

# Fertilizer Recommendation Calculator

(Modified Version)

## **Submitted to**

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# Letter of Transmittal

20th March, 2018

Coordinator  
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Subject: Submission of software requirement specification document on 'Fertilizer Recommendation Calculator'.

Sir

We, the team on which the project on 'Fertilizer Recommendation Calculator' was assigned, are submitting our software requirement specification document with due respect. We have tried our best for preparing the document. However, it might lack perfection.

So, may we therefore, hope that you would be kind enough to accept our document and oblige thereby.

Sincerely yours

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-----  
Date and Signature  
Dr. Mohammad Shoyaib  
Professor  
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## Acknowledgement

We are highly indebted for getting such a tremendous opportunity to prepare the report on Fertilizer Recommendation Calculator. We would like to thank whole-heartedly our supervisor, Dr. Mohammad Shoyaib, Professor, Institute of Information Technology, University of Dhaka, for giving us guidelines about how we can prepare this report. In completing this report, we have collected various important data and information from Bangladesh Agricultural University (BAU). We are thankful to every faculty member of BAU who provided us with necessary data and information, especially Abdullah Al Mahmud (Ph.D. fellow, Department of Soil Science, BAU).

## **Abstract**

This study is made for 'Fertilizer Recommendation Calculator'. The scope of the study is to analyze how the farmers utilize the land by providing adequate amount of fertilizers and get the best yield of crops and how information regarding the soil is collected by the experts. The study also includes knowing the drawbacks and design the SRS (software requirements and specification) of the system. The object of the study is to develop an SRS of 'Fertilizer Recommendation Calculator'. This study also describes the how this SRS can be used to better the current system.

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# Chapter 1

## Introduction

This chapter is a part of the software requirement specification for the project 'Fertilizer Recommendation Calculator'. In this chapter intended audience for the project are focused on.

### 1.1 Purpose

This document briefly describes the Software Requirement Analysis of 'Fertilizer Recommendation Calculator'. It contains functional, non-functional, and supporting requirements and establishes a requirement baseline for the development of the system. The requirements specified in the SRS are independent, uniquely numbered and organized by topic. The SRS serves as an official mean of communicating user requirements to the developer and provides a common reference point for both the developer team and the stakeholder community. The SRS will evolve over time as users and developers work together to validate, clarify and expand its contents.

### 1.2 Intended Audience

This SRS is intended for several audiences including the customers as well as the project managers, designers, developers and testers.

- The customers will use this SRS to verify that the developer team has created a product that is acceptable to the customers.
- This project managers of the developer team will use this SRS to plan milestones and a delivery date and ensure that the developing team is on track during development of the system.

# Chapter 2

## Inception

In this chapter, the inception part of the SRS will be discussed briefly.

### 2.1 Introduction

Inception is the beginning phase of requirements engineering. It defines how a software project gets started and what the scope and nature of the problem to be solved is. The goal of the inception phase is to identify the concurrent needs and conflicting requirements among the stakeholders of a software project. At project inception, a basic understanding of the effectiveness of preliminary communication and collaboration between the other stakeholders and the software team was established.

To establish the groundwork, the following factors have been worked on to the inception phase:

- List of stakeholders
- Recognizing multiple viewpoints
- Working towards collaboration
- Requirements questionnaire

#### 2.1.1 List of Stakeholders

Stakeholders refer to any person or group who will be affected by the system directly or indirectly. Stakeholders include end-users who interact with the system and everyone else in an organization that might be affected by its installation. At inception, a list of people who will contribute input as requirements are elicited. The initial list will grow as stakeholders are

contacted because every stakeholder will be asked: "whom else do you think I should talk to?"

The following stakeholders were identified for the 'Fertilizer Recommendation Calculation'.

**Normal User:** Normal user is the general software user.

**Field Worker:** Field workers are responsible for collecting soil samples. They also provide information and suggestion to the farmers about cultivation processes.

**Soil expert:** A soil expert is an individual who analyzes and researches soil. He/she researches the sample and updates the data.

**Admin:** Admin coordinates all the work. He/she decides what task will be given to which individual. He/she is also responsible for hiring and firing of an individual.

**Software Developer:** A software developer is concerned with facets of the software development process, including the research, design, programming, maintenance and testing of computer software. He will be responsible for the outcomes of the software.

