** | None |
| **Dependencies** | FR-75 |
| **Priority** | High |

#### *3.3.15.7 FR-75 Email/Phone.Support.In.Case.Of.Technical.Difficulties*

**Table 128: Email/Phone.Support.In.Case.Of.Technical.Difficulties FR**

| | |
|---|---|
| **Identifier** | FR-75 |
| **Title** | Email/Phone.Support.In.Case.Of.Technical.Difficulties |
| **Requirement** | The system shall direct users to contact support via email/phone in case of technical difficulties. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To ensure that the user get necessary assistance even when the chatbot is unavailable. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.16 UC-2.10: Register Complaints

#### *3.3.16.1 FR-76: Initiate.Complaint.Registration*

**Table 129: Initiate.Complaint.Registration FR**

| | |
|---|---|
| **Identifier** | FR-76 |
| **Title** | Initiate.Complaint.Registration |
| **Requirement** | The system shall allow users to initiate the complaint registration process by clicking on “Register Complaint” button on the dashboard |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To provide users a simple way to register complaints. |
| **Business Rule** | None |
| **Dependencies** | FR-77, FR-78, FR-79 |
| **Priority** | High |

### *3.3.16.2 FR-77: Collect.Complaint.Details*

**Table 130: Collect.Complaint.Details FR**

| | |
|---|---|
| **Identifier** | FR-77 |
| **Title** | Collect.Complaint.Details |
| **Requirement** | The system shall allow user to enter details of the complaint, such as problem type and problem description. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To ensure that the user entered all the necessary details for support team to resolve the problem. |
| **Business Rule** | The system must ensure all the details entered are complete and there are no missing fields. |
| **Dependencies** | FR-78, FR-80 |
| **Priority** | High |

### *3.3.16.3 FR-78: Register.The.Complaint*

**Table 131: Register.The.Complaint FR**

| | |
|---|---|
| **Identifier** | FR-78 |
| **Title** | Register.The.Complaint |
| **Requirement** | User is able to register complaint and view its status successfully |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To ensure that the users are provided with an easy way to register complaints. |
| **Business Rule** | Complaints must be logged into the system database and assigned to the relevant authority based on the nature of the issue. |
| **Dependencies** | FR-79, FR-80 |
| **Priority** | High |

### *3.3.16.4 FR-79: Confirm.Complaint.Status*

**Table 132: Confirm.Complaint.Status FR**

| | |
|---|---|
| **Identifier** | FR-79 |
| **Title** | Confirm.Complaint.Status |
| **Requirement** | The system shall notify the user once the complaint is successfully registered and forwarded to the appropriate authority. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To ensure that users are informed about the status of their complaint, providing them with confirmation and satisfaction that their issue is being addressed. |
| **Business Rule** | None |
| **Dependencies** | FR-80 |
| **Priority** | High |

### *3.3.16.5 FR-80: Error.Notification.And.Direct.To.Support*

**Table 133: Error.Notification.And.Direct.To.Support FR**

| | |
|---|---|
| **Identifier** | FR-80 |
| **Title** | Error.Notification.And.Direct.To.Support |
| **Requirement** | The system shall notify the user of any technical difficulties and provide instructions to contact support via email or phone. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To ensure that users can still register complaints even when the complaint registration is unavailable. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.17 UC-2.11: Feedback and Reviews

#### *3.3.17.1 FR-81: Access.Feedback.And.Reviews*

**Table 134: Access.Feedback.And.Reviews.Option FR**

| | |
|---|---|
| **Identifier** | FR-81 |
| **Title** | Access.Feedback.And.Reviews |
| **Requirement** | The system shall allow the user to access feedback and reviews by clicking on “Feedback and Reviews” option on the dashboard. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To ensure that users can submit feedback to the system. |
| **Business Rule** | Users must have appropriate permissions to access feedback and reviews section. |
| **Dependencies** | FR-82, FR-83, FR-84, FR-85, FR-86 |
| **Priority** | High |

#### *3.3.17.2 FR-82: Display.User.Reviews*

**Table 135: Display.User.Reviews FR**

| | |
|---|---|
| **Identifier** | FR-82 |
| **Title** | Display.User.Reviews |
| **Requirement** | The system shall display list of reviews provided by other users. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To enable user to see existing reviews before submitting their own feedback. |
| **Business Rule** | None |
| **Dependencies** | FR-83, FR-87 |
| **Priority** | High |

### *3.3.17.3 FR-83: Select.Submit.Feedback.Option*

**Table 136: Select.Submit.Feedback.Option FR**

| | |
|---|---|
| **Identifier** | FR-83 |
| **Title** | Select.Submit.Feedback.Option |
| **Requirement** | The system shall allow user to submit feedback by clicking on "Submit Feedback" option. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | Users need the opportunity to submit feedback for continuous improvement. |
| **Business Rule** | None |
| **Dependencies** | FR-84, FR-87 |
| **Priority** | High |

### *3.3.17.4 FR-84: Display.Domains.For.Feedbacks*

**Table 137: Display.Domains.For.Feedbacks FR**

| | |
|---|---|
| **Identifier** | FR-84 |
| **Title** | Display.Domains.For.Feedbacks |
| **Requirement** | The system shall display feedback domains (system performance, user interface etc.) for user to select from. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To ensure that user selects appropriate domain for certain feedback. |
| **Business Rule** | None |
| **Dependencies** | FR-85, FR-87 |
| **Priority** | High |

### *3.3.17.5 FR-85: Submit.Feedback*

**Table 138: Submit.Feedback FR**

| | |
|---|---|
| **Identifier** | FR-85 |
| **Title** | Submit.Feedback |
| **Requirement** | The system shall allow user to submit feedback through a form. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To ensure that feedback is collected in a structured format. |
| **Business Rule** | None |
| **Dependencies** | FR-86, FR-87 |
| **Priority** | High |

### *3.3.17.6 FR-86: Update.Feedback.Register*

**Table 139: Update.Feedback.Register FR**

| | |
|---|---|
| **Identifier** | FR-86 |
| **Title** | Update.Feedback.Register |
| **Requirement** | The system shall update the feedback register with the provided feedback input. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To ensure all the feedbacks provided by the user are stored for future use. |
| **Business Rule** | None |
| **Dependencies** | FR-87 |
| **Priority** | High |

#### *3.3.17.7 FR-87: Error.Notification.For.Technical.Issues*

**Table 140: Error.Notification.For.Technical.Issues FR**

| | |
|---|---|
| **Identifier** | FR-87 |
| **Title** | Error.Notification.For.Technical.Issues |
| **Requirement** | The system shall notify the user of any technical difficulties and guide user to retry or contact support. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | Ensure proper communication in case of technical issues and enhance user experience. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.18 UC-2.12: Identify Crop Stresses

#### *3.3.18.1 FR-88: Access.Identify.Crop.Stress*

**Table 141: Access.Identify.Crop.Stress FR**

| | |
|---|---|
| **Identifier** | FR-88 |
| **Title** | Access.Identify.Crop.Stress |
| **Requirement** | The system shall allow the user to identify crop stress by clicking on “Identify Crop Stress” option on the dashboard. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow to user to initiate the identify crop stress process. |
| **Business Rule** | Users must have appropriate permissions to access identify crop stress. |
| **Dependencies** | FR-89, FR-90, FR-91, FR-92, FR-93, FR-94 |
| **Priority** | High |

### *3.3.18.2 FR-89: Display.Registered.Crops.List*

**Table 142: Display.Registered.Crops.List FR**

| | |
|---|---|
| **Identifier** | FR-89 |
| **Title** | Display.Registered.Crops.List |
| **Requirement** | The system shall display the list of registered crops when the user clicks on “Identify Crop Stress” option on the dashboard. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow the system to display all the registered crops in a list. |
| **Business Rule** | None |
| **Dependencies** | FR-90, FR-95 |
| **Priority** | High |

### *3.3.18.3 FR-90: Select.A.Particular.Crop*

**Table 143: Select.A.Particular.Crop FR**

| | |
|---|---|
| **Identifier** | FR-90 |
| **Title** | Select.A.Particular.Crop |
| **Requirement** | The user selects a particular crop from the list of registered crops. |
| **Source** | Muhammad Moiz |
| **Rationale** | To ensure that the user selects a particular crop according to his personal preference and requirement. |
| **Business Rule** | None |
| **Dependencies** | FR-91, FR-95 |
| **Priority** | High |

### *3.3.18.4 FR-91: Analyze.Crop.Data*

**Table 144: Analyze.Crop.Data FR**

| | |
|---|---|
| **Identifier** | FR-91 |
| **Title** | Analyze.Crop.Data |
| **Requirement** | The system shall analyze the selected crop according to crop conditions such as water stress, nutrient levels and pest infestations. |
| **Source** | Muhammad Moiz |
| **Rationale** | Accurate crop health assessment requires analyzing environmental factors and crop conditions. |
| **Business Rule** | None |
| **Dependencies** | FR-92, FR-95 |
| **Priority** | High |

### *3.3.18.5 FR-92: Select.Unregistered.Crops.Option*

**Table 145: Select.Unregistered.Crops.Option FR**

| | |
|---|---|
| **Identifier** | FR-92 |
| **Title** | Select.Unregistered.Crops.Option |
| **Requirement** | The system shall allow the user to select an option for unregistered crops from the list of registered crop options. |
| **Source** | Muhammad Moiz |
| **Rationale** | To enable users select unregistered crops option from the list. |
| **Business Rule** | None |
| **Dependencies** | FR-93, FR-95 |
| **Priority** | High |

### *3.3.18.6 FR-93: Enter.Unregistered.Crops,Details*

**Table 146: Enter.Unregistered.Crops,Details FR**

| | |
|---|---|
| **Identifier** | FR-93 |
| **Title** | Enter.Unregistered.Crops,Details |
| **Requirement** | The system shall allow the user to enter the details of unregistered crops after clicking the “Unregistered Crops” option. |
| **Source** | Muhammad Moiz |
| **Rationale** | To enable users to enter details of unregistered crops in the system and entered data is sent to the registered crops list. |
| **Business Rule** | None |
| **Dependencies** | FR-94, FR-95 |
| **Priority** | High |

### *3.3.18.7 FR-94: Crop.Stress.Report.Generation*

**Table 147: Crop.Stress.Report.Generation FR**

| | |
|---|---|
| **Identifier** | FR-94 |
| **Title** | Crop.Stress.Report.Generation |
| **Requirement** | The system shall generate and presents a detailed report to the user after analyzing crop conditions. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow the system generate a detailed report regarding crop stresses. |
| **Business Rule** | None |
| **Dependencies** | FR-95 |
| **Priority** | High |

#### *3.3.18.8 FR-95: Error.Notification.For.Technical.Issues*

**Table 148: Error.Notification.For.Technical.Issues FR**

| | |
|---|---|
| **Identifier** | FR-95 |
| **Title** | Error.Notification.For.Technical.Issues |
| **Requirement** | The system shall notify the user of any technical difficulties and guide user to retry or contact support. |
| **Source** | Muhammad Moiz |
| **Rationale** | Ensure proper communication in case of technical issues and enhance user experience. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.19 UC-2.13: Identification of Crop Diseases

#### *3.3.19.1 FR-96: Access.Identify.Crop.Disease*

**Table 149: Access.Identify.Crop.Disease FR**

| | |
|---|---|
| **Identifier** | FR-96 |
| **Title** | Access.Identify.Crop.Disease |
| **Requirement** | The system shall allow the user to identify crop disease by clicking on “Identify Crop Disease” option on the dashboard. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow to user to initiate the crop disease identification process. |
| **Business Rule** | Users must have appropriate permissions to access identify crop disease. |
| **Dependencies** | FR-97, FR-98, FR-99 |
| **Priority** | High |

### *3.3.19.2 FR-97: Input.Crop.Details*

**Table 150: Input.Crop.Details FR**

| | |
|---|---|
| **Identifier** | FR-97 |
| **Title** | Input.Crop.Details |
| **Requirement** | The system shall allow the user to input crop details (including images and symptoms) for crop disease detection. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow the user to enter all the crop details including clear images of the affected crop or symptoms. |
| **Business Rule** | None |
| **Dependencies** | FR-98, FR-100 |
| **Priority** | High |

### *3.3.19.3 FR-98: Identification.Of.Disease*

**Table 151: Identification.Of.Disease FR**

| | |
|---|---|
| **Identifier** | FR-98 |
| **Title** | Identification.Of.Disease |
| **Requirement** | The system shall use Image Recognition and ML models to identify symptoms of disease in the crop by comparing it with the existing database. |
| **Source** | Muhammad Moiz |
| **Rationale** | To identify the symptoms of disease in the crop using image recognition and ML model. |
| **Business Rule** | None |
| **Dependencies** | FR-99, FR-100 |
| **Priority** | High |

### *3.3.19.4 FR-99: Crop.Diagnosis.Report.Generation*

**Table 152: Crop.Diagnosis.Report.Generation FR**

| | |
|---|---|
| **Identifier** | FR-99 |
| **Title** | Crop.Diagnosis.Report.Generation |
| **Requirement** | The system shall generate and presents a detailed diagnosis report to the user about crop disease. |
| **Source** | Muhammad Moiz |
| **Rationale** | To provide users with a detailed diagnosis report that helps in understanding diseases in crops using image recognition and machine learning. |
| **Business Rule** | None |
| **Dependencies** | FR-100 |
| **Priority** | High |

### *3.3.19.5 FR-100: Error.Notification.For.Technical.Issues*

**Table 153: Error.Notification.For.Technical.Issues FR**

| | |
|---|---|
| **Identifier** | FR-100 |
| **Title** | Error.Notification.For.Technical.Issues |
| **Requirement** | The system shall notify the user of any technical difficulties in crop disease detection process and guide user to retry or contact support. |
| **Source** | Muhammad Moiz |
| **Rationale** | Ensure proper communication in case of technical issues and enhance user experience. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.20 UC-2.14: Periodic Crop Health Information

#### *3.3.20.1 FR-101: Access.Periodic.Crop.Health.Monitoring*

**Table 154: Access.Periodic.Crop.Health.Monitoring FR**

| | |
|---|---|
| **Identifier** | FR-101 |
| **Title** | Access.Periodic.Crop.Health.Monitoring |
| **Requirement** | The system shall allow the user to access periodic crop health monitoring by clicking on “Periodic Crop Health” option on the dashboard. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow the user to initiate periodic crop monitoring process. |
| **Business Rule** | Users must have appropriate permissions to access periodic crop health monitoring. |
| **Dependencies** | FR-102, FR-103, FR-104, FR-105 |
| **Priority** | High |

#### *3.3.20.2 FR-102: Select.Schedule*

**Table 155: Select.Schedule FR**

| | |
|---|---|
| **Identifier** | FR-102 |
| **Title** | Select.Schedule |
| **Requirement** | The user selects the schedule to collect information about crop health at certain intervals |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow the user to select schedule for crop monitoring at certain intervals. |
| **Business Rule** | None |
| **Dependencies** | FR-103, FR-106 |
| **Priority** | High |

#### *3.3.20.3 FR-103: Provide.Crop.Data*

**Table 156: Provide.Crop.Data FR**

| | |
|---|---|
| **Identifier** | FR-103 |
| **Title** | Provide.Crop.Data |
| **Requirement** | The system shall inform the user to collect information about crops and user provides the data at certain intervals |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow the user to provide crop data to the system at certain intervals. |
| **Business Rule** | None |
| **Dependencies** | FR-104, FR-106 |
| **Priority** | High |

#### *3.3.20.4 FR-104: Assess.Provided.Data*

**Table 157: Assess.Provided.Data FR**

| | |
|---|---|
| **Identifier** | FR-104 |
| **Title** | Assess.Provided.Data |
| **Requirement** | The system shall use image recognition and ml model to assess the health of crops. |
| **Source** | Muhammad Moiz |
| **Rationale** | To enable the system to assess the health of crops. |
| **Business Rule** | None |
| **Dependencies** | FR-105, FR-106 |
| **Priority** | High |

### *3.3.20.5 FR-105: Periodic.Crop.Health.Report.Generation*

**Table 158: Periodic.Crop.Health.Report.Generation FR**

| | |
|---|---|
| **Identifier** | FR-105 |
| **Title** | Periodic.Crop.Health.Report.Generation |
| **Requirement** | The system shall generate and presents a periodic crop health report to the user. |
| **Source** | Muhammad Moiz |
| **Rationale** | To provide users with a periodic crop health report that helps users to monitor health of crops at certain intervals. |
| **Business Rule** | None |
| **Dependencies** | FR-106 |
| **Priority** | High |

### *3.3.20.6 FR-106: Error.Notification.For.Technical.Issues*

**Table 159: Error.Notification.For.Technical.Issues FR**

| | |
|---|---|
| **Identifier** | FR-106 |
| **Title** | Error.Notification.For.Technical.Issues |
| **Requirement** | The system shall notify the user of any technical difficulties and guide user to retry or contact support. |
| **Source** | Muhammad Moiz |
| **Rationale** | To ensure proper communication and enhance user experience. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.21 UC-2.15: Estimate Crop Yield

#### *3.3.21.1 FR-107: Access.Estimate.Crop.Yield*

**Table 160: Access.Estimate.Crop.Yield FR**

| | |
|---|---|
| **Identifier** | FR-107 |
| **Title** | Access.Estimate.Crop.Yield |
| **Requirement** | The system shall allow the user to access estimate crop yield by clicking on “Estimate Crop Yield” option on the dashboard. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow user to initiate estimate crop yield process. |
| **Business Rule** | Users must have appropriate permissions to access estimate crop yield. |
| **Dependencies** | FR-108, FR-109, FR-110, FR-111, FR-112 |
| **Priority** | High |

#### *3.3.21.2 FR-108: Display.Crops.List*

**Table 161: Display.Crops.List FR**

| | |
|---|---|
| **Identifier** | FR-108 |
| **Title** | Display.CropsList |
| **Requirement** | The system shall display the list of crops when the user clicks on “Estimate Crop Yield” option on the dashboard. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow the system display all the crops in a list. |
| **Business Rule** | None |
| **Dependencies** | FR-109, FR-113 |
| **Priority** | High |

#### *3.3.21.3 FR-109: Select.A.Particular.Crop*

**Table 162: Select.A.Particular.Crop FR**

| | |
|---|---|
| **Identifier** | FR-109 |
| **Title** | Select.A.Particular.Crop |
| **Requirement** | The user selects a particular crop from the list of crops. |
| **Source** | Muhammad Moiz |
| **Rationale** | To ensure that the user selects a particular crop according to his personal preference and requirement. |
| **Business Rule** | None |
| **Dependencies** | FR-110, FR-113 |
| **Priority** | High |

#### *3.3.21.4 FR-110: Select.Values.Of.Yield.Factors*

**Table 163: Select.Values.Of.Yield.Factors FR**

| | |
|---|---|
| **Identifier** | FR-110 |
| **Title** | Select.Values.Of.Yield.Factors |
| **Requirement** | The user selects the values of yield factors such as temperature, rainfall, soil nutrient. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow the user to select the values of yield factors for yield estimation. |
| **Business Rule** | None |
| **Dependencies** | FR-111, FR-113 |
| **Priority** | High |

### *3.3.21.5 FR-111: Crop.Yield.Estimation*

**Table 164: Crop.Yield.Estimation FR**

| | |
|---|---|
| **Identifier** | FR-111 |
| **Title** | Crop.Yield.Estimation |
| **Requirement** | The system shall utilize machine learning (ML) models to estimate crop yield based on factors such as temperature, rainfall, soil nutrient levels. |
| **Source** | Muhammad Moiz |
| **Rationale** | To provide accurate yield estimation by analyzing environmental and soil conditions using machine learning |
| **Business Rule** | None |
| **Dependencies** | FR-112, FR-113 |
| **Priority** | High |

### *3.3.21.6 FR-112: Crop.Yield.Report.Generation*

**Table 165: Crop.Yield.Report.Generation FR**

| | |
|---|---|
| **Identifier** | FR-112 |
| **Title** | Crop.Yield.Report.Generation |
| **Requirement** | The system shall generate and presents a detailed yield estimation report to the user. |
| **Source** | Muhammad Moiz |
| **Rationale** | To provide users with a detailed yield estimation report that helps in understanding potential harvest outcomes based on factors such as temperature, rainfall and soil nutrient. |
| **Business Rule** | None |
| **Dependencies** | FR-113 |
| **Priority** | High |

#### *3.3.21.7 FR-113: Error.Notification.For.TechnicalIssues*

**Table 166: Error.Notification.For.TechnicalIssues FR**

| | |
|---|---|
| **Identifier** | FR-113 |
| **Title** | Error.Notification.For.TechnicalIssues |
| **Requirement** | The system shall notify the user of any technical difficulties and guide user to retry or contact support. |
| **Source** | Muhammad Moiz |
| **Rationale** | To ensure proper communication and enhance user experience. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.22 UC-2.16: Assess Yield Risk Factors

#### *3.3.22.1 FR-114: Access.Yield.Risk.Assessment*

**Table 167: Access.Yield.Risk.Assessment FR**

| | |
|---|---|
| **Identifier** | FR-114 |
| **Title** | Access.Yield.Risk.Assessment |
| **Requirement** | The system shall allow the user to access yield risk assessment by clicking on “Yield Risk Assessment” option on the dashboard. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow user to initiate assess yield risk process. |
| **Business Rule** | Users must have appropriate permissions to access yield risk assesmment. |
| **Dependencies** | FR-115, FR-116, FR-117 |
| **Priority** | High |

#### *3.3.22.2 FR-115: Data.Collection.From.User*

**Table 168: Data.Collection.From.User FR**

| | |
|---|---|
| **Identifier** | FR-115 |
| **Title** | Data.Collection.From.User |
| **Requirement** | The system shall collect data from user regarding drought, pest infestation and disease outbreaks. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow the user to provide crucial data that initiates the assess yield risk process. |
| **Business Rule** | None |
| **Dependencies** | FR-116 |
| **Priority** | High |

#### *3.3.22.3 FR-116: Risk.Assessment.Report.Generation*

**Table 169: Risk.Assessment.Report.Generation FR**

| | |
|---|---|
| **Identifier** | FR-116 |
| **Title** | Risk.Assessment.Report.Generation |
| **Requirement** | The system shall generate and present a detailed risk assessment report to the user. |
| **Source** | Muhammad Moiz |
| **Rationale** | To provide users with a detailed risk assessment report that helps in understanding risks associated with crop yield. |
| **Business Rule** | None |
| **Dependencies** | FR-117 |
| **Priority** | High |

#### *3.3.22.4 FR-117 Provide.Risk.Mitigation.Strategies*

**Table 170: Provide.Risk.Mitigation.Strategies FR**

| | |
|---|---|
| **Identifier** | FR-117 |
| **Title** | Provide.Risk.Mitigation.Strategies |
| **Requirement** | The system shall provide risk mitigation strategies to deal with the risks associated with crop yield |
| **Source** | Muhammad Moiz |
| **Rationale** | To assist users in taking measures to minimize risks that could negatively impact crop yield, ensuring better productivity and resource management. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.23 UC-2.17: Crop Maturity Assessment

#### *3.3.23.1 FR-118: Access.Crop.Maturity.Assessment*

**Table 171: Access.Crop.Maturity.Assessment FR**

| | |
|---|---|
| **Identifier** | FR-118 |
| **Title** | Access.Crop.Maturity.Assessment |
| **Requirement** | The system shall allow the users to access crop maturity assessment by clicking on “Crop Maturity Assessment” option on the dashboard. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To allow users to initiate assess crop maturity assessment process. |
| **Business Rule** | Users must have appropriate permissions to access crop maturity assessment. |
| **Dependencies** | FR-119, FR-120, FR-121, FR-122 |
| **Priority** | High |

### *3.3.23.2 FR-119: Upload.Images.Of.Crops*

**Table 172: Upload.Images.Of.Crops FR**

| | |
|---|---|
| **Identifier** | FR-119 |
| **Title** | Upload.Images.Of.Crops |
| **Requirement** | The user uploads the images of crops by clicking on the “Upload Images” option. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To enable the user to upload the images of crop. |
| **Business Rule** | None |
| **Dependencies** | FR-120 |
| **Priority** | High |

### *3.3.23.3 FR-120: Determine.Crop.Maturity*

**Table 173: Determine.Crop.Maturity FR**

| | |
|---|---|
| **Identifier** | FR-120 |
| **Title** | Determine.Crop.Maturity |
| **Requirement** | The system shall determine the crop maturity by analyzing the images uploaded by the user |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To enable the system to analyze the images using image recognition technology and determine whether the crops are mature, providing valuable insights for harvesting decisions. |
| **Business Rule** | None |
| **Dependencies** | FR-121 |
| **Priority** | High |

#### *3.3.23.4 FR-121: Crop.Maturity.Report.Generation*

**Table 174: Crop.Maturity.Report.Generation FR**

| | |
|---|---|
| **Identifier** | FR-121 |
| **Title** | Crop.Maturity.Report.Generation |
| **Requirement** | The system shall generate and present the crop maturity report to the user. |
| **Source** | Muaaz Bin Mukhtar, Muhammad Moiz |
| **Rationale** | To provide users with a crop maturity report that helps in understanding maturity of crops. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.24 UC-2.18: Crop Quality Assessment

#### *3.3.24.1 FR-122: Access.Crop.Quality.Assessment*

**Table 175: Access.Crop.Quality.Assessmient FR**

| | |
|---|---|
| **Identifier** | FR-122 |
| **Title** | Access.Crop.Quality.Assessment |
| **Requirement** | The system shall allow the users to access crop quality assessment by clicking on “Crop Quality Assessment” option on the dashboard. |
| **Source** | Muhammad Moiz |
| **Rationale** | To allow users to initiate crop quality assessment process. |
| **Business Rule** | Users must have appropriate permissions to access crop quality assessment. |
| **Dependencies** | FR-123, FR-124, FR-125 |
| **Priority** | High |

#### *3.3.24.2 FR-123: Input.Crop.Quality.Factors*

**Table 176: Input.Crop.Quality.Factors FR**

| | |
|---|---|
| **Identifier** | FR-123 |
| **Title** | Input.Crop.Quality.Factors |
| **Requirement** | The system shall allow user to input crop quality factors such as starch, sugar content, size, color and other relevant characteristics. |
| **Source** | Muhammad Moiz |
| **Rationale** | To enable the system to assess crop quality, providing detailed insights for grading, market pricing, or processing decisions |
| **Business Rule** | None |
| **Dependencies** | FR-124 |
| **Priority** | High |

#### *3.3.24.3 FR-124: Analyze.Quality.Factors*

**Table 177: Analyze.Quality.Factors FR**

| | |
|---|---|
| **Identifier** | FR-124 |
| **Title** | Analyze.Quality.Factors |
| **Requirement** | The system shall analyze the input crop quality factors to generate a detailed crop quality report. |
| **Source** | Muhammad Moiz |
| **Rationale** | To provide users with an accurate and data-driven assessment of crop quality, enabling them to make informed decisions. |
| **Business Rule** | None |
| **Dependencies** | FR-125 |
| **Priority** | High |

#### *3.3.24.4 FR-125: Crop.Quality.Report.Generation*

**Table 178: Crop.Quality.Report.Generation FR**

| | |
|---|---|
| **Identifier** | FR-125 |
| **Title** | Crop.Quality.Report.Generation |
| **Requirement** | The system shall generate and present the crop quality report to the user. |
| **Source** | Muhammad Moiz |
| **Rationale** | To provide users with a crop quality report that helps in understanding quality of crops. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.25 UC-2.19: Optimal Harvesting Schedule

#### *3.3.25.1 FR-126: Access.Harvesting.Schedule*

**Table 179:Access.Harvesting.Schedule FR**

| | |
|---|---|
| **Identifier** | FR-126 |
| **Title** | Access.Harvesting.Schedule |
| **Requirement** | The system shall allow the users to select harvesting schedule by clicking on “Harvesting Schedule” option on the dashboard. |
| **Source** | Ammar Ali, Muhammad Moiz |
| **Rationale** | To allow users to initiate the optimal harvesting schedule process. |
| **Business Rule** | Users must have appropriate permissions to access crop quality assessment. |
| **Dependencies** | FR-127, FR-128, FR-129 |
| **Priority** | High |

### *3.3.25.2 FR-127: Develop.Optimal.Harvesting.Schedule*

**Table 180: Develop.Optimal.Harvesting.Schedule FR**

| | |
|---|---|
| **Identifier** | FR-127 |
| **Title** | Develop.Optimal.Harvesting.Schedule |
| **Requirement** | The system shall develop optimal harvesting schedule by retrieving and analyzing crop maturity reports. |
| **Source** | Ammar Ali, Muhammad Moiz |
| **Rationale** | To ensure the crops are harvested at the right time to maximize yield and quality. |
| **Business Rule** | None |
| **Dependencies** | FR-128 |
| **Priority** | High |

### *3.3.25.3 FR-128: Update.Harvesting.Schedule*

**Table 181: Update.Harvesting.Schedule FR**

| | |
|---|---|
| **Identifier** | FR-128 |
| **Title** | Update.Harvesting.Schedule |
| **Requirement** | The user updates the developed harvesting schedule |
| **Source** | Ammar Ali, Muhammad Moiz |
| **Rationale** | To ensure that the schedule developed is optimal for harvesting |
| **Business Rule** | The system must create an optimal schedule after analyzing all the critical factors outlined in the crop maturity report. |
| **Dependencies** | FR-129 |
| **Priority** | High |

#### *3.3.25.4 FR-129: Track.Schedule*

**Table 182: Track.Schedule FR**

| | |
|---|---|
| **Identifier** | FR-129 |
| **Title** | Track.Schedule |
| **Requirement** | The system shall track the progress of the developed harvesting schedule, providing updates as necessary. |
| **Source** | Ammar Ali, Muhammad Moiz |
| **Rationale** | To ensure the harvesting schedule is being followed, enabling timely interventions and adjustments to optimize the harvesting process. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.26 UC-2.20: Harvesting Tools and Techniques

#### *3.3.26.1 FR-130: Retrieve.crop.details*

**Table 183: Retrieve.crop.details FR**

| | |
|---|---|
| **Identifier** | FR-130 |
| **Title** | Retrieve.crop.details |
| **Requirement** | The system shall fetch the user's crop details when the user clicks the harvesting tools and techniques option. |
| **Source** | Ammar Ali, Muhammad Moiz |
| **Rationale** | To ensure accurate recommendation, the system must fetch related crop data from the database. |
| **Business Rule** | Users must have registered crops in the system for precise recommendations. |
| **Dependencies** | FR-131 |
| **Priority** | High |

### *3.3.26.2 FR-131: Recommend.harvesting.tools*

**Table 184: Recommend.harvesting.tools FR**

| | |
|---|---|
| **Identifier** | FR-131 |
| **Title** | Recommend.harvesting.tools |
| **Requirement** | The system shall recommend relevant harvesting tools based on the crop details been fetched. |
| **Source** | Ammar Ali, Muhammad Moiz |
| **Rationale** | To ensure the accuracy, efficiency and crop quality it helps users to use appropriate tools. |
| **Business Rule** | According to crop growth and type the recommendation should align with it. |
| **Dependencies** | FR-132, FR-133 |
| **Priority** | High |

### *3.3.26.3 FR-132: Recommend.harvesting.techniques*

**Table 185: Recommend.harvesting.techniques FR**

| | |
|---|---|
| **Identifier** | FR-132 |
| **Title** | Recommend.harvesting.techniques |
| **Requirement** | The system shall recommend relevant harvesting techniques based on the crop type and condition. |
| **Source** | Ammar Ali, Muhammad Moiz |
| **Rationale** | To ensure that crop is harvesting efficiently and their quality is maintaining in the process, it must recommend the correct technique. |
| **Business Rule** | Techniques recommended should follow back to best agricultural practices for each crop. |
| **Dependencies** | FR-133 |
| **Priority** | High |

#### *3.3.26.4 FR-133: Notify.On.Technical.Errors*

**Table 186: Notify.On.Technical.Errors FR**

| | |
|---|---|
| **Identifier** | FR-133 |
| **Title** | Notify.On.Technical.Errors |
| **Requirement** | The system shall notify if any technical issue occurs during the process and provide related steps for support or retrying the operation. |
| **Source** | Ammar Ali, Muhammad Moiz |
| **Rationale** | To ensure the effectiveness, the users must be informed about the technical issue so they can resolve them without any problem. |
| **Business Rule** | The system should provide user-friendly pop-up error messages as well as troubleshooting steps. |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.27 UC-2.21: Harvesting tools catalog

#### *3.3.27.1 FR-134: Retrieve.Tools.Catalog*

**Table 187: Retrieve.Tools.Catalog FR**

| | |
|---|---|
| **Identifier** | FR-134 |
| **Title** | Retrieve.Tools.Catalog |
| **Requirement** | The system shall retrieve the catalog of harvesting tools according to user's recommendations when user clicks the "Harvesting Tools" catalog option. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the user has access to tools related to their crops so they can make purchase or rent them. |
| **Business Rule** | Only tools related to the recommended techniques should be displayed |
| **Dependencies** | FR-135 |
| **Priority** | High |

### *3.3.27.2 FR-135: Display.Tools.Information*

**Table 188: Display.Tools.Information FR**

| | |
|---|---|
| **Identifier** | FR-135 |
| **Title** | Display.Tools.Information |
| **Requirement** | The system shall display detailed description about every tool in the catalog including price, availability for rent and user reviews. |
| **Source** | Ammar Ali |
| **Rationale** | It helps users make decision about purchasing and renting the tools by providing detailed information. |
| **Business Rule** | Tools should be filtered according to user's recommendation details. |
| **Dependencies** | FR-136 |
| **Priority** | High |

### *3.3.27.3 FR-136: Select.A.Particular.Tool*

**Table 189: Select.A.Particular.Tool FR**

| | |
|---|---|
| **Identifier** | FR-136 |
| **Title** | Select.A.Particular.Tool |
| **Requirement** | The user selects a particular crop from the displayed list of tools and proceeds to view, purchase or review |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the user selects a particular tool according to his personal requirement. |
| **Business Rule** | None |
| **Dependencies** | FR-137 |
| **Priority** | High |

