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POLITECNICO DI MILANO

# RASD: Requirement Analysis and Specification Document

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# 1 Introduction

*Data-driven Predictive Farming*, also known as *DREAM*, is a project presented by UNDP India and Healthsites initiative, promoted by Telangana's government. The aim of the project is to enhance the farm system and the entire food supply chain with an IT supporting application. This arises from modern challenges like climate change and the foreseen population growth that have underlined the critical issues of the modern system making necessary a complete overhaul.

## 1.1 Purpose

*DREAM* aims to support work categories involved into the farming industry by providing them relevant and up-to-date data about the farm activity's performance. The main stakeholders are: Telangana's policy makers, farmers and agronomists. The goal is to develop a data-driven application with the help of IT partners. Telangana's state already collect important data concerning wheather forecast, these data are publicly available with a live rainfall map on the official government website. Other data can be collected through humidity sensors deployed all over the territory and through the water irrigation system.

Agriculture has a main role in India's economy, more than half of the population depends on it and about a fifth is below the poverty line. Furthermore, as a significant increment in population is expected for 2050 (*UN's* esteem), food demand is going to significantly increase. Telangana needs an efficient application to increase the general productivity of the farm system.

The user base is expected to be the entire population of Telangana, starting with those who works in the agriculture sector up to normal citizens.

## 1.2 Scope

### Phenomena controlled by the Machine

ID	Phenomenom	Shared
M1	Check username and password	No
M2	Analysis of best practices	No
M3	Analysis of weather data	No
M4	Visualize data concerning weather, land, performance	Yes

## Phenomena controlled by the World

ID	Phenomenom	Shared
W1	User login	Yes
W2	User share best practice	Yes
W3	User ask for help on forum	Yes
W4	Collect land data from sensor	Yes
W5	User create topic in forum	Yes
W6	User insert post	Yes
W7	User reply to a post	Yes
W8	User update daily plan	Yes
W9	User check weather forecast	Yes

### 1.2.1 Goals

#### Shared goals

1. **(G1) Make crops weather-resilient across the State**

The aim of every stakeholder of the project is to grow more resilient crops to raise the productivity. This means more product to sell for the farmers as well as, for the policy makers and agronomists, more supply on the market to satisfy the increasing demand of the population.

2. **(G2) Reach out to farmers in need of help**

Farmers that struggle with their cultivation wish to be helped and turn around their business in a positive way, since their income depend on that. At the same time, given the forseen food supply demand, policy makers and agronomists strive for reaching the maximum potential of every suppliers.

#### Telangana's policy makers

1. **(G3) Identification of well-performing farmers**

Main goal of the policy makers is to identify farmers that are resilient to meteorological adverse events. This can be done comparing the productivity ratio defined as the produced amount per product in adverse condition over the amount in standard conditions. This farmers will receive special incentives and will be asked to help other farmers with useful practices.

2. **(G4) Identification of bad-performing farmers**

Identify farmers that are performing badly in order to seek the help for them to get back on track. In fact, they are the ones that need to be helped by the well-performing farmers.

3. **(G5) Visualize the results of steering initiatives**

Visualize and evaluate the results produced by the steering initiatives from agronomists and good farmers in order to assess which are resulting useful and actually improving the food production system, so that those practices can be applied on a larger scale.

Farmers

1. **(G6) Visualize relevant data for the business**

Visualize important data like weather forecast and personalized suggestion about specific crops or fertilizers. All data are based on location and type of production.

2. **(G7) Keep track of the production**

Insert data about their production to identify trends of their own doings, especially bad ones undermining their revenue. Register every type of problem they're experiencing for further inspection with the help of experts in the field.

3. **(G8) Request for help/suggestion**

Farmers can request help with a text message that will be sent directly to the agronomists responsible of the area to better their practice both in critical conditions and for improvement purposes. Thanks to this, the farmers are not required to know directly the contact of one of the agronomists, because the system will provide the contacts of the area they need automatically.

4. **(G9) Create and participate in discussions concerning the agriculture field**

Create forums to discuss with the other farmers. This feature shall allow a farmer-user to choose the name of a new topic they wish to introduce in the forum and to join all already open discussions. The purpose of this is to ease the cultivation-related knowledge spreading from which every farmer would benefit.

## Agronomists

### 1. **(G10) Receive requests for help/suggestion all in one place**

Here the agronomist can manage all the incoming request for help or suggestion and will have an higher chance of intervening promptly in critical situations before it's too late. In fact, having just one place in which all the requests that need attention are cumulated makes easier for them to not miss them, rather than losing them because of the different means they could come from and in a cluttered way.

### 2. **(G11) Visualize area stats**

Keep track of the area general performance through a list of best-performing farmers and visualize data about whether forecast.

### 3. **(G12) Easy daily planning procedure**

The daily plan consists in a list of farms to be visited during the day. Since, by regulations, every farm must be visited at least twice a year, with particular attention to the under-performing ones that should be visited more often, agronomists wish to be suggested of which are the farms that are due to be visited or the ones that have not been visited yet during the year.

## 1.3 Definitions, acronyms, abbreviations

### Definitions

- **Telangana:** Indian state promoting the *DREAM* project
- **User:** either Policy Makers, Farmers or Agronomists
- **Production:** anytype of
- **Forum:**
- **Agronomist:**
- **Policy Maker:**
- **Farmer:**
- **Daily plan:**



## Acronyms

- **RASD**: Requirement Analysis and Specification Document
- **DREAM**: *Data-driven predictive farming* project
- **PDPA**: Personal Data Protection Act

## 1.4 Revision history

## 1.5 Reference documents

- Specification document: "Assignment RDD AY 2021-2022"
- Alloy documentation: <https://alloytools.org/documentation.html>
- UML documentation: <https://www.uml-diagrams.org/>
- BPMN documentation: <https://www.bpmn.org/>
- Paper: "The World and the Machine" by M. Jackson and P. Zave

## 1.6 Document structure

- **Section 1** gives an introduction about the problem to tackle and about which functionalities will be implemented in the final product in order to solve it.
- **Section 2** contains the overall description of the whole project, presenting it in a more formal way through class diagrams which will contain the backbone blocks that will build the final application. Furthermore, there will be presented the so-called *actors* who are the ones that will use the application, the expected functionalities and the domain assumptions taken in consideration throughout the whole project, from the specification phase to the actual developing phase.
- **Section 3** delves deeply into the technical aspects of the topics presented in *Section 2*, in order to be more useful for the development, by providing a standard interfaces' system *a priori* to stick to during the project implementation. It will show functional and non-functional requirements. The former will be presented through some use-cases and

scenarios as meaningful examples; while the latter will be disclosed by analysing performance, design and software system features that the project will have.

- **Section 4** presents the Alloy code briefly explaining the purpose of it in modeling the given problem.

## 2 Overall Description

### 2.1 Product perspective

DREAM is a system that offers the functionalities described in the *Product Functions (2.2)* section. It manages to use some external interfaces, for more details refers to the *Software Interfaces (3.1.3)* section. We can see below an high-level class diagram that shows the basic structure of the system.

#### 2.1.1 Class diagram

A UML class diagram that describes the main entities in the system. Three types of actors can access the system: farmers, policy makers and agronomists. During sign up they all create a user account with basic informations such as username, password and email. At this point users are requested to insert other informations based on their type of account. For example, to complete the registration, farmers need to specify the address of their farm and agronomists must declare their area of responsibility. The system provides several functionalities, one of this is the forum. When the farmers select the forum section they basically access the topics that are characterized by a list of messages where the sender is specified. The agronomists can confirm and update a daily plan. This is composed by the current date, the list of farms visited and a status flag that indicates whether the plan has already been confirmed or not. Moreover they have access to the list of farmers currently under their area of responsibility. Finally there are various type of data that can be visualized and analyzed by the users, which ones to display dependes on the type of account. There are four types of data:

- **Sensor data**  
Acquired by the sensors distributed all over the territory, characterized by a value that is the humidity of soil.

- Weather forecast data  
Meteorological short-term and long-term forecast acquired by the Telangana's government and displayed on their official website. The data to display to the user are temperature, rainfall, wind and humidity.
- Water irrigation data  
Acquired by the water irrigation system installed in the farm, the only significant value is the amount of water.
- Production data  
Provided by the farmers, this type of data is displayed as a table that map the type of product to the amount produced.

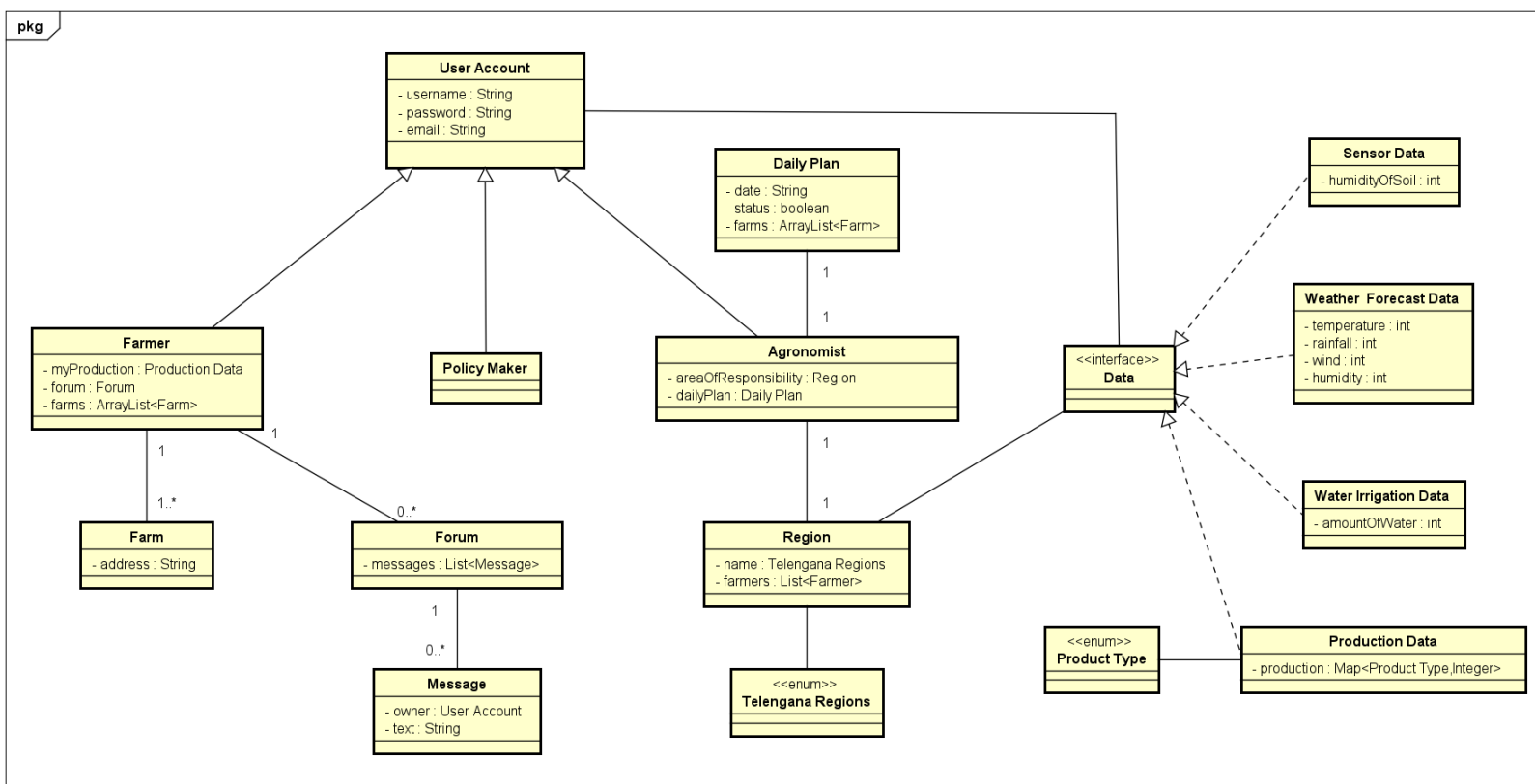


Figure 1: High-level UML



## 2.2 Product functions

### 2.2.1 Sign-up and shared functions

- **Sign-up:** let the user sign-up through an email and a password, creating a profile tailored for the user's job. Specify the area in which they live and what type of cultivation they manage.

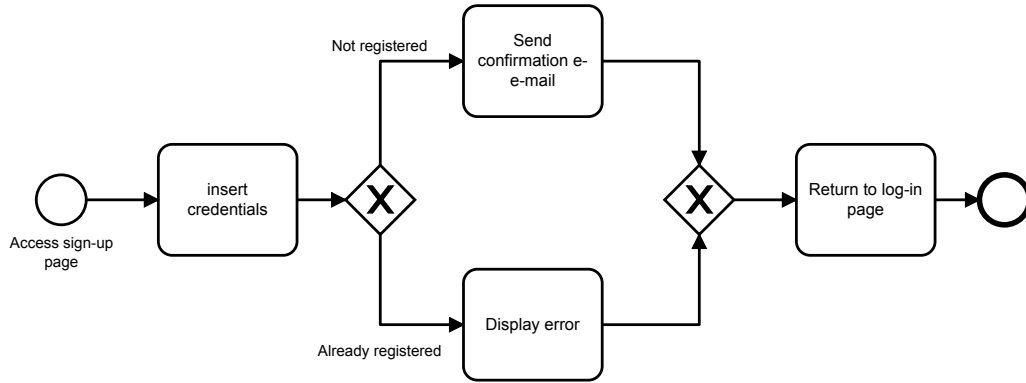


Figure 2: Sign Up BPMN

### 2.2.2 Policy makers functions

- **Visualize relevant data and initiative:** let the policy makers know a variety of different data like the performances of the farmers by grouping them in a rank to know who are the farmers that are performing well and who are the worst one based on informations insert by them. Policy makers can also visualize the steering initiative presented by the agronomist in a specific subsection of their system.

### 2.2.3 Farmers functions

- **Profile edit:** allow the farmers change their profile in order to upgrade information like:

Area: allow to change the area where farmers have their plantation;

Plant type: allow to change the type of plant;

Username and password: allow to change their username and password.