### **2.1.2 Recognizing Multiple Viewpoints**

Different stakeholders demand different features from the software. To satisfy the stakeholders, most of these features should be included in the software.

#### **Normal user's viewpoint**

- Error free system

- Fast generation of fertilizer output
- Provide accurate cost for the required fertilizers
- Offline result
- User friendly
- Suggestion for best crop pattern for a specific region
- Application for feature phone (normal phone)
- Keep history

### **Field Worker's viewpoint**

- User friendly
- Error free system
- Suggestion for best crop pattern for a specific region
- Fast generation of fertilizer output
- Provide as less input as possible
- Less internet data usage
- Keep history

### **Expert's viewpoint**

- Error free system
- Fast generation of fertilizer output
- Nutrient requirements for a specific crop for a particular region
- User friendly nutrient balance sheet
- Soil sampling
- Keep history

### **Admin's viewpoint**

- Error free system
- Strong authentication
- User friendly

### **Developer's viewpoint**

- Easy to built
- Error free effective software
- No ambiguous requirement
- Getting a decent amount of money for project budget

### **2.1.3 Working towards collaboration**

While working with different stakeholders, some conflicting and common viewpoints can be noticed. For this reason, final requirements can be gotten by collaborating the viewpoints.

### **Common viewpoints**

- Error free effective system
- User friendly
- Easy to maintain the software

### **Conflicting viewpoints**

- Developing the project in minimum budget
- Less internet usage
- Application for feature phone (normal phone)
- Keep history

### **Final Requirements**

- Error free effective system
- User friendly
- Suggestion for best crop pattern for a specific region
- Fast generation of fertilizer output

- Nutrient requirements for a specific crop for a particular region
- User friendly nutrient balance sheet
- Offline result

#### **2.1.4 Requirements Questionnaire**

At first some context free questions were asked for identifying the stakeholders. Context free questions are helpful to identifying some stakeholders who cannot be identified by structural questions. Then questions regarding the software were regarding to know their demands.

### **2.2 Conclusion**

In this inception phase, a basic understanding of the problem was developed and a preliminary nature of the solution was obtained. The requirements which are identified in this phase, will be used later for further steps of requirement engineering.



# Chapter 3

## Elicitation

This chapter specifies the Elicitation phase.

### 3.1 Introduction

Requirements Elicitation is a part of requirements engineering that is the practice of gathering requirements from the users, customers and other stakeholders. Many difficulties were faced, like understanding the problems, making questions for the stakeholders, limited communication with the stakeholders due to a short amount of time and volatility. Though it is not easy to gather requirements within a very short time, these problems have been surpassed in an organized and systematic manner.

### 3.2 Eliciting Requirements

The main task of this phase is to combine the elements of problem solving, elaboration, negotiation and specification. The collaborative working approach of the stakeholders is required to elicit the requirements. The following tasks were done for eliciting requirements-

- Collaborative Requirements Gathering
- Quality Function Deployment
- Usage Scenarios
- Elicitation work products

### **3.2.1 Collaborative Requirements Gathering**

The meetings with the stakeholders created an indecisive state to elicit the requirements. To solve this problem, more than one meeting was held with the stakeholders. A slightly different scenario from these approaches has been found following activities have been completed to accomplish this task.

- The meetings were conducted with the owner, employees and suppliers. They were questioned about their requirements and expectations from the Grocery Management System.
- They were asked about the problems they were facing with the current manual system.
- Lastly final requirement list was selected from the meetings.

### **3.2.2 Quality Function Deployment**

Quality Function Deployment (QFD) is a technique that translates the needs of the customer into technical requirements for software. Ultimately the goal of QFD is to translate subjective quality criteria into objective ones that can be quantified and measured and which can then be used to design and manufacture the product. It is a methodology that concentrates on maximizing customer satisfaction from the software engineering process. The requirements, which are given below, are identified successfully by the QFD.

#### **3.2.2.1 Normal Requirements**

The normal requirements are generally the objectives and goals that are stated for a product or system during meetings with the customer. The presence of these requirements fulfills customers' satisfaction. These are the normal requirements for the project.