#### *3.3.27.4 FR-137: Update.Database*

**Table 190: Update.Database FR**

| | |
|---|---|
| **Identifier** | FR-137 |
| **Title** | Update.Database |
| **Requirement** | The system shall update the database once the user has taken an action against a particular tool. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the all the information regarding harvesting tools is up-to-date in the database. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.28 UC-2.22: Transport Recommendation

#### *3.3.28.1 FR-138: Access.Transport.Recommendation*

**Table 191: Access.Transport.Recommendation FR**

| | |
|---|---|
| **Identifier** | FR-138 |
| **Title** | Access.Transport.Recommendation |
| **Requirement** | The system shall allow user to access transport recommendation when the user clicks the “Transport Recommendation” option from the dashboard |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the system recommend suitable transportation when user access transport recommendation. |
| **Business Rule** | None |
| **Dependencies** | FR-139, FR-140 |
| **Priority** | High |

### *3.3.28.2 FR-139: Display.Suitable.Transport*

**Table 192: Display.Suitable.Transport FR**

| | |
|---|---|
| **Identifier** | FR-139 |
| **Title** | Display.Suitable.Transport |
| **Requirement** | The system shall retrieve crop details from databasae and show suitable transport types related to crop type and weight. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the user can select tha best vehicle to easily transport crops. |
| **Business Rule** | The transport type must match the crop quantity and weight to easily transport them. |
| **Dependencies** | FR-140, FR-141 |
| **Priority** | High |

### *3.3.28.3 FR-140: Select.Tranportation*

**Table 193: Select.Tranportation FR**

| | |
|---|---|
| **Identifier** | FR-140 |
| **Title** | Select.Tranportation |
| **Requirement** | The system shall allow the user to select specific transport type when user click the specified option. |
| **Source** | Ammar Ali |
| **Rationale** | To provide farmers flexibility in selecting the most appropriate transportation type. |
| **Business Rule** | None |
| **Dependencies** | FR-141 |
| **Priority** | High |

#### *3.3.28.4 FR-141: Notify.On.Technical.Errors*

**Table 194: Notify.On.Technical.Errors FR**

| | |
|---|---|
| **Identifier** | FR-141 |
| **Title** | Notify.On.Technical.Errors |
| **Requirement** | The system shall notify the user if any technical issue occurs while performing any task about retrieving crop details or transport recommendations and guide them to contact support team or retry. |
| **Source** | Ammar Ali |
| **Rationale** | To provide smooth user experience, the system must provide support services. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.29 UC-2.23: Transportation

#### *3.3.29.1 FR-142: Book.Ride*

**Table 195: Book.Ride FR**

| | |
|---|---|
| **Identifier** | FR-142 |
| **Title** | Book.Ride |
| **Requirement** | The system shall allow the user to book ride from the dashboard to transport their crops by selecting the “Book Ride” option. |
| **Source** | Ammar Ali |
| **Rationale** | To provide users a convenient way to arrange ride for their crop transportation. |
| **Business Rule** | None |
| **Dependencies** | FR-143, FR-144 |
| **Priority** | High |

### *3.3.29.2 FR-143: Enter.PickUp.DropOff.Location*

**Table 196: Enter.PickUp.DropOff.Location FR**

| | |
|---|---|
| **Identifier** | FR-143 |
| **Title** | Enter.PickUp.DropOff.Location |
| **Requirement** | The system shall allow the user to select the pickup and dropoff location for their transportation. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the system knows all details about the delivery to easily transport crops. |
| **Business Rule** | User must provide valid location data to process the booking. |
| **Dependencies** | FR-144 |
| **Priority** | High |

### *3.3.29.3 FR-144: Notify.On.Technical.Error*

**Table 197: Notify.On.Technical.Error FR**

| | |
|---|---|
| **Identifier** | FR-144 |
| **Title** | Notify.On.Technical.Error |
| **Requirement** | The system shall notify the user if any technical issue occurs while performing any task. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that user is clear and aware of system issues and can take preventive steps to resolve them. |
| **Business Rule** | Clear and actionable error message must be shown to user if any error occurs. |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.30 UC-2.24: Packaging Assist

#### *3.3.30.1 FR-145: Access.Packaging.Assist*

**Table 198: Access.Packaging.Assist FR**

| | |
|---|---|
| **Identifier** | FR-145 |
| **Title** | Access.Packaging.Assist |
| **Requirement** | The system shall allow users to access packaging assist when the user clicks “packaging assist” button on the dashboard. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the system recommend suitable packaging guide when user access packaging assist. |
| **Business Rule** | None |
| **Dependencies** | FR-146, FR-147, FR-148 |
| **Priority** | High |

#### *3.3.30.2 FR-146: Input.Particular.Crop.Details*

**Table 199: Input.Particular.Crop.Details FR**

| | |
|---|---|
| **Identifier** | FR-146 |
| **Title** | Input.Particular.Crop.Details |
| **Requirement** | The user inputs the specified crop details |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the system recommends good packaging material when the user inputs the specified crop details. |
| **Business Rule** | None |
| **Dependencies** | FR-147, FR-149 |
| **Priority** | High |

### *3.3.30.3 FR-147: Recommend.Packaging.Material*

**Table 200: Recommend.Packaging.Material FR**

| | |
|---|---|
| **Identifier** | FR-147 |
| **Title** | Recommend.Packaging.Material |
| **Requirement** | The system shall recommend suitable packaging materials related to crop details when the user access packaging assist. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the system recommend suitable packaging material when user clicks recommend packaging material. |
| **Business Rule** | None |
| **Dependencies** | FR-148, FR-149 |
| **Priority** | High |

### *3.3.30.4 FR-148: Display.Material.Details*

**Table 201: Display.Material.Details FR**

| | |
|---|---|
| **Identifier** | FR-148 |
| **Title** | Display.Material.Details |
| **Requirement** | The system shall display the appropriate details of recommended material like how it is good for the specified crop. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the system displays details of a material when user select the specified crop. |
| **Business Rule** | Displayed packaging material must be recommended according to the user-inputted crop details. |
| **Dependencies** | FR-149 |
| **Priority** | High |

#### *3.3.30.5 FR-149: Notify.On.Technical.Errors*

**Table 202: Notify.On.Technical.Errors FR**

| | |
|---|---|
| **Identifier** | FR-149 |
| **Title** | Notify.On.Technical.Errors |
| **Requirement** | The system shall notify if any technical issue occurs during the process and provide related steps for support or retrying the operation. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure the effectiveness, the users must be informed about the technical issue so they can resolve them without any problem. |
| **Business Rule** | The system should provide user-friendly pop-up error messages as well as troubleshooting steps. |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.31 UC-2.25: Climate-Controlled Storage Reservation

#### *3.3.31.1 FR-150: Retrieve.Crop.Details*

**Table 203: Retrieve.Crop.Details FR**

| | |
|---|---|
| **Identifier** | FR-150 |
| **Title** | Retrieve.Crop.Details |
| **Requirement** | The system shall fetch the user's harvesting and crop details when the user clicks the climate-controlled storage reservation button. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure accurate, the system must fetch related crop data from the database. |
| **Business Rule** | Users must have registered crops in the system for precise recommendations. |
| **Dependencies** | FR-151, FR-152, FR-153, FR-154 |
| **Priority** | High |

### *3.3.31.2 FR-151: Recommend.Suitable.Temperature.And.Storage.Conditions*

**Table 204: Recommend.Suitable.Temperature.And.Storage.Conditions FR**

| | |
|---|---|
| **Identifier** | FR-151 |
| **Title** | Recommend.Suitable.Temperature.And.Storage.Conditions |
| **Requirement** | The system shall provide suitable temperature and storage conditions related to crop type and size. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure quality of crops by providing the optimal storage environment. |
| **Business Rule** | Recommendations must align with the crop's related storage requirements. |
| **Dependencies** | FR-152, FR-155 |
| **Priority** | High |

### *3.3.31.3 FR-152: Display.Storage.Provider*

**Table 205: Display.Storage.Provider FR**

| | |
|---|---|
| **Identifier** | FR-152 |
| **Title** | Display.Storage.Provider |
| **Requirement** | The system shall provide suitable list of storage providers offering climate-controlled storage, allowing the user to review them. |
| **Source** | Ammar Ali |
| **Rationale** | To find user's suitable storage facilities |
| **Business Rule** | Only climate-controlled storage providers will be shown. |
| **Dependencies** | FR-153, FR-155 |
| **Priority** | High |

### *3.3.31.4 FR-153: Reserve.Storage.Facility*

**Table 206: Reserve.Storage.Facility FR**

| | |
|---|---|
| **Identifier** | FR-153 |
| **Title** | Reserve.Storage.Facility |
| **Requirement** | The system shall allow user to reserve a selected climate-controlled facility. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure the preservation of crops, it allows users to reserve storage space. |
| **Business Rule** | None |
| **Dependencies** | FR-154, FR-155 |
| **Priority** | High |

### *3.3.31.5 FR-154: Update.Database.After.Reservation*

**Table 207: Update.Database.After.Reservation FR**

| | |
|---|---|
| **Identifier** | FR-154 |
| **Title** | Update.Database.After.Reservation |
| **Requirement** | The system shall update the database after reservation of storage facility. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure consistency and efficiency, all information is up-to-date within the system. |
| **Business Rule** | None |
| **Dependencies** | FR-155 |
| **Priority** | High |

#### *3.3.31.6 FR-155: Notify.On.Technical.Errors*

**Table 208: Notify.On.Technical.Errors FR**

| | |
|---|---|
| **Identifier** | FR-155 |
| **Title** | Notify.On.Technical.Errors |
| **Requirement** | The system shall notify if any technical issue occurs during the process and provide related steps for support or retrying the operation. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure the effectiveness, the users must be informed about the technical issue so they can resolve them without any problem. |
| **Business Rule** | The system should provide user-friendly pop-up error messages as well as troubleshooting steps. |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.32 UC-2.26: Crop Quality Grading

#### *3.3.32.1 FR-156: Retrieve.Crop.Details*

**Table 209: Retrieve.Crop.Details FR**

| | |
|---|---|
| **Identifier** | FR-156 |
| **Title** | Retrieve.Crop.Details |
| **Requirement** | The system shall fetch the user's harvesting and crop details when the user clicks the crop quality grading button. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure accurate results, the system must fetch related crop data from the database. |
| **Business Rule** | Users must have registered crops in the system for precise recommendations. |
| **Dependencies** | FR-157 |
| **Priority** | High |

#### *3.3.32.2 FR-157: Provide.Grading.Tips.Based.On.Standards*

**Table 210: Provide.Grading.Tips.Based.On.Standards FR**

| | |
|---|---|
| **Identifier** | FR-157 |
| **Title** | Provide.Grading.Tips.Based.On.Standards |
| **Requirement** | The system shall recommend good quality grading tips to ensure the quality and characteristics of crops. |
| **Source** | Ammar Ali |
| **Rationale** | To help users in classifying and grading their crops to ensure their quality standards. |
| **Business Rule** | Grading standard should align with the industry practices. |
| **Dependencies** | FR-158, FR-159 |
| **Priority** | High |

#### *3.3.32.3 FR-158: Generate.Quality.Index.Report*

**Table 211: Generate.Quality.Index.Report FR**

| | |
|---|---|
| **Identifier** | FR-158 |
| **Title** | Generate.Quality.Index.Report |
| **Requirement** | The system shall provide a quality index report to show crop quality and quantity. |
| **Source** | Ammar Ali |
| **Rationale** | To provide an accurate and efficient way to grade crop quality that can be used to assess user. |
| **Business Rule** | The quality index must align with industry practices |
| **Dependencies** | FR-159 |
| **Priority** | High |

#### *3.3.32.4 FR-159: Notify.On.Technical.Errors*

**Table 212: Notify.On.Technical.Errors FR**

| | |
|---|---|
| **Identifier** | FR-159 |
| **Title** | Notify.On.Technical.Errors |
| **Requirement** | The system shall notify if any technical issue occurs during the process and provide related steps for support or retrying the operation. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure the effectiveness, the users must be informed about the technical issue so they can resolve them without any problem. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.33 UC-2.27: Switch Profile

#### *3.3.33.1 FR-160: Access.Switch.Profile*

**Table 213: Access.Switch.Profile FR**

| | |
|---|---|
| **Identifier** | FR-160 |
| **Title** | Access.Switch.Profile |
| **Requirement** | The user shall access switch profile by clicking on “Switch Profile” option on the dashboard |
| **Source** | Ammar Ali |
| **Rationale** | To enable the user to switch profile. |
| **Business Rule** | Users must have appropriate permissions to access switch profile. |
| **Dependencies** | FR-161, FR-162, FR-163 |
| **Priority** | High |

#### *3.3.33.2 FR-161: Displays.Available.Profiles*

**Table 214: Displays.Available.Profiles FR**

| | |
|---|---|
| **Identifier** | FR-161 |
| **Title** | Displays.Available.Profiles |
| **Requirement** | The system shall display the available profiles when user access switch profile. |
| **Source** | Ammar Ali |
| **Rationale** | To enable user to select a specific profile from the available profiles. |
| **Business Rule** | None |
| **Dependencies** | FR-162 |
| **Priority** | High |

#### *3.3.33.3 FR-162: Selects.A.Profile*

**Table 215: Selects.A.Profile FR**

| | |
|---|---|
| **Identifier** | FR-162 |
| **Title** | Selects.A.Profile |
| **Requirement** | The user selects a desired profile from the available profiles. |
| **Source** | Ammar Ali |
| **Rationale** | To enable the user switch to desired profile. |
| **Business Rule** | None |
| **Dependencies** | FR-163 |
| **Priority** | High |

#### *3.3.33.4 FR-163: Switch.To.Selected.Profile*

**Table 216: Switch.To.Selected.Profile FR**

| | |
|---|---|
| **Identifier** | FR-163 |
| **Title** | Switch.To.Selected.Profile |
| **Requirement** | The system shall switch to the profile selected by the admin and provide access to the corresponding dashboard. |
| **Source** | Ammar Ali |
| **Rationale** | To allow the user to switch between profiles (seller, customer) and manage actions. |
| **Business Rule** | Requested profile must be registered to gain access. |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.34 UC-2.28 Manage Profile

#### *3.3.34.1 FR-164: Manipulate.Profile.Information*

**Table 217: Manipulate.Profile.Information FR**

| | |
|---|---|
| **Identifier** | FR-164 |
| **Title** | Manipulate.Profile.Information |
| **Requirement** | The system shall display the user's stored profile information and allow them to select and update individual fields. |
| **Source** | Ammar Ali |
| **Rationale** | To give users control over updating their personal information stored in the system. |
| **Business Rule** | All information fields must be editable, and changes must follow the correct data format. |
| **Dependencies** | FR-165 |
| **Priority** | Low |

#### *3.3.34.2 FR-165: Validate.Profile.Information.Format*

**Table 218: Validate.Profile.Information.Format FR**

| | |
|---|---|
| **Identifier** | FR-165 |
| **Title** | Validate.Profile.Information.Format |
| **Requirement** | The system shall validate the updated profile information to ensure that the data follows the correct format (e.g., email format, phone number length). |
| **Source** | Ammar Ali |
| **Rationale** | To prevent incorrect or invalid data from being saved to the user's profile. |
| **Business Rule** | All updates must comply with data validation rules (e.g., valid email addresses, phone numbers). |
| **Dependencies** | FR-166 |
| **Priority** | Low |

#### *3.3.34.3 FR-166: Apply.Changes*

**Table 219: Apply.Changes FR**

| | |
|---|---|
| **Identifier** | FR-166 |
| **Title** | Apply.Changes |
| **Requirement** | The system shall apply the changes after the user clicks the "Apply" button and the system successfully validates the changes. |
| **Source** | Ammar Ali |
| **Rationale** | To update the user's profile with the latest information provided. |
| **Business Rule** | The system must ensure that updated information is saved correctly across system |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.35 UC-2.29 Sign Out

#### *3.3.35.1 FR-167: Initiates.SignOut.Process*

**Table 220: Initiates.SignOut.Process FR**

| | |
|---|---|
| **Identifier** | FR-167 |
| **Title** | Initiates.SignOut.Process |
| **Requirement** | The user shall be able to initiate the sign-out process by clicking on the "Sign Out" button in the profile management section. |
| **Source** | Ammar Ali |
| **Rationale** | To allow users to safely end their session and log out of the system. |
| **Business Rule** | None |
| **Dependencies** | FR-168 |
| **Priority** | High |

#### *3.3.35.2 FR-168: Terminate.User.Session*

**Table 221: Terminate.User.Session FR**

| | |
|---|---|
| **Identifier** | FR-168 |
| **Title** | Terminate.User.Session |
| **Requirement** | The system shall terminate the user's session and redirect them to the Sign In page after the user successfully signs out. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure the user is securely logged out and no longer has access to restricted areas. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

## Customer Functional Requirements

### 3.3.36 UC-3.1 Sign Up

#### *3.3.36.1 FR-169: Initiate.Registration*

**Table 222: Initiate.Registration FR**

| | |
|---|---|
| **Identifier** | FR-169 |
| **Title** | Initiate.Registration |
| **Requirement** | The user shall be able to initiate registration by clicking on Sign up button |
| **Source** | Ammar Ali |
| **Rationale** | Provide user an option to register in to the system. |
| **Business Rule** | None |
| **Dependencies** | FR-170, FR-171, FR-172, FR-173 |
| **Priority** | High |

#### *3.3.36.2 FR-170: Enter.Credentials*

**Table 223: Enter.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-170 |
| **Title** | Enter.Credentials |
| **Requirement** | The user shall be able to enter credentials. |
| **Source** | Ammar Ali |
| **Rationale** | Allow users to enter credentials to register as a customer. |
| **Business Rule** | None |
| **Dependencies** | FR-171 |
| **Priority** | High |

### *3.3.36.3 FR-171: Validate.Credentials*

**Table 224: Validate.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-171 |
| **Title** | Validate.Credentials |
| **Requirement** | The system shall validate the correctness and accuracy of user-entered email, password and username before proceeding with registration |
| **Source** | Ammar Ali |
| **Rationale** | The system ensure that the user entered credentials are correct and accurate and could be used as a valid email and password. |
| **Business Rule** | None |
| **Dependencies** | FR-172 |
| **Priority** | High |

### *3.3.36.4 FR-172: Confirm.Registration*

**Table 225: Confirm.Registration FR**

| | |
|---|---|
| **Identifier** | FR-172 |
| **Title** | Confirm.Registration |
| **Requirement** | The system shall confirm the successful registration of user's account and display a message that the user account is created. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the user's account is successfully created and allow them to sign in to his account. |
| **Business Rule** | The user must be directed to the login page after successful sign up. |
| **Dependencies** | FR-173, FR-174 |
| **Priority** | High |

#### *3.3.36.5 FR-173: Handle.Invalid.Input*

**Table 226: Handle.Invalid.Input FR**

| | |
|---|---|
| **Identifier** | FR-173 |
| **Title** | Handle.Invalid.Input |
| **Requirement** | The system shall display a message that information is invalid if the user enters invalid input. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the user enters valid data so that sign up is successful. |
| **Business Rule** | The system must validate each field and notifies user if there is any error or missing field. |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.37 UC-3.2 Sign In

#### *3.3.37.1 FR-174: Initiate.SignIn.Process*

**Table 227: Initiate.SignIn.Process FR**

| | |
|---|---|
| **Identifier** | FR-174 |
| **Title** | Initiate.SignIn.Process |
| **Requirement** | The user shall be able to initiate the sign in process by clicking on “Sign In” button. |
| **Source** | Ammar Ali |
| **Rationale** | Provide users an option to access their accounts and services. |
| **Business Rule** | None |
| **Dependencies** | FR-175 |
| **Priority** | High |

### *3.3.37.2 FR-175: Enter.Credentials*

**Table 228: Enter.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-175 |
| **Title** | Enter.Credentials |
| **Requirement** | The system shall prompt the user to enter their registered credentials to authenticate their identity. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the user enters registered credentials to successfully log in to the system |
| **Business Rule** | Email and password must match the one stored in database. |
| **Dependencies** | FR-176 |
| **Priority** | High |

### *3.3.37.3 FR-176: Verify.Credentials*

**Table 229: Verify.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-176 |
| **Title** | Verify.Credentials |
| **Requirement** | The system shall verify credentials against database to authenticate the user. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the user enter credentials to successfully to log in to the system |
| **Business Rule** | None |
| **Dependencies** | FR-177 |
| **Priority** | High |

#### *3.3.37.4 FR-177: Handle.Invalid.Credentials*

**Table 230: Handle.Invalid.Credentials FR**

| | |
|---|---|
| **Identifier** | FR-177 |
| **Title** | Handle.Invalid.Credentials |
| **Requirement** | The system shall display the message “Invalid Credentials” if the user enters invalid credentials. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the user does not enter invalid credentials. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.38 UC-3.3 Access Products

#### *3.3.38.1 FR-178: Access.Catalog*

**Table 231: Access.Catalog FR**

| | |
|---|---|
| **Identifier** | FR-178 |
| **Title** | Access.Catalog |
| **Requirement** | The user shall access catalog by clicking on “Access Catalog” option on the dashboard |
| **Source** | Ammar Ali |
| **Rationale** | To enable the user view, buy or review products from the catalog. |
| **Business Rule** | User must be logged in. |
| **Dependencies** | FR-179, FR-180, FR-181, FR-182, FR-183, FR-184, FR-185 |
| **Priority** | High |

### *3.3.38.2 FR-179: Display.Products.List*

**Table 232: Display.Products.List FR**

| | |
|---|---|
| **Identifier** | FR-179 |
| **Title** | Display.Products.List |
| **Requirement** | The system shall display the list of products when the user clicks on "Access Catalog" option on the dashboard |
| **Source** | Ammar Ali |
| **Rationale** | To enable the user buy or review a product from the displayed list. |
| **Business Rule** | None |
| **Dependencies** | FR-180 |
| **Priority** | High |

### *3.3.38.3 FR-180 Search.Product*

**Table 233: Search.Product FR**

| | |
|---|---|
| **Identifier** | FR-180 |
| **Title** | Search.Product |
| **Requirement** | The system shall provide an option to the user to search a product |
| **Source** | Ammar Ali |
| **Rationale** | To enable users to efficiently find specific products from a large catalog, improving user experience and engagement |
| **Business Rule** | None |
| **Dependencies** | FR-181 |
| **Priority** | High |

### *3.3.38.4 FR-181: Select.A.Particular.Product*

**Table 234: Select.A.Particular.Product FR**

| | |
|---|---|
| **Identifier** | FR-181 |
| **Title** | Select.A.Particular.Product |
| **Requirement** | The user shall be able to select a particular product from the list. |
| **Source** | Ammar Ali |
| **Rationale** | To enable users buy or review a particular product from the catalog. |
| **Business Rule** | None |
| **Dependencies** | FR-182 |
| **Priority** | High |

### *3.3.38.5 FR-182: Display.Product.Details*

**Table 235: Display.Product.Details FR**

| | |
|---|---|
| **Identifier** | FR-182 |
| **Title** | Display.Product.Details |
| **Requirement** | The system shall display detailed description about the product in the catalog including price, user reviews, available stock. |
| **Source** | Ammar Ali |
| **Rationale** | It helps users make decision about purchasing the products. |
| **Business Rule** | None |
| **Dependencies** | FR-183 |
| **Priority** | High |

### *3.3.38.6 FR-183: Review.Products*

**Table 236: Review.Products FR**

| | |
|---|---|
| **Identifier** | FR-183 |
| **Title** | Review.Products |
| **Requirement** | The system shall display an option for user to review the products. |
| **Source** | Ammar Ali |
| **Rationale** | To enable users to provide feedback on products, enhancing product visibility and assisting other users. |
| **Business Rule** | None |
| **Dependencies** | FR-184 |
| **Priority** | High |

### *3.3.38.7 FR-184: Buy.Products*

**Table 237: Buy.Products FR**

| | |
|---|---|
| **Identifier** | FR-184 |
| **Title** | Buy.Products |
| **Requirement** | The system shall display an option for user to buy the products. |
| **Source** | Ammar Ali |
| **Rationale** | To provide users with the ability to purchase products directly through the system with add to cart option, enhancing the shopping experience and increasing conversions. |
| **Business Rule** | None |
| **Dependencies** | FR-185 |
| **Priority** | High |

#### *3.3.38.8 FR-185: Update.Database*

**Table 238: Update.Database FR**

| | |
|---|---|
| **Identifier** | FR-185 |
| **Title** | Update.Database |
| **Requirement** | The system shall update the database after user makes a purchase from the catalog. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure consistency and efficiency, all information is up-to-date within the system. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.39 UC-3.4 Bidding

#### *3.3.39.1 FR-186: Access.Bidding.Section*

**Table 239: Access.Bidding.Section FR**

| | |
|---|---|
| **Identifier** | FR-186 |
| **Title** | Access.Bidding.Section |
| **Requirement** | The user shall access bidding section by clicking on “Bidding” option on the dashboard |
| **Source** | Ammar Ali |
| **Rationale** | To enable the user to make a bid to purchase a product according to his own range. |
| **Business Rule** | None |
| **Dependencies** | FR-187, FR-188, FR-189, FR-190, FR-191, FR-192, FR-193, FR-194 |
| **Priority** | High |

### *3.3.39.2 FR-187: Display.Products.List*

**Table 240: Display.Products.List FR**

| | |
|---|---|
| **Identifier** | FR-187 |
| **Title** | Display.Products.List |
| **Requirement** | The system shall display the list of products when the user clicks on "Bidding" option on the dashboard |
| **Source** | Ammar Ali |
| **Rationale** | To enable the system to display a list of products for user to choose from. |
| **Business Rule** | None |
| **Dependencies** | FR-188 |
| **Priority** | High |

### *3.3.39.3 FR-188: Search.Product*

**Table 241: Search.Product FR**

| | |
|---|---|
| **Identifier** | FR-188 |
| **Title** | Search.Product |
| **Requirement** | The system shall provide an option to the user to search a product |
| **Source** | Ammar Ali |
| **Rationale** | To enable users to efficiently find specific products from a large catalog, improving user experience and engagement |
| **Business Rule** | None |
| **Dependencies** | FR-189 |
| **Priority** | High |

### *3.3.39.4 FR-189: Select.A.Particular.Product*

**Table 242: Select.A.Particular.Product FR**

| | |
|---|---|
| **Identifier** | FR-189 |
| **Title** | Select.A.Particular.Product |
| **Requirement** | The user shall be able to select a particular product from the list. |
| **Source** | Ammar Ali |
| **Rationale** | To enable users to make a bid for a particular product from the catalog. |
| **Business Rule** | None |
| **Dependencies** | FR-190 |
| **Priority** | High |

### *3.3.39.5 FR-190: Display.Bidding.Details*

**Table 243: Display.Bidding.Details FR**

| | |
|---|---|
| **Identifier** | FR-190 |
| **Title** | Display.Bidding.Details |
| **Requirement** | The system shall display Bidding details once the user selects a particular product from the list. |
| **Source** | Ammar Ali |
| **Rationale** | To allow the users view if there are bids made for a particular product. |
| **Business Rule** | None |
| **Dependencies** | FR-191 |
| **Priority** | High |

### *3.3.39.6 FR-191: Bid.Price*

**Table 244: Bid.Price FR**

| | |
|---|---|
| **Identifier** | FR-191 |
| **Title** | Bid.Price |
| **Requirement** | The user selects “Bid Price” option to make a bid for a product. |
| **Source** | Ammar Ali |
| **Rationale** | To allow the users make a bid to purchase a product. |
| **Business Rule** | None |
| **Dependencies** | FR-192 |
| **Priority** | High |

### *3.3.39.7 FR-192: Bid.Acceptance*

**Table 245: Bid.Acceptance FR**

| | |
|---|---|
| **Identifier** | FR-192 |
| **Title** | Bid.Acceptance |
| **Requirement** | The system shall notify the user if the bid is accepted by the farmer. |
| **Source** | Ammar Ali |
| **Rationale** | To notify the user whether the bid is accepted or not by the farmer |
| **Business Rule** | None |
| **Dependencies** | FR-193 |
| **Priority** | High |

### *3.3.39.8 FR-193: Payment*

**Table 246: Payment FR**

| | |
|---|---|
| **Identifier** | FR-193 |
| **Title** | Payment |
| **Requirement** | The system shall display the payment window if the user's bid is accepted by the farmer |
| **Source** | Ammar Ali |
| **Rationale** | To allow the users make a payment to purchase the product. |
| **Business Rule** | None |
| **Dependencies** | FR-194 |
| **Priority** | High |

### *3.3.39.9 FR-194: Update.Database*

**Table 247: Update.Database FR**

| | |
|---|---|
| **Identifier** | FR-194 |
| **Title** | Update.Database |
| **Requirement** | The system shall update the database after user's bid is accepted and purchase is made from the catalog. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure consistency and efficiency, all information is up-to-date within the system. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.40 UC-3.5 Switch Profile

#### *3.3.40.1 FR-195: Access.Switch.Profile*

**Table 248: Access.Switch.Profile FR**

| | |
|---|---|
| **Identifier** | FR-195 |
| **Title** | Access.Switch.Profile |
| **Requirement** | The user shall access switch profile by clicking on “Switch Profile” option on the customer dashboard. |
| **Source** | Ammar Ali |
| **Rationale** | To enable the user to switch profile if registered. |
| **Business Rule** | User must be logged in. |
| **Dependencies** | FR-196 |
| **Priority** | High |

#### *3.3.40.2 FR-196: Displays.Available.Profiles*

**Table 249: Displays.Available.Profiles FR**

| | |
|---|---|
| **Identifier** | FR-196 |
| **Title** | Displays.Available.Profiles |
| **Requirement** | The system shall display the available profiles when user access switch profile. |
| **Source** | Ammar Ali |
| **Rationale** | To enable user to select a specific profile from the available profiles where the user is registered. |
| **Business Rule** | None |
| **Dependencies** | FR-197 |
| **Priority** | High |

### *3.3.40.3 FR-197: Selects.A.Profile*

**Table 250: Selects.A.Profile FR**

| | |
|---|---|
| **Identifier** | FR-197 |
| **Title** | Selects.A.Profile |
| **Requirement** | The user selects a desired profile from the available profiles. |
| **Source** | Ammar Ali |
| **Rationale** | To enable the user switch to desired profile (farmer or seller). |
| **Business Rule** | None |
| **Dependencies** | FR-198 |
| **Priority** | High |

### *3.3.40.4 FR-198: Switch.To.Selected.Profile*

**Table 251: Switch.To.Selected.Profile FR**

| | |
|---|---|
| **Identifier** | FR-198 |
| **Title** | Switch.To.Selected.Profile |
| **Requirement** | The system shall switch to the profile selected by the admin and provide access to the corresponding dashboard. |
| **Source** | Ammar Ali |
| **Rationale** | To allow the user to switch between profiles (farmer, seller) and manage actions. |
| **Business Rule** | Requested profile must be registered to gain access. |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.41 UC-3.6 Manage Profile

#### *3.3.41.1 FR-199: Manipulate.Profile.Information*

**Table 252: Manipulate.Profile.Information FR**

| | |
|---|---|
| **Identifier** | FR-199 |
| **Title** | Manipulate.Profile.Information |
| **Requirement** | The system shall display the user's stored profile information and allow them to select and update individual fields. |
| **Source** | Ammar Ali |
| **Rationale** | To give users control over updating their personal information stored in the system. |
| **Business Rule** | All information fields must be editable, and changes must follow the correct data format. |
| **Dependencies** | FR-200 |
| **Priority** | Low |

#### *3.3.41.2 FR-200: Validate.Profile.Information.Format*

**Table 253: Validate.Profile.Information.Format FR**

| | |
|---|---|
| **Identifier** | FR-200 |
| **Title** | Validate.Profile.Information.Format |
| **Requirement** | The system shall validate the updated profile information to ensure that the data follows the correct format (e.g., email format, phone number length). |
| **Source** | Ammar Ali |
| **Rationale** | To prevent incorrect or invalid data from being saved to the user's profile. |
| **Business Rule** | All updates must comply with data validation rules (e.g., valid email addresses, phone numbers). |
| **Dependencies** | FR-201 |
| **Priority** | Low |

#### *3.3.41.3 FR-201: Apply.Changes*

**Table 254: Apply.Changes FR**

| | |
|---|---|
| **Identifier** | FR-201 |
| **Title** | Apply.Changes |
| **Requirement** | The system shall apply the changes after the user clicks the "Apply" button and the system successfully validates the changes. |
| **Source** | Ammar Ali |
| **Rationale** | To update the user's profile with the latest information provided. |
| **Business Rule** | The system must ensure that updated information is saved correctly across system |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.42 UC-3.7 Sign Out

#### *3.3.42.1 FR-202: Initiates.SignOut.Process*

**Table 255: Initiates.SignOut.Process FR**

| | |
|---|---|
| **Identifier** | FR-202 |
| **Title** | Initiates.SignOut.Process |
| **Requirement** | The user shall be able to initiate the sign-out process by clicking on the "Sign Out" button in the profile management section. |
| **Source** | Ammar Ali |
| **Rationale** | To allow users to safely end their session and log out of the system. |
| **Business Rule** | None |
| **Dependencies** | FR-203 |
| **Priority** | High |

#### *3.3.42.2 FR-203: Terminate.User.Session*

**Table 256: Terminate.User.Session FR**

| | |
|---|---|
| **Identifier** | FR-203 |
| **Title** | Terminate.User.Session |
| **Requirement** | The system shall terminate the user's session and redirect them to the Sign In page after the user successfully signs out. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure the user is securely logged out and no longer has access to restricted areas. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

## Seller Functional Requirements

### 3.3.43 UC-4.1 Set Profile

#### *3.3.43.1 FR-204: Switch.Profile*

**Table 257: Switch.Profile FR**

| | |
|---|---|
| **Identifier** | FR-204 |
| **Title** | Switch.Profile |
| **Requirement** | The system shall allow the users to switch their profile to a seller account |
| **Source** | Ammar Ali |
| **Rationale** | To allow users to initiate the seller registration process |
| **Business Rule** | Users must not have registered as a seller. |
| **Dependencies** | FR-205 |
| **Priority** | High |