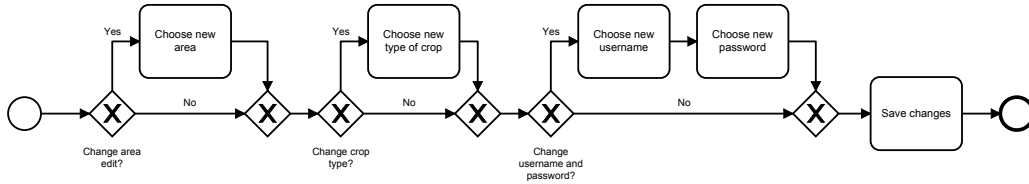


Figure 3: Profile edit BPMN

- **Manipulation of informations:** allow farmers to visualize every kind of their interest like the wheather forecast for the day or for the next few days or some suggestions about own crops and specific fertilizers.
- **Send message:** allow farmers to send messages to the agronomist.
- **Usage of the forum:** allow farmers to create a new topic or reply to a message in the dedicated forum.

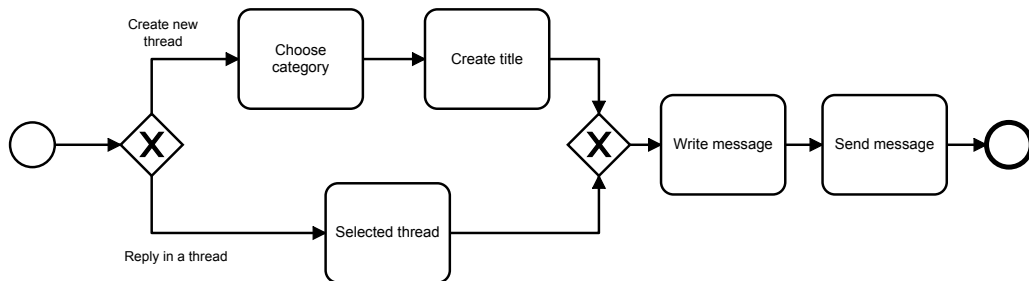


Figure 4: Forum BPMN

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#### 2.2.4 Agronomists functions

- **Area functions:** allow the agronomist to insert their responsibility area and visualize the correspondant data like wheather forecast or the rank of the farmers.
- **Manage farmers requests:** farmers can send help or suggestion request to whom agronomist have to reply.
- **Manage daily plan:** allow the agronomist to make their daily plan by registering the incoming visits to the farmers. At the end of the day a farmers must confirm if they were able to complete the plan or specify the deviations occurred during the day.

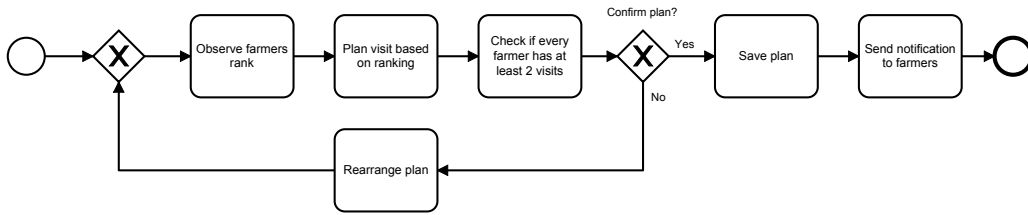


Figure 5: Daily plan BPMN

### 2.3 User characteristics

The application has been thought for the three different user categories that follows:

- **Policy makers** are government's employees that are in charge of analysing the general agriculture trends among all the districts in Telangana, then promote based state-wide policies to better the whole food system. Their main goal is not only to secure the current provision, but also to identify now the best practices that will lead to a flourishing food production in the future. By doing so, the plan is to grow more resilient and profitable crops and prepare the lands to face future menaces, for instance the climate that is getting more hostile or the

foreseen increment of the food demand. As a consequence, they want to be notified about the best performing farmers in order to contact them and get more insight from them about their procedures, with the aim to acquire best practises to be shared and applied on a larger scale. At the same time, they need to know who, on the other hand, is performing particularly badly, so that they can be given the help they need to better their results, since obtaining the foresaid goal requires the structure to run smoothly in all its parts. Policy makers also need a feedback system that let them be aware of the true impact *a posteriori* of the initiatives carried out by the agronomists in collaboration with the knowledge and practice of the best farmers.

- **Farmers** are interested in functionalities that will help with their day-to-day life at work, so they would like to receive in one place all the information about the weather to plan before hand the work day and useful data, like suggestions and news about the specific crop they cultivate, if some crop's illness is spreading in their area and how to treat it, which fertilizers boost the plant's production, etc. Moreover, they should insert data about their own production and ask for help to a regional agronomist through the app if it's needed. Being part of a larger community of people that share the same purpose (such as being more productive) brings more knowledge in general, so it's easier for the farmers to get in touch with their colleagues that grow the same crops and might have faced the same challenges they do through the in-app forum. The feature allows them to enlarge their pool of acquaintances and brings them together online, even though they might be kilometers away from each other.
- **Agronomists** are the experts in the agriculture field, so the main function needed for them is the possibility of helping out the farmers that reach out to them. Each agronomist is in charge of a specific geographical area in Telangana, in order to be efficiently present on the territory in a fair and useful way according to the actual helping demand. In fact, they visit each farm spread among their area at least twice a year. That said, agronomists would like some functionalities that help them planning out their trips on the field in an simple yet flexible way. Furthermore, they would like to be notified of the farms' performace, especially the ones scoring poor results in order to plan



their visits more often for those, depending on the problem they facing. Nonetheless, in order to make a complete and exhaustive report about the area productivity for the central government, they are also interested into acknowledging the top performing farms.

## 2.4 Assumptions, dependencies and constraints

- D1: Agronomists actually stick to the scheduled daily plan
- D2: Agronomists correct their schedule at the end of the day if deviations occur
- D3: Each user registers according to their role and always feeds correct information to the app
- D4: The internet connection works properly
- D5: The sensors measuring humidity level of the soil work properly
- D6: Weather forecasts are accurate up to a 80% for the short-term and up to 60% on the long-term
- D7: Water irrigation system send the information accurately, with an error of at most 1%
- D8: Agronomists always reply to farmers requests of help
- D9: Farmers periodically insert data about their crop status and resulting production
- D10: Data inserted by the Farmers sticks to the reality of the produced quantity.
- D11: Agronomists periodically report their initiatives to the central government.

## **3 Specific Requirements**

### **3.1 External Interface Requirements**

#### **3.1.1 User Interfaces**

The system should interface with users through devices which must be connected to the Internet. Everyone that needs to use this service would connect to it through a web browser from an existing domain, for example: dream.com. It must be easy to use as it will have to be used from different kind of people, sometimes with a not great affinity with technologies.

#### **3.1.2 Hardware Interfaces**

The system "as it is" does not provide specific hardware equipment in order to access to web site. To use all functionalities it's required to have an IT devices connected to the internet, eventually a user can decide to use GPS to insert his own location and only proper devices with GPS equipment can do this.

Soil data, obtained from sensors, are collect by someone else and will be added by the policy makers, also this not requires any special kind of hardware.

#### **3.1.3 Software Interfaces**

In order to use the system it's required the use of a web browser, on that will run the application.

System will also use some important interfaces in order to accomplish its functionalities.

First is an external API to access maps which will use the position acquired by the user settings to return an interactive map with a marker on that exact position.

Second API service used is the one of the DBMS system which will be adopted in order to query the internal database.

Another API will be use to access the external database containing data regarding the sensor data and the other external data that the system need.

### 3.1.4 Communication Interfaces

Internet connection is mandatory in order to access to every formation that the system will display. Users that want full functionalities have to have a GPS system on their device in order to guarantee a certain level of precision in the localization phase.

## 3.2 Functional Requirements

### 3.2.1 List of Requirements

ID	Requirement
R1	The system can be used only by registered and logged-in users.
R2	If the IT device is equipped with GPS technology, then the system must suggest the users the area in which they are during the registration phase. In any case, the final decision will be up to the registering user.
R3	The system must allow the users to change their location in any moment, except when they have connectivity issues.
R4	The system must allow Policy Makers to see up-to-date statistic data, accordingly to the database, about water irrigation systems and soil humidity sensors.
R5	The system must give Policy Makers up-to-date ranking of the best and worst performing farmers.
R6	The system must use a fair and scientific score to rank the Farmers in order to represent the real situation.
R7	The system must let Farmers insert their production information every day, even without connection.
R8	If a Farmer has temporary connectivity issues while trying to upload production data, the system must keep them locally stored until connection is reestablished. Once there is connection, data must be uploaded to the database.

R9	The system must suggest a list of agronomists appointed to the area of the Farmer requesting professional help.
R10	The system must notify Agronomists of unresolved requests of help from Farmers.
R11	The system must show weather forecasts relevant to the area concerning the Farmer or the Agronomist.
R12	The system must present news concerning crop only if relevant to the Farmer's own crop type.
R13	If users are experimenting connectivity issues, the system must inform them to try later.
R14	The system must allow every user registered as Farmer to access the forum, to create new discussions and to post replies to already existing ones.
R15	The system must suggest to the Agronomists which farms to visit (among the ones in their area of competence) while planning the Daily Plan based upon the last visit day following a FIFO policy. Exceptions to the FIFO policy are the farms under-performing, which shall have higher priority.
R16	The system must allow the Agronomists to add a schedule for the day each day, even without connection.
R17	The system must allow the Agronomists to update their schedule during the day and to confirm the execution before the end of the day. If the user doesn't confirm before 23:59, the system must register the already uploaded schedule as definitive.
R18	The system must allow Policy Makers to retrieve all agronomists' steering initiative reports uploaded to the database.

### 3.2.2 Mapping

<b>G1</b>	Make crops weather-resilient across the State
D5	The sensors measuring humidity level of the soil work properly
D7	Water irrigation system sends the information accurately, with an error of at most 1%
R4	The system must allow Policy Makers to see up-to-date statistic data, accordingly to the database, about water irrigation system and soil humidity sensors.

<b>G2</b>	Reach out to farmers in need of help
D3	Each user registers according to their role and always feeds correct information to the app
D4	The internet connection works properly
D8	Agronomists always reply to farmers requests of help
R9	The system must suggest a list of agronomists appointed to the area of the Farmer requesting professional help.

<b>G3</b>	Identification of well-performing farmers
D9	Farmers periodically insert data about their crop status and resulting production
D10	Data inserted by the Farmers sticks to the reality of the produced quantity.
R5	The system must give Policy Makers up-to-date ranking of the best and worst performing farmers.
R6	The system must use a fair and scientific score to rank the Farmers in order to represent the real situation.
R7	The system must let Farmers insert their production information every day, even without connection.

<b>G4</b>	Identification of under-performing farmers
D3	Each user registers according to their role and always feeds correct information to the app.
D9	Farmers periodically insert data about their crop status and resulting production
D10	Data inserted by the Farmers sticks to the reality of the produced quantity.
R5	The system must give Policy Makers up-to-date ranking of the best and worst performing farmers.
R6	The system must use a fair and scientific score to rank the Farmers in order to represent the real situation.
R7	The system must let Farmers insert their production information every day, even without connection.

<b>G5</b>	Visualize the results of steering initiatives
D5	Each user registers according to their role and always feeds correct information to the app.
D11	Agronomists periodically report their initiatives to the central government.
R18	The system must allow Policy Makers to retrieve all agronomists' steering initiative reports uploaded to the database.

<b>G6</b>	Visualize relevant data for the business
D3	Each user registers according to their role and always feeds correct information to the app
D6	Weather forecasts are accurate up to a 80% for the short-term and up to 60% on the lonr-term
R11	The system must show weather forecasts relevant to the area concerning the Farmer or the Agronomists.
R12	The system must present news concerning crop only if relevant to the Farmer's own crop type.
R13	If users are experimenting connectivity issues, the system must inform them to try later.

<b>G7</b>	Keep track of the production
D3	Each user registers according to their role and always feeds correct information to the app
D9	Farmers periodically insert data about their crop status and resulting production.
D10	Data inserted by the Farmers sticks to the reality of the produced quantity
R7	The system must let Farmers insert their production information every day, even without connection.
R8	If a Farmer has temporary connectivity issues while trying to upload production data, the system must keep the, locally stored until connection is reestablished. Once there is connection, data must be uploaded to the database.