- Suggestion for best crop pattern for a specific region
- Fast generation of fertilizer output

- Nutrient requirements for a specific crop for a particular region
- User friendly nutrient balance sheet
- Soil sampling
- Offline result
- Fertilizer requirement for a specific crop pattern

### **3.2.2.2 Expected Requirements**

These requirements are intrinsic to the product or system and may be so elementary that the customer does not explicitly state them. Their absence will be a cause for significant dissatisfaction. Below the expected requirements for our project are briefly described.

- Error free software
- User friendly
- Effective system
- No ambiguous feature

### **3.2.2.3 Exciting Requirements**

These requirements are for features that go beyond the customer's expectations and prove to be very satisfying when present. Following are some exciting requirements of this project.

- Providing Partial Crop Balance Sheet and Crop Balance Sheet.

## **3.2.3 Usage Scenario**

### **Required Fertilizer Calculation**

To calculate the required fertilizer for a specific crop in a particular region, at first the required nutrients for the crop has to be calculated. After that the calculation of the required fertilizers can be conducted. This section will also

estimate the cost for the required fertilizers. User will also be shown the best crop pattern for his/her region.

### **Nutrients Calculation**

Required nutrients will be calculated for a particular crop for a specific region. It varies from crop to crop and land to land. So user will give input of the crop's name first. After that the varieties of that crop will be shown. User needs to select one of the varieties. Some varieties of a specific crop requires same nutrient amount while some varieties of the same crop do not. So crop class (if some varieties of the same crop requires similar nutrition, it is kept under the same class) is determined from crop name and its variety. User will then input soil texture. Texture class will be calculated from crop type and soil texture. Then user will give amount of six nutrients including nitrogen (N), phosphorous (P), potassium (K), zinc (Zn), sulfur (S) and boron (B) in the soil. 'Interpretation of the soil' (Very low, low, optimum, medium, high, very high) will be calculated from texture class and nutrient amount. This interpretation is different for each texture class. Each interpretation for a specific nutrient has lower limit, upper limit and range or interval (difference between upper limit and the lower limit). To calculate the required nutrients, the interval ( $C_s$ ) and the lower limit ( $L_s$ ) will be used of the soil interpretation. There is another interpretation called 'interpretation of nutrients for a specific crop class' which is as same as interpretation of soil but related to crop class rather than texture class. Using the interpretation of the soil (Very low, low, optimum, medium, high, very high) and crop class, the upper limit ( $U_f$ ), range ( $C_i$ ) has to be determined from called 'interpretation of nutrients for a specific crop class'. These values will have to be put in the following equation for a specific nutrient:

$$F_r = U_f - C_i / C_s * (S_t - L_s)$$

Where

$F_r$  = Required fertilizer nutrient for the soil test value

$U_f$  = The upper limit of the 'interpretation of nutrients for a specific crop class'

$C_i$  = range 'interpretation of nutrients for a specific crop class'

$C_s$  = range of 'interpretation of soil'

$S_t$  = soil test value given by the user

$L_s$  = lower limit of 'interpretation of soil'

From this equation, the amount for a specific nutrient for a specific crop will be determined.

### **Fertilizers Calculation and Cost Estimation**

Amount of fertilizers will be calculated from nutrients calculation. Inorganic fertilizers including urea, TSP (Triple Super Phosphate), MoP (Muriate of Potash), gypsum, zinc sulphate and Boric Acid amount will be calculated. Each fertilizer is used to supply a certain amount of nutrients to the soil (For example: Urea has x amount of nitrogen per kg. So, if there is a lacking of y kg nitrogen in the soil, (y/x) kg urea has to be used then.). Urea, TSP, MoP, gypsum, zinc sulphate and boric acid are used for lack of nitrogen, phosphorous, potassium, zinc, sulfur and boron respectively. If organic fertilizers including cowdung, FYM (Farm Yard Manure), poultry manure (compost), GM (green manure), brown manure, crop residues are also used, user will need to put the amount that is available for usage and the amount of the inorganic fertilizer will be calculated accordingly.

After calculating the required amount of fertilizers, user will be shown an estimation of total cost for the fertilizers. Cost of the organic fertilizers are assumed to be cost-free and therefore those will not be calculated. If organic manure was used, the cost of the inorganic manure will be calculated accordingly.