### *3.3.43.2 FR-205: Input.Product.Details*

**Table 258: Input.Product.Details FR**

| | |
|---|---|
| **Identifier** | FR-205 |
| **Title** | Input.Product.Details |
| **Requirement** | The system shall provide form to users to input product details they intend to sell. |
| **Source** | Ammar Ali |
| **Rationale** | To collect necessary information about the product to set up the seller profile |
| **Business Rule** | None |
| **Dependencies** | FR-206 |
| **Priority** | High |

### *3.3.43.3 FR-206: Input.Bank.Details*

**Table 259: Input.Bank.Details FR**

| | |
|---|---|
| **Identifier** | FR-206 |
| **Title** | Input.Bank.Details |
| **Requirement** | The system shall allow the user to input their bank details for receiving payments. |
| **Source** | Ammar Ali |
| **Rationale** | To facilitate future transactions and payments to the user. |
| **Business Rule** | None |
| **Dependencies** | FR-207 |
| **Priority** | High |

### *3.3.43.4 FR-207 Register.Seller*

**Table 260: Register.Seller FR**

| | |
|---|---|
| **Identifier** | FR-207 |
| **Title** | Register.Seller |
| **Requirement** | The system shall allow the users to register as a seller when they click on the “Register” button after entering all the details. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the user’s seller account is successfully created and allow them to sign in to his account. |
| **Business Rule** | None |
| **Dependencies** | FR-208 |
| **Priority** | High |

### *3.3.43.5 FR-208: Validate.Registration.Data*

**Table 261: Validate.Registration.Data FR**

| | |
|---|---|
| **Identifier** | FR-208 |
| **Title** | Validate.Registration.Data |
| **Requirement** | The system shall validate all user-inputted details including product and bank details to complete registration. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the user enters valid data so that registration is successful. |
| **Business Rule** | The system must validate each data field and notifies user if there is any error or missing field. |
| **Dependencies** | FR-209 |
| **Priority** | High |

#### *3.3.43.6 FR-209: Grant.Seller.Dashboard.Access*

**Table 262: Grant.Seller.Dashboard.Access FR**

| | |
|---|---|
| **Identifier** | FR-209 |
| **Title** | Grant.Seller.Dashboard.Access |
| **Requirement** | The system shall grant the access of seller dashboard to the user upon the successful validation |
| **Source** | Ammar Ali |
| **Rationale** | To enable users to manage their products and services. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.44 UC-4.2 Upload Product/Service

#### *3.3.44.1 FR-210: Select.Upload.Product.In.Marketplace*

**Table 263: Select.Upload.Product.In.Marketplace FR**

| | |
|---|---|
| **Identifier** | FR-210 |
| **Title** | Select.Upload.Product.In.Marketplace |
| **Requirement** | The system shall allow the user to click “Upload Product” option in the marketplace. |
| **Source** | Ammar Ali |
| **Rationale** | To initiate the process of uploading products in the marketplace. |
| **Business Rule** | None |
| **Dependencies** | FR-211 |
| **Priority** | High |

### *3.3.44.2 FR-211: Enter.Product.Type.And.Details*

**Table 264: Enter.Product.Type.And.Details FR**

| | |
|---|---|
| **Identifier** | FR-211 |
| **Title** | Enter.Product.Type.And.Details |
| **Requirement** | The system shall allow the user to enter product type and details on clicking “Upload Product” option. |
| **Source** | Ammar Ali |
| **Rationale** | To collect product information and images from the seller for product listing. |
| **Business Rule** | None |
| **Dependencies** | FR-212 |
| **Priority** | High |

### *3.3.44.3 FR-212: Upload.Quality.Index.Document*

**Table 265: Upload.Quality.Index.Document FR**

| | |
|---|---|
| **Identifier** | FR-212 |
| **Title** | Upload.Quality.Index.Document |
| **Requirement** | The system shall allow the user to upload the quality index document as part of the biding process. |
| **Source** | Ammar Ali |
| **Rationale** | To include additional information about product quality to increase buyer’s interest in the product |
| **Business Rule** | None |
| **Dependencies** | FR-213 |
| **Priority** | Medium |

#### *3.3.44.4 FR-213: Upload.Product*

**Table 266: Upload.Product FR**

| | |
|---|---|
| **Identifier** | FR-213 |
| **Title** | Upload.Product |
| **Requirement** | The system shall provide an "Upload" button for the user to submit product details. |
| **Source** | Ammar Ali |
| **Rationale** | To finalize the product submission process and list the product in the marketplace. |
| **Business Rule** | None |
| **Dependencies** | FR-214 |
| **Priority** | High |

#### *3.3.44.5 FR-214: Validate.Product.Data*

**Table 267: Validate.Product.Data FR**

| | |
|---|---|
| **Identifier** | FR-214 |
| **Title** | Validate.Product.Data |
| **Requirement** | The system shall validate all user-inputted details including product type, details and images to ensure correctness and accuracy. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure that the user enters valid data so that crop listing is successful. |
| **Business Rule** | The system must validate each data field and notifies user if there is any error or missing field. |
| **Dependencies** | FR-215, FR-216 |
| **Priority** | High |

### *3.3.44.6 FR-215: Upload.Product.To.Marketplace*

**Table 268: Upload.Product.To.Marketplace FR**

| | |
|---|---|
| **Identifier** | FR-215 |
| **Title** | Upload.Product.To.Marketplace |
| **Requirement** | The system shall allow the user to upload product to marketplace listing upon the successful validation |
| **Source** | Ammar Ali |
| **Rationale** | To make the product visible to potential buyers in the marketplace |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | Medium |

### *3.3.44.7 FR-216: Notify.Incorrect.Data*

**Table 269: Notify.Incorrect.Data FR**

| | |
|---|---|
| **Identifier** | FR-216 |
| **Title** | Notify.Incorrect.Data |
| **Requirement** | The system shall notify the user if the product data is incorrect or incomplete. |
| **Source** | Ammar Ali |
| **Rationale** | To inform the user of errors so that they can fix and re-submit the product |
| **Business Rule** | None |
| **Dependencies** | FR-217 |
| **Priority** | Medium |

#### *3.3.44.8 FR-217: Re-enter.Product.Data*

**Table 270: Re-enter.Product.Data FR**

| | |
|---|---|
| **Identifier** | FR-217 |
| **Title** | Re-enter.Product.Data |
| **Requirement** | The system shall allow the user to re-enter the product data if an error notification is displayed. |
| **Source** | Ammar Ali |
| **Rationale** | To allow the user a chance to fix data and reupload product |
| **Business Rule** | The system must allow the user to correct and re-submit product data after an error notification. |
| **Dependencies** | FR-218 |
| **Priority** | Medium |

#### *3.3.44.9 FR-218: Retry.Upload*

**Table 271: Retry.Upload FR**

| | |
|---|---|
| **Identifier** | FR-218 |
| **Title** | Retry.Upload |
| **Requirement** | The system shall allow the user to retry the upload process after fixing the data. |
| **Source** | Ammar Ali |
| **Rationale** | To allow the user to continue the process after an error without starting over. |
| **Business Rule** | Only registered sellers can access the biding section. |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.45 UC-4.3 Bidding

#### *3.3.45.1 FR-219: Access.Bidding.Section*

**Table 272: Access.Bidding.Section FR**

| | |
|---|---|
| **Identifier** | FR-219 |
| **Title** | Access.Bidding.Section |
| **Requirement** | The user shall access bidding section by clicking on “Bidding” option on the dashboard |
| **Source** | Ammar Ali |
| **Rationale** | To enable the user to make a product available for bid according to his own range. |
| **Business Rule** | Only registered sellers can access the biding section. |
| **Dependencies** | FR-220, FR-221, FR-222, FR-223, FR-224, FR-225, FR-226 |
| **Priority** | High |

#### *3.3.45.2 FR-220: Uploading.product*

**Table 273: Uploading.product FR**

| | |
|---|---|
| **Identifier** | FR-220 |
| **Title** | Uploading.product |
| **Requirement** | The system shall allow user to add a product for bidding by uploading product details, type, time limit and pictures. |
| **Source** | Ammar Ali |
| **Rationale** | To enable the user to make a list of their products for bids coming from buyers. |
| **Business Rule** | None |
| **Dependencies** | FR-221, FR-222 |
| **Priority** | High |

### *3.3.45.3 FR-221: Upload.Quality.Index.Document*

**Table 274: Upload.Quality.Index.Document FR**

| | |
|---|---|
| **Identifier** | FR-221 |
| **Title** | Upload.Quality.Index.Document |
| **Requirement** | The system shall allow the user to upload the quality index document as part of the biding process. |
| **Source** | Ammar Ali |
| **Rationale** | To provide buyer with the great knowledge about the product and its quality. |
| **Business Rule** | None |
| **Dependencies** | FR-222 |
| **Priority** | High |

### *3.3.45.4 FR-222: Verify.Product.Data*

**Table 275: Verify.Product.Data FR**

| | |
|---|---|
| **Identifier** | FR-222 |
| **Title** | Verify.Product.Data |
| **Requirement** | The system shall verify the correctness and completeness of the product details, product pictures and quality index. |
| **Source** | Ammar Ali |
| **Rationale** | To make the product information accurate and ensure it before making the product available for bidding. |
| **Business Rule** | None |
| **Dependencies** | FR-223 |
| **Priority** | High |

### *3.3.45.5 FR-223: Upload.Product.For.Bidding*

**Table 276: Upload.Product.For.Bidding FR**

| | |
|---|---|
| **Identifier** | FR-223 |
| **Title** | Upload.Product.For.Bidding |
| **Requirement** | The system shall upload the product for bidding once the verification completes. |
| **Source** | Ammar Ali |
| **Rationale** | To make the product available for potential buyers. |
| **Business Rule** | None |
| **Dependencies** | FR-224 |
| **Priority** | High |

### *3.3.45.6 FR-224: Notify.Seller*

**Table 277: Notify.Seller FR**

| | |
|---|---|
| **Identifier** | FR-224 |
| **Title** | Notify.Seller |
| **Requirement** | The system shall notify the seller once a new bid is made by the user for the product. |
| **Source** | Ammar Ali |
| **Rationale** | To keep the seller updated about bidding activity and help them to track bids. |
| **Business Rule** | None |
| **Dependencies** | FR-225 |
| **Priority** | High |

### *3.3.45.7 FR-225: Best.Bid.Selection*

**Table 278: Best.Bid.Selection FR**

| | |
|---|---|
| **Identifier** | FR-225 |
| **Title** | Best.Bid.Selection |
| **Requirement** | The system shall allow the user to select the best bid from the list of bids to initiate selling of the products |
| **Source** | Ammar Ali |
| **Rationale** | To ensure the user selects the best bid from the list. |
| **Business Rule** | The system must enable the user to compare and select the best bid based on predefined criteria such as price, quantity, and buyer reliability. |
| **Dependencies** | FR-226 |
| **Priority** | High |

### *3.3.45.8 FR-226 Update.Database*

**Table 279: Update.Database FR**

| | |
|---|---|
| **Identifier** | FR-226 |
| **Title** | Update.Database |
| **Requirement** | The system shall update the database after user accepts the bid and purchase is made from the catalog. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure consistency and efficiency, all information is up-to-date within the system. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.46 UC-4.4 Reports and Analytics

#### *3.3.46.1 FR-227 Access.Reports.And.Analytics*

**Table 280: Access.Reports.And.Analytics FR**

| | |
|---|---|
| **Identifier** | FR-227 |
| **Title** | Access.Reports.And.Analytics |
| **Requirement** | The system shall allow user to access reports and analytics when the user clicks on “reports and analytics” option on the dashboard. |
| **Source** | Ammar Ali |
| **Rationale** | To allow the user to generate reports according to his requirements. |
| **Business Rule** | Only registered sellers can access reports and analytics section |
| **Dependencies** | FR-228, FR-229, FR-230 |
| **Priority** | High |

#### *3.3.46.2 FR-228: Display.Available.Reports*

**Table 281: Display.Available.Reports FR**

| | |
|---|---|
| **Identifier** | FR-228 |
| **Title** | Display.Available.Reports |
| **Requirement** | The system shall display list of available reports when user clicks on “reports and analytics” option. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure the accuracy, system will provide the list of available reports. |
| **Business Rule** | None |
| **Dependencies** | FR-229 |
| **Priority** | High |

### *3.3.46.3 FR-229: Select.And.Filter.Report*

**Table 282: Select.And.Filter.Report FR**

| | |
|---|---|
| **Identifier** | FR-229 |
| **Title** | Select.And.Filter.Report |
| **Requirement** | The system shall allow user to select and filter the specific report to click and shows the detailed information about it. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure the accuracy of information the system must allow the user to select and filter the specific reports |
| **Business Rule** | None |
| **Dependencies** | FR-230 |
| **Priority** | High |

### *3.3.46.4 FR-230: Report.Generation*

**Table 283: Report.Generation FR**

| | |
|---|---|
| **Identifier** | FR-230 |
| **Title** | Report.Generation |
| **Requirement** | The system shall generate the report according to the specific needs and inputs of the user. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure the quality and accuracy of information the system must provide the reports according to specific needs of user. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.47 UC-4.5 Feature products

#### *3.3.47.1 FR-231: Access.Promotion*

**Table 284: Access.Promotion FR**

| | |
|---|---|
| **Identifier** | FR-231 |
| **Title** | Access.Promotion |
| **Requirement** | The system shall allow user to access promotion when the user clicks on "promotion" option on the dashboard. |
| **Source** | Ammar Ali |
| **Rationale** | To allow the user to market its products on the seller marketplace. |
| **Business Rule** | Only registered sellers can access promotion section. |
| **Dependencies** | FR-232 , FR-233, FR-234, FR-235, FR-236 |
| **Priority** | High |

#### *3.3.47.2 FR-232: Display.Promotion.Rates*

**Table 285: Display.Promotion.Rates FR**

| | |
|---|---|
| **Identifier** | FR-232 |
| **Title** | Display.Promotion.Rates |
| **Requirement** | The system shall display list promotion rates according to specific features. |
| **Source** | Ammar Ali |
| **Rationale** | To allow the user to market its product the system must allow the user to buy promotion to make its ads about the product with specific feature included in promotion. |
| **Business Rule** | None |
| **Dependencies** | FR-233 |
| **Priority** | High |

### *3.3.47.3 FR-233 Select.Suitable.Promotion*

**Table 286: Select.Suitable.Promotion FR**

| | |
|---|---|
| **Identifier** | FR-233 |
| **Title** | Select.Suitable.Promotion |
| **Requirement** | The system shall allow user to select specific promotion according to his need with specific features. |
| **Source** | Ammar Ali |
| **Rationale** | To allow the user to select the specific promotion according to his need. |
| **Business Rule** | None |
| **Dependencies** | FR-234 |
| **Priority** | High |

### *3.3.47.4 FR-234: Selecting.The.Product*

**Table 287: Selecting.The.Product FR**

| | |
|---|---|
| **Identifier** | FR-234 |
| **Title** | Selecting.The.Product |
| **Requirement** | The system shall allow user to select the product to be used as gig to market it. |
| **Source** | Ammar Ali |
| **Rationale** | To help the user to market his product the system must allow the user to select his product. |
| **Business Rule** | None |
| **Dependencies** | FR-235 |
| **Priority** | High |

### *3.3.47.5 FR-235: Payment.Method*

**Table 288: Payment.Method FR**

| | |
|---|---|
| **Identifier** | FR-235 |
| **Title** | Payment.Method |
| **Requirement** | The system shall display the payment window if the user selects the specified gig. |
| **Source** | Ammar Ali |
| **Rationale** | To allow the users make a payment to purchase the required promotion to market his gig. |
| **Business Rule** | None |
| **Dependencies** | FR-236 |
| **Priority** | High |

### *3.3.47.6 FR-236: Update.Database*

**Table 289: Update.Database FR**

| | |
|---|---|
| **Identifier** | FR-236 |
| **Title** | Update.Database |
| **Requirement** | The system shall update the database after the user make payment about the promotion of the gig |
| **Source** | Ammar Ali |
| **Rationale** | To ensure consistency and efficiency, all information is up-to-date within the system. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

### 3.3.48 UC-4.6 Manage Profile

#### *3.3.48.1 FR-237: Manipulate.Profile.Information*

**Table 290: Manipulate.Profile.Information FR**

| | |
|---|---|
| **Identifier** | FR-237 |
| **Title** | Manipulate.Profile.Information |
| **Requirement** | The system shall display the user's stored profile information and allow them to select and update individual fields. |
| **Source** | Ammar Ali |
| **Rationale** | To give users control over updating their personal information stored in the system. |
| **Business Rule** | All information fields must be editable, and changes must follow the correct data format. |
| **Dependencies** | FR-238 |
| **Priority** | Low |

#### *3.3.48.2 FR-238: Validate.Profile.Information.Format*

**Table 291: Validate.Profile.Information.Format FR**

| | |
|---|---|
| **Identifier** | FR-238 |
| **Title** | Validate.Profile.Information.Format |
| **Requirement** | The system shall validate the updated profile information to ensure that the data follows the correct format (e.g., email format, phone number length). |
| **Source** | Ammar Ali |
| **Rationale** | To prevent incorrect or invalid data from being saved to the user's profile. |
| **Business Rule** | All updates must comply with data validation rules (e.g., valid email addresses, phone numbers). |
| **Dependencies** | FR-239 |
| **Priority** | Low |

#### *3.3.48.3 FR-239: Apply.Changes*

**Table 292: Apply.Changes FR**

| | |
|---|---|
| **Identifier** | FR-239 |
| **Title** | Apply.Changes |
| **Requirement** | The system shall apply the changes after the user clicks the "Apply" button and the system successfully validates the changes. |
| **Source** | Ammar Ali |
| **Rationale** | To update the user's profile with the latest information provided. |
| **Business Rule** | The system must ensure that updated information is saved correctly across system |
| **Dependencies** | None |
| **Priority** | Medium |

### 3.3.49 UC-4.7 Sign Out

#### *3.3.49.1 FR-240: Initiates.SignOut.Process*

**Table 293: Initiates.SignOut.Process FR**

| | |
|---|---|
| **Identifier** | FR-240 |
| **Title** | Initiates.SignOut.Process |
| **Requirement** | The user shall be able to initiate the sign-out process by clicking on the "Sign Out" button in the profile management section. |
| **Source** | Ammar Ali |
| **Rationale** | To allow users to safely end their session and log out of the system. |
| **Business Rule** | None |
| **Dependencies** | FR-241 |
| **Priority** | High |

#### *3.3.49.2 FR-241: Terminate.User.Session*

**Table 294: Terminate.User.Session FR**

| | |
|---|---|
| **Identifier** | FR-241 |
| **Title** | Terminate.User.Session |
| **Requirement** | The system shall terminate the user's session and redirect them to the Sign In page after the user successfully signs out. |
| **Source** | Ammar Ali |
| **Rationale** | To ensure the user is securely logged out and no longer has access to restricted areas. |
| **Business Rule** | None |
| **Dependencies** | None |
| **Priority** | High |

## 3.4 Non-Functional Requirements

### 3.4.1 Reliability

**REL-1:** The system must remain functional with at least 85% uptime 24/7.
**REL-2:** The system must be fault tolerant 95% of the times.
**REL-3:** In case of failure, it will require a hot refresh to resolve most issues.
**REL-4:** In case when the whole system becomes dysfunctional, an average downtime of 10-15 hours would be required to get it running again depending on the intensity of default.

### 3.4.2 Usability

**USE-1:** AgroTech will allow users get response from each module in less than 1 minute.
**USE-2:** System will follow simple workflow allowing users to access any major feature within 3 clicks.
**USE-3:** System will be easy to use and provide tooltips for all advanced features, ensuring that every type of user can easily navigate through platform within 1 hour of use.
**USE-4:** System Interface will be responsive and compatible with common web browsers (Chrome, Firefox etc.).

### 3.4.3 Performance

**PER-1:** 95% of analysis and reports will be generated and displayed within 5 seconds when processed over a 10 Mbps or faster internet connection.
**PER-2:** System should be able to handle 1000 concurrent users with no degradation in response time, maintaining an average processing speed of 2 seconds per request.

**PER-3:** 90% of chatbot queries shall be responded to within 5 seconds, with a maximum response time of 10 seconds during peak hours.

**PER-4:** System should ensure that recent pictures of yield are uploaded every month.

#### 3.4.4 Security

**SEC-1:** User passwords must be stored using industry standard hashing algorithms.

**SEC-2:** All communication between client and server must be encrypted by HTTPS.

**SEC-3:** System will implement protection against common web vulnerabilities (injection, cross-site scripting etc.).

## 3.5 External Interface Requirements

#### 3.5.1 User Interfaces Requirements

**UI-1:** System shall use responsive design framework to ensure compatibility across different desktop devices.

**UI-2:** Color scheme should be minimal for a cleaner and professional look.

**UI-3:** Buttons should have effects like hover to provide visual feedback to users.

**UI-4:** Error messages should be displayed in red so they are clearly visible.

**UI-5:** System should use commonly used icons (save, del etc.) for ease of use.

#### 3.5.2 Software interfaces

**SI-1:** System will integrate Stripe API for handling payments.

**SI-2:** System will integrate Firebase API for social sign-ins.

**SI-3:** System will integrate API for transportation module.

**SI-4:** System will integrate Open API GPT-3.5 for AgroTech Chatbot.

**SI-5:** System will use third party services for transportation module.

#### 3.5.3 Hardware interfaces

AgroTech is a web-based application and requires no direct hardware interfaces.

#### 3.5.4 Communications interfaces

**CI-1:** System will use SMTP to send emails to users for account verification, password resets, and important updates.

**CI-2:** System will use HTTPS for all client-server communications to ensure data security.

**CI-3:** System must provide clear messages when API rate limits are exceeded, including guidance on when the limit will reset.

# 4 Design and Architecture

## 4.1 Architectural Design

### 4.1.1 Box and Line Diagram

This diagram illustrates the interconnected modules of AgroTech, focusing on user profiling, crop recommendation, and supporting services like soil and climate analysis, health monitoring, AI chatbot, and marketplace functionalities, aimed at enhancing agricultural productivity and decision-making.

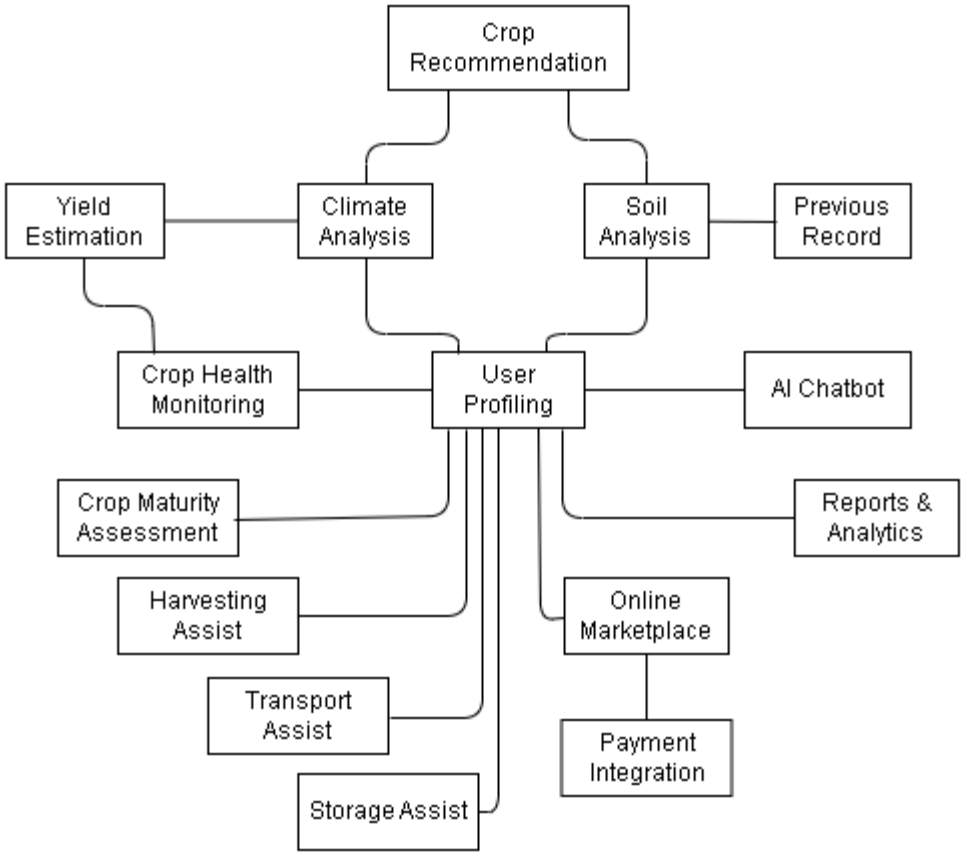


**Figure 6 Box and Line Diagram**

### 4.1.2 Architecture Diagram

This diagram shows AgroTech's architecture, where the **Controller** processes user requests, updates the **Model**, and retrieves data. The **View** displays this data to users. The system uses **MongoDB** for storage, with APIs managed through **Node** and **Fast API Servers**.