### 3.2.3 Use Cases

#### 3.2.3.1 Use Cases Diagram

- Policy Makers



Figure 6: Policy Maker - Use Case Diagram



- Farmers

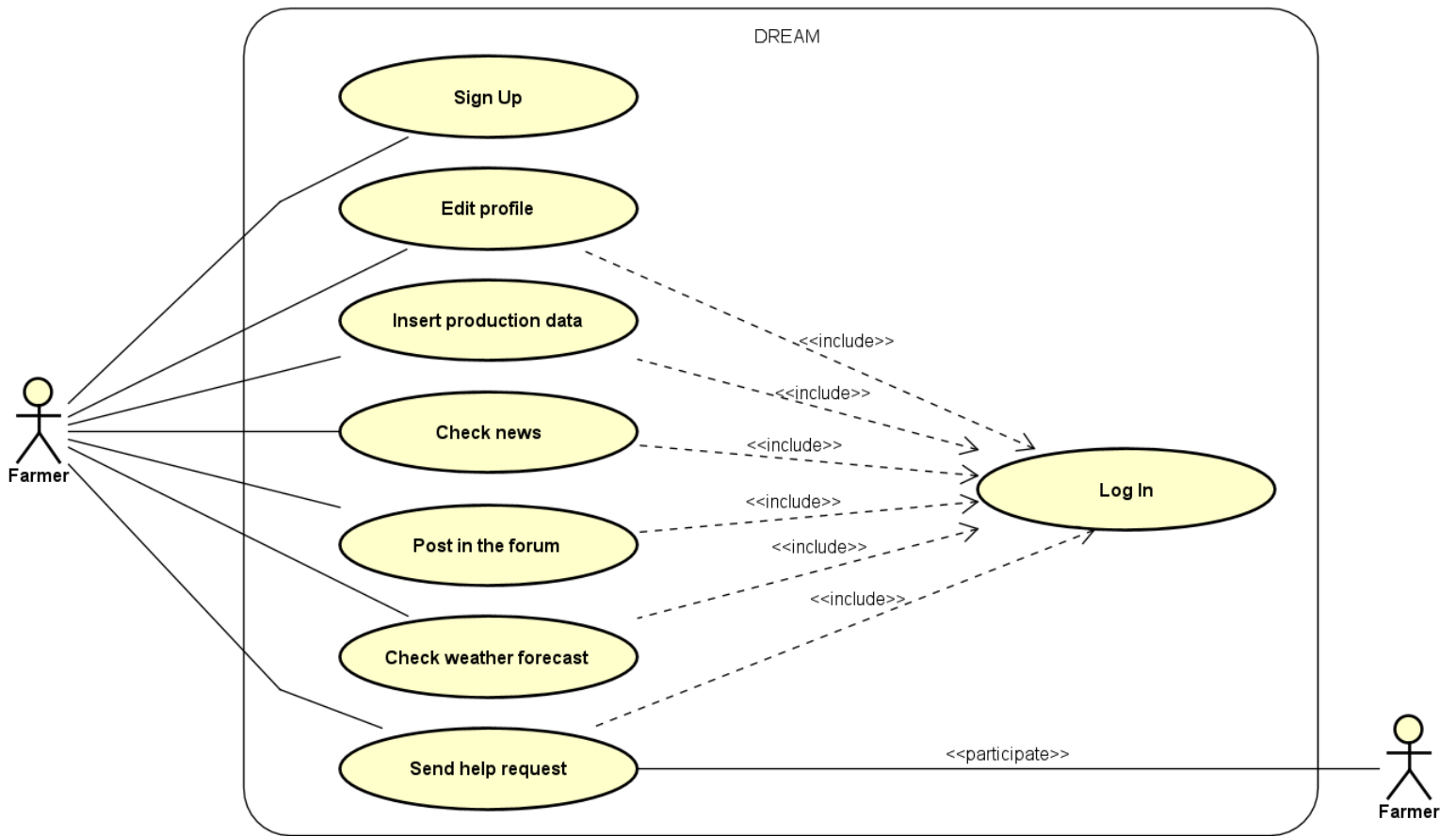


Figure 7: Farmer - Use Case Diagram

- Agronomists

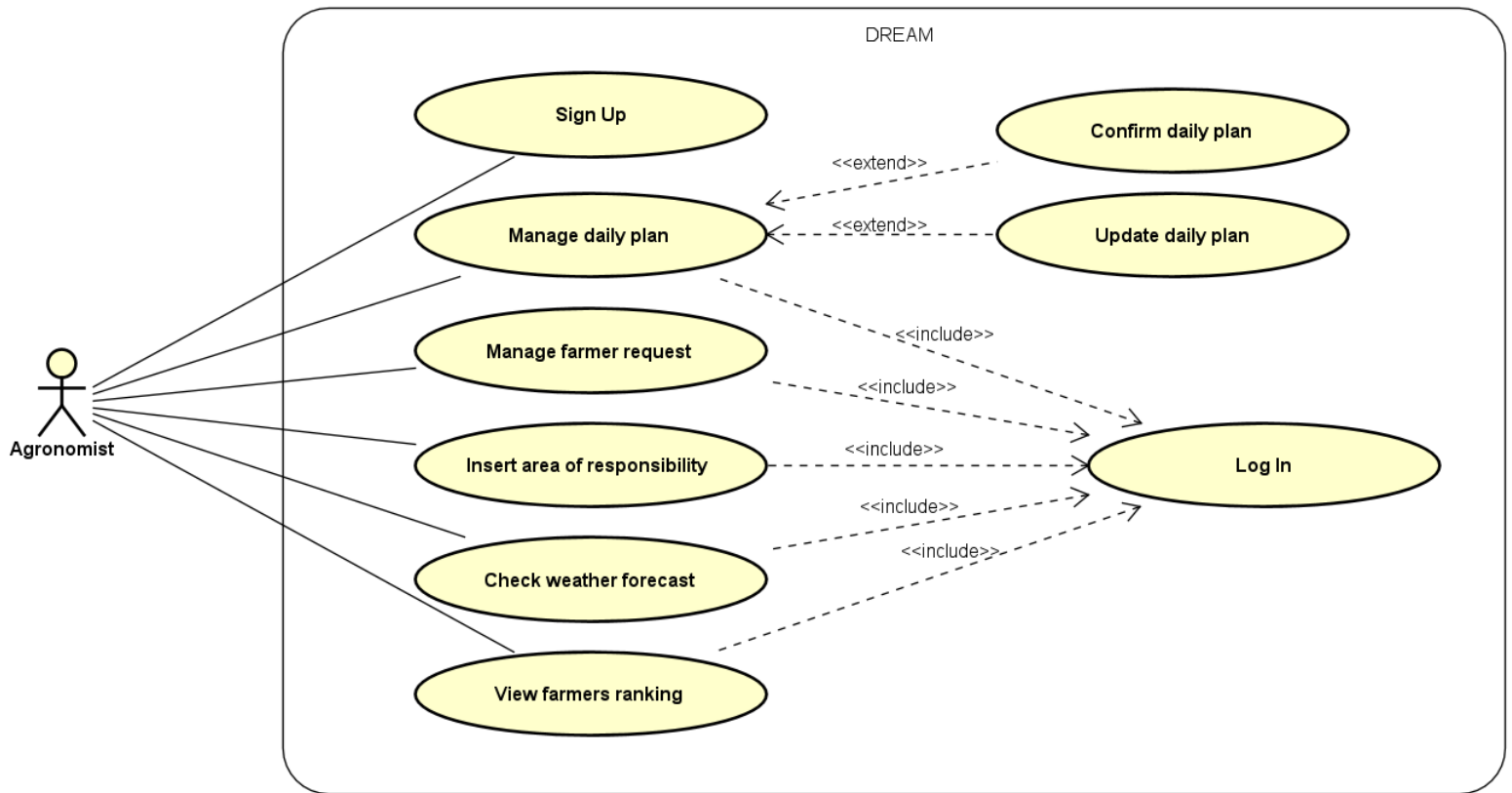


Figure 8: Agronomist - Use Case Diagram

### 3.2.3.2 Use Cases Description

- Shared Use Cases

#### Sign Up

<b>Use Case</b>	Sign Up
<b>Actor</b>	Policy Maker, Farmer, Agronomist
<b>Entry condition</b>	User want to register in the system
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. User press the sign up button</li><li>2. User select its username, password and role</li></ol>
<b>Exit condition</b>	The system shows a confirmation message to the user
<b>Exceptions</b>	<ol style="list-style-type: none"><li>1. If the user insert an already taken username</li><li>2. If the user press the cancel button</li><li>3. Internet connection isn't working</li></ol>

#### Log In

<b>Use Case</b>	Log In
<b>Actor</b>	Policy Maker, Farmer, Agronomist
<b>Entry condition</b>	User want to log in the system
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. User put its own username and password</li></ol>
<b>Exit condition</b>	The system correctly log in the system
<b>Exceptions</b>	<ol style="list-style-type: none"><li>1. If the user insert a wrong username and password</li><li>2. Internet connection isn't working</li></ol>

- Policy Makers

#### View Initiatives Reports

<b>Use Case</b>	View Initiatives Reports
<b>Actor</b>	Policy Maker
<b>Entry condition</b>	User wants to check the Steering Initiative proposed by agronomists
<b>Flow of events</b>	<ol style="list-style-type: none"> <li>1. User press the "View Initiatives Reports" button</li> <li>2. System send to the user the steering initiative insert by the agronomist</li> </ol>
<b>Exit condition</b>	User press the back button
<b>Exceptions</b>	

#### Check Soil Humidity Data

<b>Use Case</b>	Check Soil Humidity Data
<b>Actor</b>	Policy Maker
<b>Entry condition</b>	User wants to check the soil humidity data
<b>Flow of events</b>	<ol style="list-style-type: none"> <li>1. User press the "Check Sensors Data" button</li> <li>2. User press the soil humidity data button</li> <li>3. System retrieve soil humidity data and send them back to the user</li> <li>4. System display the data</li> </ol>
<b>Exit condition</b>	User press the "Home" button
<b>Exceptions</b>	

### Check Water Irrigation Data

<b>Use Case</b>	Check Water Irrigation Data
<b>Actor</b>	Policy Maker
<b>Entry condition</b>	User wants to check the water irrigation data
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. User press the "Check Sensors Data" button</li><li>2. User press the water irrigation button</li><li>3. System retrieve water irrigation data and send them back to the user</li><li>4. System display the data</li></ol>
<b>Exit condition</b>	User press the "Home" button
<b>Exceptions</b>	

### View Farmers Ranking

<b>Use Case</b>	View Farmers Ranking
<b>Actor</b>	Policy Maker
<b>Entry condition</b>	User wants to see the farmers ranking
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. User press the best or the worst performing ranking</li><li>2. System retrieve data on farmers ranking</li><li>3. System show ranking data</li></ol>
<b>Exit condition</b>	User press the "Back" button
<b>Exceptions</b>	

### View Specific Farmer Informations (View Farmers Ranking)

<b>Use Case</b>	View Specific Farmer Informations (View Farmers Ranking)
<b>Actor</b>	Policy Maker
<b>Entry condition</b>	User wants to see the specific informations of a farmer
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. First three events are the same of the "View Farmers Ranking" use case</li><li>2. User press on a farmer name</li><li>3. System retrieve farmer data</li><li>4. System display farmer data</li></ol>
<b>Exit condition</b>	User press "Back" button
<b>Exceptions</b>	

- Farmers

#### Profile Edit

<b>Use Case</b>	Profile Edit
<b>Actor</b>	Farmers
<b>Entry condition</b>	User wants to modify or update its profile
<b>Flow of events</b>	<ol style="list-style-type: none"> <li>1. User press the "Settings" button on its home page</li> <li>2. User modify the interest data (username, password, crop type or area)</li> <li>3. User press "Confirm" button</li> </ol>
<b>Exit condition</b>	User receive a confirmation message
<b>Exceptions</b>	<ol style="list-style-type: none"> <li>1. User choose an already taken username</li> <li>2. User choose the old password</li> </ol>

#### Insert Production Data

<b>Use Case</b>	Insert Production Data
<b>Actor</b>	Farmers
<b>Entry condition</b>	User wants to insert the production data
<b>Flow of events</b>	<ol style="list-style-type: none"> <li>1. User press the "Insert Production Data" button</li> <li>2. User insert data regarding its coulivation performance</li> <li>3. User press "Confirm" button</li> <li>4. System collect and analiyze data</li> </ol>
<b>Exit condition</b>	User receive a confirmation message
<b>Exceptions</b>	<ol style="list-style-type: none"> <li>1. User insert data in a wrong manner</li> <li>2. User press "Back" button</li> </ol>

### Check News

<b>Use Case</b>	Check News
<b>Actor</b>	Farmers
<b>Entry condition</b>	User want to check the news
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. User press the news box</li><li>2. The system retrive data regarding news</li></ol>
<b>Exit condition</b>	User press "Back" button
<b>Exceptions</b>	

### Post in the Forum

<b>Use Case</b>	Post in the Forum
<b>Actor</b>	Farmers
<b>Entry condition</b>	User wants to post in the forum
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. User press "Forum" button</li><li>2. User choose a thread to reply in or the creation of new thread</li><li>3. User write the text</li></ol>
<b>Exit condition</b>	User press "Post" button
<b>Exceptions</b>	<ol style="list-style-type: none"><li>1. User exceed the maximum number of character</li></ol>

### Check Weather Forecast

<b>Use Case</b>	Check Weather Forecast
<b>Actor</b>	Farmers
<b>Entry condition</b>	User wants to check weather forecast
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. User press on the weather forecast widget</li></ol>
<b>Exit condition</b>	User press "Home" button
<b>Exceptions</b>	



### Send an Help Request

<b>Use Case</b>	Send an Help Request
<b>Actor</b>	Farmers
<b>Entry condition</b>	User needs the agronomist help
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. User press "Contact Agronomist" button</li><li>2. User choose the object of its help request</li><li>3. User write the message</li><li>4. User send the request by pressing "Send request" button</li></ol>
<b>Exit condition</b>	The system shows a confirmation message to the user
<b>Exceptions</b>	<ol style="list-style-type: none"><li>1. User doesn't fill every mandatory boxes</li></ol>

- Agronomist

### Confirm Daily Plan

<b>Use Case</b>	Confirm Daily Plan
<b>Actor</b>	Agronomist
<b>Entry condition</b>	User want to confirm its daily plan
<b>Flow of events</b>	<ol style="list-style-type: none"> <li>1. Press the daily "Daily Plan" button</li> <li>2. Choose the farmers that he want to visit during the day</li> <li>3. Check if the farmers has at least two visit</li> <li>4. Confirm the plan with the "Confirm" button</li> </ol>
<b>Exit condition</b>	System display a confirmation message
<b>Exceptions</b>	<ol style="list-style-type: none"> <li>1. At the end of the year a farmer has less than two visit</li> </ol>

### Update Daily Plan

<b>Use Case</b>	Update Daily Plan
<b>Actor</b>	Agronomist
<b>Entry condition</b>	User want to update its daily plan
<b>Flow of events</b>	<ol style="list-style-type: none"> <li>1. Press the daily "Daily Plan" button</li> <li>2. User press the "Modify" button</li> <li>3. Choose the farmers to add or the ones to remove</li> <li>4. Check if the farmers has at least two visit</li> <li>5. Check if there are farmers to visit in the list</li> <li>6. Confirm the plan with the "Confirm" button</li> </ol>
<b>Exit condition</b>	System display a confirmation message
<b>Exceptions</b>	<ol style="list-style-type: none"> <li>1. At the end of the year a farmer has less than two visit</li> </ol>

### Manage Farmers Request

<b>Use Case</b>	Manage Farmers Request
<b>Actor</b>	Agronomist
<b>Entry condition</b>	User wants to reply to a farmer help request
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. System displays the notification of an incoming message</li><li>2. User press the inbox icon</li><li>3. User insert the object</li><li>4. User replies the request</li><li>5. User send the message</li></ol>
<b>Exit condition</b>	System show the user a confirmation message
<b>Exceptions</b>	<ol style="list-style-type: none"><li>1. Object field is empty</li><li>2. Message field is empty</li><li>3. User press the "Cancel" button</li></ol>

### Insert Responsibility Area

<b>Use Case</b>	Insert Responsibility Area
<b>Actor</b>	Agronomist
<b>Entry condition</b>	User wants to insert its own coverage area
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. User press the settings button</li><li>2. User select the new responsibility area</li><li>3. User press the "Confirm" button</li></ol>
<b>Exit condition</b>	
<b>Exceptions</b>	<ol style="list-style-type: none"><li>1. User press the "Cancel" button</li><li>2. User select an already taken area</li></ol>