## **Nutrients Balance Sheet**

This section is mainly for the soil experts. They will have to provide information about the land type, agro-ecological zone (AEZ), name of three crops in the three seasons (Rabi, Kharif-1 and Kharif-2), the amount of nutrients (nitrogen, phosphorus and potassium) each of the crop got because of the inorganic fertilizer, organic manure name and amount of the organic manure (if organic manure was applied) and percentage of residues removed for each crop. Then the nutrient input, nutrient output and balance sheet will be calculated accordingly. Also for a specific AEZ, its fertility class and average rainfall will also be shown.

## **Nutrients Inputs**

User will be shown total amount of nutrients that was provided to the crop for the specific AEZ in a particular season. The amount of the nutrients can be provided to the crop by organic and inorganic manure, BNF (fixation), deposition (rain), sedimentation (flood) and irrigation. These are also known as nutrients inputs. After showing all nutrients input information for each crop, the total amount of nutrients that was provided in the year for all three crops will be shown.

BNF varies from crop to crop. For some crops BNF is a fixed value where for others crops it either depends on the nitrogen-addition due to fertilizers or nitrogen-uptake by the crop. Deposition depends on the average annual rainfall of the location (AEZ). The amount of nitrogen, phosphorus and potassium increases due to rainfall ( $N = 0.14 * \text{square root of rainfall}$ ,  $P = 0.023 * \text{square root of rainfall}$ ,  $K = 0.092 * \text{square root of rainfall}$ ). The amount gets divided into three seasons (Rabi, Kharif-1 and Kharif-2). Sedimentation is based on the land type of the AEZ and irrigation is based on the crop.

## **Nutrients Outputs**

Crop produce, crop residues, leaching, denitrification, volatilization and soil erosion are considered as nutrients outputs. User will be shown the nutrient output for his/her desired crops in the particular season. Total nutrients outputs will also be shown for the year.

Harvested product or crop produce depends on the nutrient concentration and yield of the crop. Crop residues is based on the nutrient concentration, yield and produce-residue ratio of the crop. Leaching depends on the soil fertility of the land, average rainfall, amount of nutrient provided to the crop and nutrient-uptake by the crop. Denitrification is related to the soil fertility, nitrogen provided to the crops and nitrogen-uptake by the crop. Volatilization depends on the crop and soil erosion depends on the AEZ.

## **Balance Sheet**

After calculating nutrients input and output, a balance sheet for nutrients will be calculated. There are two kinds of balance sheets: Total balance sheet and partial balance sheet. These are calculated for each nutrient for each crop in a particular season. Total balance sheet is calculated by substituting each nutrient output from each nutrient input for each crop. Partial balance sheet is calculated by adding each nutrient gained from fertilizer and manure and then substituting it by each nutrient that was outputted due to crop produce and crop residues. For both balance sheet, the similar nutrients for each crop is added to get the yearly balance sheet.

## **Fertilizer Recommendation based on AEZ and Cropping Pattern**

Based on district, AEZ will be calculated and all the cropping pattern of that AEZ will be shown. After selecting any cropping pattern, user will be shown the required fertilizer for the crops.

### **3.2.4 Elicitation Work Product**

At first, it has to be known whether the output of the Elicitation task may vary because of the dependency on the size of the system or the product to be built. Here, the Elicitation work product includes

- Making a statement of our requirements for the Fertilizer Recommendation Calculator
- Making a bounded statement of scope for our system.
- Making a list of customers, users and other stakeholders who participated in the requirements elicitation.
- Making a list of requirements that are organized by function and domain constraints that apply to each other.
- A set of usage scenarios that provide insight into the use of the system.
- Description of the system's technical environment.



# Chapter 4

## Scenario Based Modeling

This chapter describes the scenario based model for the Grocery Management System.

(**N.B:** All information related to Admin, Authentication and Soil Sampling will be excluded).

### 4.1 Introduction

Although the success of a computer-based system or product is measured in many ways, user satisfaction resides at the top of the list. If the software developer team understands how end users (and other actors) want to interact with a system, they will be better able to properly characterize requirements and build meaningful analysis and design models. Hence, requirements modeling begins with the creation of scenarios in the form of Use Cases, activity diagrams and swim lane diagrams.

### 4.2 Definition of Use Case

A Use Case captures a contract that describes the system's behavior under various conditions as the system responds to a request from one of its stakeholders. In essence, a Use Case tells a stylized story about how an end user interacts with the system under a specific set of circumstances. A Use Case diagram simply describes a story using corresponding actors who perform important roles in the story and makes the story understandable for the users.