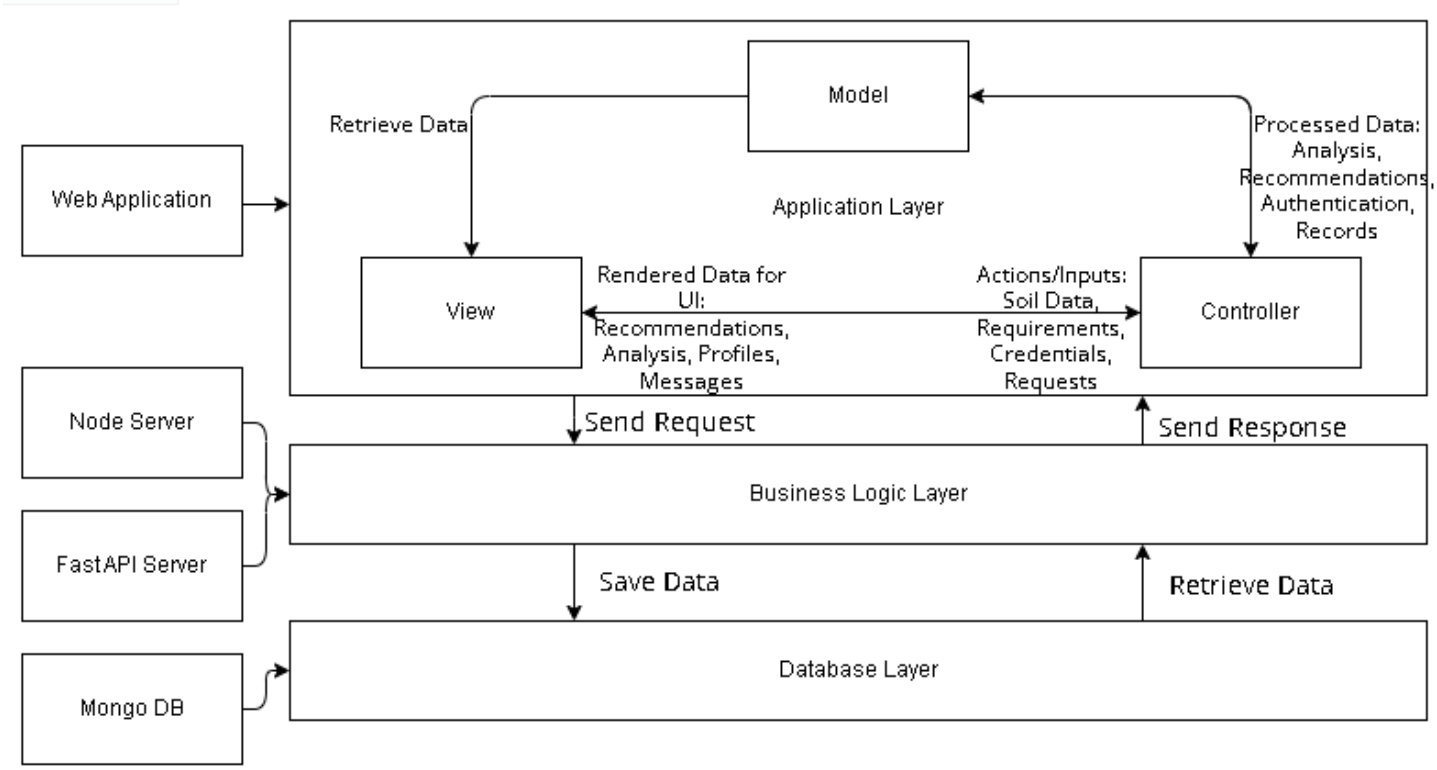


**Figure 7 Architecture Diagram**

## 4.2 Design Models

### 4.2.1 Activity Diagrams

## General Functionalities for all users

#### *4.2.1.1 Sign up*

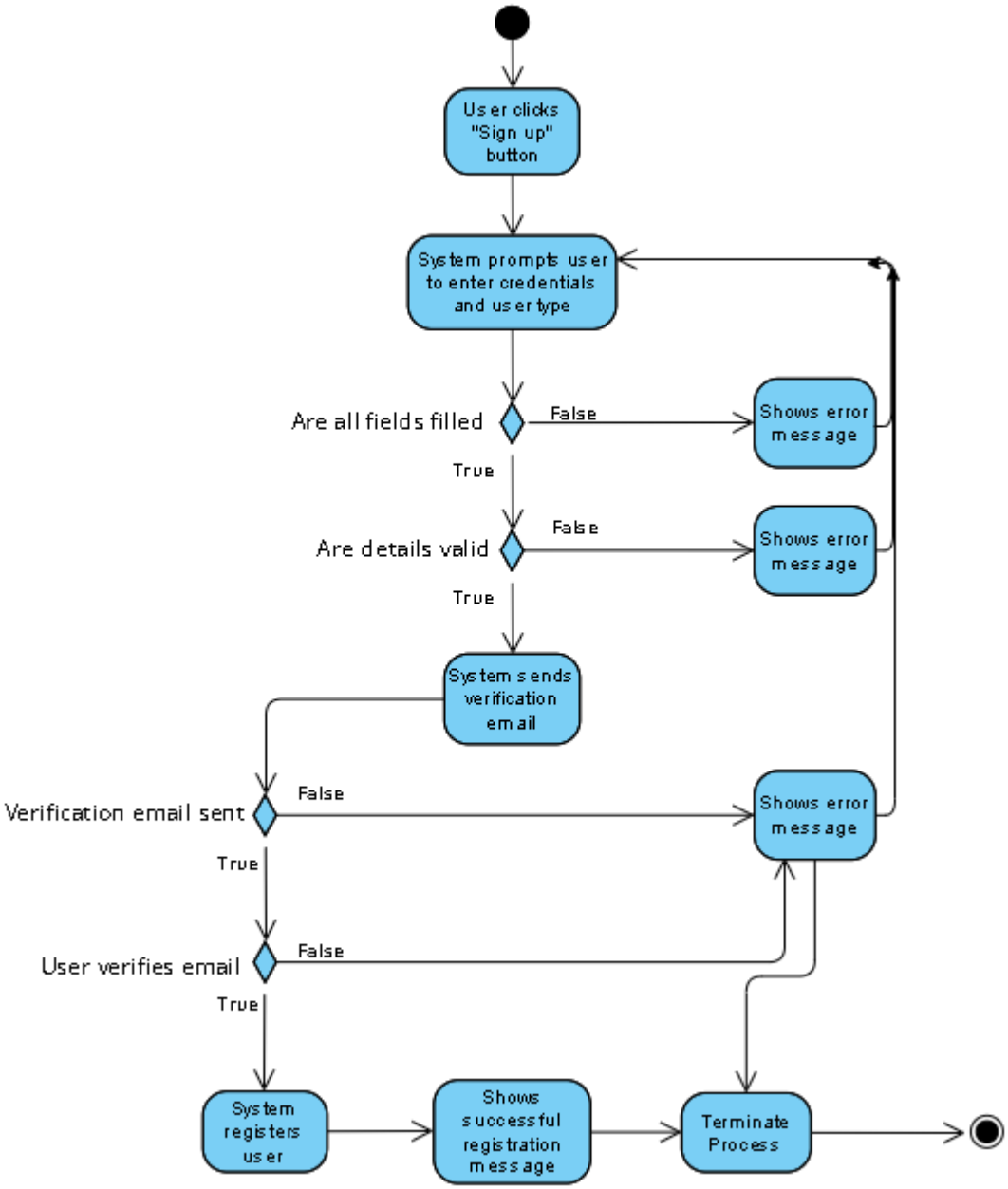


**Figure 8 Sign up Activity Diagram**

#### *4.2.1.2 Sign in*

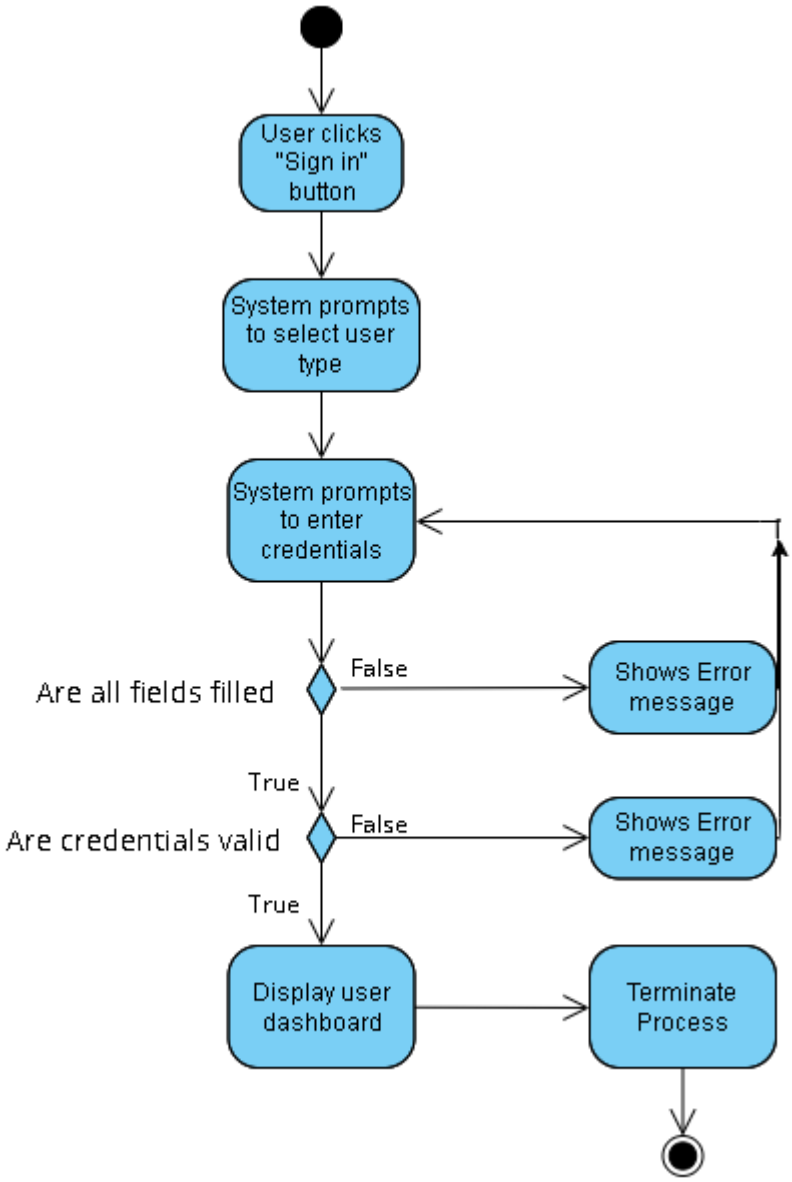


**Figure 9 Sign in Activity Diagram**

### *4.2.1.3 Manage Profile*

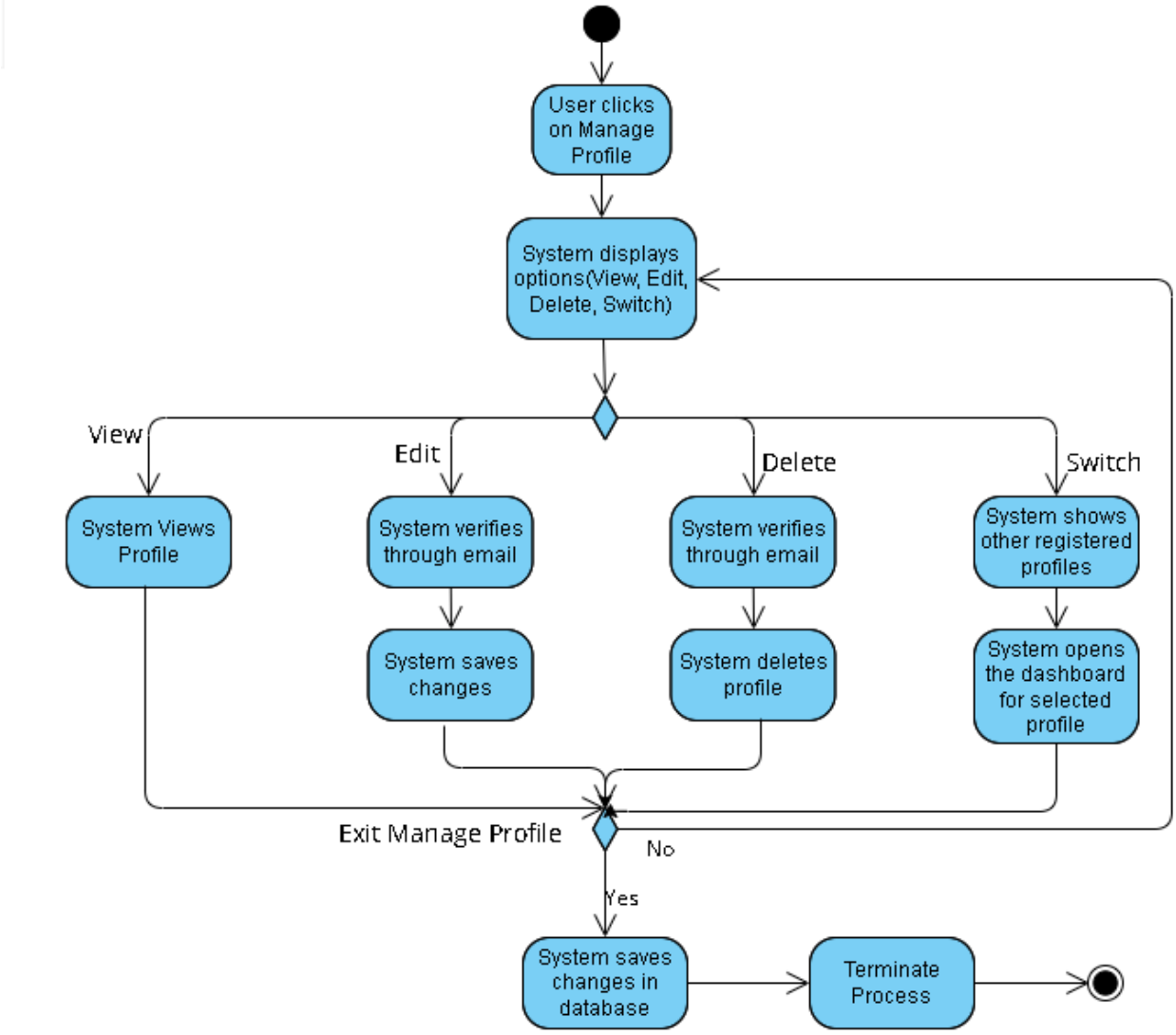


**Figure 10 Manage Profile Activity Diagram**

## Admin Functionalities

### *4.2.1.4 Manage Registered Users*

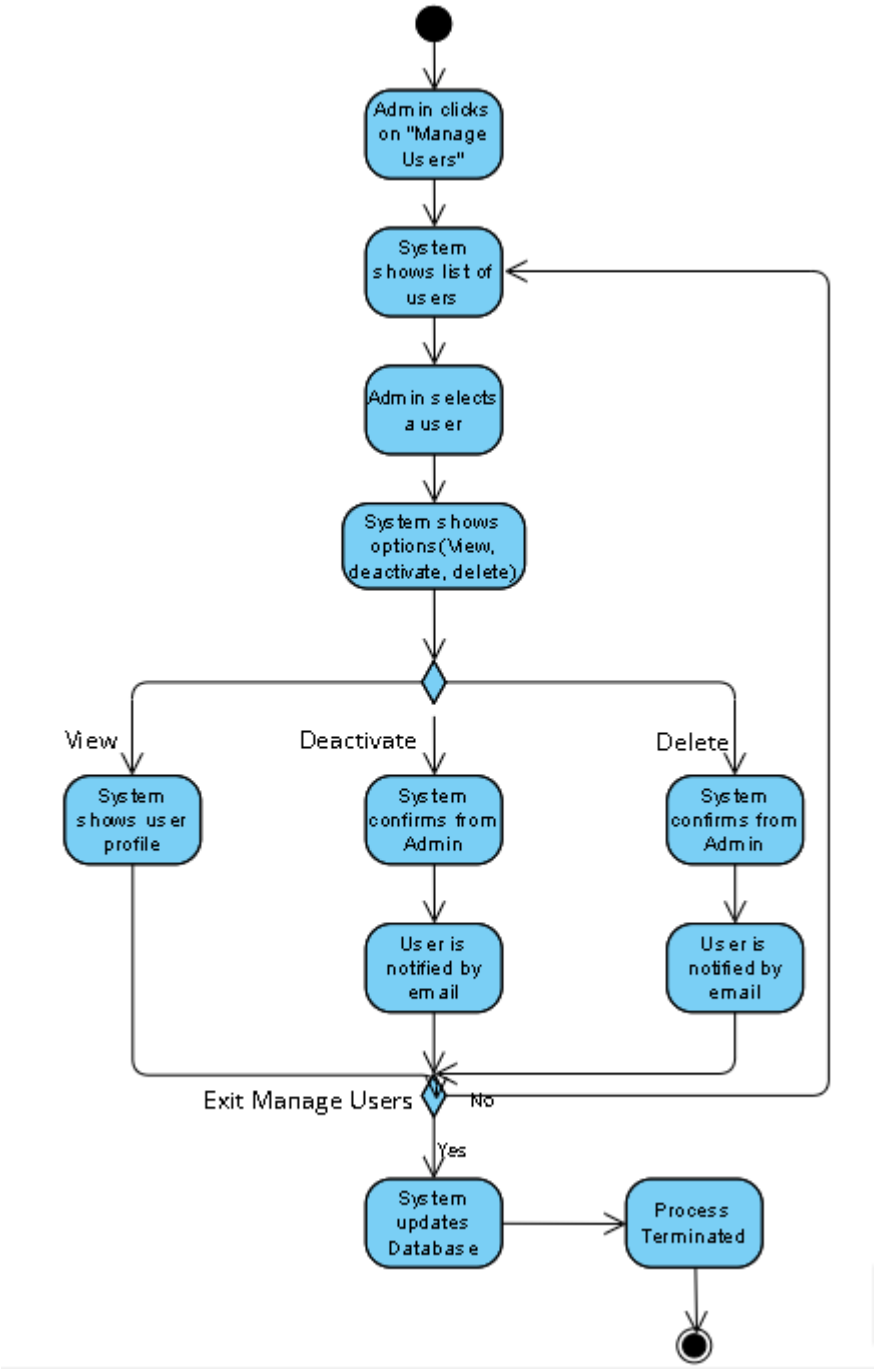


**Figure 11 Manage Registered Users Activity Diagram**

### *4.2.1.5 Manage Complaints*

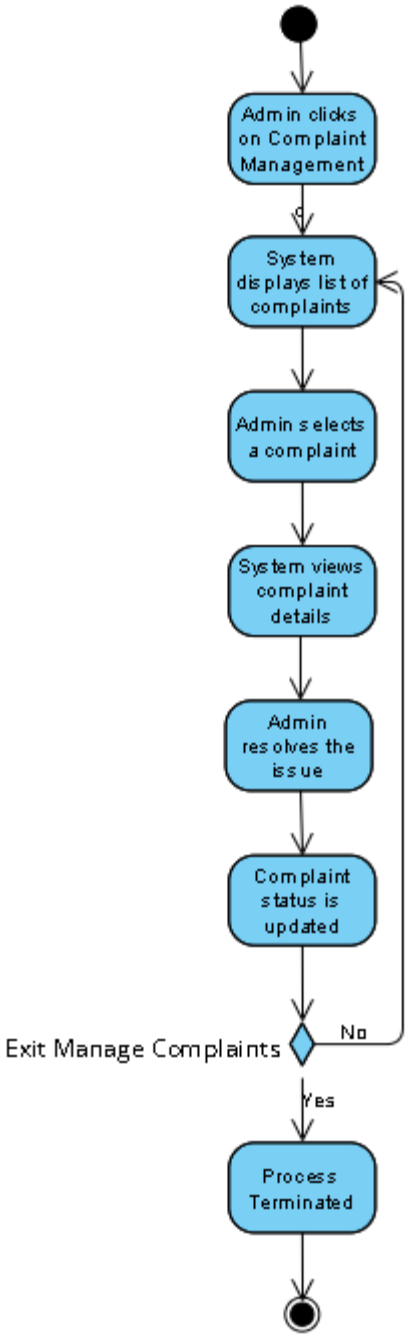


**Figure 12 Manage Complaints Activity Diagram**

#### *4.2.1.6 Manage Reports*

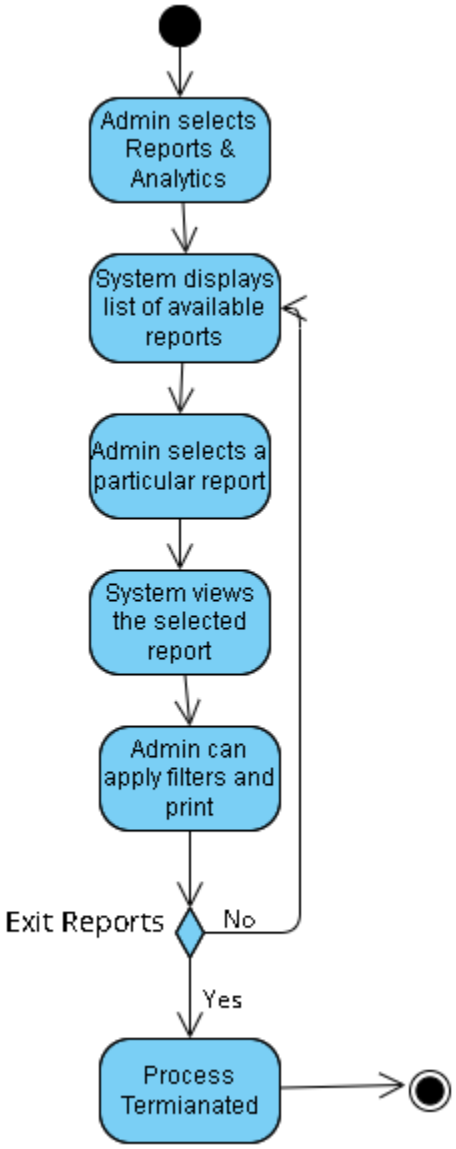


**Figure 13 Manage Reports Activity Diagram**

# Farmer Functionalities

### *4.2.1.7 Analyze Soil*

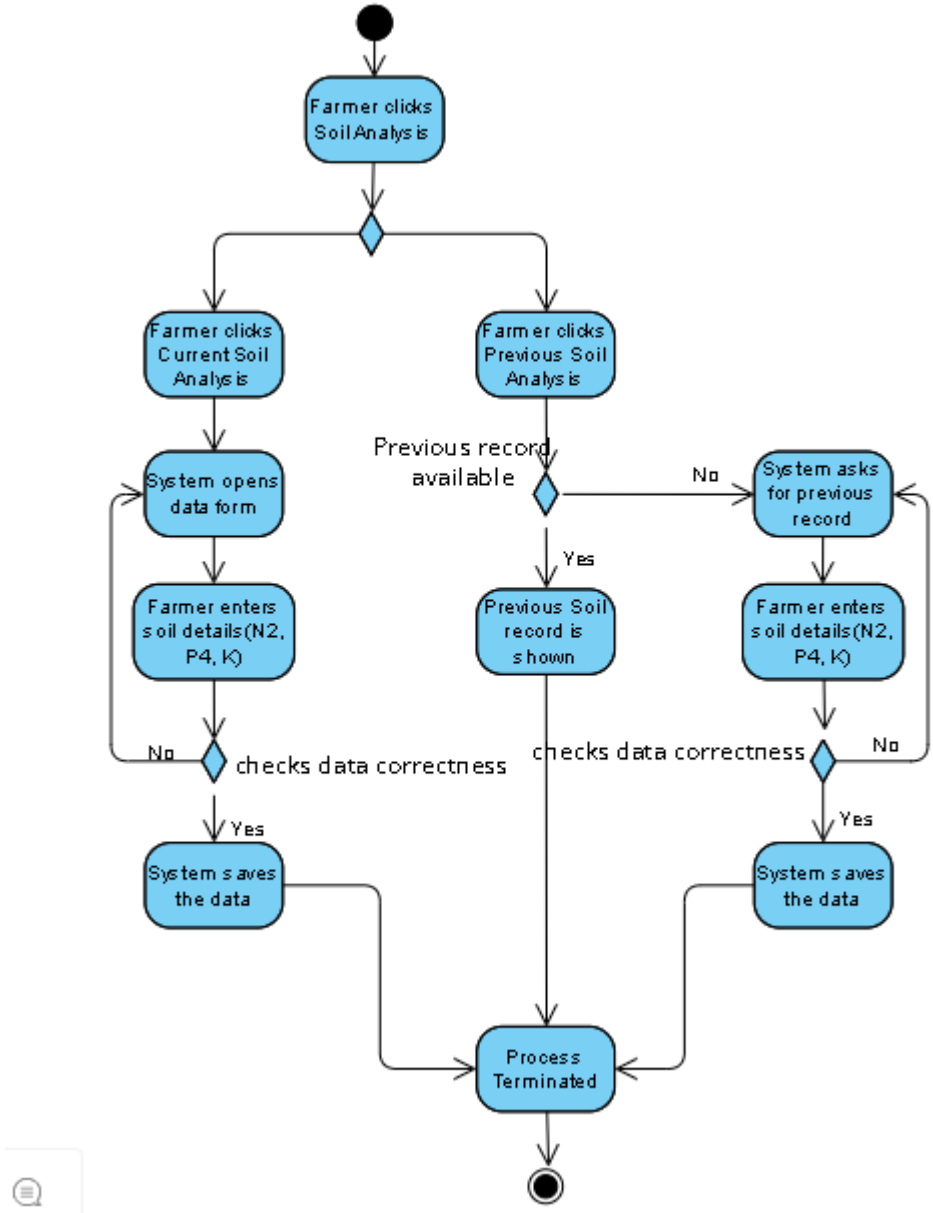


**Figure 14 Soil Analysis Activity Diagram**

#### *4.2.1.8 Analyze Climate*

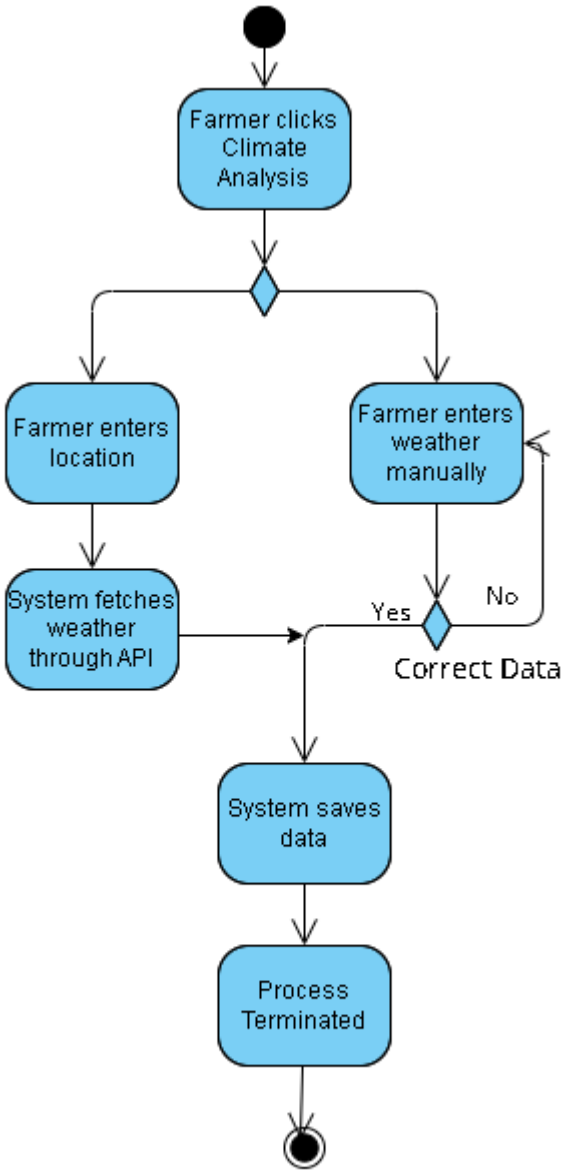


**Figure 15 Climate Analysis Activity Diagram**

#### *4.2.1.9 Crop Recommendation*

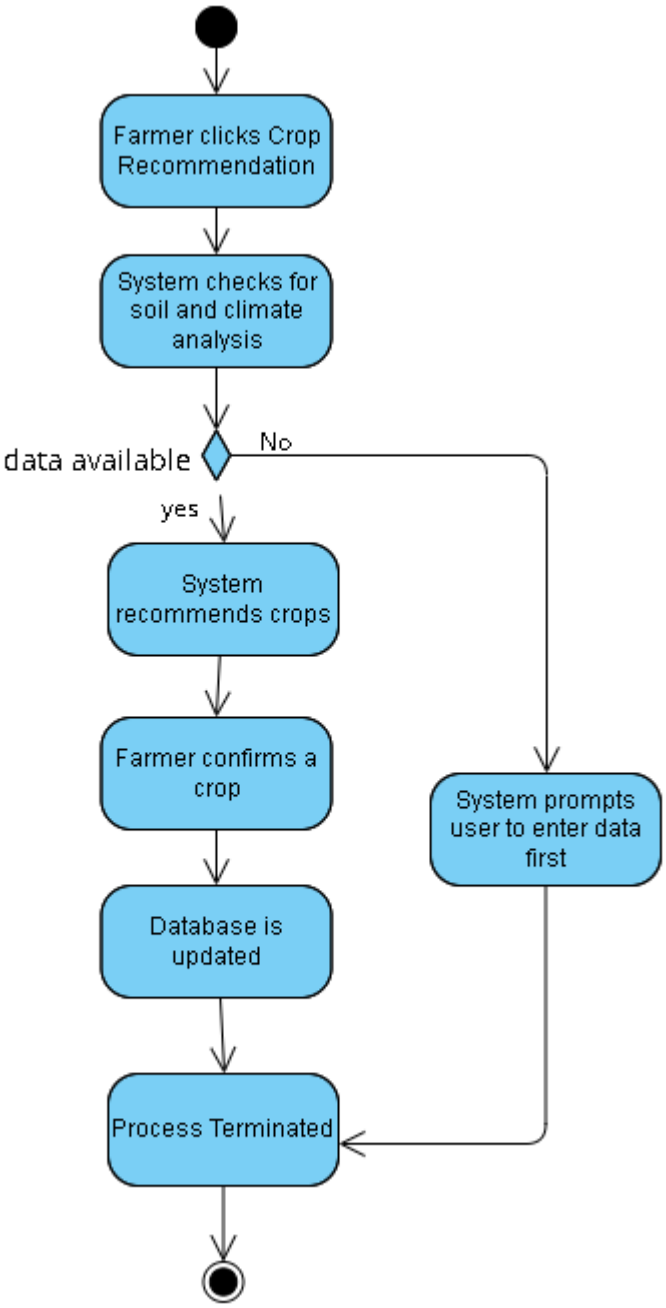


**Figure 16 Crop Recommendation Activity Diagram**

### *4.2.1.10 AI Chatbot*

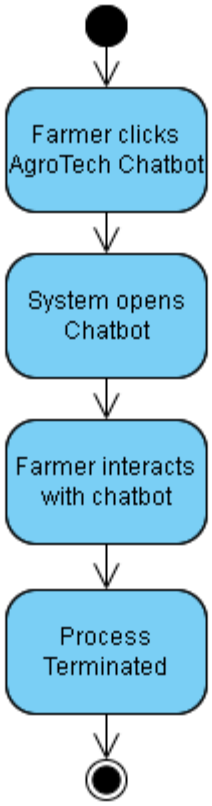


**Figure 17 AI Chatbot Activity Diagram**

### *4.2.1.11 Register Complaints*

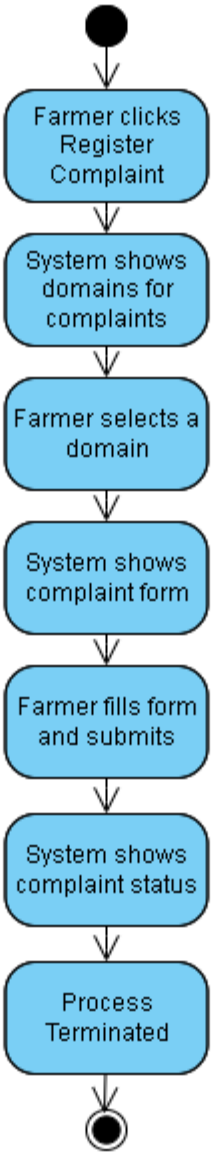


**Figure 18 Register Complaints Activity Diagram**

### *4.2.1.12 Identify Crop Stresses*

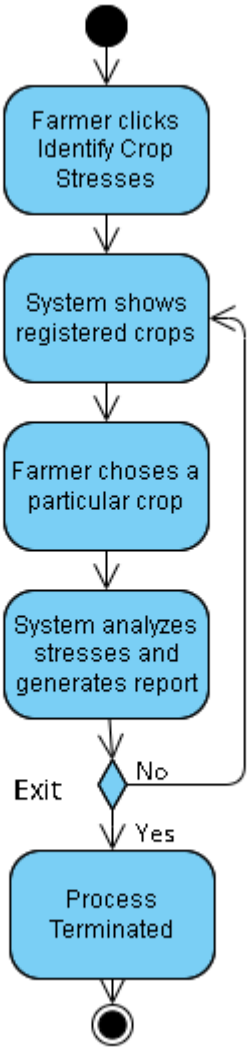


**Figure 19 Identify Crop Stresses Activity Diagram**

### *4.2.1.13 Identify Crop Diseases*

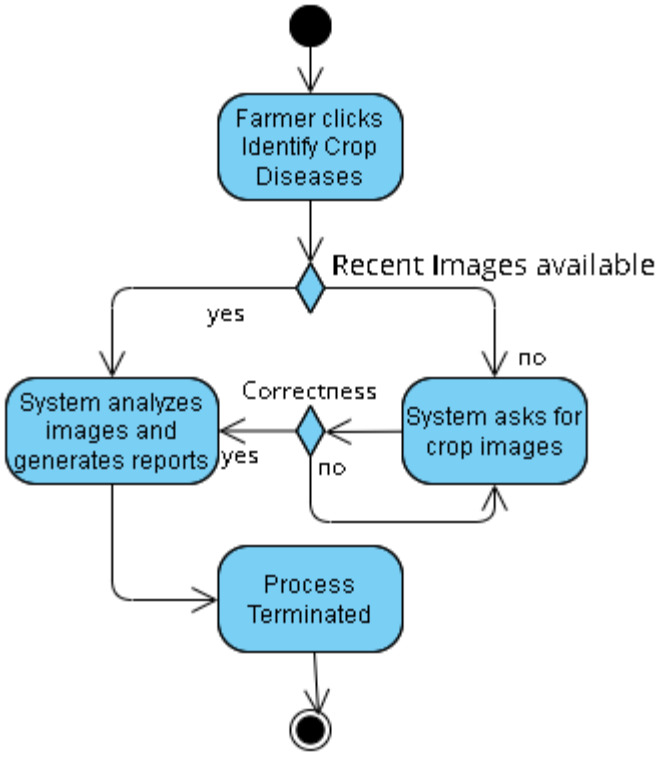


**Figure 20 Identify Crop Diseases Activity Diagram**

### *4.2.1.14 Estimate Crop Yield*

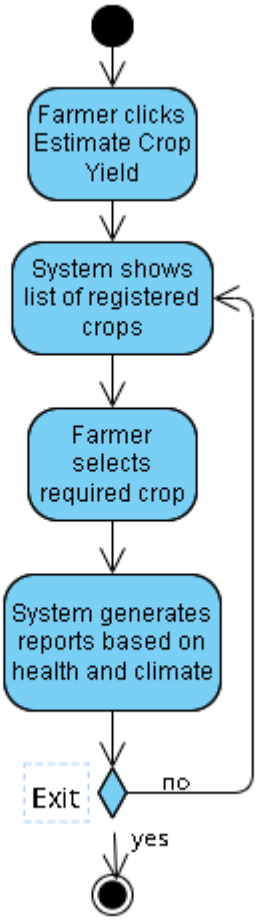


**Figure 21 Estimate Crop Yield Activity Diagram**

### *4.2.1.15 Crop Health Monitoring*

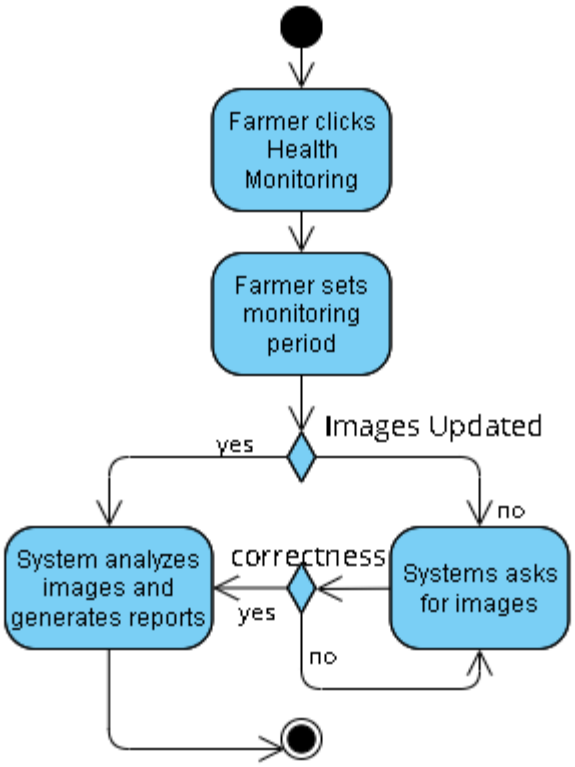


**Figure 22 Crop Health Monitoring Activity Diagram**

### *4.2.1.16 Crop Maturity Assessment*

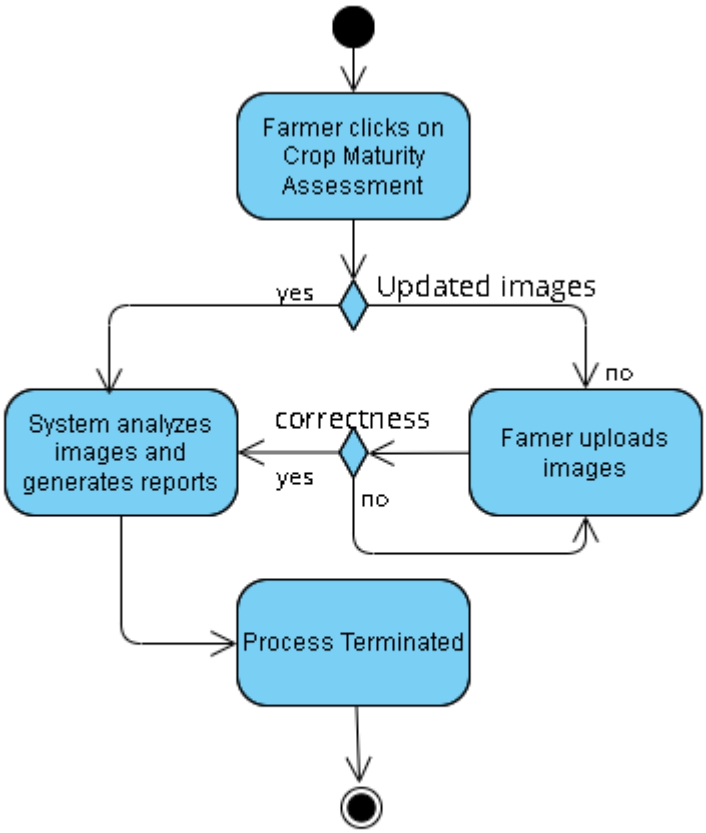


**Figure 23 Crop Maturity Assessment Activity Diaram**

### *4.2.1.17 Crop Quality Assessment*

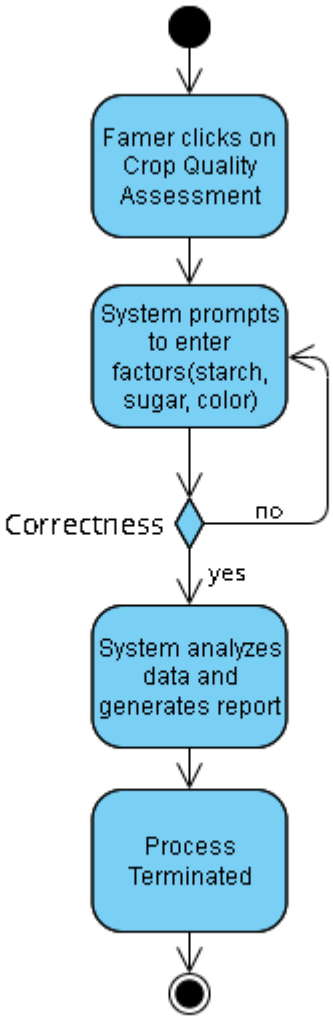