### Check Weather Forecast

<b>Use Case</b>	Check Weather Forecast
<b>Actor</b>	Agronomist
<b>Entry condition</b>	User wants to check the weather forecast in its responsibility area
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. User press the wheather widget</li><li>2. System retrieve and display data</li></ol>
<b>Exit condition</b>	User press "Home" button
<b>Exceptions</b>	

### View Farmers Area Ranking

<b>Use Case</b>	View Farmers Area Ranking
<b>Actor</b>	Agronomist
<b>Entry condition</b>	User wants to see the ranking of farmers in the area
<b>Flow of events</b>	<ol style="list-style-type: none"><li>1. User press the ranking widget</li><li>2. System retrieves and displays data</li></ol>
<b>Exit condition</b>	User press "Home" button
<b>Exceptions</b>	

### 3.2.4 Sequence Diagrams

- Shared Sequence Diagrams

#### Sign Up

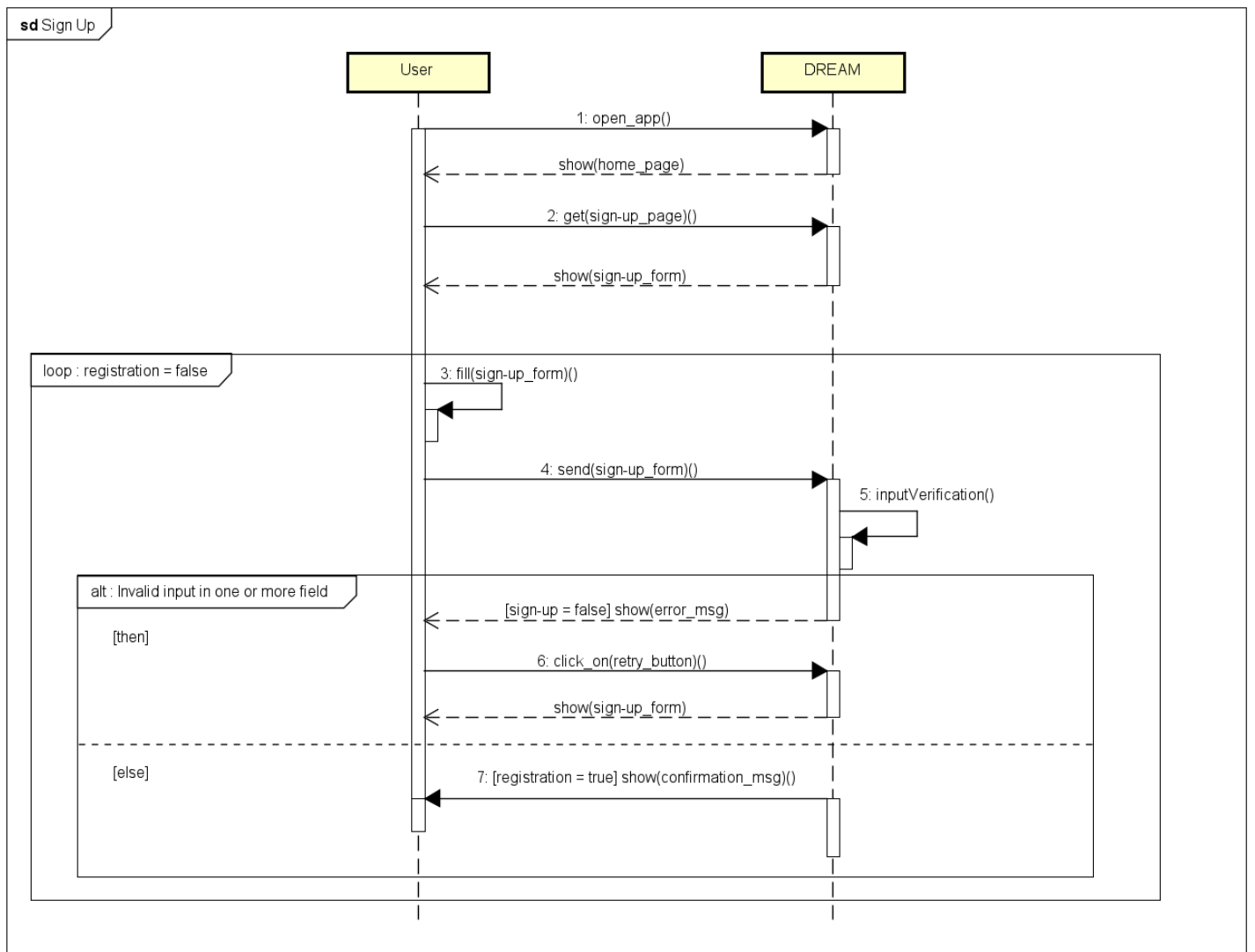


Figure 9: Shared Sequence Diagram - Sign Up Sequence Diagram

## Log In

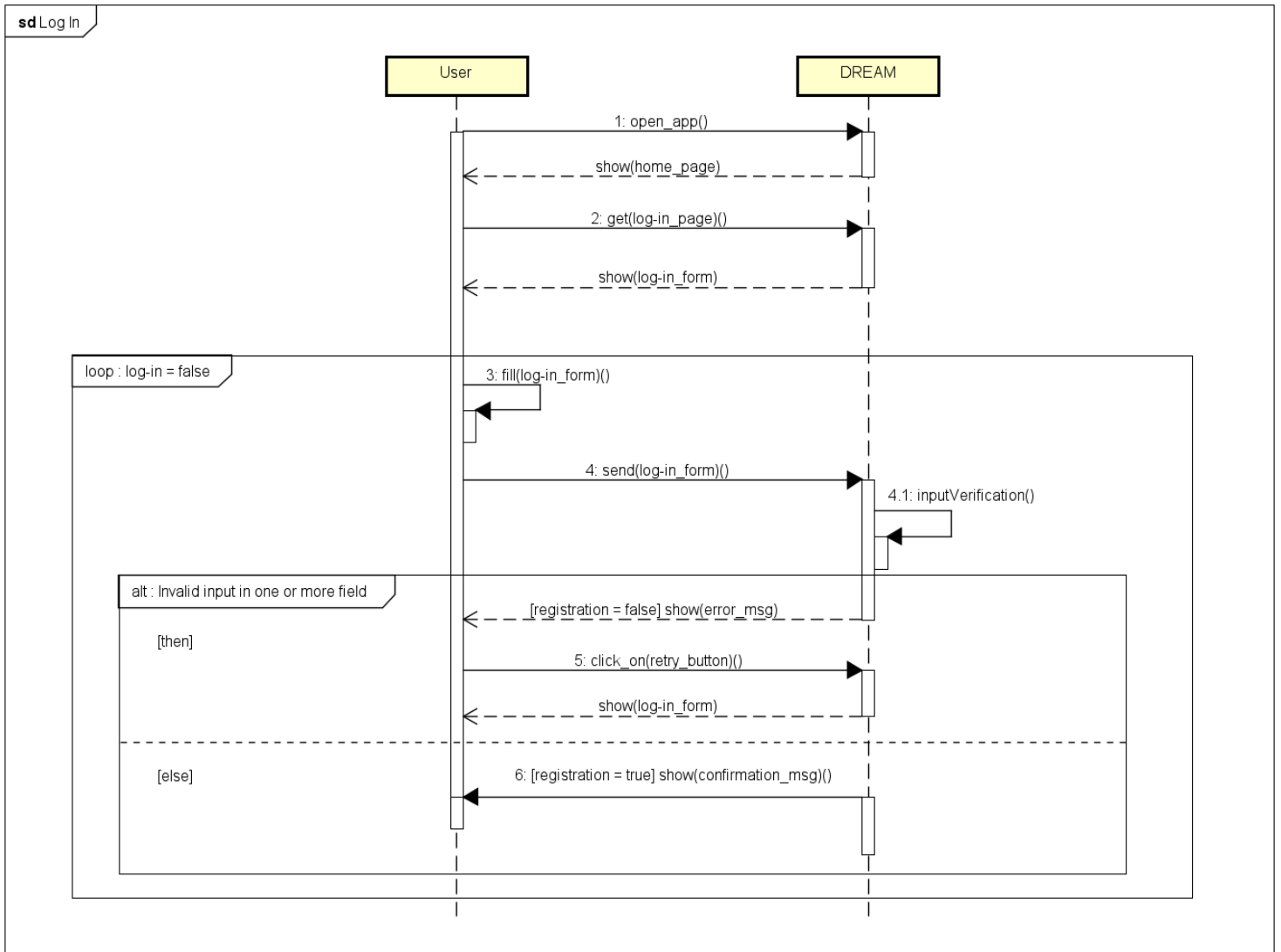


Figure 10: Shared Sequence Diagram - Log In Sequence Diagram

- PolicyMakers

### View Initiative Report Sequence

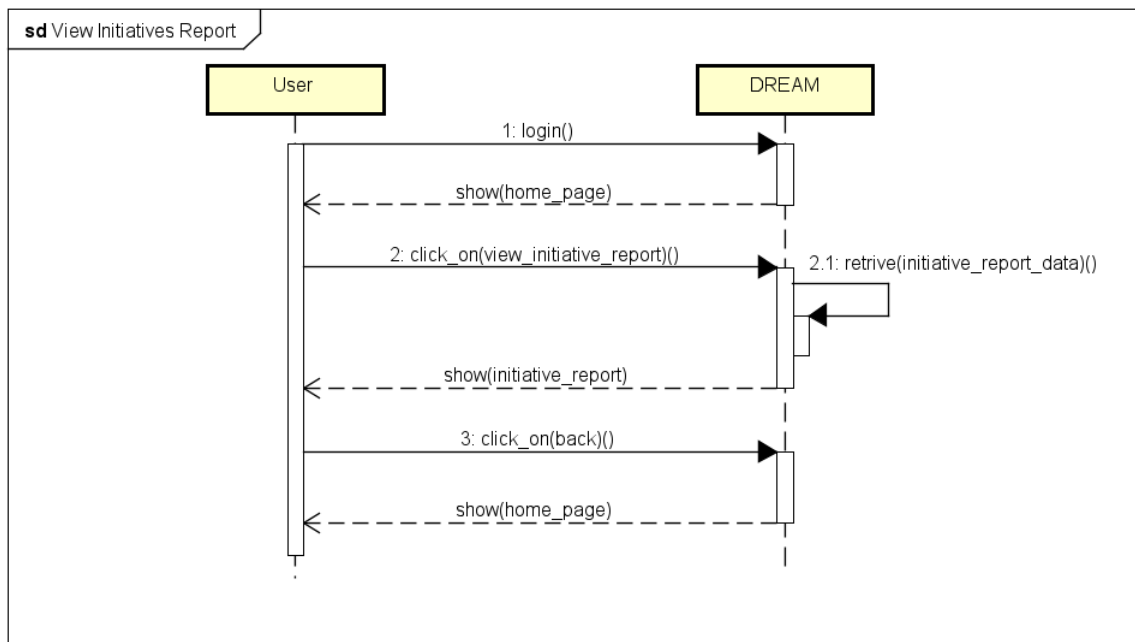


Figure 11: Policy Makers - View Initiative Report Sequence Diagram

## Check Soil Humidity Data

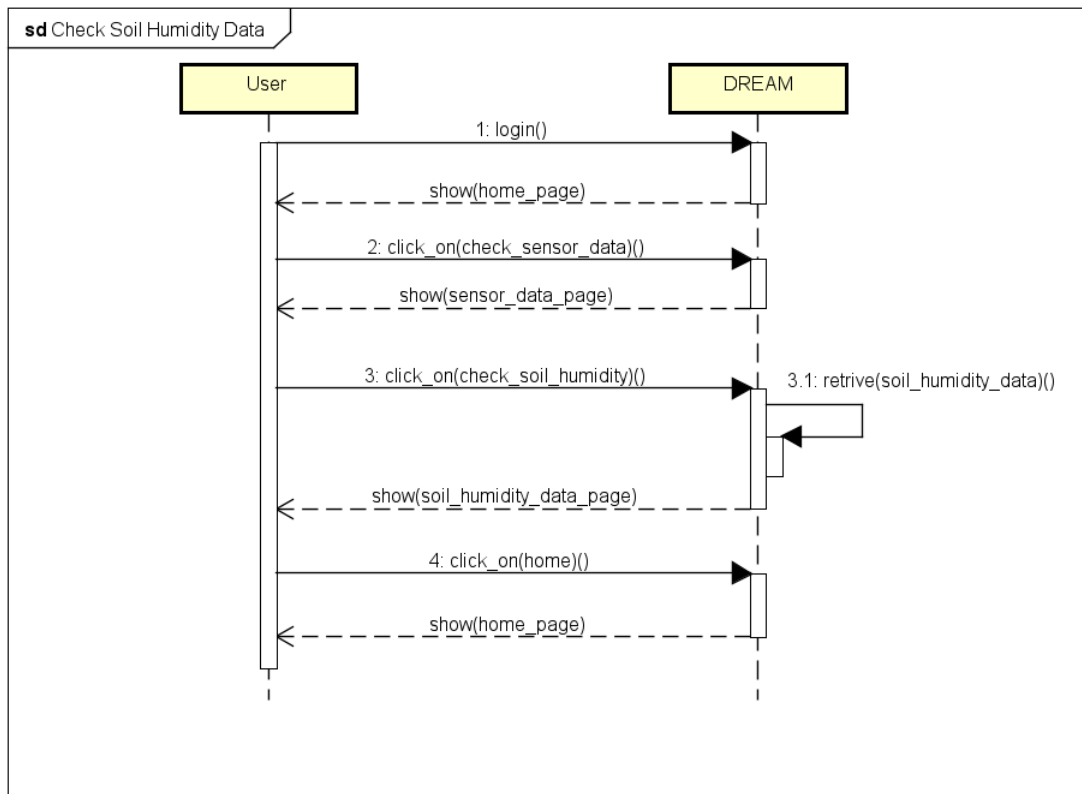


Figure 12: Policy Makers - Check Soil Humidity Data Sequence Diagram



## Check Water Irrigation Data

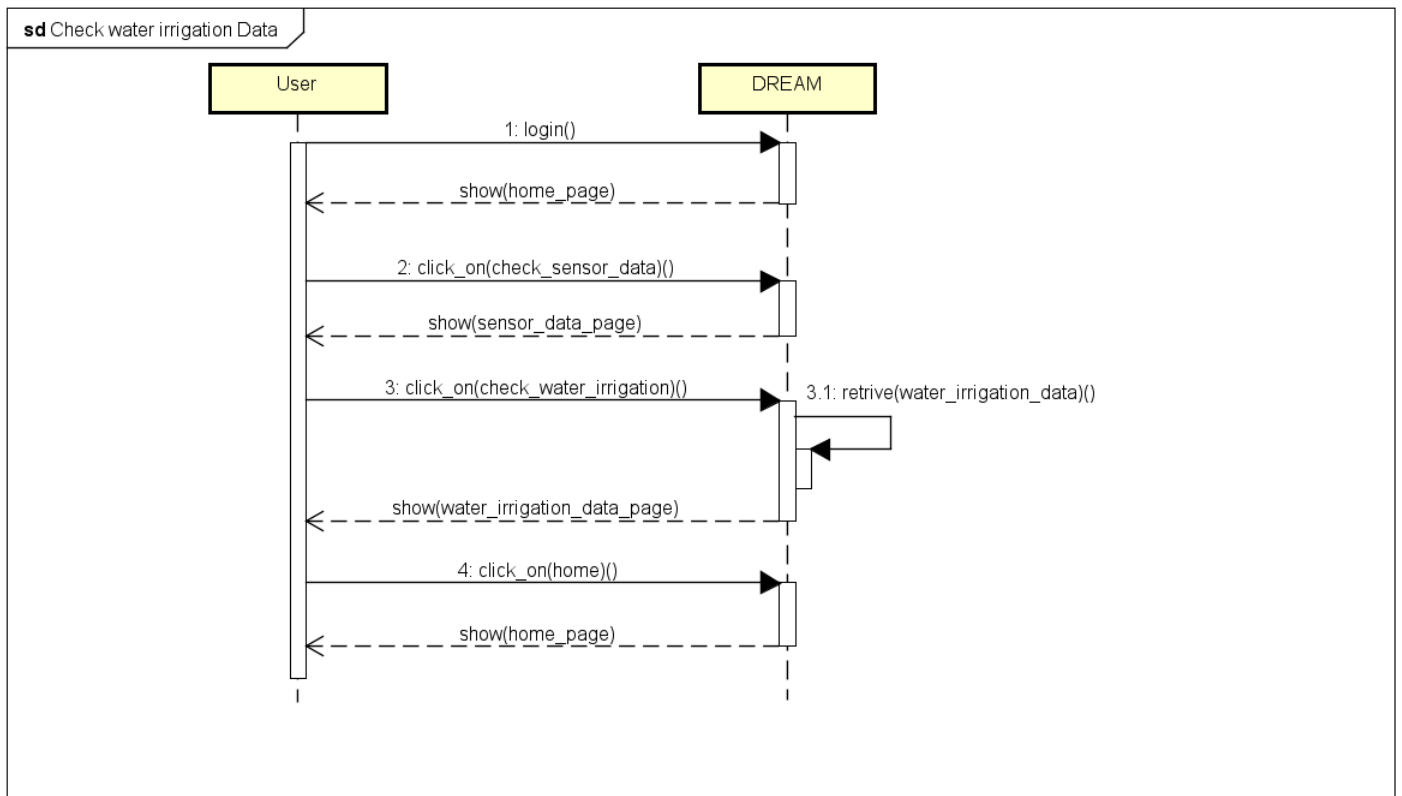


Figure 13: Policy Makers - Check Water Irrigation Data Sequence Diagram

## View Farmers Ranking

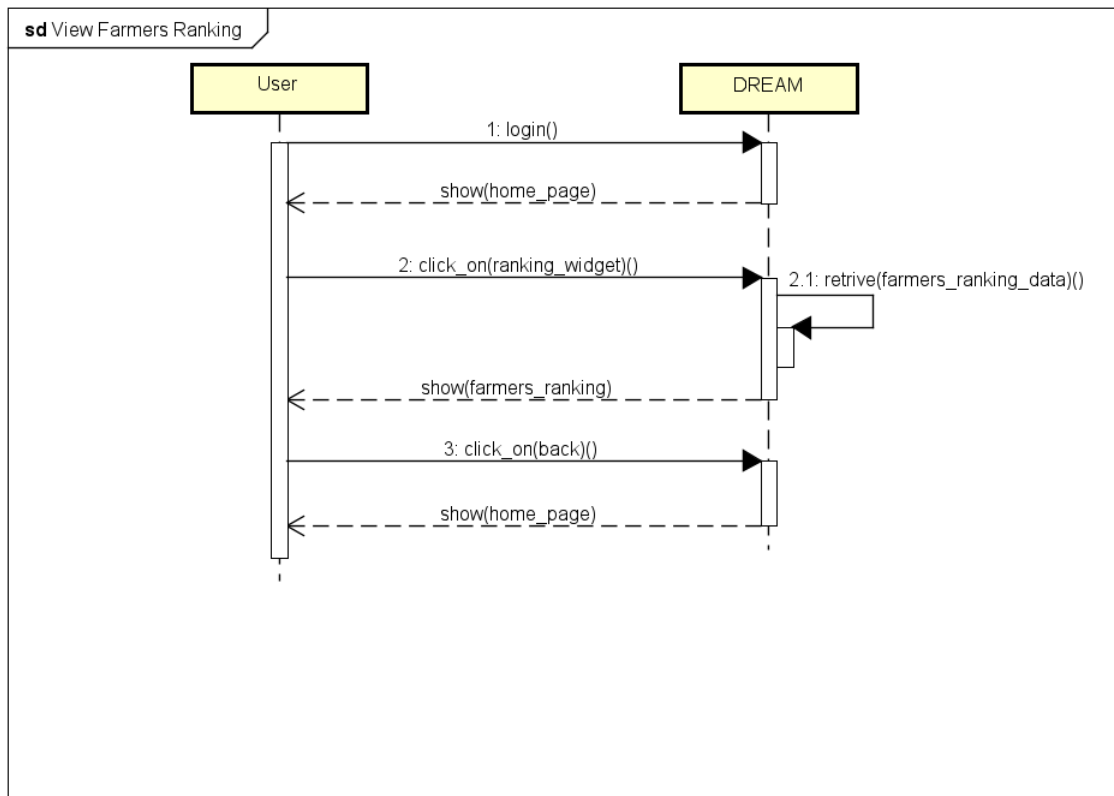


Figure 14: Policy Makers - View Farmers Ranking Sequence Diagram

## View Specific Farmers Informations

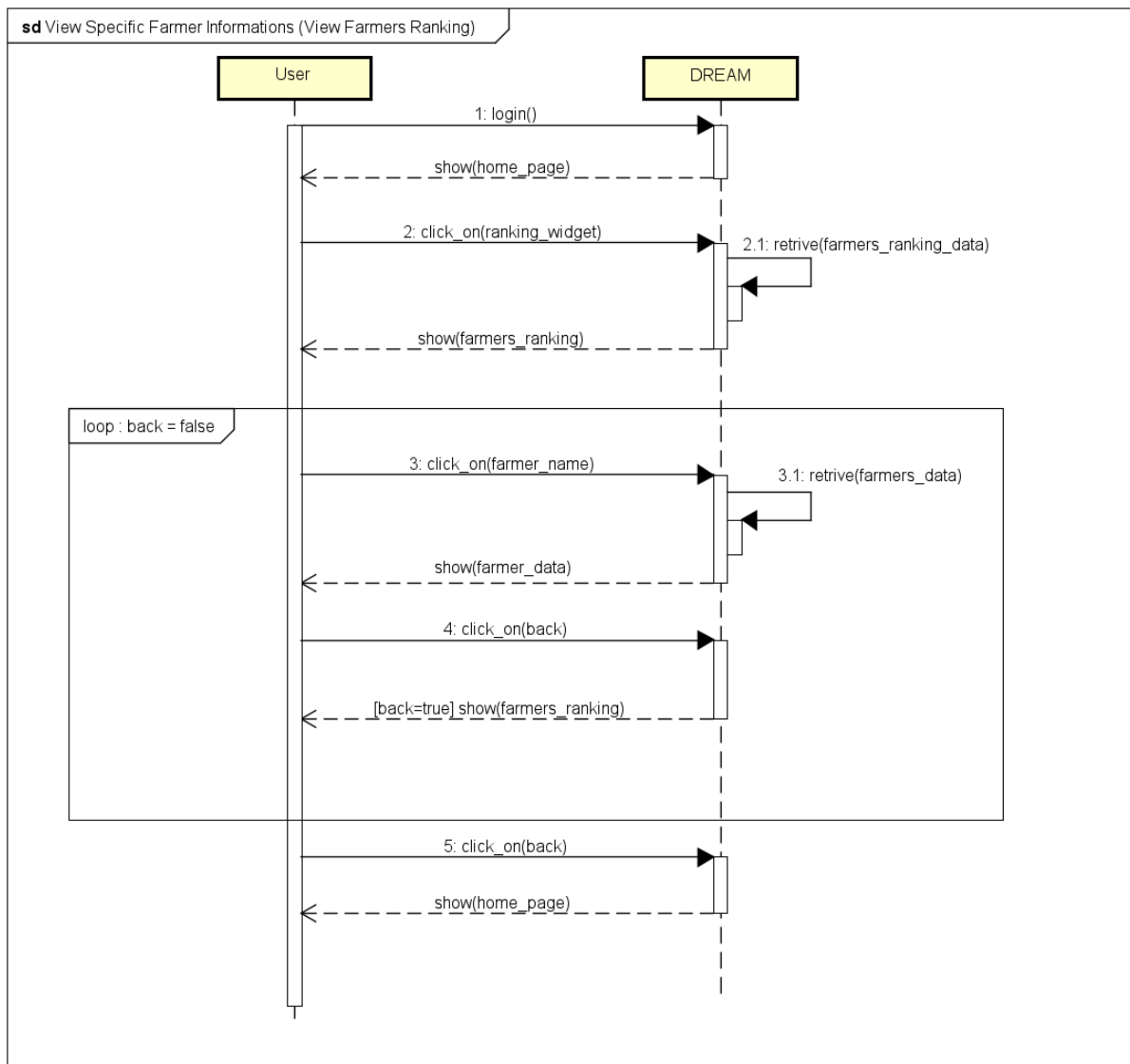


Figure 15: Policy Makers - View Specific Farmers Informations Sequence Diagram

- **Farmers**

**Profile Edit**

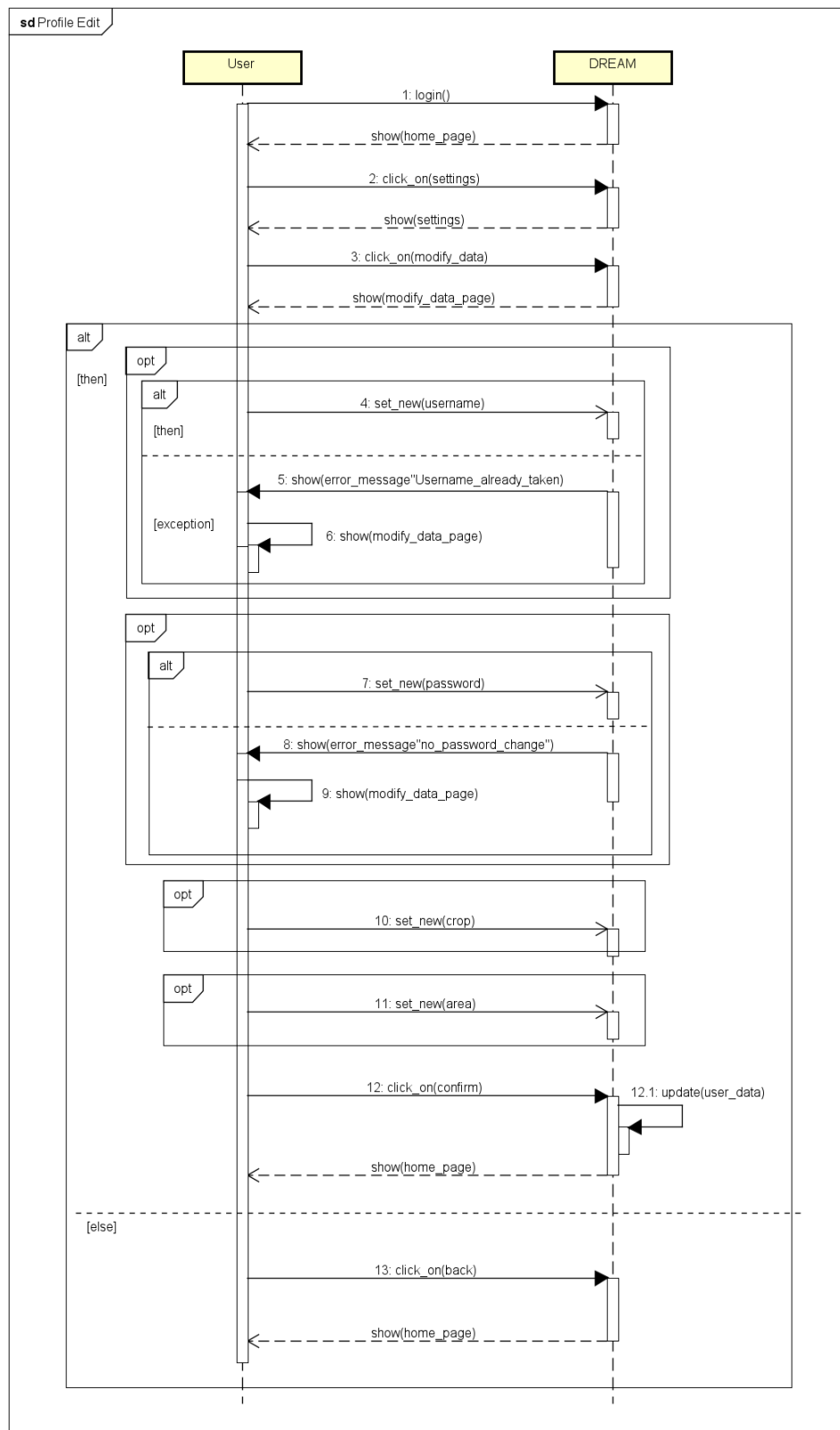


Figure 16: Farmers - Profile Edit Sequence Diagram

## Insert Production Data

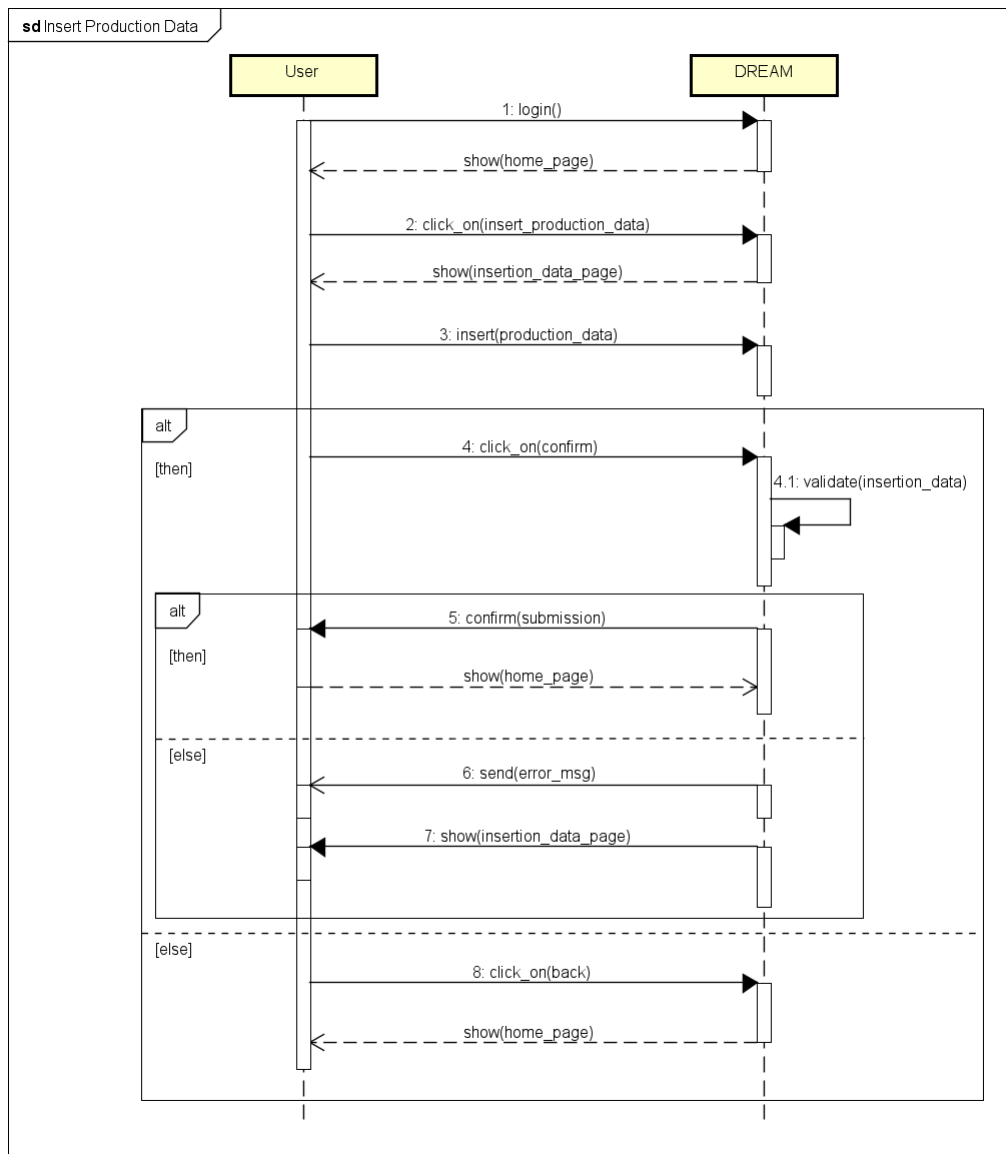