The first step in writing a Use Case is to define that set of “actors” that will be involved in the story. Actors are the different people that use the system or product within the context of the function and behavior that is to be described. Actors represent the roles that people play as the system operators. Every user has one or more goals when using system.

### **Primary Actor**

Primary actors interact directly to achieve required system function and derive the intended benefit from the system. They work directly and frequently with the software.

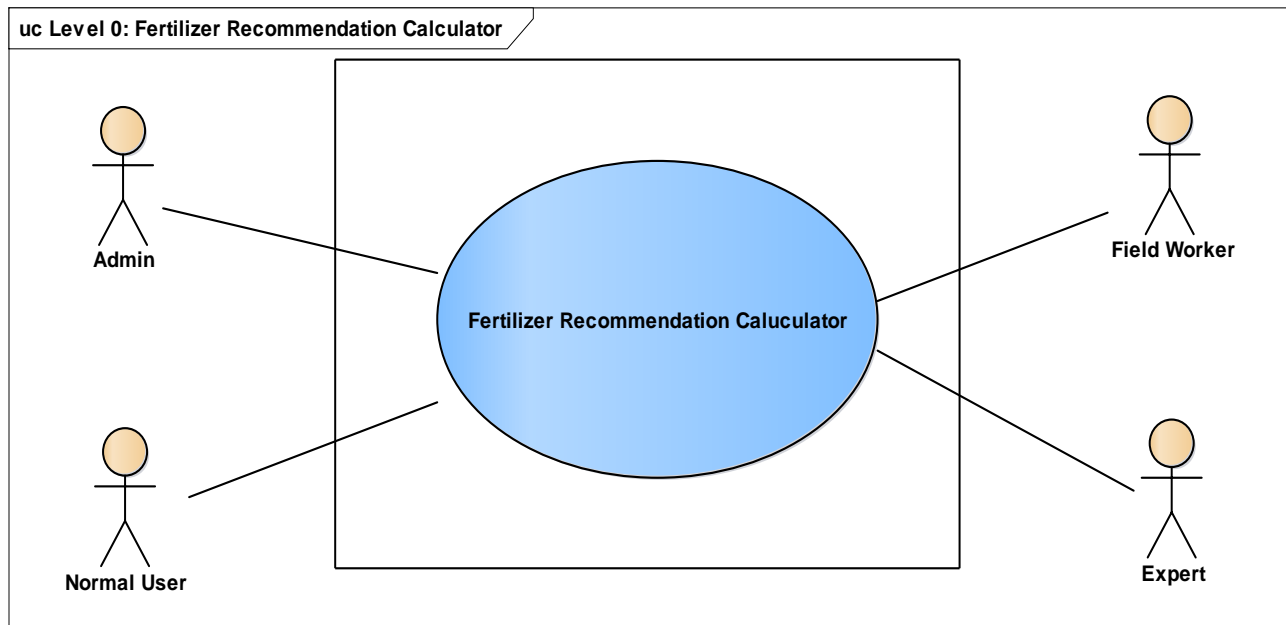
### **Secondary Actor**

Secondary actors support the system so that primary actors can do their work. They either produce or consume information.

## **4.3 Use Case Diagrams**

Use Case diagrams give the non-technical view of overall system.

### 4.3.1 Level 0 - Fertilizer Recommendation Calculator



*Figure 1: Use Case Level 0 - Fertilizer Recommendation Calculator*

#### Actors

1. Admin
2. Normal User
3. Field Worker
4. Expert

#### Description

There are four actors in this system who will use the system directly. Primary actors are those who will play action and get replies from the system. Secondary actors only produce or consume information.