**Figure 24 Crop Quality Assessment Activity Diagram**

### *4.2.1.18 Calculate Optimal Harvest Time*

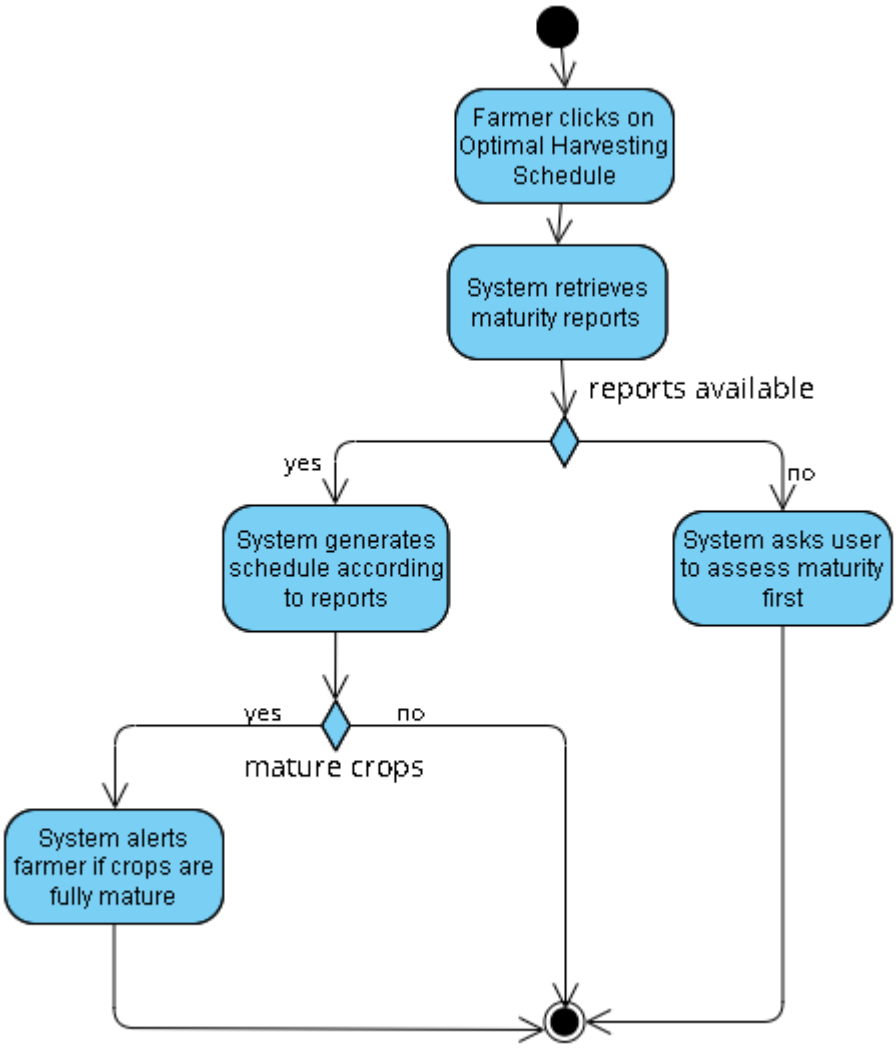


**Figure 25 Harvest Scheduling Activity Diaram**

### *4.2.1.19 Recommend Harvesting Tools*

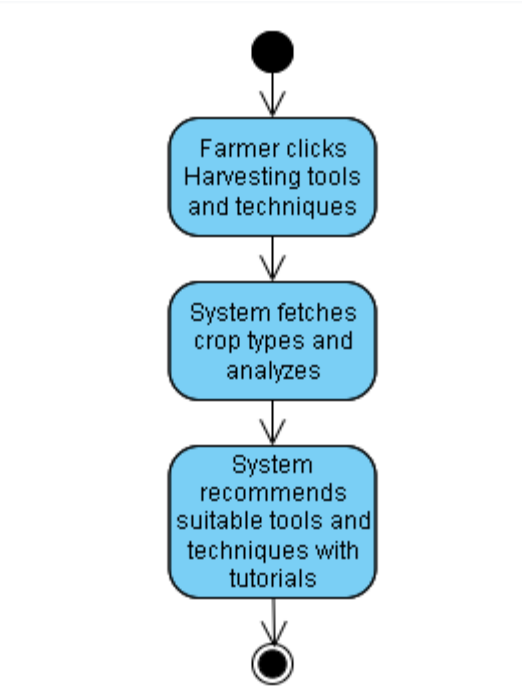


**Figure 26 Recommend Harvesting Tools Activity Diagram**

### *4.2.1.20 Recommend Transport*

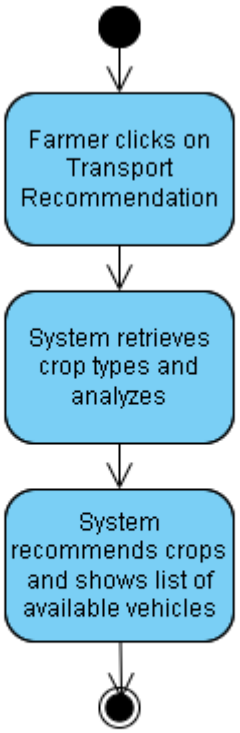


**Figure 27 Transport Recommendation Activity Diagram**

### *4.2.1.21 Packaging Assist*

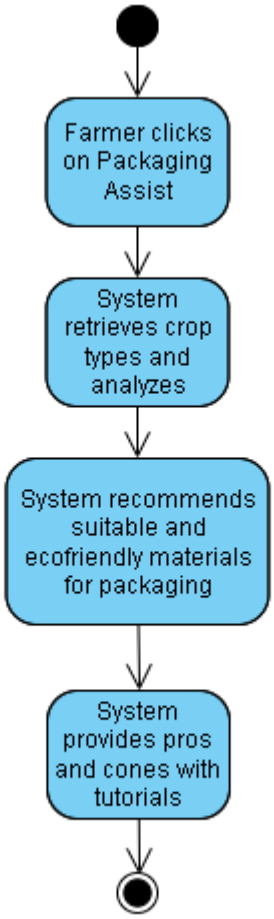


**Figure 28 Packaging Assist Activity Diagram**

### *4.2.1.22 Climate Controlled Storage Reservation*

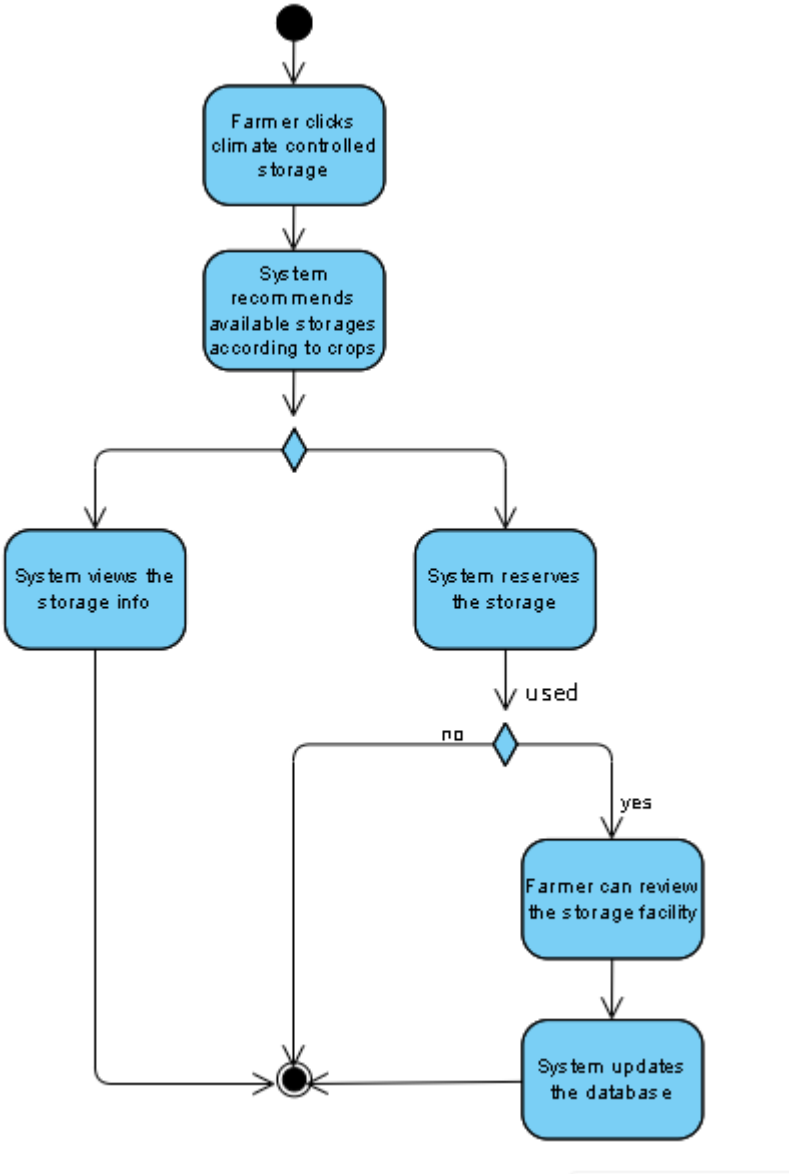


**Figure 29 Storage Reservation Activity Diagram**

### *4.2.1.23 Crop Quality Grading*

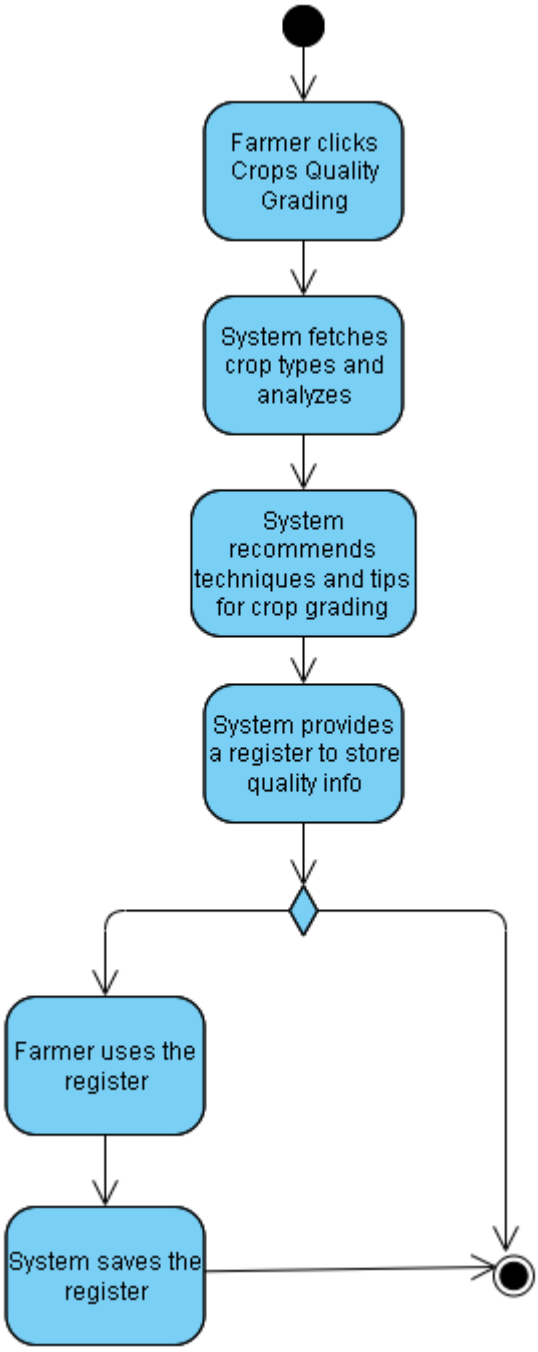


**Figure 30 Crop Quality Grading Activity Diagram**

## Customer Functionalities

### *4.2.1.24 Bidding*

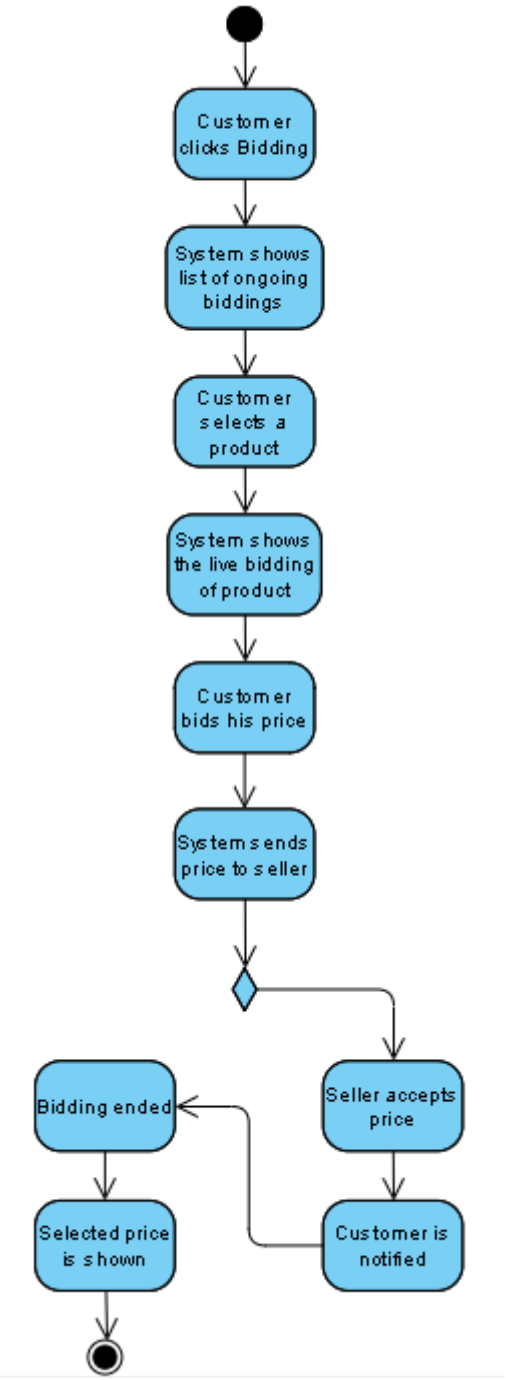


**Figure 31 Bidding (Customer) Activity Diagram**

### *4.2.1.25 Access Products*

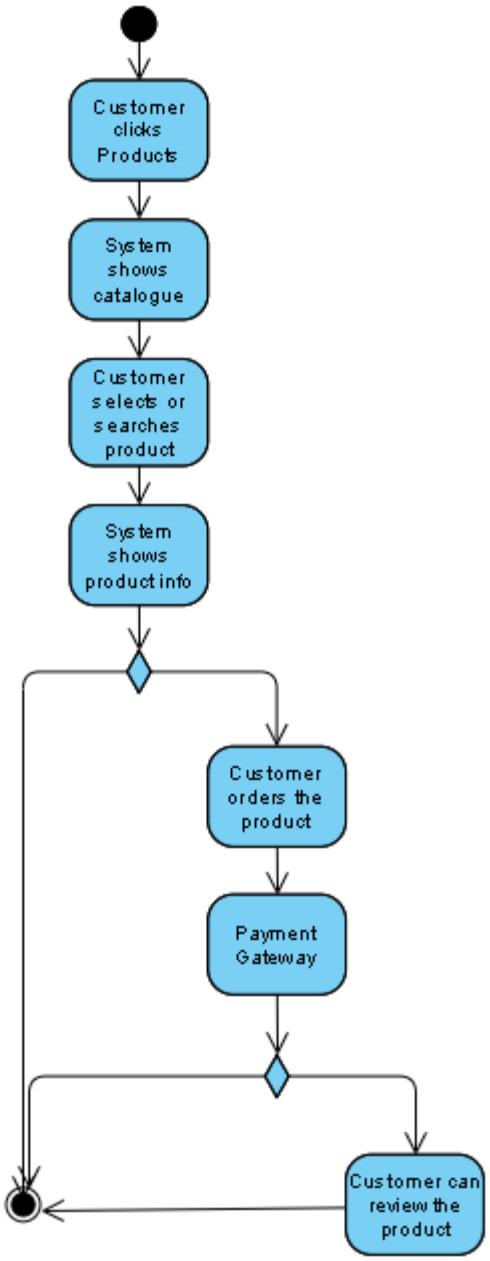


**Figure 32 Access Products Activity Diagram**

## Seller Functionalities

### *4.2.1.26 Upload Product*

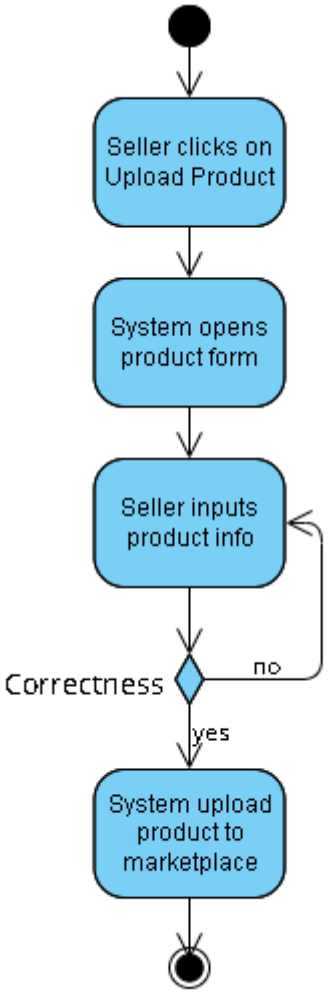


**Figure 33 Upload Product Activity Diagram**

### *4.2.1.27 Bidding*

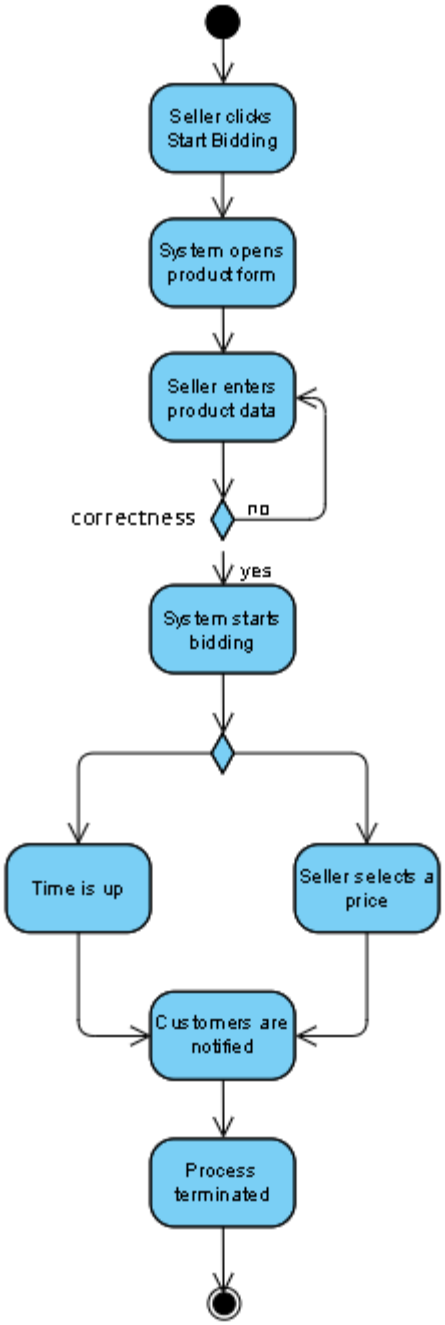


**Figure 34 Bidding (Seller) Activity Diagram**

### *4.2.1.28 Reports and Analytics*

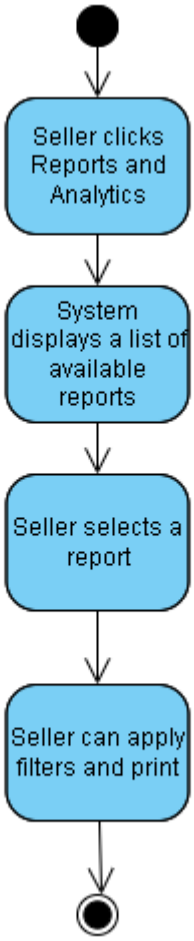


**Figure 35 Reports and Analytics Activity Diagram**

### *4.2.1.29 Feature Products*

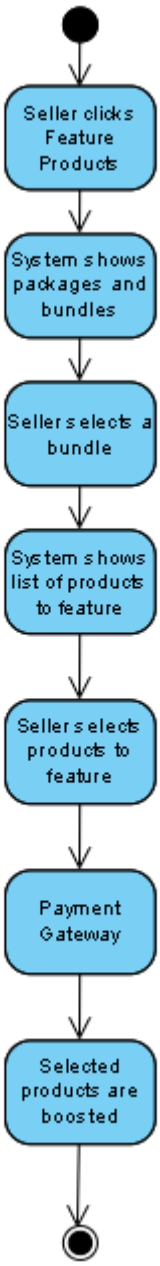


**Figure 30 Feature Products Activity Diagram**

### 4.2.2 Data Flow Diagrams

#### *4.2.2.1 Level 0*

Represents the high-level interaction between AgroTech and external entities such as users (farmers, customers, and sellers) and external systems (payment gateways and transportation services). It highlights the flow of data across the system boundaries

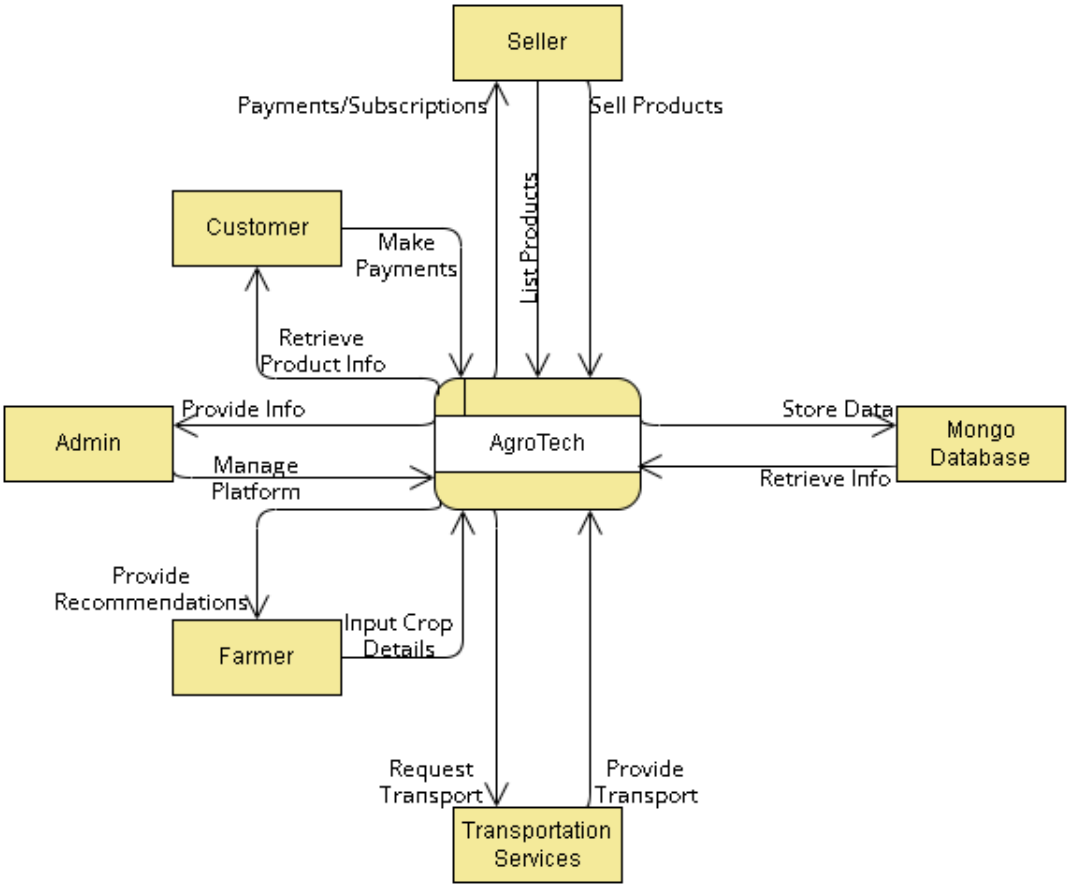


**Figure 31 DFD Level 0**

### *4.2.2.2 Level 1*

Depicts the decomposition of the AgroTech system into its major modules, including User Management, Crop Management, and Payment Services. It shows the detailed data flow between the system's internal components and external entities.