Figure 17: Farmers - Insert Production Data Sequence Diagram

## Check News

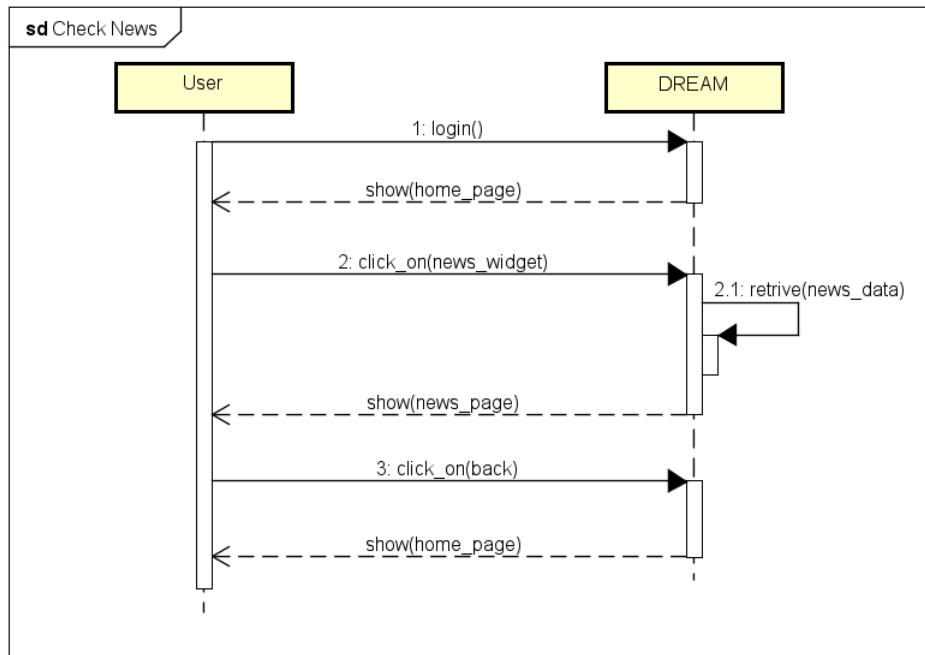


Figure 18: Farmers - Check News Sequence Diagram

## Post in the Forum

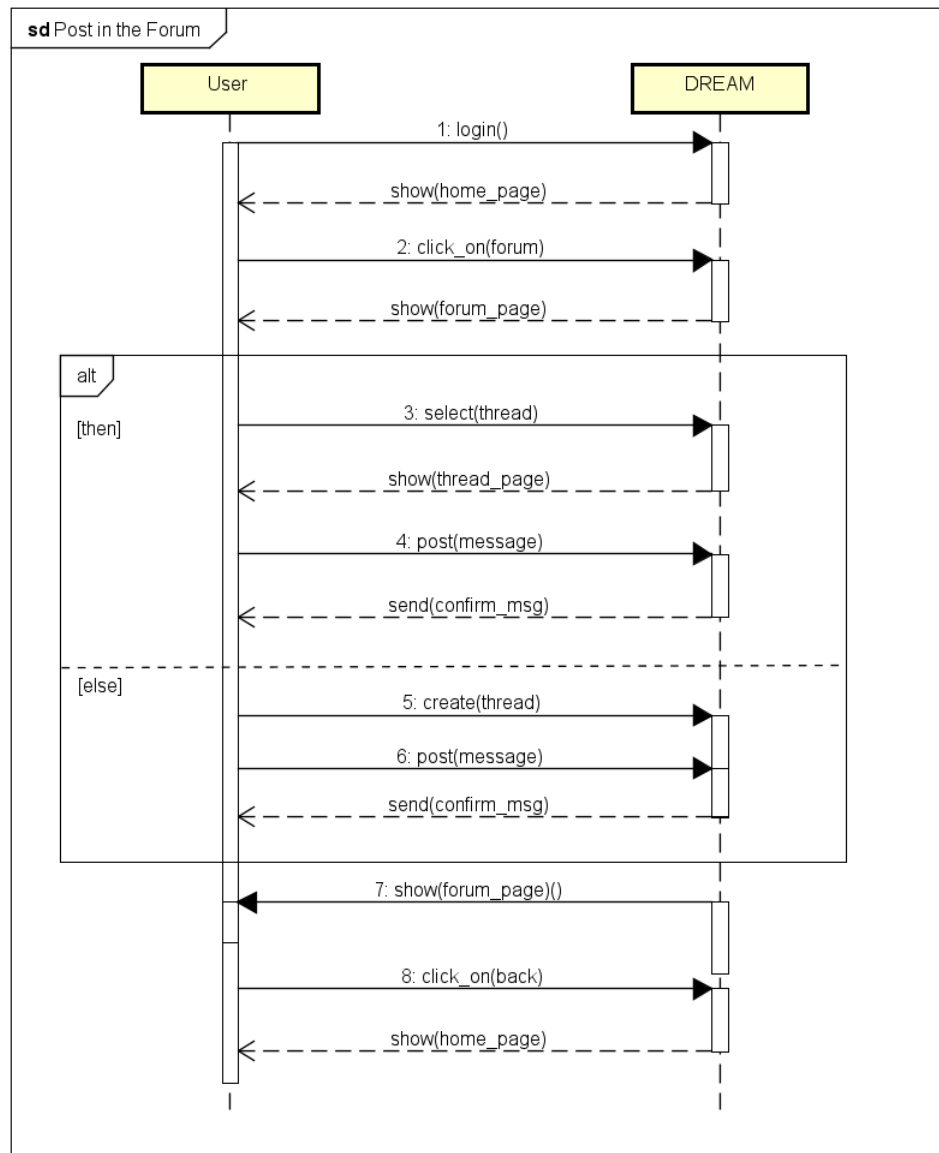


Figure 19: Farmers - Post in the Forum Sequence Diagram



## Check Weather Forecast

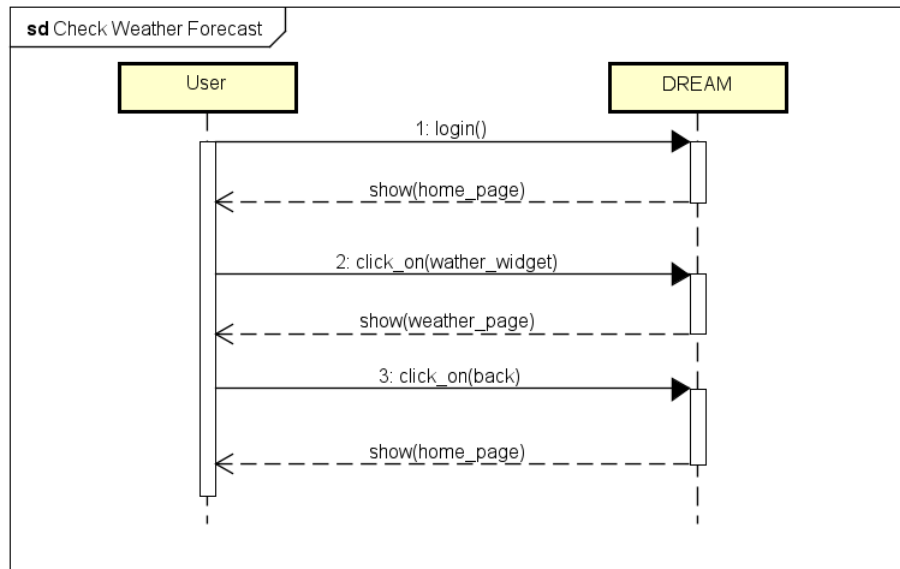


Figure 20: Farmers - Check Weather Forecast Sequence Diagram

## Send Help Request

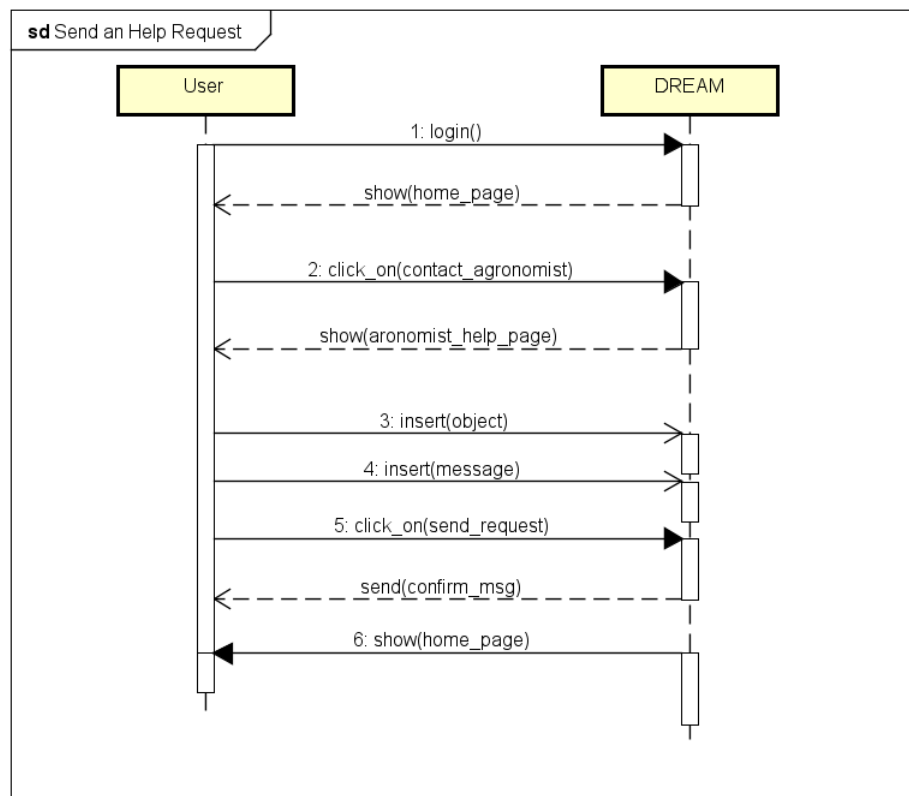


Figure 21: Farmers - Send Help Request Sequence Diagram

- Agronomists

## Confirm Daily Plan

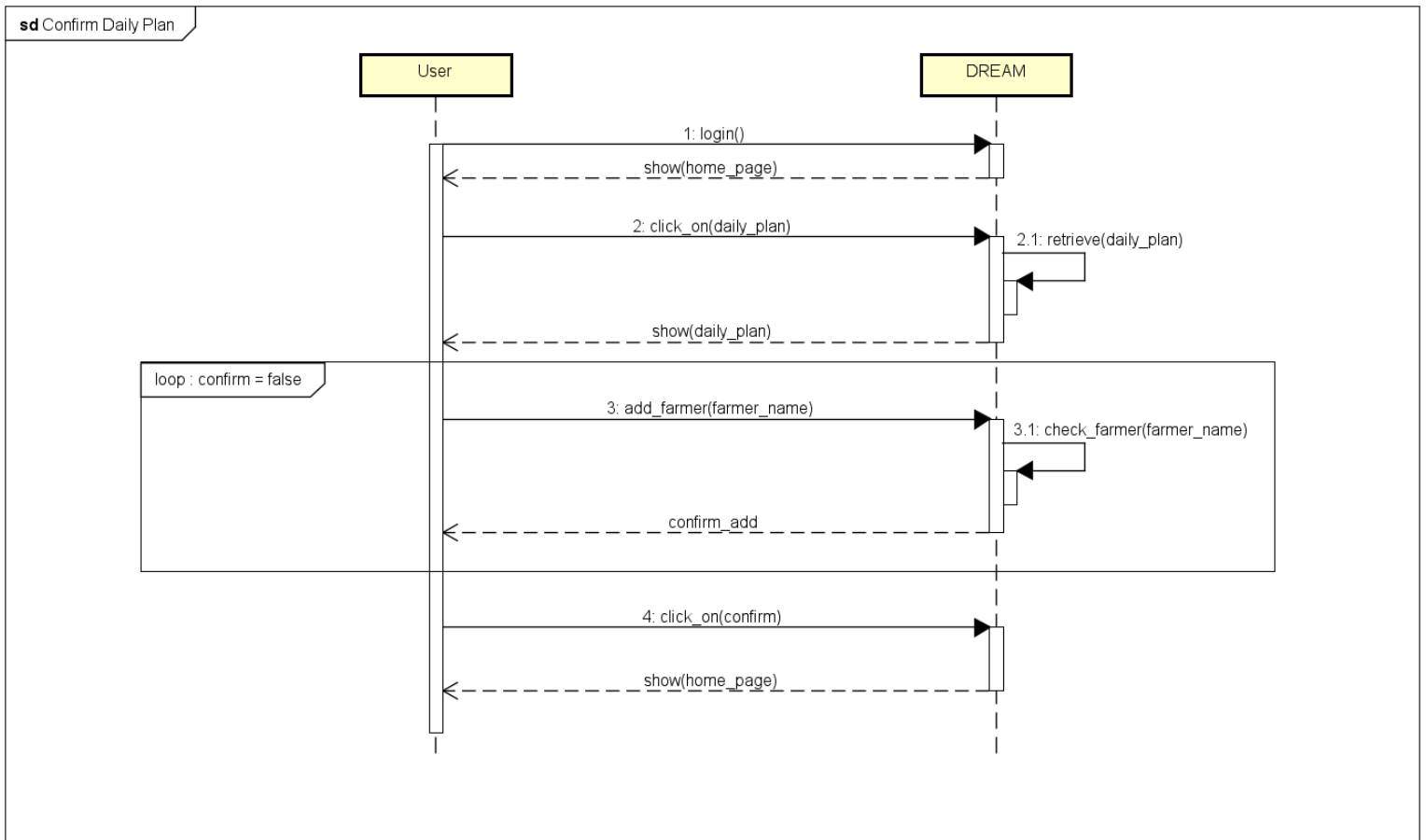


Figure 22: Agronomists - Confirm Daily Plan Sequence Diagram

## Update Daily Plan

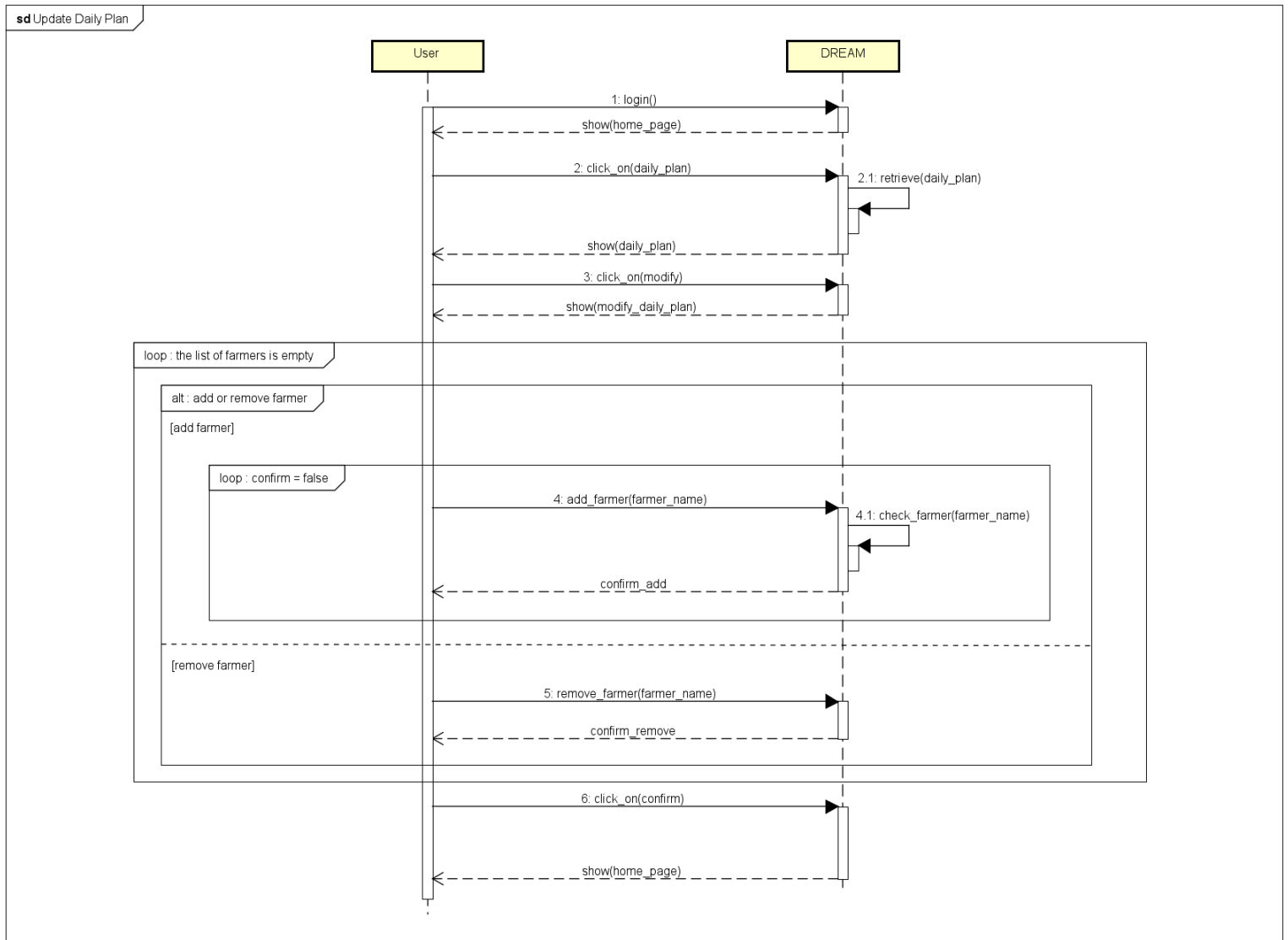


Figure 23: Agronomists - Update Daily Plan Sequence Diagram

## Manage Farmers Request

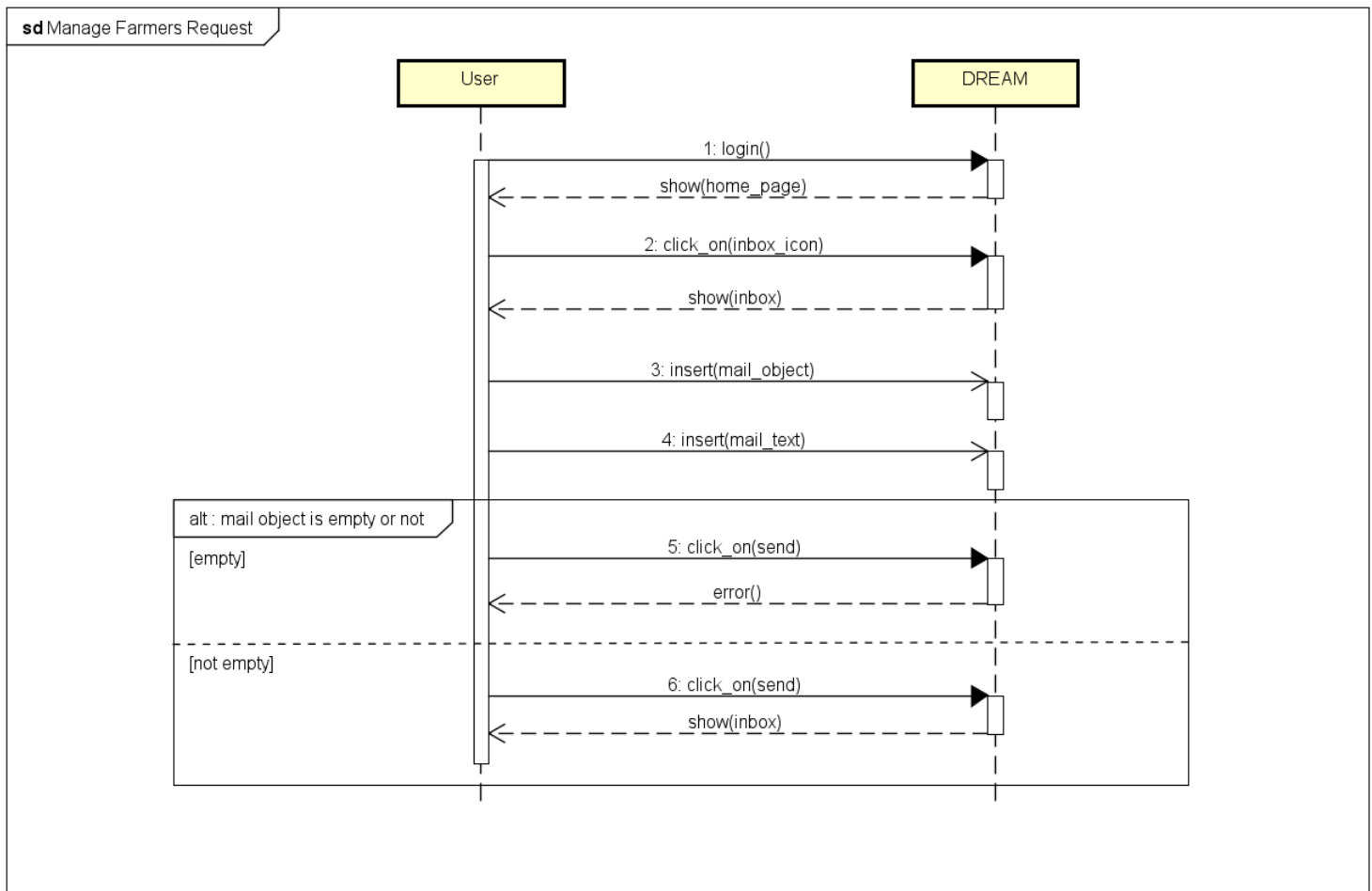


Figure 24: Agronomists - Manage Farmers Request Sequence Diagram

## Insert Responsibility Area

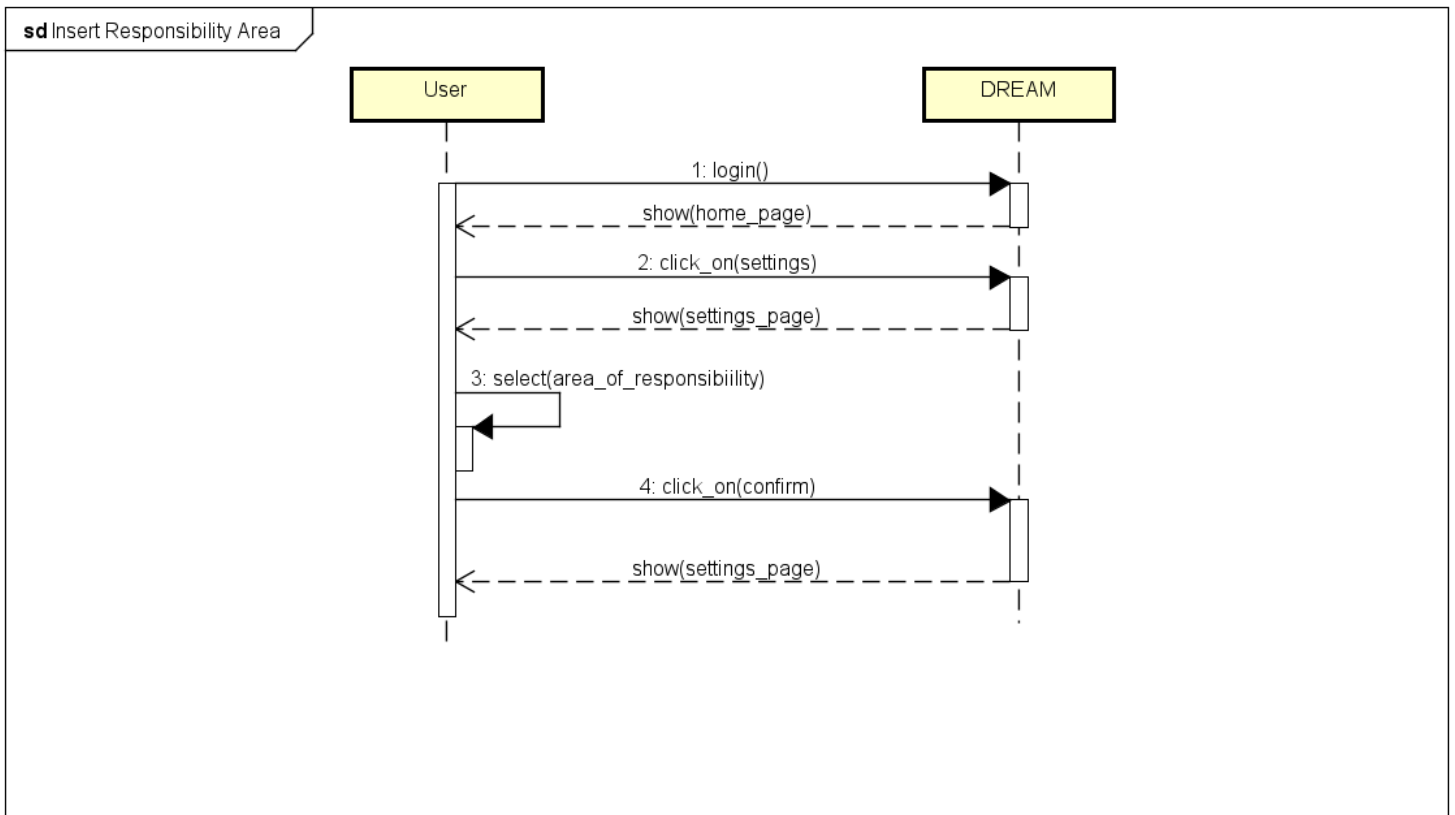


Figure 25: Agronomists - Insert Responsibility Area Sequence Diagram

## Check Weather Forecast

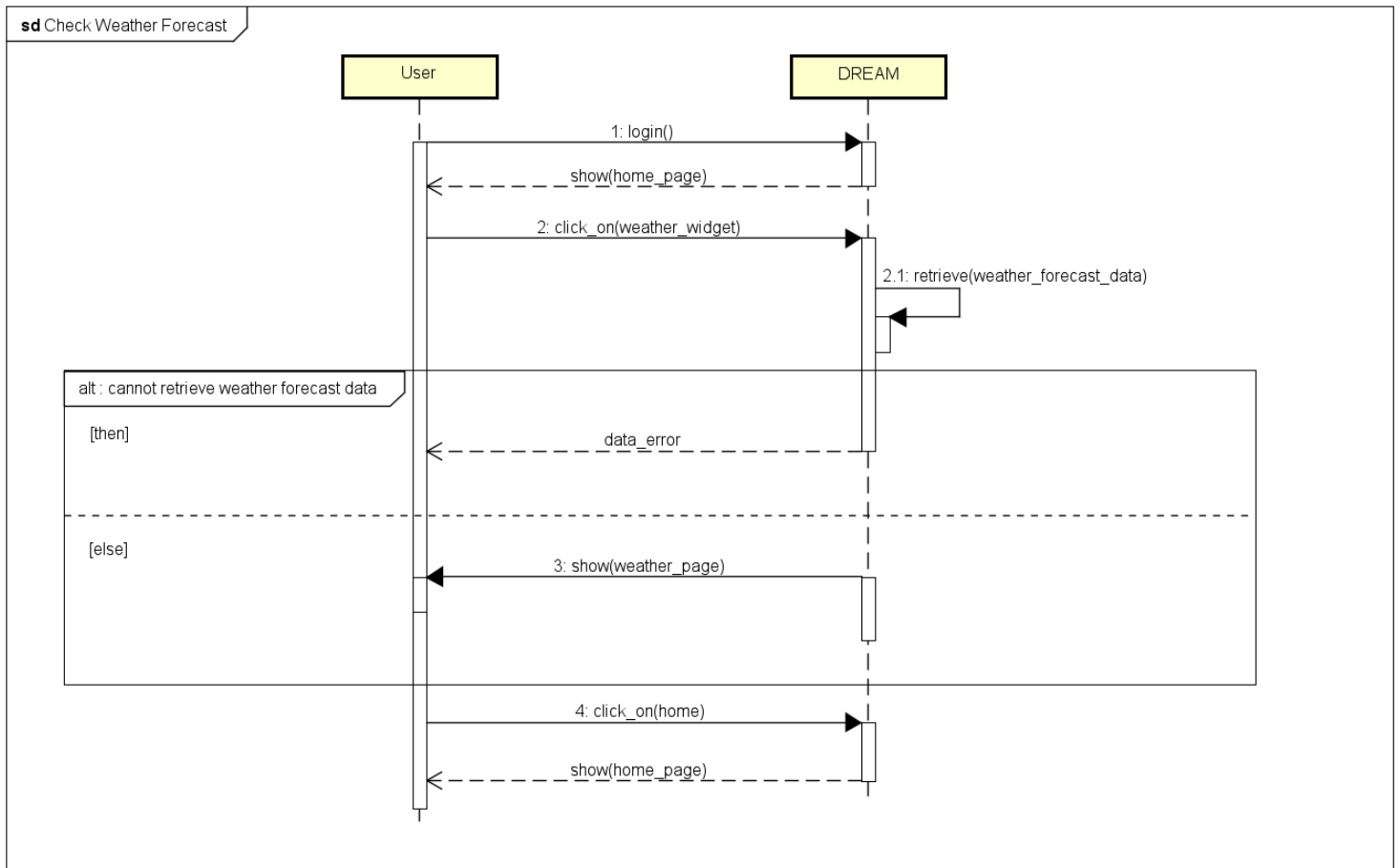


Figure 26: Agronomists - Check Weather Forecast Sequence Diagram

## View Farmers Area Ranking

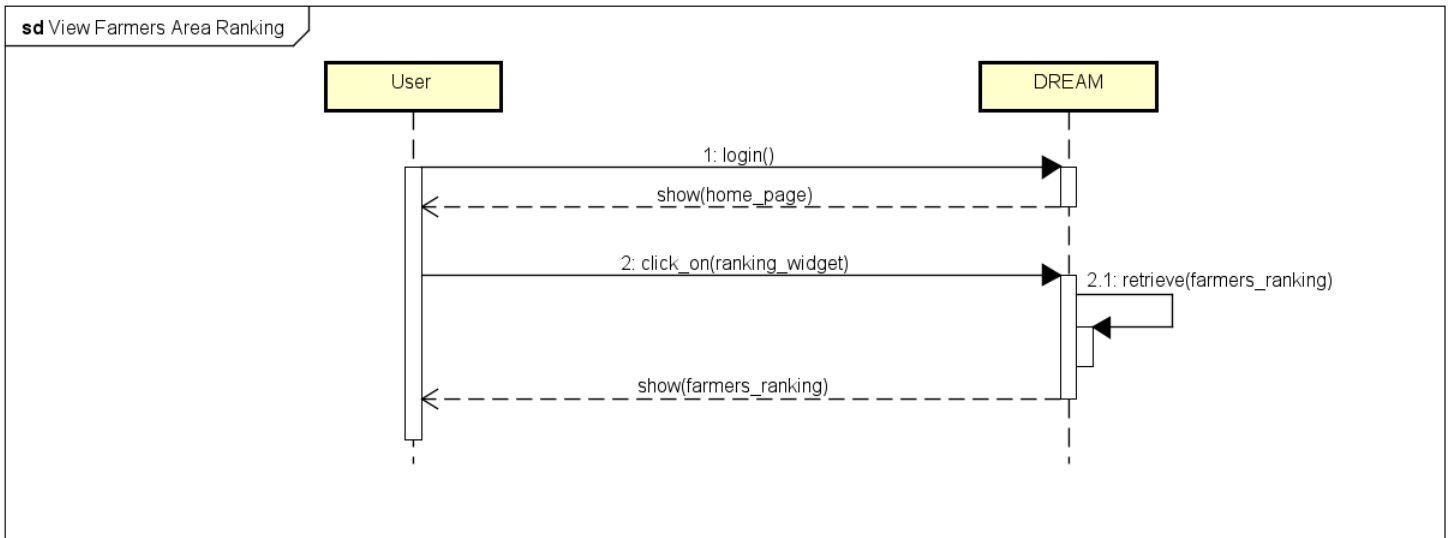


Figure 27: Agronomists - View Farmers Area Ranking Sequence Diagram



### 3.2.5 Scenarios

1. Sahil is a farmer that would like to share some best-practices about a particular product that he has cultivated during the last year. He decides to open a new discussion on the forum and invites all his colleagues.
  - He opens the app on his device, if he is already registered he logs in
  - The system shows the homepage for a farmer user
  - He clicks on the "Forum" and access the forum section
  - Now he clicks on the "Create new topic" where he can select the name of the discussion
  - Finally he writes a new message in the discussion
2. Pajeet is one of the main policy makers in the state of Telangana. He wants to distribute special incentives to the best farmers and to do this he decides to open the app and visualize the data.