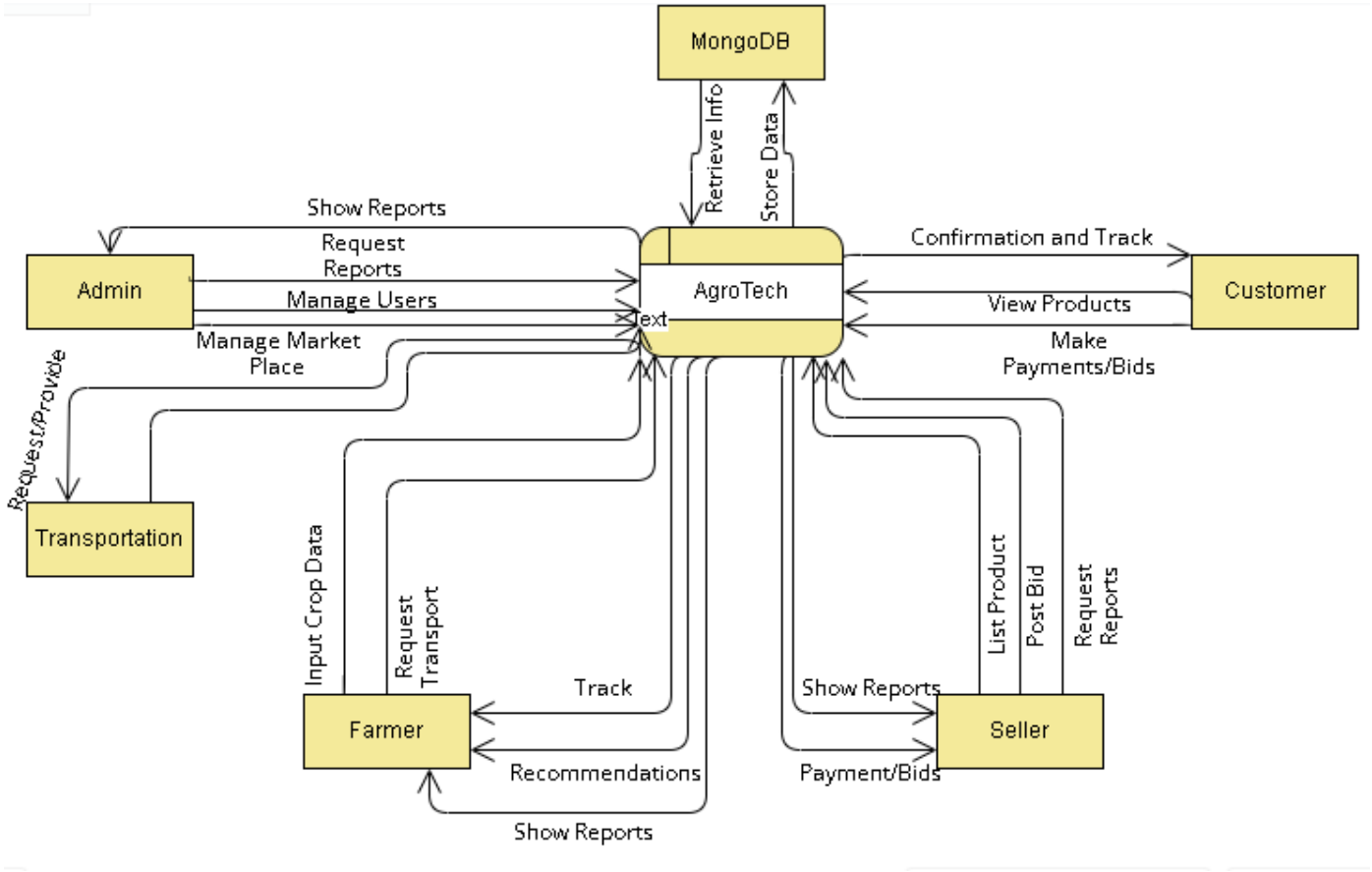


**Figure 32 DFD Level 1**

#### *4.2.2.3 Level 2*

##### 4.2.2.3.1 Module 1: User Profiling

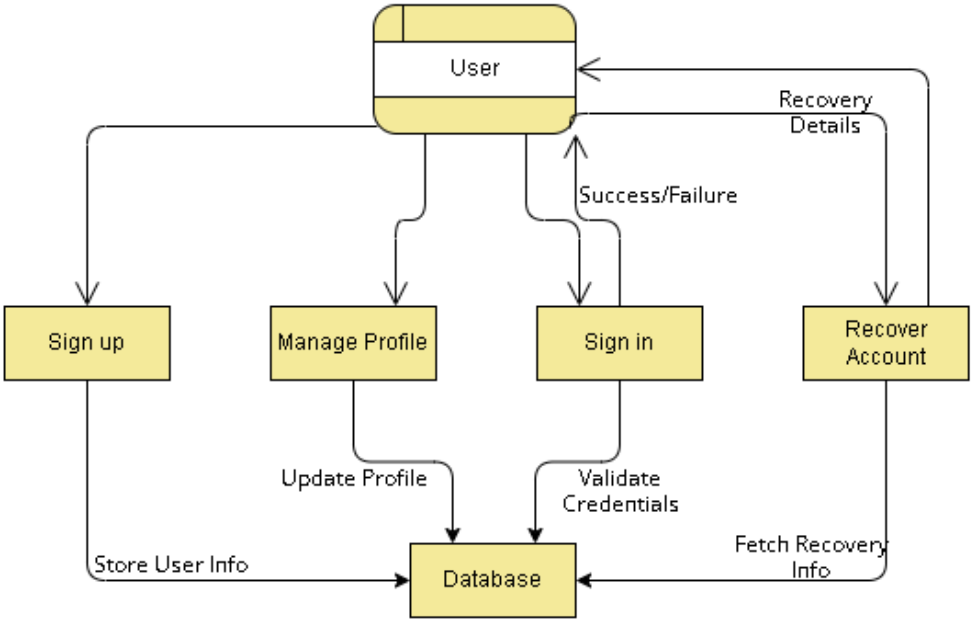


**Figure 33 Module 1 Data Flow Diagram**

##### 4.2.2.3.2 Module 2: Soil Analysis

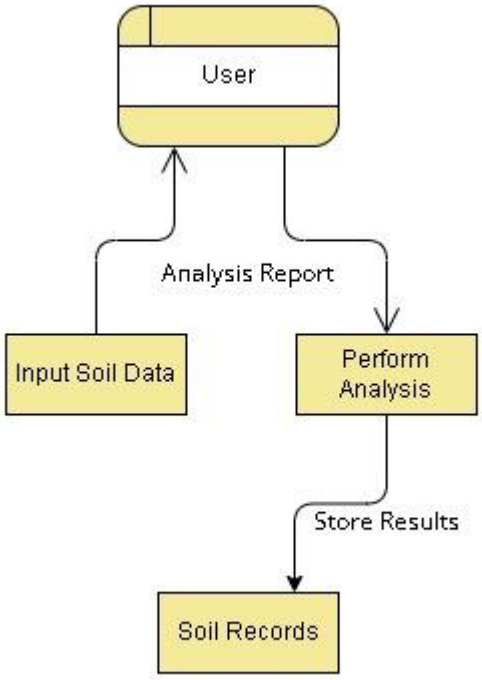


**Figure 34 Module 2 Data Flow Diagram**

#### 4.2.2.3.3 Module 3: Climate Analysis

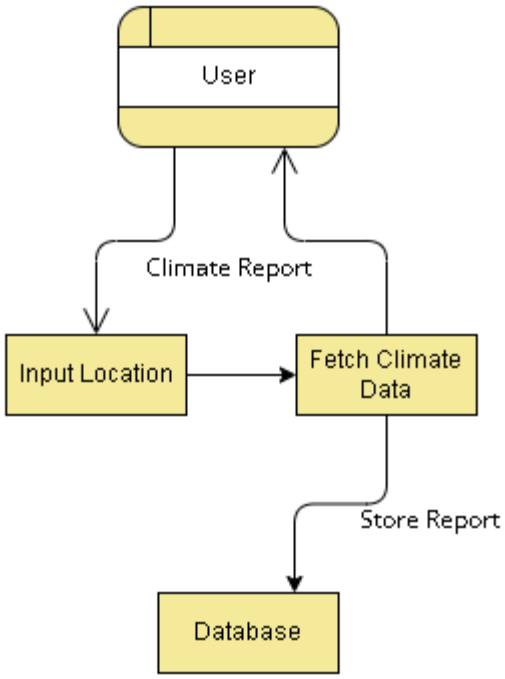


**Figure 35 Module 3 Data Flow Diagram**

#### 4.2.2.3.4 Module 4: Crop Recommendation

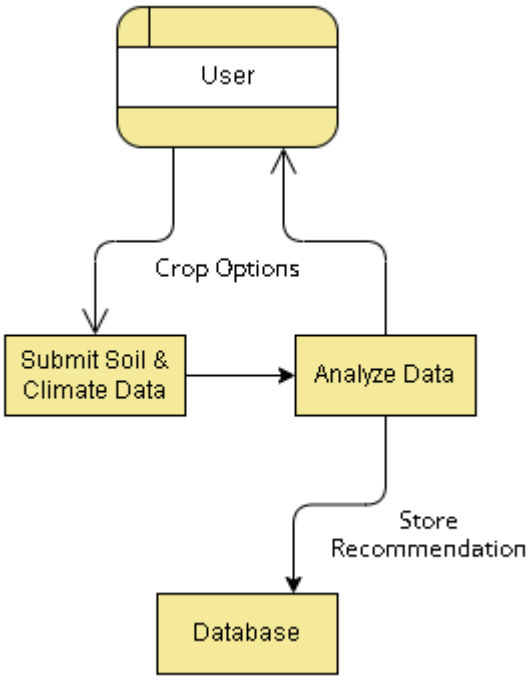


**Figure 36 Module 4 Data Flow Diagram**

#### 4.2.2.3.5 Module 5: AI Chatbot

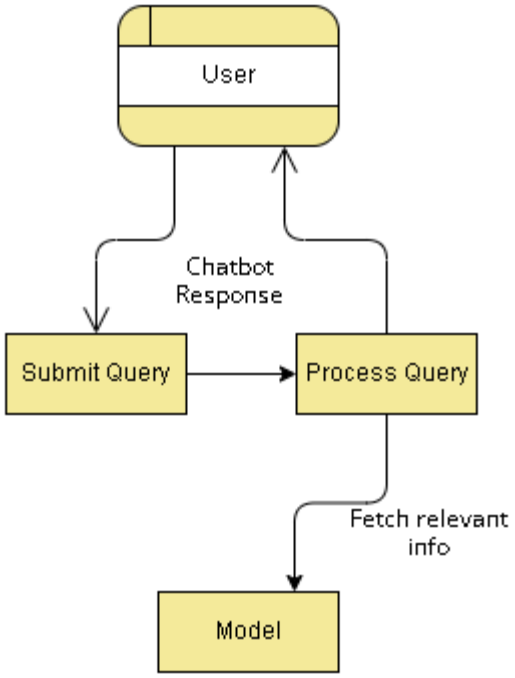


**Figure 37 Module 5 Data Flow Diagram**

#### 4.2.2.3.6 Module 6: Crop Health Monitoring

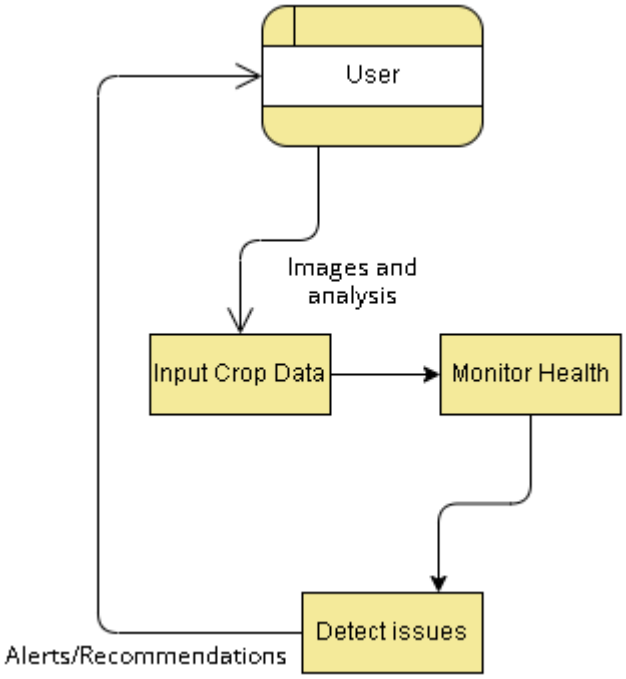


**Figure 38 Module 6 Data Flow Diagram**

#### 4.2.2.3.7 Module 7: Yield Estimation and Prediction

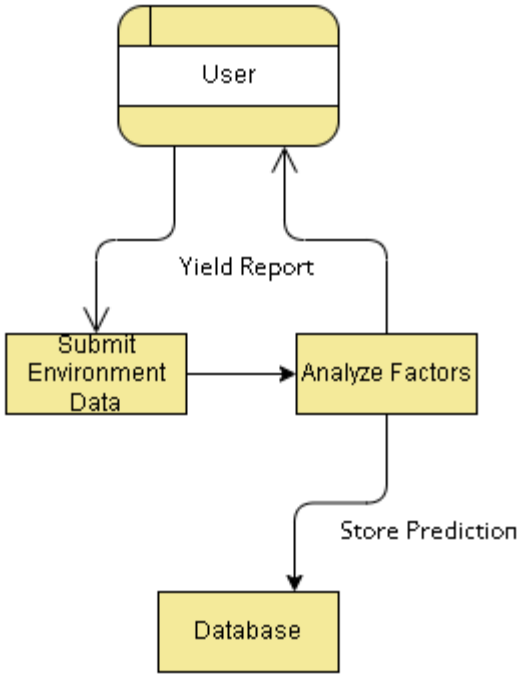


**Figure 39 Module 7 Data Flow Diagram**

#### 4.2.2.3.8 Module 8: Crop Maturity Assessment

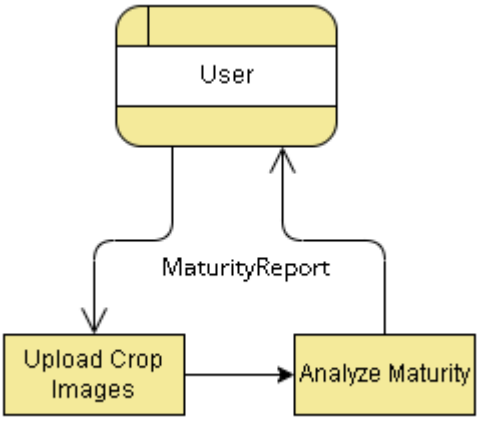


**Figure 40 Module 8 Data Flow Diagram**

#### 4.2.2.3.9 Module 9: Harvesting Assist

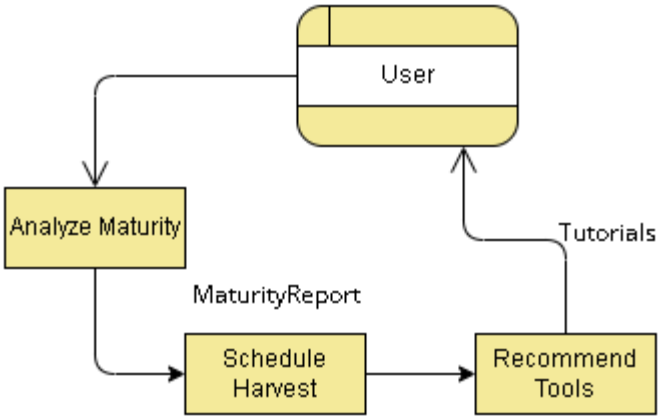


**Figure 41 Module 9 Data Flow Diagram**

#### 4.2.2.3.10 Module 10: Transport Assist

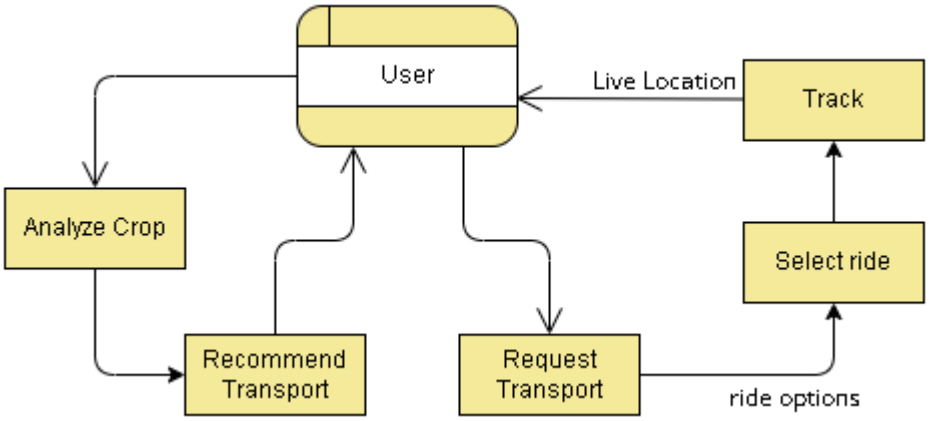


**Figure 42 Module 10 Data Flow Diagram**

### 4.2.2.3.11 Module 11: Storage Assist

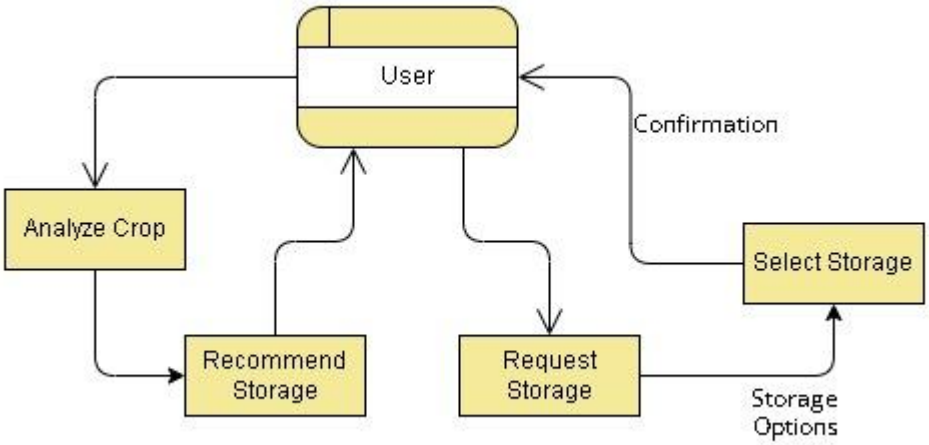


**Figure 43 Module 11 Data Flow Diagram**

### 4.2.2.3.12 Module 12: Online Marketplace

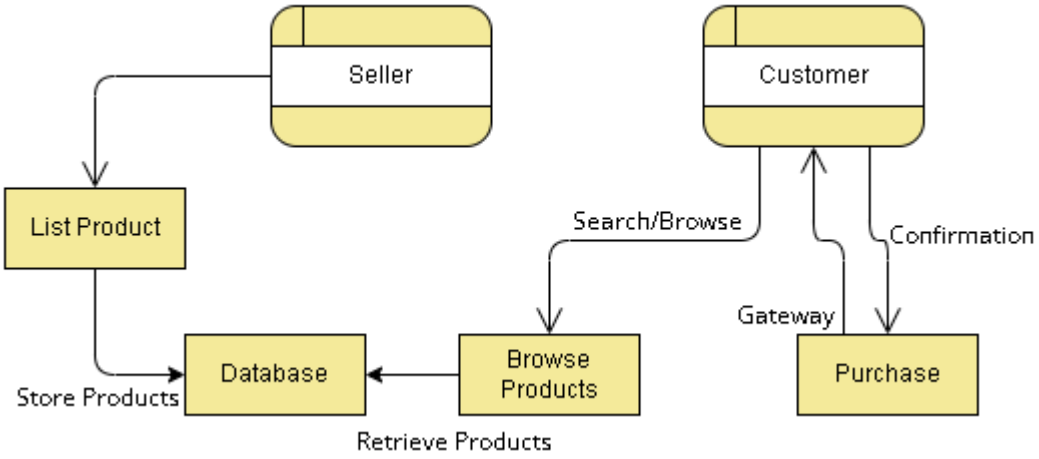


**Figure 44 Module 12 Data Flow Diagram**

#### 4.2.2.3.13 Module 13: Reports and Analytics

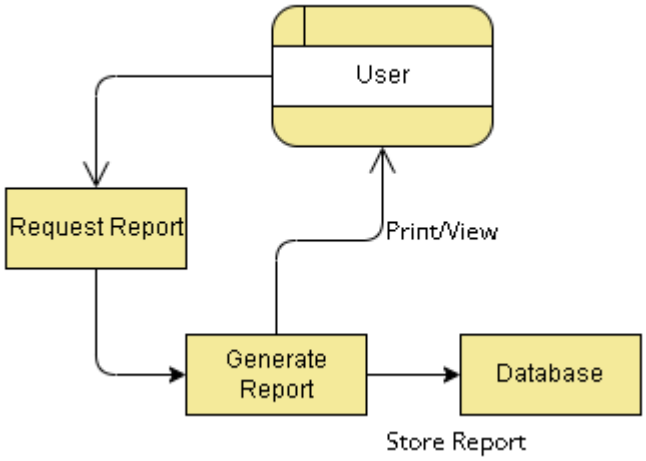


**Figure 45 Module 13 Data Flow Diagram**

### 4.2.3 State Transition Diagrams

#### *4.2.3.1 Crop Maturity Assessment*

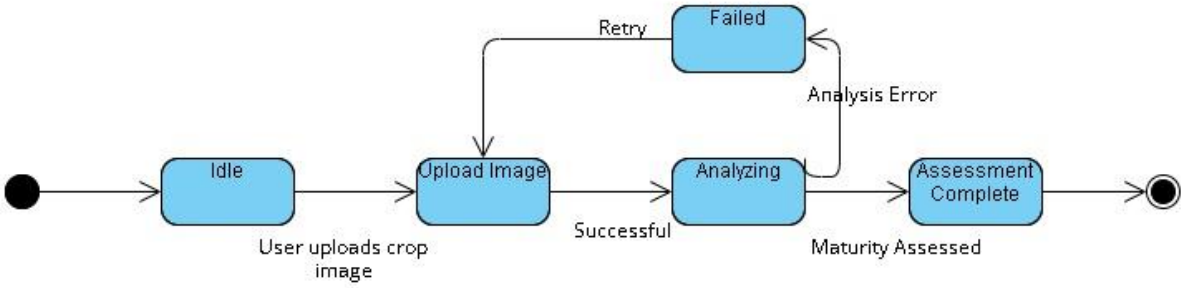


**Figure 46 Maturity Assessment State Transition Diagram**

### *4.2.3.2 Crop Health Monitoring*

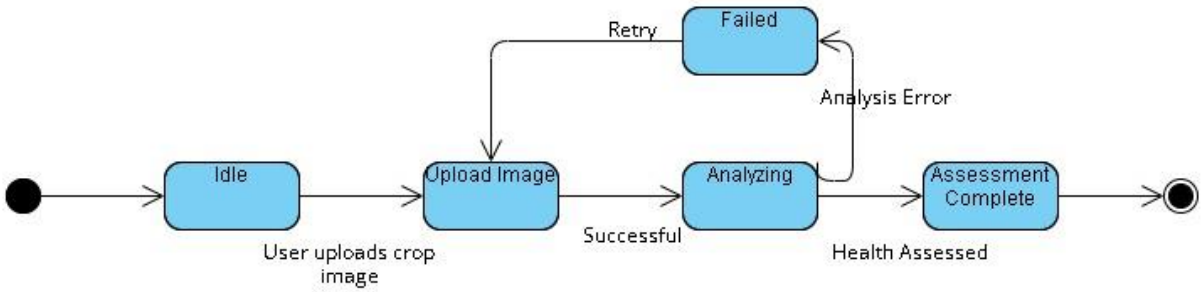


**Figure 47 Health Monitoring State Transition Diagram**

### *4.2.3.3 Soil Analysis*

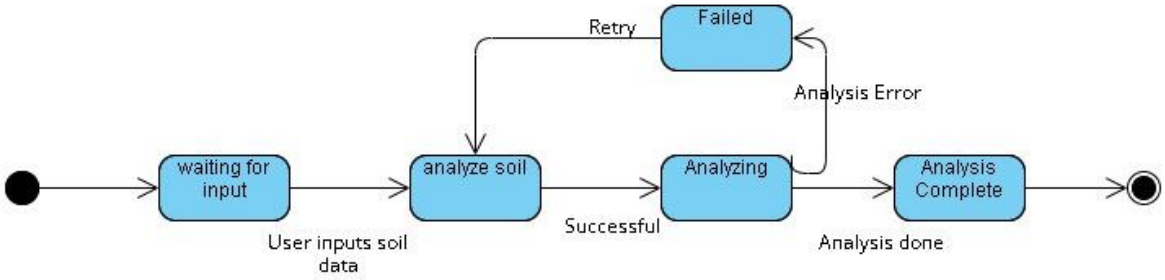


**Figure 48 Soil Analysis State Transition Diagram**

### *4.2.3.4 Yield Estimation and Prediction*

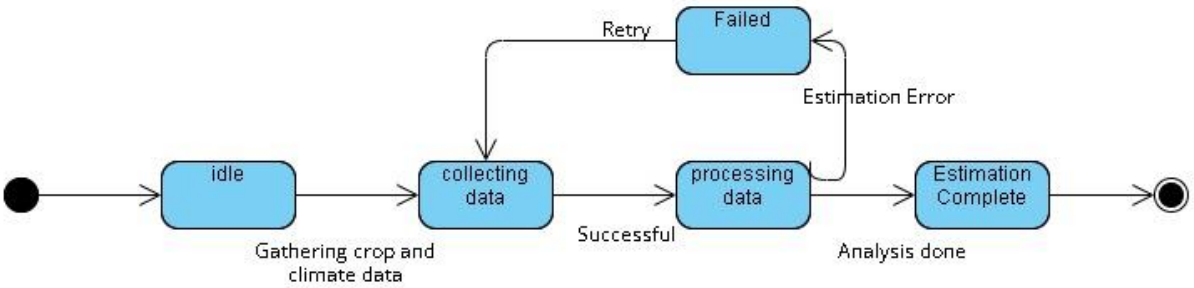


**Figure 49 Yield Estimation and Prediction State Transition Diagram**

### *4.2.3.5 Online Marketplace*

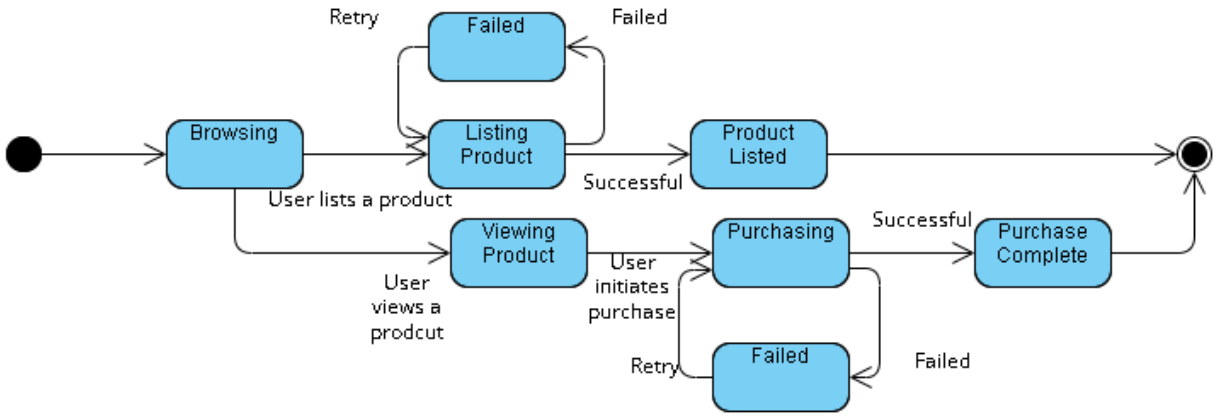


**Figure 50 Online Marketplace State Transition Diagram**

### *4.2.3.6 Bidding*

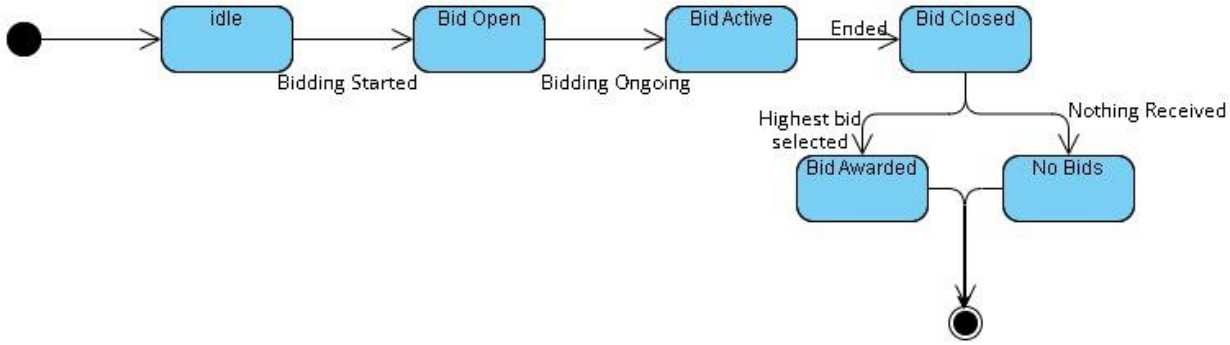


**Figure 57 Bidding State Transition Diagram**

### *4.2.3.7 Transportation Assist*

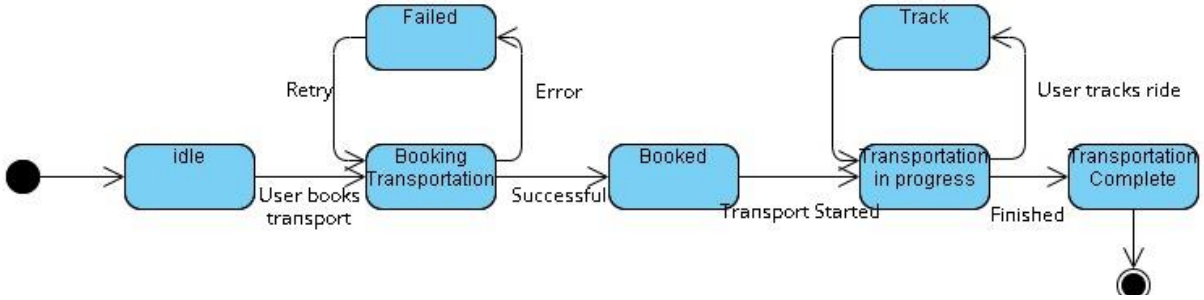


**Figure 51 Transportation Assist State Transition Diagram**

### *4.2.3.8 Manage User Complaints*

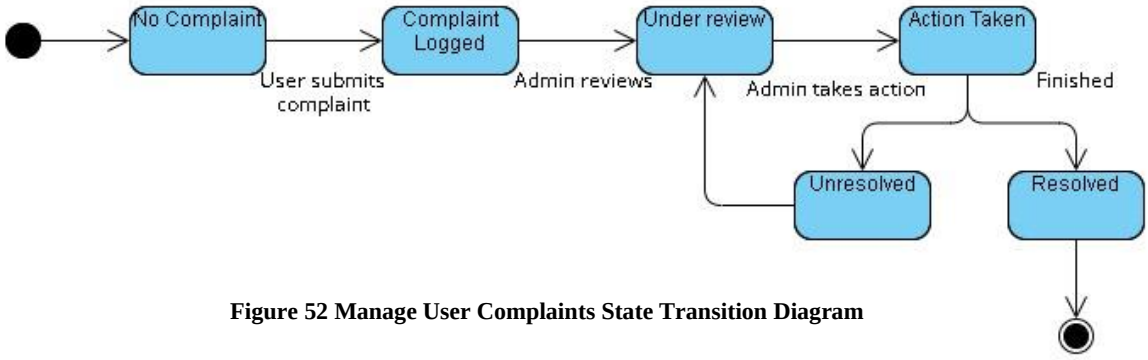


**Figure 52 Manage User Complaints State Transition Diagram**

### *4.2.3.9 Storage Assist*

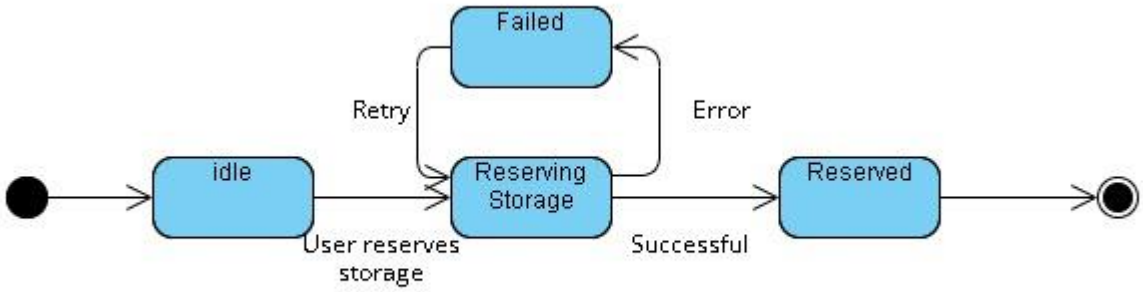


**Figure 53 Storage Assist State Transition Diagram**

#### *4.2.3.10 Reports and Analytics*

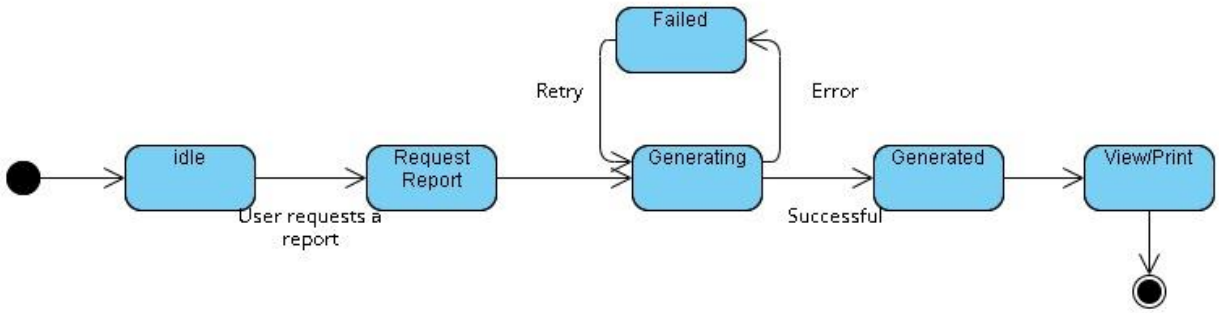


**Figure 54 Reports and Analytics State Transition Diagram**

## 4.3 Data Design

This section explains how the information domain of our system is transformed into data structures.

### 4.3.1 Data Dictionary

**Table 295 Data Dictionary**

| Collection | Property | DataType | Description |
|---|---|---|---|
| User | _id | Schema.Types.ObjectId | The auto generated primary key for User |
| User | username | String | The unique username for the user. |
| User | firstName | String | The first name of the user. |
| User | lastName | String | The last name of the user. |
| User | email | String | The unique email address for the user. |
| User | password | String | The user's password. |
| User | userType | String | The type of user (Admin, Farmer, Customer, Seller). |
| User | googleId | String | The Google |

| | | | |
|---|---|---|---|
| | | | account ID, used for Google login |
| User | profilePicture | String | URL of the user's profile picture. |
| User | phoneNumber | String | The phone number of the user. |
| User | isActive | Boolean | A flag indicating if the user's account is active. |
| User | isLoggedIn | Boolean | A flag indicating if the user is currently logged in. |
| User | verificationToken | String | A token for email verification. |
| User | verificationTokenExpire | Date | Expiration date for the verification token. |
| Report | reportType | String | The type of report (e.g., userActivity, salesData, systemMetrics) |
| Report | generatedBy | ObjectId | Reference to the User who generated the report. |
| Report | reportData | Object | Contains the actual data of the report |
| Report | generatedAt | Date | The date and time the report was generated (default: current date/time). |
| Report | Filters | Object | Filters applied to generate the report. |
| CropRecommendations | userId | ObjectId | Reference to the User who requested the crop recommendation. |
| CropRecommendations | Nitrogen | Number | The Nitrogen content in the soil. |

| | | | |
|---|---|---|---|
| CropRecommendations | Phosphorus | Number | The Phosphorus content in the soil. |
| CropRecommendations | Potassium | Number | The Potassium content in the soil. |
| CropRecommendations | temperature | Number | The current temperature in the region. |
| CropRecommendations | humidity | Number | The current humidity in the region. |
| CropRecommendations | pH | Number | The pH level of the soil (required). |
| CropRecommendations | rainfall | Number | The annual rainfall in the region. |
| CropRecommendations | recommendedCrop | String | The recommended crop based on the provided data. |
| CropRecommendations | CreatedAt | Date | The date and time when the recommendation was generated. |
| Complaint | userId | ObjectId | Reference to the User who raised the complaint. |
| Complaint | complaintText | String | The content of the complaint. |
| Complaint | status | String | The current status of the complaint (e.g., pending, resolved, closed). Default: pending. |
| Complaint | createdAt | Date | The date and time when the complaint was created. |
| Complaint | resolvedBy | ObjectId | Reference to the User who resolved the |

| | | | |
|---|---|---|---|
| | | | complaint. |
| Complaint | resolutionText | String | The text explaining the resolution of the complaint. |
| ChatBot | userId | ObjectId | Reference to the User who initiated the conversation with Chatbot. |
| ChatBot | userMessage | String | The content of the query of the user. |
| ChatBot | botResponse | String | The response of the chatbot against user's query |
| ChatBot | timeStamp | String | Exact time when the message is logged |
| ChatBot | messageType | String | Indicates whether the message is from the user or the bot. |
| ChatBot | isResolved | Boolean | Flag to indicate whether the query has been resolved or not. |
| ChatBot | context | Object | Store additional context if needed (e.g., user's previous questions, bot intent) |

## 4.4 Human Interface Design

### 4.4.1 Screen Images


**Figure 55 Home Page**

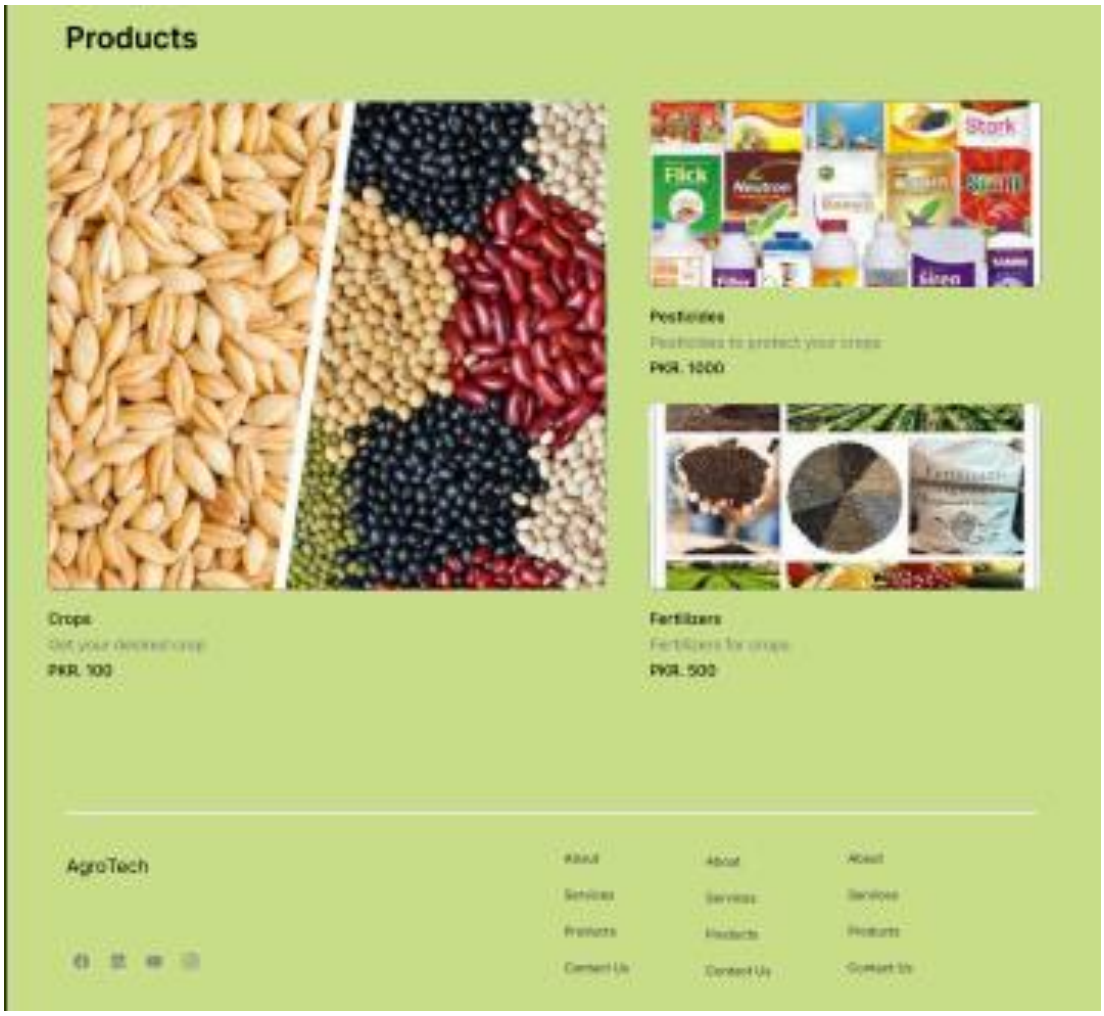


**Figure 56 Products**

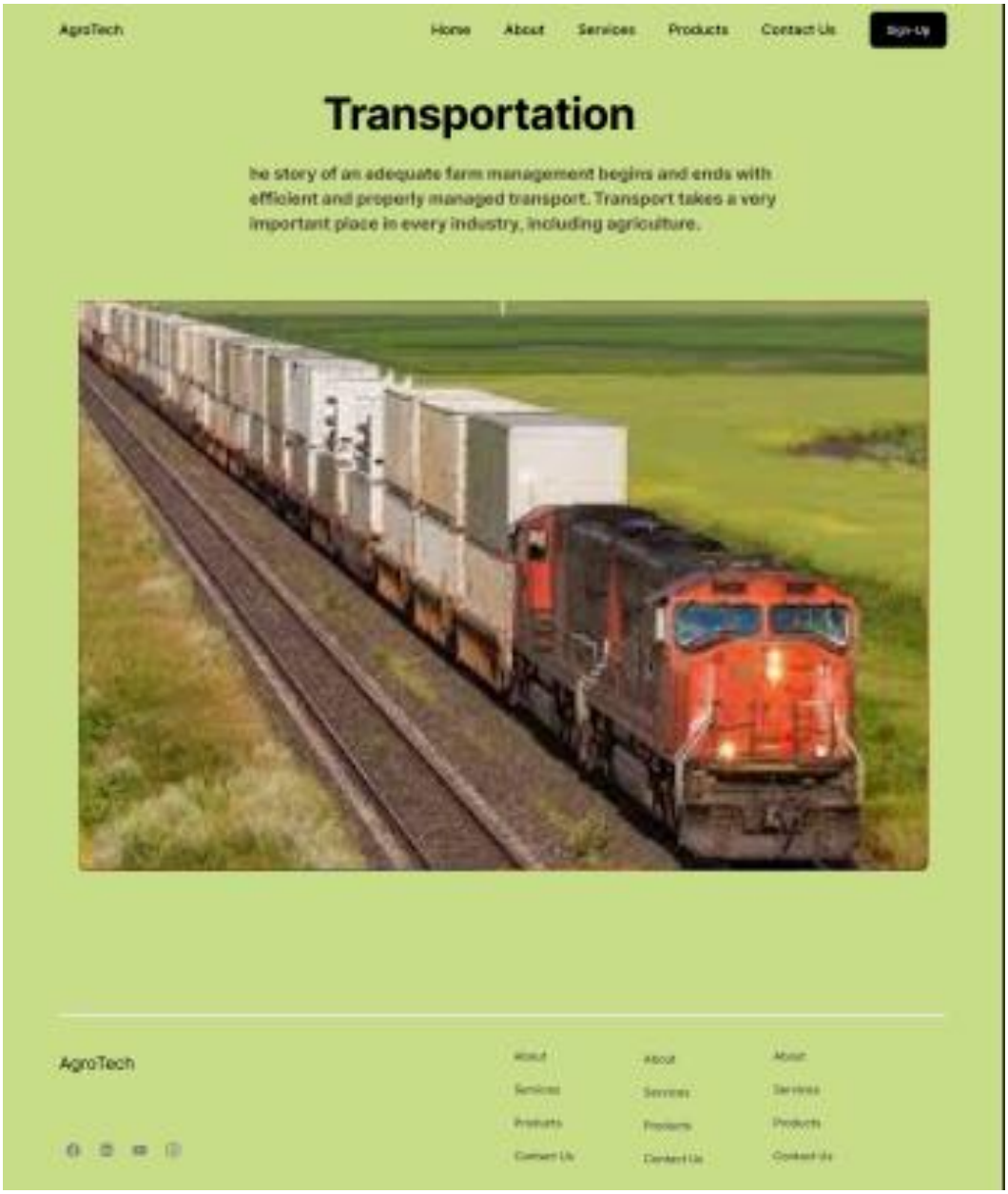


**Figure 57 Transportation**

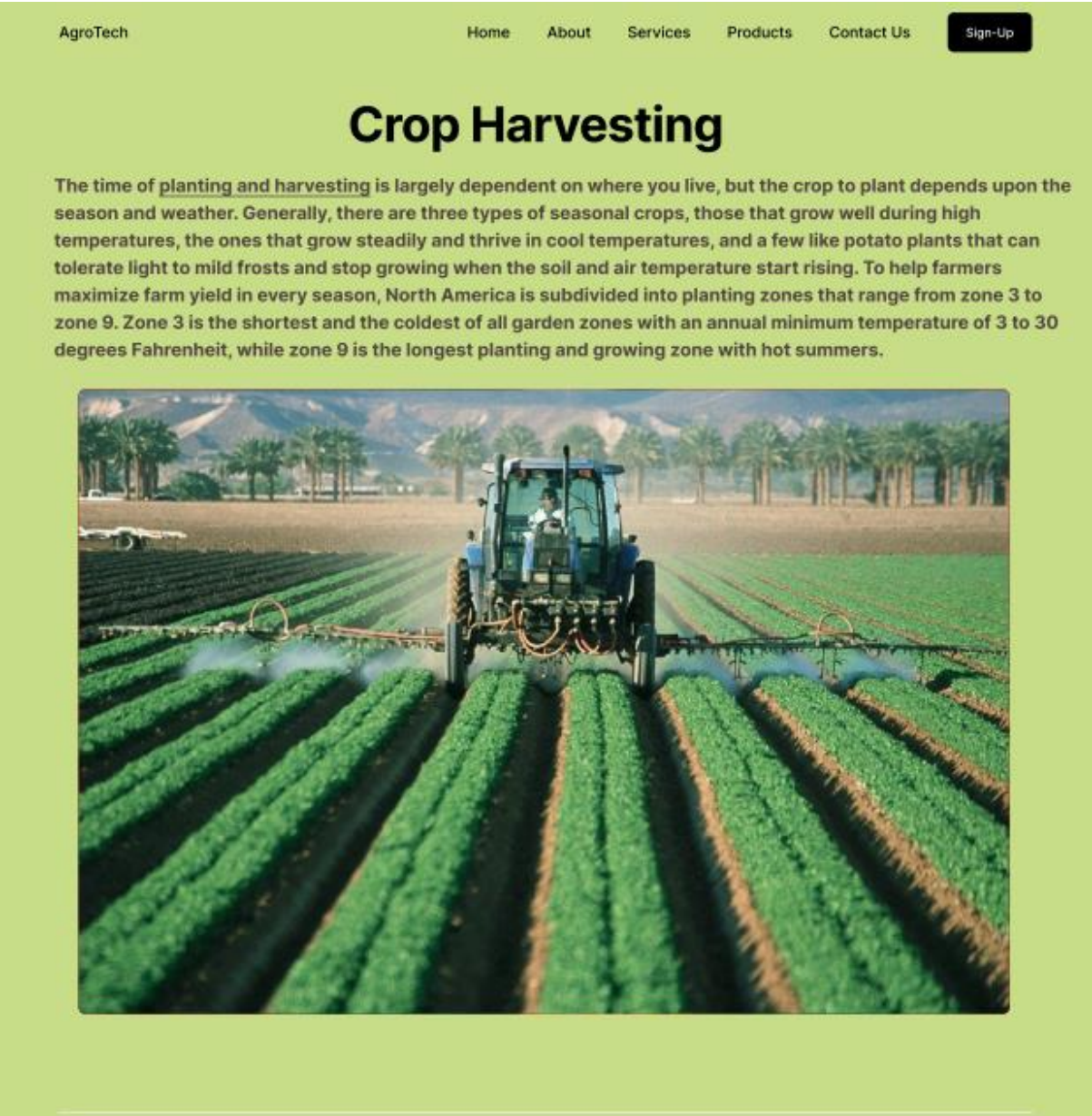


**Figure 58 Harvest Assist**


**Figure 59 Soil Analysis**

### 4.4.2 Screen Objects and Actions

**Table 296 Screen Objects and Actions**

| Screen Object | Actions |
|---|---|
| Button | Buttons are used for various purposes in the application, those application may include clicking on sign in button etc. |
| Radio Button | To select option from multiple options given. E.g., selecting userType |
| Field | Fields to provide input |
| RouterLink | Link to navigate to other pages |
| NavBar | Navlinks provided to navigate to different sections of the application |
| Icons | Used for various purposes like viewing information, navigation to certain page etc. |
| Header | To provide user with navigation links |
| DashBoard Title | Displays the title (e.g., "Farmer Dashboard," "Admin Dashboard") |

# 5 Implementation

This chapter will discuss implementation details of the project. You will not put your source code here, however, are required to write the core modules functionalities in pseudocode form (Following sections are required in this chapter).