  - He opens the app on his device, if he is already registered he logs in
  - The system shows the homepage for a policy maker user
  - He visualize the ranking of the well-performing farmers
  - He clicks on the name of a farmer
  - Now the system shows the profile of the selected farmer
  - Here the policy maker can find useful contact informations such as phone number and email
  - He takes note of the desirable contact informations and close the app
3. Shaleena is an agronomist responsible of Mahbubnagar, one of the biggest region in Telangana. She wants to compose the daily plan to decides which farms to visit today and for this reason she decides to open the app.
  - She opens the app on his device, if she is already registered she logs in

- The system shows the homepage for an agronomist user
  - She clicks on the "Daily plan" and access the new section
  - She can add the farms she wants to visit to the daily plan by choosing them from the list of available ones
  - Now the system shows the addresses and the date of the last visit of the selected farms
  - She takes note of the addresses of the farms to visit and close the app
4. Chaitanya is an agronomist that after a hard day of work wants to update the daily plan on the app. At the end of the day she realizes that she has visited three farms instead of the two indicated in the daily plan.
- She opens the app on his device, if she is already registered she logs in
  - The system shows the homepage for an agronomist user
  - She clicks on the "Daily plan" and access the new section
  - Here she can visualize the daily plan
  - She can click on the "Add" or on the "Remove"
  - In case of "Add" the system would redirect her to the list of available ones, in case of "Remove" she can delete a farm from the list simply by clicking on the cross at the right
  - She clicks on the "Confirm" to validate the daily plan
  - The system returns to the homepage
  - Finally she close the app
5. Damayanti is a farmer that would like to improve the productivity of his farm. To do so he decides to consult the section regarding the suggestions on specific crops to plant or specific fertilizers to use.
- He opens the app on his device, if he is already registered he logs in
  - The system shows the homepage for a farmer user
  - He clicks on the "News" and access the new section

- Here he visualizes suggestions based on his type of production and on his location
  - If he is not satisfied he clicks on the "Request for suggestions" to ask agronomists or other farmers
  - Otherwise he takes note of the suggestions
  - He closes the app
6. Pradeep is an agronomist who wants to take care about help requests before going to work.
- He opens the app on his device, if he is already registered he logs in
  - The system shows the homepage for an agronomist user
  - He clicks on the "Mail box" and access the new section
  - Here he visualizes a list of help requests
  - By clicking on a help request he can visualize the request and answer
  - He do this for every help request until they are finished
  - Finally he closes the app and begins his working day

### 3.3 Performance Requirements

The majority of the user base will be represented by the farmers that cover the 58% of the entire population of Telangana. According to Unique Identification Aadhar India the Telangana population in 2021 is estimated to be 39.9 million. This means that the system is expected to be widely adopted with the registration of millions of users just in the first year. Also the average workload of the system is expected to be high, the goal is to guarantee the simultaneous connection of 200.000 individuals. A mid-term goal could be to improve the scalability of the system in order to guarantee an efficient service to all users. Finally the system should have a good response time, less than 3 seconds is reasonable.