Note: You are required to follow proper coding standard to write your source code. For guidelines, **General Coding Standards & Guidelines** are provided in Appendix D.

## 5.1 Algorithm

### 5.1.1 Register User

Input: username, firstName, lastName, email, password, userType, phoneNumber, otp
Output: JSON response with success or error message

Try:
  If OTP is provided:

```
        user = FindUserByEmail(email)
        If user does not exist:
            Return 404: 'User not found'

        If verificationTokenExpire < current time:
            DeleteUserById(user.id)
            Return 400: 'OTP expired. Please register again.'

        hashedOtp = HashOTP(otp)
        If verificationToken does not match hashedOtp:
            Return 400: 'Invalid OTP. Please try again.'

        ActivateUser(user)
        SendWelcomeEmail(user.email, user.username)
        Return 200: 'Account activated successfully. Welcome email sent.'

    Else:
        If UserExists(email):
            Return 400: 'User already exists'

        If userType not in ['Admin', 'Farmer', 'Customer', 'Seller']:
            Return 400: 'Invalid user type'

        If userType == 'Admin' and AdminExists():
            Return 400: 'Only one admin is allowed.'

        (isValid, message) = ValidatePassword(password)
        If isValid is False:
            Return 400: message

        hashedPassword = HashPassword(password)
        otpCode = GenerateOTP()
        hashedOtp = HashOTP(otpCode)

        newUser = CreateUser(username, firstName, lastName, email, hashedPassword,
phoneNumber, userType, hashedOtp, OTPExpireTime, isActive=False)
        SaveUser(newUser)

        SendOTPEmail(email, username, otpCode)
        Return 201: 'OTP sent to your email for account activation'

  Catch error:
    If ValidationError in error:
        Return 400: error.message
    LogError(error)
    Return 500: 'Error registering user'
End Function
```

### 5.1.2 Login User

Input: email, password, rememberMe
Output: JSON response with success or error message

```
    Try:
        user = FindUserByEmail(email, includePassword=True)
        If user does not exist:
            Return 404: 'User not found'

        If user.isActive is False:
            Return 403: 'Account is not active. Please verify your email.'

        If user.isLoggedIn is True:
            Return 400: 'User is already logged in. Please log out first.'

        If PasswordsDoNotMatch(password, user.password):
            Return 400: 'Invalid credentials'

        expiresIn = '7d' if rememberMe else '1h'
        token = GenerateToken(user.id, expiresIn)

        MarkUserAsLoggedIn(user)
        Return 200: 'Login successful', token, expiresIn

    Catch error:
        LogError(error)
        Return 500: 'Error logging in'
End Function
```

### 5.1.3 Google Login

```
Input: email, googleId, name, profilePicture
    Output: JSON response with success or error message

    Try:
        If any of email, googleId, or name is missing:
            Return 400: 'Missing required fields'

        user = FindUserByEmail(email)
        If user does not exist:
            user = CreateUser(username=name, email=email, googleId=googleId,
profilePicture=profilePicture, userType='Customer', isActive=True)
            SaveUser(user)
        Else:
            If user.googleId is empty and googleId is provided:
                UpdateGoogleId(user, googleId)

        token = GenerateToken(user.id, '7d')
        Return 200: 'Google login successful', user, token

    Catch error:
        LogError(error)
        Return 500: 'Error logging in with Google'
End Function
```

### 5.1.4 Logout User

```
   Input: token from Authorization header
   Output: JSON response with success or error message

   If token is missing:
      Return 401: 'Token not provided'

   Try:
      user = FindUserById(request.user.id)
      If user does not exist:
         Return 404: 'User not found. Please check the token.'

      If user.isLoggedIn is False:
         Return 400: 'User is already logged out. Please log in first.'

      MarkUserAsLoggedOut(user)
      Return 200: 'Logout successful'

   Catch error:
      LogError(error)
      Return 500: 'Error logging out'
End Function
```

### 5.1.5 Recommend Crop Using Random Forest Classifier

```
STEP 1:
Function SetUpFlaskAppAndLoadModels():
   app = InitializeFlaskApp()
   EnableCORS(app)

   model = LoadModelFromPickle("model.pkl")
   sc = LoadScalerFromPickle("standscaler.pkl")
   ms = LoadScalerFromPickle("minmaxscaler.pkl")

   Return app, model, sc, ms
End Function
STEP 2:
Function ConnectToMongoDB():
   Try:
      // Connect to MongoDB database using the URI
      client =
ConnectToMongoDBWithURI("mongodb+srv://Moiz:Moiz123@agrotech.mqmge.mongodb.net/
")
      db = GetMongoDBDatabase(client, "agrotech")
      crop_recommendations_collection = GetMongoDBCollection(db, "croprecommendations")
      Print("Connected to MongoDB")
   Catch Exception as e:
      Print("Error connecting to MongoDB: " + e)

   Return crop_recommendations_collection
End Function
```

STEP 3:

```
Function DefinePredictRoute(app, model, sc, ms, crop_recommendations_collection):
    // Define the API route for crop prediction
    app.Route("/api/predict", method="POST", Function predict):
        // Parse input JSON data from the request
        data = ParseJSONRequest(request)

        N = ConvertToFloat(data["Nitrogen"])
        P = ConvertToFloat(data["Phosphorus"])
        K = ConvertToFloat(data["Potassium"])
        temp = ConvertToFloat(data["Temperature"])
        humidity = ConvertToFloat(data["Humidity"])
        ph = ConvertToFloat(data["Ph"])
        rainfall = ConvertToFloat(data["Rainfall"])

        feature_list = [N, P, K, temp, humidity, ph, rainfall]
        single_pred = ReshapeToArray(feature_list)

        scaled_features = ms.Transform(single_pred)
        final_features = sc.Transform(scaled_features)

        // Predict the crop using the model
        prediction = model.Predict(final_features)

        crop_dict = MapPredictionToCrop(prediction)
        crop = crop_dict[prediction[0]]

        recommendation_data = CreateRecommendationData(data, crop)

        // Save the recommendation data to MongoDB
        SaveToMongoDB(crop_recommendations_collection, recommendation_data)

        // Return a success response with the recommendation data
        Return CreateJSONResponse(True, "Crop recommendation saved successfully",
recommendation_data)
    End Function
```

STEP 4:

```
Function Main():
    // Set up Flask app, model, and scalers
    app, model, sc, ms = SetUpFlaskAppAndLoadModels()

    crop_recommendations_collection = ConnectToMongoDB()

    // Define the API route for crop prediction
    DefinePredictRoute(app, model, sc, ms, crop_recommendations_collection)

    RunFlaskApp(app, debug=True, port=5001)
End Function
```

## Function that is using Random Forest Classifier:

```
def recommendation(N,P,k,temperature,humidity,ph,rainfal):
    features = np.array([[N,P,k,temperature,humidity,ph,rainfal]])
    transformed_features = ms.fit_transform(features)
    prediction = rfc.predict(transformed_features)
```

print(prediction)
return prediction[0]
End Function

### 5.1.6 Crop yield estimation

Algorithm Predict_Crop_Yield
Input:
Year (numeric)
average_rain_fall_mm_per_year (numeric)
pesticides_tonnes (numeric)
avg_temp (numeric)
Area (string)
Item (string)
Output: Predicted crop yield (numeric)

Step 1: Create an array 'features' with input values:
features = [Year, average_rain_fall_mm_per_year, pesticides_tonnes, avg_temp, Area, Item]

Step 2: Transform 'features' using the preprocessor:
transformed_features = preprocesser.transform(features)

Step 3: Use the trained Decision Tree Regressor model to predict yield:
predicted_yield = dtr.predict(transformed_features)

Step 4: Return the predicted yield value.
End Algorithm

### 5.1.7 Crop health monitoring

Algorithm Crop_Health_Monitoring_API

Step 1: Load Pretrained DenseNet Model
- Use DenseNet121 with ImageNet weights
- Exclude top layers
- Set input shape to (224, 224, 3)
- Freeze base model layers (set trainable to False)

Step 2: Add Custom Classification Layers
- Flatten the output of DenseNet model
- Add a Dense layer with 256 neurons (ReLU activation)
- Apply Dropout (0.5) for regularization
- Add final Dense layer with softmax activation (number of classes)

Step 3: Compile the Model
- Use Adam optimizer with a learning rate of 0.0001
- Set loss function as categorical crossentropy
- Track accuracy metric

Step 4: Train the Model
- Train using training dataset (train_data)
- Validate using validation dataset (val_data)
- Run for 10 epochs
- Use steps_per_epoch and validation_steps based on dataset size

Step 5: Set Up Flask API
- Initialize Flask application
- Load trained DenseNet model from file
- Define class labels for prediction

Step 6: Define Image Preprocessing Function
- Resize input image to (224, 224)
- Normalize pixel values (divide by 255)
- Expand dimensions to match model input

Step 7: Create API Endpoints
- "/" (GET) → Return API running message
- "/predict" (POST)
  - Read image from request
  - Preprocess image
  - Predict class using trained model
  - Return predicted class and confidence score in JSON format

Step 8: Start Flask Server
- Run Flask on host 0.0.0.0 and port 8000 in a separate thread

Step 9: Establish Public URL using ngrok
- Authenticate ngrok
- Create public URL for the API
- Print the public URL for external access

End Algorithm

### 5.1.8 Chatbot

Algorithm AgroTech_Chatbot
BEGIN
  // Step 1: Initialize chatbot
  Load NLP_Model()
  Load Knowledge_Base()

```
  Connect_To_Database()
  // Step 2: Handle user query
  WHILE chatbot_active DO
    Display "Hello! How can I assist you today?"
    user_query ← Get_User_Input()
    // Step 3: Preprocess the query
    cleaned_query ← Preprocess(user_query)
    // Step 4: Identify user type
    user_type ← Identify_User_Type()
    // Step 5: Classify intent
    intent ← Classify_Intent(cleaned_query)
    // Step 6: Extract key entities
    entities ← Extract_Entities(cleaned_query)
    // Step 7: Process request based on intent
    IF intent == "Crop Recommendation" THEN
      response ← Get_Crop_Recommendation(entities)
    ELSE IF intent == "Disease Diagnosis" THEN
      IF image_uploaded THEN
        response ← Analyze_Crop_Image(user_image)
      ELSE
        Request_Image_Upload()
    ELSE IF intent == "Yield Prediction" THEN
      response ← Predict_Yield(entities)
    ELSE IF intent == "Marketplace Inquiry" THEN
      response ← Fetch_Marketplace_Data(entities)
    ELSE IF intent == "Storage Booking" THEN
      response ← Book_Storage_Facility(entities)
    ELSE IF intent == "Transportation Inquiry" THEN
      response ← Provide_Transport_Options(entities)
    ELSE IF intent == "General FAQ" THEN
      response ← Fetch_FAQ_Answer(cleaned_query)
    ELSE
      response ← "I'm sorry, I didn't understand your request. Can you rephrase it?"
    // Step 8: Display response
    Display(response)
    // Step 9: Ask if the user needs more help
    Display "Would you like assistance with anything else? (Yes/No)"
    user_response ← Get_User_Input()
    IF user_response == "No" THEN
      chatbot_active ← FALSE
      Display "Thank you for using AgroTech Chatbot! Have a great day."
  END WHILE
END
```

## 5.2 External APIs/SDKs

**Table 297 Details of APIs used in the project**

| Name of API and version | Description of API | Purpose of usage | List down the API endpoint/function/class in which it is used |
|---|---|---|---|
| Stripe (version 2020-08-27) | Credit Card payment integration | Sandbox used for the orders payment | stripe.paymentMethods.create |
| JamAI | ChatBot Text Generation | Ai Based Text Generation for Chatting with users | https://api.jamai.com/v1/generate |
| Open-Mateo | Open-Source Weather Api | Fetches weather and humidity data for crop recommendation | fetch_weather_data(location) |
| Firebase | Backend-as-a-Service platform | Google Authentication for user login | firebase.auth().signInWithPopup(), firebase.auth().signOut() |

## 5.3 User Interface

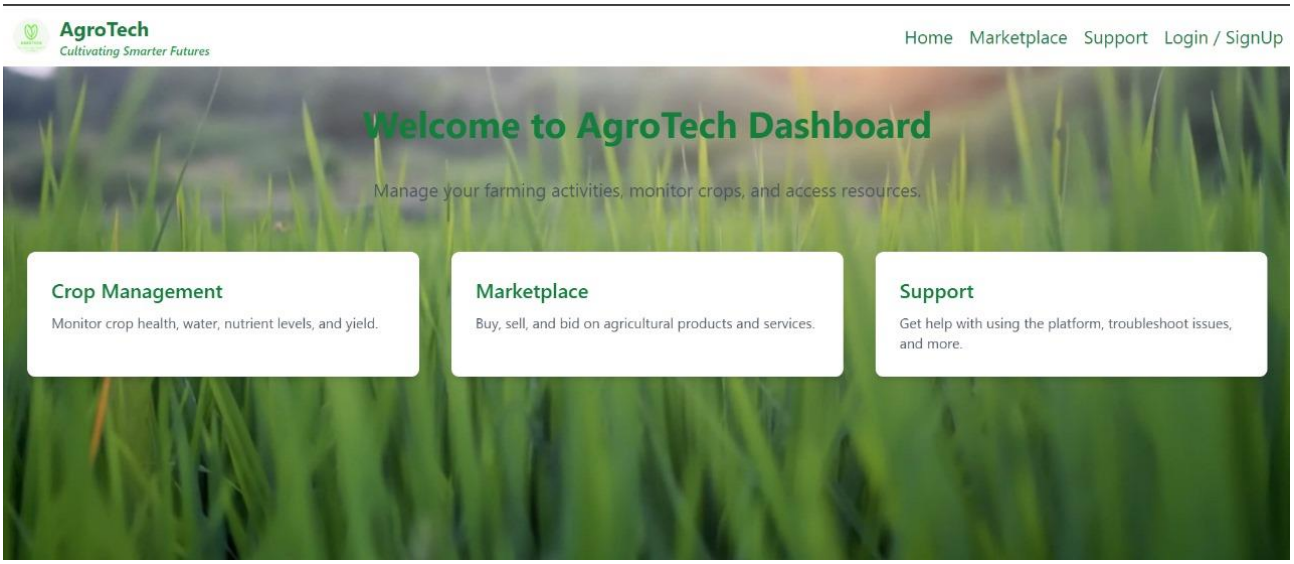


**Figure 60 Home page**

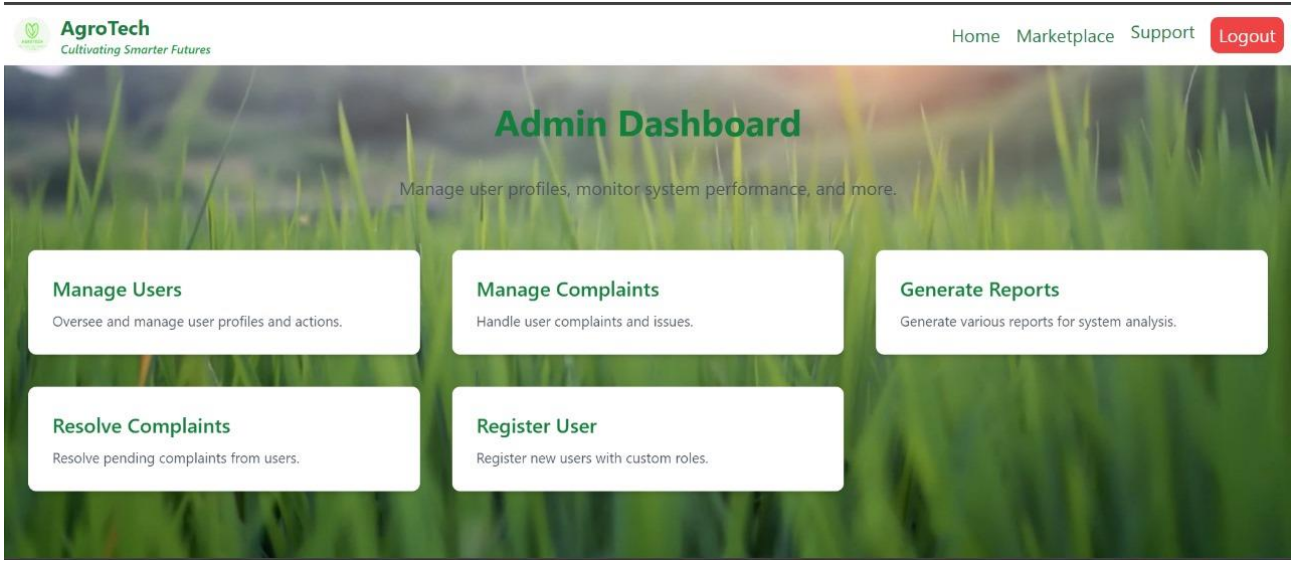


**Figure 62 Admin Dashboard**

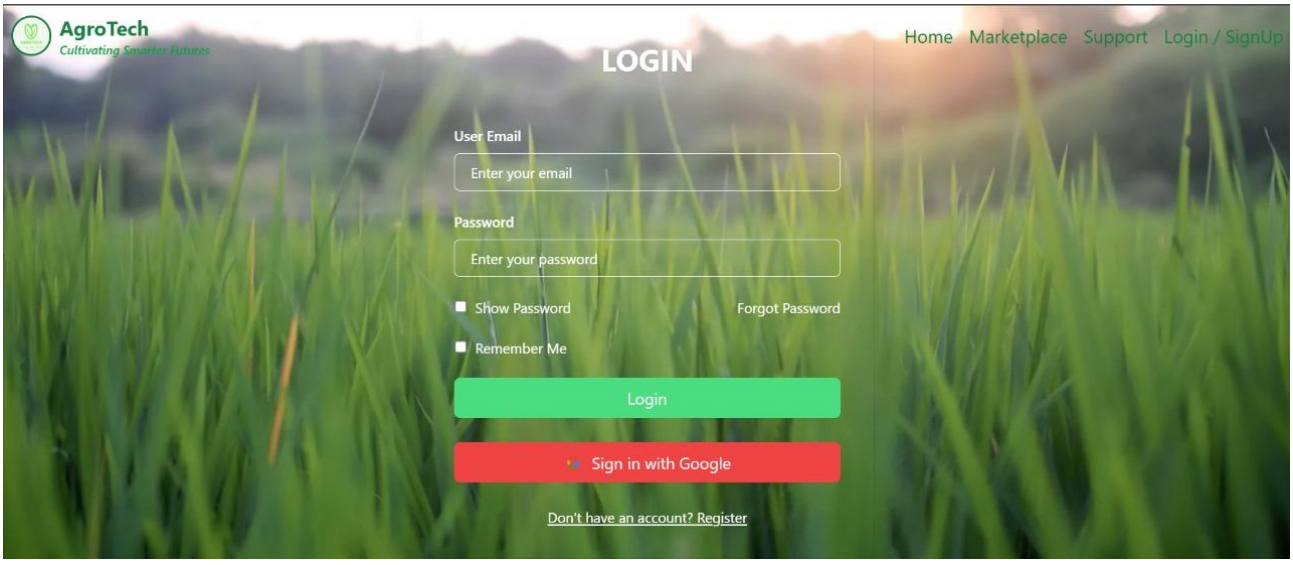


**Figure 63 Login**

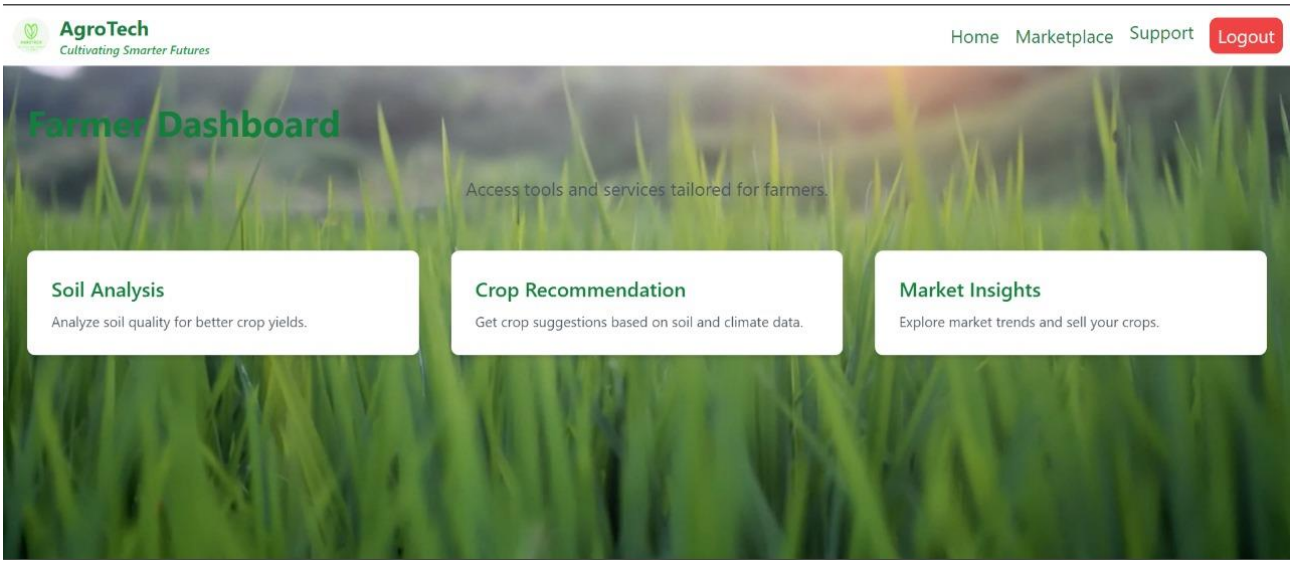


**Figure 61 Farmer Dashboard**

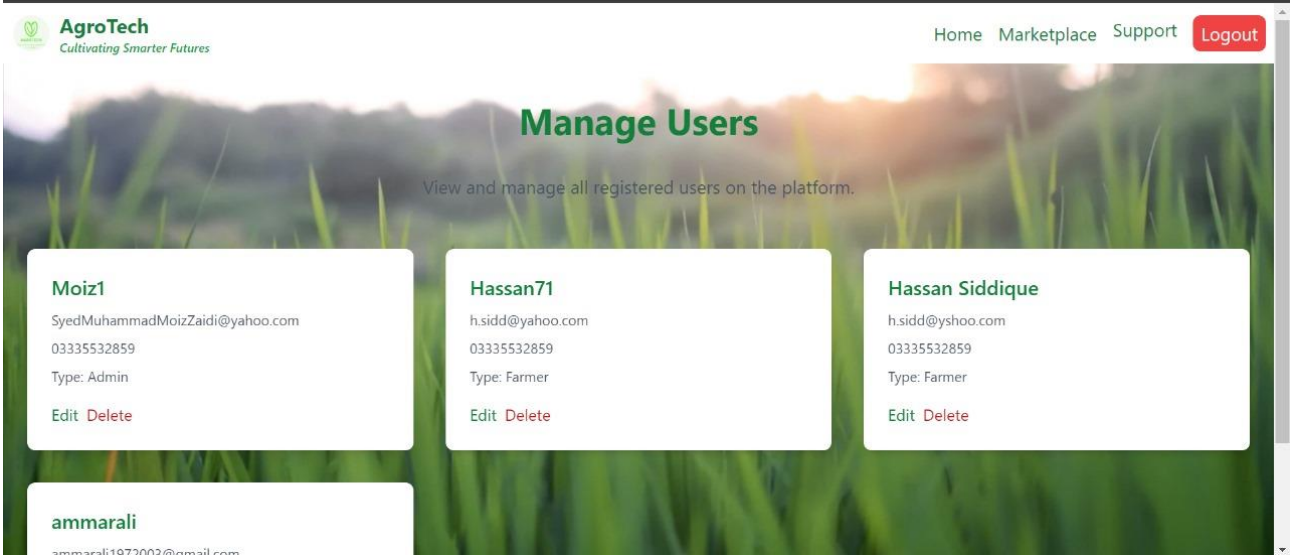


**Figure 65 Manage Users**


**Figure 66 Registeration**

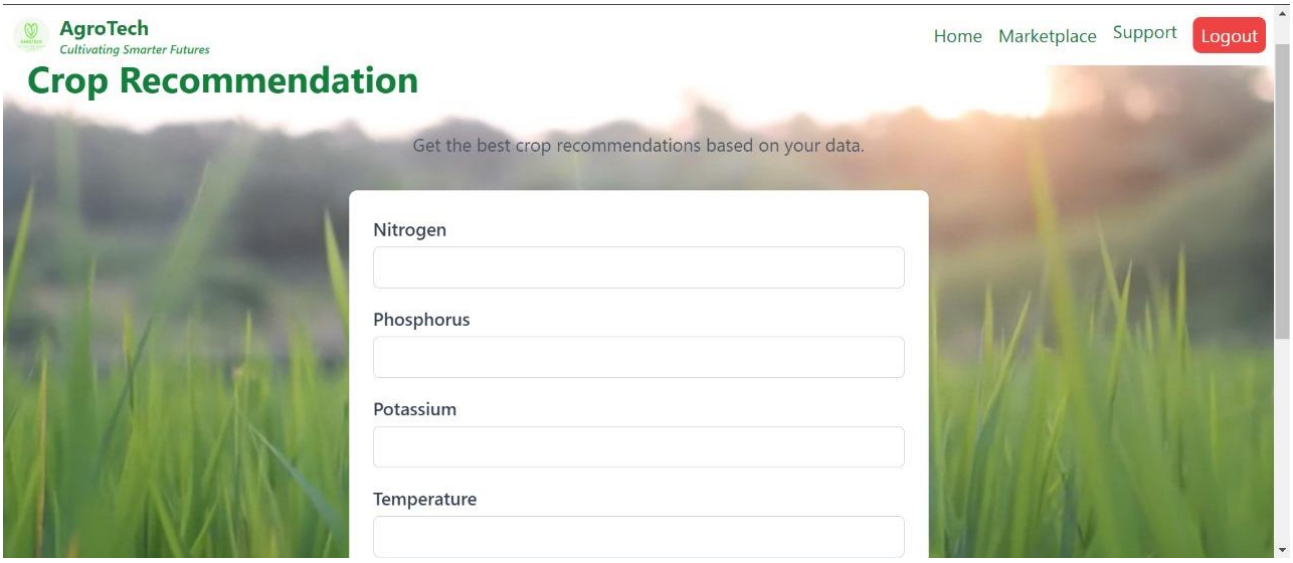


**Figure 64 Crop Recommendation**

## 5.4 Deployment

The AgroTech application's frontend, developed using the React.js framework, will be hosted on **Vercel**, a cloud platform optimized for frontend frameworks and static site generation. Vercel ensures seamless deployment, optimized performance, and scalability, leveraging its Jamstack architecture. The current version of Vercel being utilized is **34.2.0**, providing cutting-edge features for frontend deployment.

For the backend services, we plan to utilize **Heroku**, **Microsoft Azure**, or **Amazon Web Services (AWS)**, depending on the application's scalability, reliability, and infrastructure needs. This combination of Vercel for frontend hosting and one of these leading cloud platforms for backend services ensures a robust, scalable, and efficient deployment solution for the AgroTech application.

# 6 Testing and Evaluation

Once the system has been successfully developed, testing has to be conducted to ensure that the system works as intended. This is also to check that the system meets the requirements stated earlier. Besides that, system testing will help in finding the errors that may be hidden from the user. The testing must be completed before it is deployed for use.

There are a few types of testing which includes unit testing, functional testing and integration testing.
You are *required* to perform each of these in-depth to ensure system quality.