## **3.4 Design Constraints**

### **3.4.1 Standards compliance**

DREAM's user data must be treated respecting the law according to the PDPA. All hardware devices distributed all over the territory (sensors) must comply the CE safety standards.

### **3.4.2 Hardware limitations**

The software is designed to enhance the portability, in fact it is enough to have a device with a stable internet connection. In order to use the application correctly it is required to have a device equipped with GPS.

## **3.5 Software System Attributes**

### **3.5.1 Reliability**

To ensure data consistency the system must have a fully backup infrastructure, this allows to recover from general failures in the main system.

### **3.5.2 Availability**

The system should be up almost 24/7 in order to allow users to use the application's services at any time. The peak of use is expected during the working hours, it means that it is better to do all the maintenance activities during the night hours.

### **3.5.3 Security**

All the data stored by the system must be encrypted with a standard algorithm like the AES (Advanced Encryption Standard). The communications goes on a secure channel powered by the SSL protocol. In addition users can request a two-factor authentication (2FA) to improve the security of the personal account. All data should be stored in compliance with PDPA's regulation.

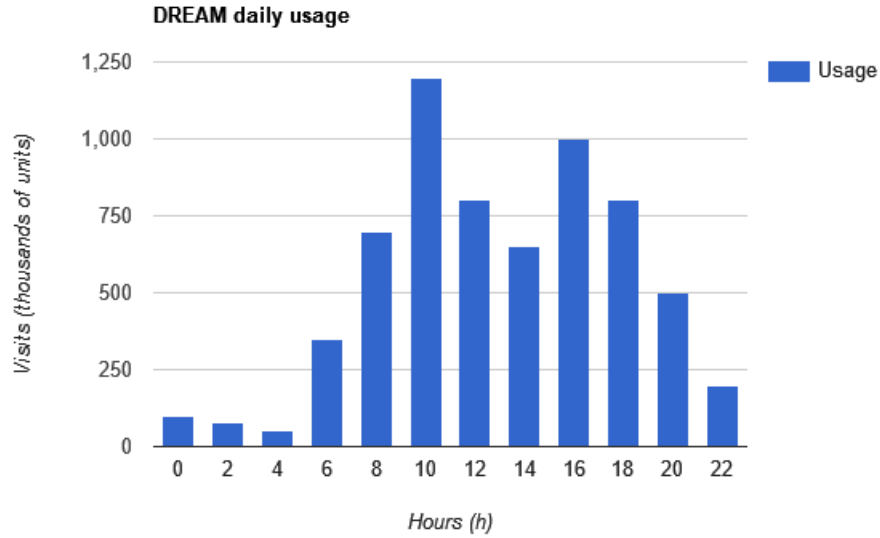


Figure 28: DREAM daily usage

#### 3.5.4 Maintainability

The maintainability is guaranteed by high standard of code, the use of design patterns will enhance this point and guarantee high reusability. The code must be extensively tested. The system must be extendible in order to support future updates. User's application will be regularly updated.

#### 3.5.5 Portability

The system is designed to work on different operating systems like Windows, MacOS and Linux. All main browsers are supported.

## 4 Formal Analysis using Alloy

## 5 Effort Spent

Student	Time for S.1	S.2	S.3	S.4
Ottavia Belotti	2h	2h	2h	?
Alessio Braccini	2h	2h	6h	?
Riccardo Izzo	2h	2h	5h	?

## 6 References