## 6.1 Unit Testing

### 6.1.1 Unit Testing 1: Admin Controller

**Testing Objective:** To ensure the controller is working correctly with valid and invalid credentials/inputs.

**Table 297 Admin Controller Unit Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Result |
|---|---|---|---|---|
| 1 | Fetch all registered users and verify they are returned without passwords. | Request: GET /users | Responds with a list of users without their passwords. | Pass |
| 2 | Update a user's | Request: PUT /users/:userIdBody: { | Responds with | Pass |

| | | | | |
|---|---|---|---|---|
| | details successfully. | "username": "NewName", "email": "newemail@example.com", "userType": "Farmer" } | status 200 and updated user details. | |
| 3 | Attempt to update details for a non-existent user. | Request: PUT /users/:invalidUserId | Responds with status 404 and message "User not found". | Pass |
| 4 | Delete a user successfully and send a deletion email. | Request: DELETE /users/:userId | Responds with status 200 and message "User deleted successfully". Email is sent to the user. | Pass |
| 5 | Attempt to delete a non-existent user. | Request: DELETE /users/:invalidUserId | Responds with status 404 and message "User not found". | Pass |
| 6 | Fetch all complaints successfully. | Request: GET /complaints | Responds with a list of all complaints. | Pass |
| 7 | Resolve a complaint and mark it as "resolved". | Request: PUT /complaints/resolveBody: { "complaintId": "12345", "action": "resolved", "resolutionText": "Resolved explanation" } | Responds with status 200 and updated complaint details. | Pass |
| 8 | Attempt to resolve a non-existent complaint. | Request: PUT /complaints/resolveBody: { "complaintId": "invalidId", "action": "resolved" } | Responds with status 404 and message "Complaint not found". | Pass |
| 9 | Generate a report successfully. | Request: POST /reportsBody: { "reportType": "Sales", "filters": { "year": 2023 } } | Responds with status 200 and new report details. | Pass |
| 10 | Fetch all reports and verify the "generatedBy" field is populated. | Request: GET /reports | Responds with a list of reports with "generatedBy" field populated with user details. | Pass |
| 11 | Register a user as an admin with valid details. | Request: POST /users/registerByAdminBody: { "username": "JohnDoe", "email": "johndoe@example.com", "password": "Secure123!", "userType": "Farmer" } | Responds with status 201 and message "User created successfully and welcome email sent". | Pass |

| | | | | |
|---|---|---|---|---|
| 12 | Attempt to register a user with an invalid user type. | Request: POST /users/registerByAdminBody: { "username": "JaneDoe", "email": "janedoe@example.com", "password": "Secure123!", "userType": "InvalidType" } | Responds with status 400 and message "Invalid user type". | Pass |
| 13 | Attempt to register a user with an existing email. | Request: POST /users/registerByAdminBody: { "username": "JaneDoe", "email": "existingemail@example.com", "password": "Secure123!", "userType": "Farmer" } | Responds with status 400 and message "User already exists". | Pass |

### 6.1.2 Unit Testing 2: AUTH Controller

**Testing Objective:** To ensure the controller is working correctly with valid and invalid credentials/inputs.

**Table 29954 AUTH Controller Unit Testing**

| No. | Function | Test Case/Test Script | Input Example | Expected Result | Result |
|---|---|---|---|---|---|
| 1 | registerUser | Register a new user with valid details. | Body: { "username": "John", "firstName": "John", "lastName": "Doe", "email": "john@example.com", "password": "Password123!", "userType": "Farmer", "phoneNumber": "1234567890" } | Responds with status 201 and message "OTP sent to your email for account activation". | Pass |
| 2 | registerUser | Register a user with an existing email. | Body: { "email": "existingemail@example.com", ... } | Responds with status 400 and message "User already exists". | Pass |
| 3 | registerUser | Register a user with an invalid userType. | Body: { "userType": "InvalidType", ... } | Responds with status 400 and message "Invalid user type". | Pass |
| 4 | registerUser | Register another admin when one already exists. | Body: { "userType": "Admin", ... } | Responds with status 400 and message "An admin is already | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | | | | registered. Only one admin is allowed". | |
| 5 | registerUser | Submit an invalid OTP during account activation. | Body: { "email": "john@example.com", "otp": "123456" } | Responds with status 400 and message "Invalid OTP. Please try again". | Pass |
| 6 | registerUser | Submit a valid OTP for account activation. | Body: { "email": "john@example.com", "otp": "validOTP" } | Responds with status 200 and message "Account activated successfully. Welcome email sent". | Pass |
| 7 | registerUser | Submit an OTP after expiration. | Body: { "email": "john@example.com", "otp": "expiredOTP" } | Responds with status 400 and message "OTP expired. Please register again". | Pass |
| 8 | loginUser | Login with valid credentials. | Body: { "email": "john@example.com", "password": "Password123!" } | Responds with status 200 and message "Login successful" along with user details and token. | Pass |
| 9 | loginUser | Login with incorrect password. | Body: { "email": "john@example.com", "password": "WrongPassword" } | Responds with status 400 and message "Invalid credentials". | Pass |
| 10 | loginUser | Login for a user who has not activated their account. | Body: { "email": "inactive@example.com", "password": "Password123!" } | Responds with status 403 and message "Account is not active. Please verify your email". | Pass |
| 11 | loginUser | Attempt to login a user | Body: { "email": "loggedin@example.com", | Responds with status 400 and | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | | who is already logged in. | "password": "Password123!" } | message "User is already logged in. Please log out first". | |
| 12 | googleLogin | Perform Google login for a new user. | Body: { "email": "googleuser@example.com", "googleId": "Google123", "name": "Google User", "profilePicture": "http://picture.com/image.png" } | Responds with status 200 and message "Google login successful" with user details and token. | Pass |
| 13 | googleLogin | Perform Google login for an existing user without a Google ID. | Body: { "email": "existinguser@example.com", "googleId": "Google123", ... } | Updates the user with Google ID and responds with status 200 and message "Google login successful". | Pass |
| 14 | googleLogin | Perform Google login with missing required fields. | Body: { "email": "user@example.com", "googleId": "" } | Responds with status 400 and message "Missing required fields". | Pass |
| 15 | logoutUser | Logout a logged-in user with a valid token. | Header: Authorization: Bearer <token> | Responds with status 200 and message "Logout successful". | Pass |
| 16 | logoutUser | Attempt to logout without a token. | Header: Authorization not provided. | Responds with status 401 and message "Token not provided". | Pass |
| 17 | logoutUser | Attempt to logout a user who is already logged out. | Header: Authorization: Bearer <token> | Responds with status 400 and message "User is already logged out. Please log in first". | Pass |
| 18 | logoutUser | Logout with an invalid | Header: Authorization: Bearer <invalidToken> | Responds with status 404 and | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | | token. | | message "User not found. Please check the token". | |

### 6.1.3 Unit Testing 3: User Controller

**Testing Objective:** To ensure the controller is working correctly with valid and invalid credentials/inputs.

**Table 30055 User Controller Unit Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Result |
|---|---|---|---|---|
| 1 | Check the email field of forgotPassword to validate that it takes a proper email. | Email: abc@gmail.com | Validates email address and proceeds to generate a reset token. | Pass |
| 2 | Check the email field of forgotPassword to validate that it displays an error for invalid email. | Email: abc.gmail.com | Highlights field and returns { message: 'User not found' }. | Pass |
| 3 | Check the forgotPassword function with a valid email to ensure email is sent successfully. | Email: validuser@example.com | Returns { message: 'Reset email sent successfully' } and saves token and expiration in the database. | Pass |
| 4 | Check the forgotPassword function with an invalid email to validate error handling. | Email: invaliduser@example.com | Returns { message: 'User not found' }. | Pass |
| 5 | Check the resetPassword function with a valid token and new password. | Token: validToken, NewPassword: NewPass123 | Returns { message: 'Password reset successfully' }, clears token and expiration in the database. | Pass |
| 6 | Check the resetPassword function with an expired or invalid token. | Token: expiredToken | Returns { message: 'Invalid or expired token' }. | Pass |
| 7 | Check the updateProfile function to ensure all valid fields update | Valid fields for firstName, lastName, etc. | Returns { message: 'Profile updated successfully', user: | Pass |

| | | | | |
|---|---|---|---|---|
| | successfully. | | updatedUser }. | |
| 8 | Check the updateProfile function with missing fields to ensure partial updates work correctly. | Only firstName or email | Updates only provided fields and keeps others unchanged. | Pass |
| 9 | Check the getUserProfile function to fetch user profile successfully. | User ID: validUserId | Returns { user: userDetails }. | Pass |
| 10 | Check the getUserProfile function with an invalid user ID. | User ID: invalidUserId | Returns { message: 'User not found' }. | Pass |
| 11 | Check the changePassword function with correct current password and new password. | CurrentPassword: correctPass, NewPassword: 123 | Returns { message: 'Password Updated Successfully' }. | Pass |
| 12 | Check the changePassword function with incorrect current password. | CurrentPassword: wrongPass | Returns { message: 'Current Password is Invalid' }. | Pass |
| 13 | Check the deleteUserAccount function to ensure account deletion works. | User ID: validUserId | Returns { message: 'User account deleted successfully' }. | Pass |
| 14 | Check the deleteUserAccount function with an invalid user ID to ensure proper error handling. | User ID: invalidUserId | Returns { message: 'Error deleting account', error }. | Pass |

### 6.1.4 Unit Testing 4: Crop Recommendation Module

**Testing Objective: To ensure the Crop Recommendation module provides accurate recommendations.**

**Table 301 Crop Recommendation Unit Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Result |
|---|---|---|---|---|
| 1 | Get recommended crops based on soil and climate conditions. | Request: GET /crop-recommendation?soilType=Loamy&temperature=25 | Responds with a list of recommended crops. | Pass |
| 2 | Attempt to get | Request: GET /crop-recommendation | Responds | Pass |

| | | | | |
|---|---|---|---|---|
| | recommendations with missing parameters. | | with status 400 and message "Missing required parameters". | |

### 6.1.5 Unit Testing 5: Chatbot Module

**Testing Objective: To ensure the chatbot responds correctly to queries.**

**Table 302 Chatbot Unit Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Result |
|---|---|---|---|---|
| 1 | Ask the chatbot a valid question. | Request: POST /chatbot Body: { "question": "How to grow wheat?" } | Responds with an informative answer. | Pass |
| 2 | Send an empty query. | Request: POST /chatbot Body: { "question": "" } | Responds with status 400 and message "Question cannot be empty". | Pass |

### 6.1.6 Unit Testing 6: Crop Health Monitoring Module

**Testing Objective: To verify the system correctly identifies crop health issues.**

**Table 303 Crop Health Monitoring Unit Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Result |
|---|---|---|---|---|
| 1 | Upload an image of a crop with disease symptoms. | Request: POST /crop-health Body: { "image": "diseased_crop.jpg" } | Responds with status 200 and diagnosis details. | Pass |
| 2 | Upload an unsupported file format. | Request: POST /crop-health Body: { "image": "document.pdf" } | Responds with status 400 and message "Invalid file format". | Pass |

### 6.1.7 Unit Testing 7: Online Marketplace Module

**Testing Objective: To ensure the marketplace functions correctly.**

**Table 304 Online Marketplace Unit Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Result |
|---|---|---|---|---|
| 1 | List a new product for sale. | Request: POST /marketplace Body: { "name": "Tomatoes", | Responds with status 201 and product details. | Pass |

| | | | | |
|---|---|---|---|---|
| | | "price": 100, "quantity": 50 } | | |
| 2 | Attempt to list a product without required fields. | Request: POST /marketplace Body: { "name": "" } | Responds with status 400 and message "Missing required fields". | Pass |

## 6.2 Functional Testing

### 6.2.1 Functional Testing 1: Admin Controller

**Objective**: To ensure that the controller is working properly.

**Table 30556 Admin Controller Functional Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Actual Result | Result |
|---|---|---|---|---|---|
| 1 | Login as an Admin to view registered users. | Admin credentials: Username: admin Password: 1234 | Successfully logged in as Admin. List of all registered users displayed (excluding passwords). | List of users displayed correctly. | Pass |
| 2 | Attempt to fetch registered users as non-admin. | Non-admin credentials: Username: customer123 Password: password | Access denied with a 403 Forbidden response. | Correct error message returned. | Pass |
| 3 | Update user details by Admin. | User ID: 12345 Username: newUsername Email: newemail@example.com | User details updated successfully with a confirmation message. | User details updated in the database. | Pass |
| 4 | Attempt to update user details with invalid ID. | User ID: invalidID Email: invalidemail | "User not found" error returned with a 404 response. | Correct error message displayed. | Pass |
| 5 | Delete a user by Admin. | User ID: 67890 | User deleted successfully. Email notification sent to the deleted user. | User deleted and email sent successfully. | Pass |
| 6 | Attempt to | User ID: invalidID | "User not found" | Correct error | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | delete a non-existent user. | | error returned with a 404 response. | message displayed. | |
| 7 | Fetch all complaints raised in the system. | None | List of complaints displayed successfully. | Complaints fetched and displayed. | Pass |
| 8 | Resolve a complaint. | Complaint ID: 98765 Action: "resolved" Resolution Text: "Issue addressed." | Complaint status updated to "resolved" with the resolution text saved. | Complaint resolved and status updated. | Pass |
| 9 | Attempt to resolve a non-existent complaint. | Complaint ID: invalidID | "Complaint not found" error returned with a 404 response. | Correct error message displayed. | Pass |
| 10 | Generate a report. | Report Type: "User Statistics" Filters: None | Report created successfully with data logged in the system. | Report generated and saved successfully. | Pass |
| 11 | Fetch all generated reports. | None | List of all reports displayed successfully. | Reports fetched and displayed correctly. | Pass |
| 12 | Register a user by Admin. | Username: newUser Email: user@example.com Password: pass123 User Type: Farmer | User created successfully. Welcome email sent to the user. | User created and email sent successfully. | Pass |
| 13 | Attempt to register a user with an invalid type. | Username: invalidUser Email: invalid@example.com Password: pass123 User Type: InvalidType | "Invalid user type" error returned with a 400 response. | Correct error message displayed. | Pass |
| 14 | Attempt to register a user with an existing email. | Username: newUser Email: existing@example.com Password: pass123 User Type: Customer | "User already exists" error returned with a 400 response. | Correct error message displayed. | Pass |

### 6.2.2 Functional Testing 2: AUTH Controller

**Objective**: To ensure that the controller is working properly.

**Table 30657 AUTH Controller Functional Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Actual Result | Result |
|---|---|---|---|---|---|
| 1 | Register a new user with valid data. | Username: JohnDoeEmail: johndoe@example.comPassword: Pass@1234UserType: Farmer | OTP is sent to the registered email, and a message confirms successful registration. | OTP email received, and confirmation message displayed. | Pass |
| 2 | Register with an existing email. | Email: johndoe@example.com | Registration fails with a message: "User already exists." | Registration failed with expected message. | Pass |
| 3 | Register with invalid password. | Password: pass123 | Registration fails with a message: "Password must contain at least 8 characters, one uppercase, one lowercase, one number, and one special character." | Registration failed with expected message. | Pass |
| 4 | Register as Admin when an admin already exists. | UserType: Admin | Registration fails with a message: "An admin is already registered. Only one admin is allowed." | Registration failed with expected message. | Pass |
| 5 | Activate account | OTP: (Valid OTP sent to the email during registration) | Account is activated | Account activated | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | using valid OTP. | | successfully, and a welcome email is sent to the registered email. | and welcome email received. | |
| 6 | Activate account using expired OTP. | OTP: 123456 (expired) | Activation fails with a message: "OTP expired. Please register again." | Activation failed with expected message. | Pass |
| 7 | Activate account using invalid OTP. | OTP: 999999 (invalid) | Activation fails with a message: "Invalid OTP. Please try again." | Activation failed with expected message. | Pass |
| 8 | Login with valid credentials. | Email: johndoe@example.comPassword: Pass@1234 | Login successful, JWT token is generated, and the user is redirected to their dashboard. | Logged in and redirected successfully. | Pass |
| 9 | Login with invalid credentials. | Email: johndoe@example.comPassword: wrongpass | Login fails with a message: "Invalid credentials." | Login failed with expected message. | Pass |
| 10 | Login for an inactive account. | Email: janedoe@example.comPassword: Pass@1234 | Login fails with a message: "Account is not active. Please verify your email." | Login failed with expected message. | Pass |
| 11 | Login for a logged- | Email: johndoe@example.comPassword: | Login fails with a | Login failed with | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | in user. | Pass@1234 (while the user is logged in) | message: "User is already logged in. Please log out first." | expected message. | |
| 12 | Google login with new account. | Email: newgoogleuser@example.comGoogleID: 12345Name: Google User | User is created, marked as active, and redirected with a valid token. | Account created, token generated successfully. | Pass |
| 13 | Google login for existing account. | Email: existinguser@example.comGoogleID: 67890Name: Existing User | User details are updated with the Google ID, and the user is logged in successfully. | Logged in successfully. | Pass |
| 14 | Logout for an active user. | Token: Valid JWT token | User is logged out, and isLoggedIn is set to false. | Logged out successfully. | Pass |
| 15 | Logout without providing a token. | No token provided | Logout fails with a message: "Token not provided." | Logout failed with expected message. | Pass |
| 16 | Logout for an already logged-out user. | Email: johndoe@example.com (while isLoggedIn is false) | Logout fails with a message: "User is already logged out. Please log in first." | Logout failed with expected message. | Pass |

### 6.2.3 Functional Testing 3: User Controller

**Objective**: To ensure that the controller is working properly.

**Table 30758 User Controller Functional Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Actual Result | Result |
|---|---|---|---|---|---|
| 1 | Forgot Password with valid email. | Email: johndoe@example.com | A password reset email is sent successfully to the registered email address with a reset URL. | Password reset email sent successfully. | Pass |
| 2 | Forgot Password with non-existing email. | Email: notfound@example.com | A message is returned: "User not found." | Message: "User not found." | Pass |
| 3 | Forgot Password and failure to send email. | Email: johndoe@example.com | Failure message returned: "Error sending email. Please try again later." | Error sending email, message returned as expected. | Pass |
| 4 | Reset Password with valid token. | Token: valid-tokenNewPassword: NewPass@1234 | The password is updated successfully, and the user is able to log in with the new password. | Password updated successfully. | Pass |
| 5 | Reset Password with expired token. | Token: expired-tokenNewPassword: NewPass@1234 | The reset fails with the message: "Invalid or expired token." | Password reset failed with expected message. | Pass |
| 6 | Reset Password with invalid token. | Token: invalid-tokenNewPassword: NewPass@1234 | The reset fails with the message: "Invalid or expired | Password reset failed with expected message. | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | | | token." | | |
| 7 | Update Profile with valid data. | FirstName: JohnLastName: DoeEmail: newemail@example.comPhoneNumber: 1234567890 | Profile updated successfully with new data. | Profile updated with new data. | Pass |
| 8 | Update Profile with missing data. | Email: newemail@example.comPhoneNumber: 1234567890 | Only provided fields are updated (first name, last name, user type remain unchanged). | Profile updated with partial data. | Pass |
| 9 | Update Profile for non-existing user. | User not found | The system returns: "User not found." | User not found message displayed. | Pass |
| 10 | Get User Profile for logged-in user. | Valid JWT token | The user profile is returned successfully. | User profile returned successfully. | Pass |
| 11 | Get User Profile for non-existing user. | Invalid JWT token | A message is returned: "User not found." | User not found message displayed. | Pass |
| 12 | Change Password with correct current password. | CurrentPassword: OldPass@1234NewPassword: NewPass@1234 | The password is successfully updated, and the user can log in with the new password. | Password updated successfully. | Pass |
| 13 | Change Password with incorrect current password. | CurrentPassword: WrongPass@1234NewPassword: NewPass@1234 | Error message returned: "Current password is invalid." | Error message returned as expected. | Pass |
| 14 | Change Password with | NewPassword: NewPass@1234 | Error message returned: | Error message returned as | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | missing current password. | | "Current password is required." | expected. | |
| 15 | Delete User Account for logged-in user. | Valid JWT token | The user account is deleted successfully, and a success message is returned. | User account deleted successfully. | Pass |
| 16 | Delete User Account for non-existing user. | Invalid JWT token | Error message returned: "User not found." | Error message returned as expected. | Pass |

### 6.2.4 Functional Testing 4: Crop Health Monitoring

**Objective:** To ensure that crop health monitoring functionalities are working correctly.

**Table 308 Crop Health Monitoring Functional Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Actual Result | Result |
|---|---|---|---|---|---|
| 1 | Identify stress in crops. | Image of stressed crop uploaded | System detects water, nutrient, or pest stress and provides recommendations. | System correctly identifies stress type and provides recommendations. | Pass |
| 2 | Classify disease in crop. | Image of infected crop uploaded | Disease classified correctly against the database. | Disease identified and classified accurately. | Pass |
| 3 | Provide periodic crop health report. | Scheduled report request | System generates and sends a report with images and analysis. | Report generated and sent successfully. | Pass |

### 6.2.5 Functional Testing 5: Yield Estimation and Prediction

**Objective:** To ensure yield estimation and prediction functionalities are accurate.

**Table 309 Yield Estimation and Prediction Functional Testing**

| No. | Test Case/Test | Attribute and | Expected Result | Actual Result | Result |
|---|---|---|---|---|---|

| | Script | Value | | | |
|---|---|---|---|---|---|
| 1 | Estimate crop yield based on input parameters. | Temperature: 25°C, Rainfall: 100mm, Soil Moisture: 40% | System predicts estimated yield in tons/hectare. | Yield estimated accurately. | Pass |
| 2 | Assess risk factors affecting yield. | Input disease and weather data | System provides insights on possible risks and mitigation measures. | Risks identified, and mitigation strategies provided. | Pass |

### 6.2.6 Functional Testing 6: Harvesting

**Objective:** To ensure harvesting scheduling and tools recommendation work as expected.

**Table 310 Harvesting Functional Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Actual Result | Result |
|---|---|---|---|---|---|
| 1 | Schedule a harvesting event. | Crop: Wheat, Date: 15th July | Harvesting scheduled successfully, and reminders set. | Event scheduled and reminder set. | Pass |
| 2 | Recommend harvesting tools. | Crop: Corn | System recommends appropriate tools for harvesting corn. | Tools recommended successfully. | Pass |

### 6.2.7 Functional Testing 7: Online Marketplace

**Objective:** To ensure the marketplace functions correctly.

**Table 311 Online Marketplace Functional Testing**

| No. | Test Case/Test Script | Attribute and Value | Expected Result | Actual Result | Result |
|---|---|---|---|---|---|
| 1 | List a crop for sale. | Crop: Tomatoes, Price: $5/kg | Crop listed successfully in the marketplace. | Crop appears in marketplace. | Pass |
| 2 | Place an order for a listed crop. | Crop: Tomatoes, Quantity: 10kg | Order placed successfully. | Order confirmed and reflected in dashboard. | Pass |
| 3 | Bid on a crop. | Crop: Rice, Bid: $4/kg | Bid placed successfully and updated in the system. | Bid successfully placed and updated. | Pass |

## 6.3 Business Rules Testing

### 6.3.1 Admin Controller

**Table 312 Admin Controller Business Rules Testing**

| Condition | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|---|---|---|---|---|---|---|---|---|
| **Username exists** | T | T | F | F | T | T | F | F |
| **Password is correct** | T | F | T | F | T | F | T | F |
| **Account is active** | T | T | T | T | F | F | F | F |
| **Actions** | | | | | | | | |
| **Login successful** | T | F | F | F | F | F | F | F |
| **Display "Invalid username" error** | F | F | T | T | F | F | T | T |
| **Display "Invalid password" error** | F | T | F | T | F | T | F | T |

### 6.3.2 AUTH Controller

**Table 313 AUTH Controller Business Rules Testing**

| Condition | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|---|---|---|---|---|---|---|---|---|
| **Username exists** | T | T | F | F | T | T | F | F |
| **Password is correct** | T | F | T | F | T | F | T | F |
| **Account is active** | T | T | T | T | F | F | F | F |
| **Actions** | | | | | | | | |
| **Login successful** | T | F | F | F | F | F | F | F |
| **Display "Invalid username" error** | F | F | T | T | F | F | T | T |
| **Display "Invalid password" error** | F | T | F | T | F | T | F | T |

### 6.3.3 User Controller

**Table 314 User Controller Business Rules Testing**

| Condition | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|---|---|---|---|---|---|---|---|---|
| **Username exists** | T | T | F | F | T | T | F | F |
| **Password is correct** | T | F | T | F | T | F | T | F |
| **Account is active** | T | T | T | T | F | F | F | F |
| **Actions** | | | | | | | | |
| **Login successful** | T | F | F | F | F | F | F | F |
| **Display "Invalid username" error** | F | F | T | T | F | F | T | T |
| **Display "Invalid password" error** | F | T | F | T | F | T | F | T |
| **Display "Account is not active" error** | F | F | F | F | T | T | T | T |
| **Display "Token expired" error** | F | F | F | F | F | T | T | T |
| **Display "Password reset successfully"** | F | F | F | T | T | F | F | F |
| **Display "Error updating password"** | F | F | F | F | F | F | T | F |
| **Display "Account deleted successfully"** | F | F | F | F | F | F | F | T |

### 6.3.4 Crop Health Monitoring Controller

**Table 315 Crop Health Monitoring Controller Business Rules Testing**

| Condition | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|---|---|---|---|---|---|---|---|---|
| Image is uploaded | T | T | F | F | T | T | F | F |
| Valid crop detected | T | F | T | F | T | F | T | F |
| Model processes image | T | T | T | T | F | F | F | F |
| **Actions** | | | | | | | | |
| Display crop health status | T | F | F | F | F | F | F | F |
| Display "Invalid image" error | F | F | T | T | F | F | T | T |
| Display "Processing error" | F | T | F | T | F | T | F | T |

### 6.3.5 Yield Estimation Controller

**Table 316 Admin Controller Business Rules Testing**

| Condition | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|---|---|---|---|---|---|---|---|---|
| Valid data provided | T | T | F | F | T | T | F | F |
| Model is available | T | F | T | F | T | F | T | F |
| Prediction is generated | T | T | T | T | F | F | F | F |
| **Actions** | | | | | | | | |
| Display yield estimate | T | F | F | F | F | F | F | F |
| Display "Invalid data" error | F | F | T | T | F | F | T | T |
| Display "Prediction error" | F | T | F | T | F | T | F | T |

### 6.3.6 Harvesting Controller

**Table 317 Harvesting Controller Business Rules Testing**

| Condition | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|---|---|---|---|---|---|---|---|---|
| Schedule is created | T | T | F | F | T | T | F | F |
| Valid crop type selected | T | F | T | F | T | F | T | F |
| Equipment available | T | T | T | T | F | F | F | F |
| **Actions** | | | | | | | | |
| Display harvest schedule | T | F | F | F | F | F | F | F |
| Display "Invalid crop type" error | F | F | T | T | F | F | T | T |
| Display "Equipment not available" error | F | T | F | T | F | T | F | T |

### 6.3.7 Transportation Controller

**Table 31859 Transportation Controller Business Rules Testing**

| Condition | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|---|---|---|---|---|---|---|---|---|
| Pickup location provided | T | T | F | F | T | T | F | F |
| Delivery location provided | T | F | T | F | T | F | T | F |
| Route available | T | T | T | T | F | F | F | F |

| Actions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Display transportation details | T | F | F | F | F | F | F | F |
| Display "Invalid pickup/delivery" error | F | F | T | T | F | F | T | T |
| Display "Route unavailable" error | F | T | F | T | F | T | F | T |

### 6.3.8 Storage Controller

**Table 319 Storage Controller Business Rules Testing**

| Condition | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|---|---|---|---|---|---|---|---|---|
| Storage request created | T | T | F | F | T | T | F | F |
| Climate control enabled | T | F | T | F | T | F | T | F |
| Space available | T | T | T | T | F | F | F | F |
| **Actions** | | | | | | | | |
| Display storage details | T | F | F | F | F | F | F | F |
| Display "Invalid storage request" error | F | F | T | T | F | F | T | T |
| Display "Storage full" error | F | T | F | T | F | T | F | T |

## 6.4 Integration Testing

### 6.4.1 Integration Testing 1: Register User

**Testing Objective:** To ensure that user is registered after proper process.

**Table 320 Register User Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1. | Register User (Valid) | username: "johnDoe", email: "john@example.com", password: "Password123", userType: "Farmer" | Successfully register user and send OTP to email for verification. | OTP sent to user email for account activation. | Pass |
| 2. | Register User (User Exists) | email: "john@example.com" (Already exists) | Return error "User already exists". | Error returned: "User already exists". | Pass |
| 3. | Register User | userType: "Admin" (Admin | Return error "An | Error | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | (Invalid User Type) | already registered) | admin is already registered". | returned: "An admin is already registered". | |
| 4. | Register User (Invalid Password) | password: "123" | Return error "Password is too weak". | Error returned: "Password is too weak". | Pass |
| 5. | Register User (OTP Verification) | otp: "123456" | Successfully verify OTP and activate the user account. | Account activated, welcome email sent. | Pass |

### 6.4.2 Integration Testing 2: Login User

**Testing Objective:** To ensure that login is properly verified.

**Table 321 Login User Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1. | Login User (Valid) | email: "john@example.com", password: "Password123", rememberMe: true | Successfully login user and return token. | User logged in, token generated. | Pass |
| 2. | Login User (Invalid Credentials) | email: "john@example.com", password: "WrongPassword" | Return error "Invalid credentials". | Error returned: "Invalid credentials". | Pass |
| 3. | Login User (Inactive Account) | email: "john@example.com", password: "Password123", isActive: false | Return error "Account is not active. Please verify your email". | Error returned: "Account is not active. Please verify your email". | Pass |
| 4. | Login User (Already Logged In) | email: "john@example.com", password: "Password123", isLoggedIn: true | Return error "User is already logged in. Please log out first". | Error returned: "User is already logged in. Please log out first". | Pass |

### 6.4.3 Integration Testing 3: Forgot Password

**Testing Objective:** To ensure that email is sent for forgotten password.

**Table 322 Forgot Password Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1. | Forgot Password (Valid) | email: "john@example.com" | Successfully send reset password email. | Reset email sent. | Pass |
| 2. | Forgot Password (User Not Found) | email: "notfound@example.com" | Return error "User not found". | Error returned: "User not found". | Pass |
| 3. | Forgot Password (Email Sending Failure) | email: "john@example.com" (Simulate email sending failure) | Return error "Error sending email". | Error returned: "Error sending email". | Pass |

### 6.4.4 Integration Testing 4: Reset Password

**Testing Objective:** To ensure that password is reset securely and properly.

**Table 323 Reset Password Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1. | Reset Password (Valid Token) | token: "validToken", newPassword: "NewPassword123" | Successfully reset the password. | Password reset successfully. | Pass |
| 2. | Reset Password (Invalid or Expired Token) | token: "expiredToken", newPassword: "NewPassword123" | Return error "Invalid or expired token". | Error returned: "Invalid or expired token". | Pass |
| 3. | Reset Password (Invalid Password) | token: "validToken", newPassword: "123" | Return error "Password is too weak". | Error returned: "Password is too weak". | Pass |

### 6.4.5 Integration Testing 5: Update Profile

**Testing Objective:** To ensure that profile is updating the details.

**Table 324 Update Profile Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1. | Update Profile (Valid Update) | firstName: "John", lastName: "Doe", email: "john@example.com", userType: "Farmer", phoneNumber: "1234567890" | Successfully update profile with new details. | Profile updated with new details. | Pass |
| 2. | Update Profile (User Not Found) | firstName: "John" (User does not exist) | Return error "User not found". | Error returned: "User not found". | Pass |

### 6.4.6 Integration Testing 6: Change Password

**Testing Objective:** To ensure that change password is securely and properly done.

**Table 325 Change Password Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1. | Change Password (Valid Current Password) | currentPassword: "Password123", newPassword: "NewPassword123" | Successfully change the password. | Password changed successfully. | Pass |
| 2. | Change Password (Invalid Current Password) | currentPassword: "WrongPassword", newPassword: "NewPassword123" | Return error "Current password is invalid". | Error returned: "Current password is invalid". | Pass |

### 6.4.7 Integration Testing 7: Delete User

**Testing Objective:** To ensure user is deleted properly.

**Table 326 Delete User Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1. | Delete User | userId: "validUserId" | Successfully | Account deleted | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | Account (Valid) | | delete user account. | successfully. | |
| 2. | Delete User Account (User Not Found) | userId: "nonExistentUserId" | Return error "User not found". | Error returned: "User not found". | Pass |

### 6.4.8 Integration Testing 8: Crop Health Monitoring

**Testing Objective:** To ensure crop health monitoring features function correctly.

**Table 327 Crop Health Monitoring Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1 | Identify Crop Stress (Valid) | image: "healthy_crop.jpg" | Return "No stress detected" | "No stress detected" | Pass |
| 2 | Identify Crop Stress (Water Deficiency) | image: "dry_crop.jpg" | Return "Water stress detected" | "Water stress detected" | Pass |
| 3 | Identify Crop Disease (Valid) | image: "infected_crop.jpg" | Return "Disease identified: Blight" | "Disease identified: Blight" | Pass |
| 4 | Provide Periodic Crop Health Report | Scheduled check | Return report with health analysis | Report generated | Pass |

### 6.4.9 Integration Testing 9: Yield Estimation and Prediction

**Testing Objective:** To ensure yield estimation is accurate.

**Table 328 Yield Estimation and Prediction Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1 | Estimate Yield (Valid Data) | temp: "30C", rainfall: "100mm", soil: "Optimal" | Return yield estimate | Yield estimate provided | Pass |
| 2 | Estimate Yield (Missing Data) | temp: "30C", rainfall: "", soil: "Optimal" | Return error "Insufficient data" | Error returned | Pass |

### 6.4.10 Integration Testing 10: Harvesting

**Testing Objective:** To ensure harvesting features function properly.

**Table 329 Harvesting Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1 | Schedule Harvesting (Valid) | crop: "Wheat", date: "2025-03-10" | Harvesting scheduled | Harvesting scheduled | Pass |

| | | | | | |
|---|---|---|---|---|---|
| | | | successfully | | |
| 2 | Schedule Harvesting (Invalid Date) | crop: "Wheat", date: "Invalid" | Return error "Invalid date" | Error returned | Pass |

### 6.4.11 Integration Testing 11: Transportation

**Testing Objective**: To ensure transportation services work correctly.

**Table 330 Transportation Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1 | Book Transport (Valid) | pickup: "Farm A", drop: "Market B" | Transport booked successfully | Transport booked | Pass |
| 2 | Book Transport (Invalid Location) | pickup: "Unknown", drop: "Market B" | Return error "Invalid location" | Error returned | Pass |

### 6.4.12 Integration Testing 12: Storage

**Testing Objective:** To ensure storage management works properly.

**Table 331 Storage Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1 | Reserve Storage (Valid) | storageType: "Cold", quantity: "100kg" | Storage reserved successfully | Storage reserved | Pass |
| 2 | Reserve Storage (Exceeds Limit) | storageType: "Cold", quantity: "10000kg" | Return error "Storage capacity exceeded" | Error returned | Pass |

### 6.4.13 Integration Testing 13: Online Marketplace

**Testing Objective:** To ensure online marketplace functionalities work correctly.

**Table 332Online Marketplace Integration Testing**

| No. | Test case/Test script | Attribute and value | Expected result | Actual result | Result |
|---|---|---|---|---|---|
| 1 | List Item (Valid) | name: "Wheat", price: "100" | Item listed successfully | Item listed | Pass |
| 2 | Buy Item (Valid) | itemID: "1234", quantity: "10" | Order placed successfully | Order placed | Pass |

### 6.4.14 Integration Testing 14: Reports and Analytics

**Testing Objective:** To ensure reports and analytics work correctly.

**Table 33360Reports and Analytics Integration Testing**

| No. | Test case/Test script | Attribute and | Expected result | Actual | Result |
|---|---|---|---|---|---|

| | | value | | result | |
|---|---|---|---|---|---|
| 1 | Generate Sales Report | duration: "Last Month" | Report generated successfully | Report generated | Pass |
| 2 | Generate User Engagement Report | filter: "Most Active Users" | Report generated successfully | Report generated | Pass |

# 7 Conclusion and Future Work

This chapter concludes the project and highlights future work.

## 7.1 Conclusion

AgroTech is being developed as a comprehensive agricultural assisting platform, including features such as soil analysis, crop analysis, crop recommendation, health monitoring, yield estimation, harvesting management, transport and storage assist and online marketplace. By utilizing AI, machine learning, and scheduled data processing, the platform provides accurate decision-making and resource optimization for farmers. The implementation of automated analysis for crop health, yield estimation and logistics planning enhance the efficiency of modern farming. Despite the challenges in integrating multiple functionalities within the same and single platform. AgroTech successfully demonstrates a scalable and practical solution for farmers. This platform bridges the gap between traditional farming practices, technology insights and digital commerce, making agricultural processes more efficient, profitable and sustainable.

## 7.2 Future Work

Future work for AgroTech will be focusing on expanding the AI capabilities for more precise crop health monitoring and yield estimation based on environmental factors and scheduled data. Along with that integrating a chatbot for instant farmer assistance will improve user engagement by providing quick solutions to queries about farming practices, disease management and marketplace operation and platform’s options and opportunities. The harvesting assist will optimize scheduling and resource allocation for improved efficiency, while storage assist will enhance post-harvest management by providing better storage recommendations based on crop type, quality and season. Implementing crop maturity assessment using AI-driven image processing will enable farmers to determine the best time for harvesting the maximum yield and quality. Lastly, continuous user feedback and iterative updates will be essential for improving the platform’s usability and effectiveness.

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