### 4.3.2 Level 1: Fertilizer Recommendation Calculator Subsystems

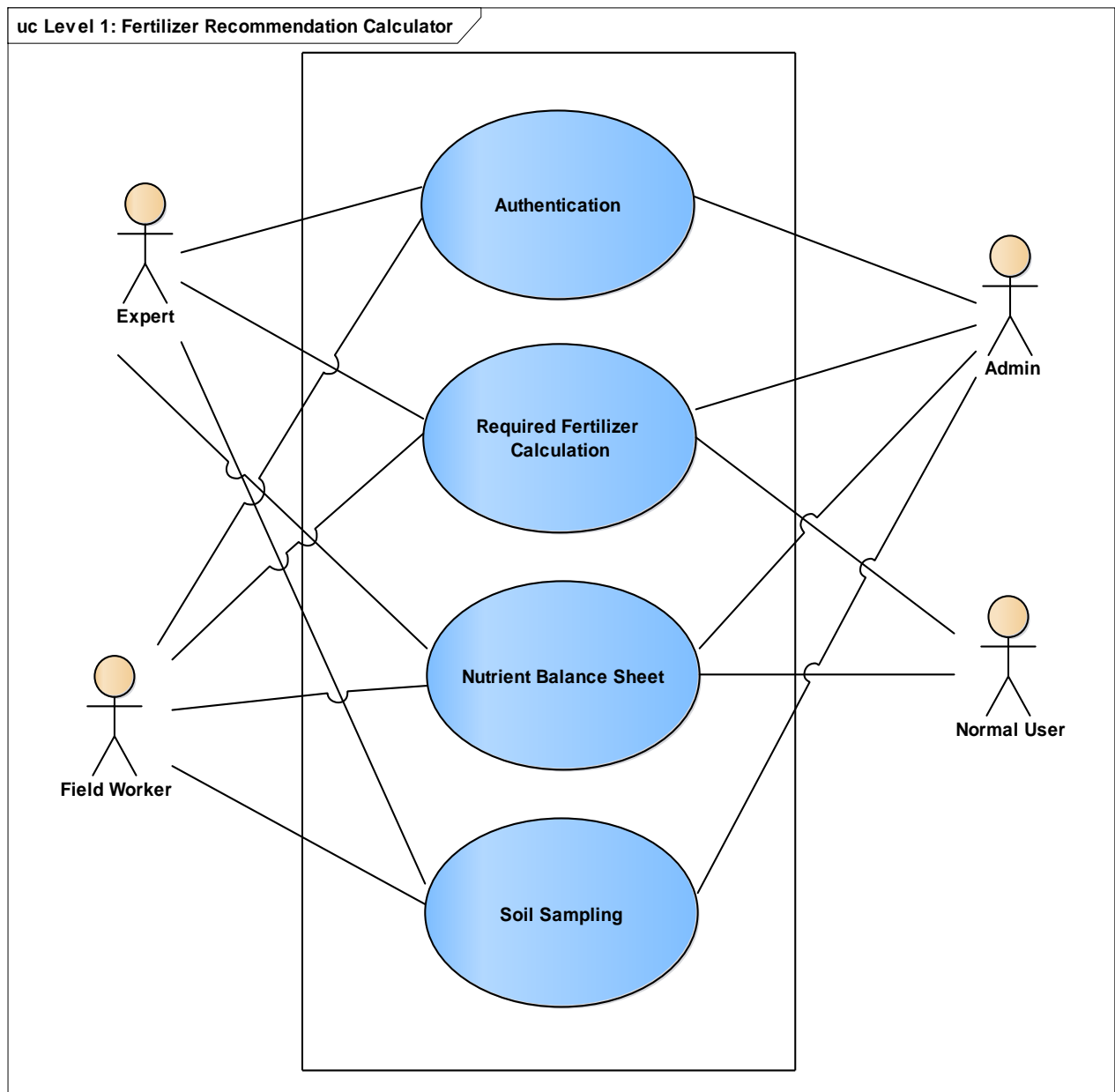


Figure 2: Use Case Level 1 - FRC Subsystems

#### Actors

1. Admin
2. Normal User

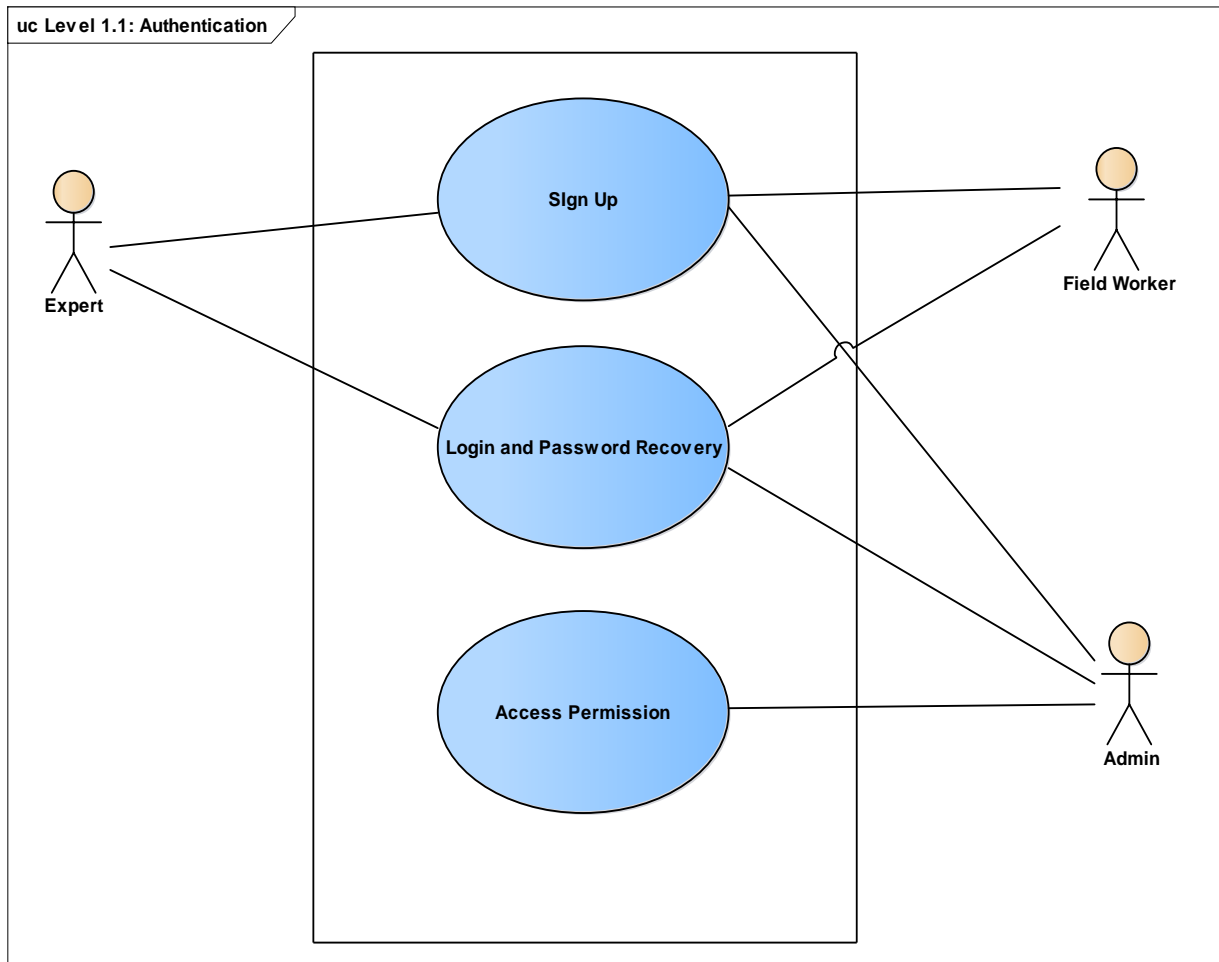
3. Expert
4. Field Worker

### **Description**

There are four subsystems in the Fertilizer Recommendation Calculator. They are:

1. Authentication
2. Calculation of Fertilizers
3. Nutrients Balance Sheet
4. Soil Sampling

### 4.3.3 Level 1.1: Authentication



*Figure 3: Use Case Level 1.1: Authentication*

#### **Actor**

1. Expert
2. Field Worker
3. Admin

#### **Description**

Users have to authenticate when they are going to upload any data to the server or while manipulating any existing data.

## **Sign Up**

To have an account, user needs to sign up first. He/she needs to provide his/her email address, phone number and password. The password must contain at least eight characters including at least one digit. It is optional for him/her to provide his/her name, job title and account type ("field worker", "expert" or "admin"). Email address and phone number will be verified by checking for validity and duplicity checking. After it is verified, he/she will be sent a verification code. When he/she confirms the verification code, the account information will be stored to be verified by the admin. He/she will verify the phone number and choose whether the account type for the user will be "admin", "field worker" or "expert".

## **Login and Password Recovery**

If a user currently has an account, he/she can log in to the system. To log in, he/she has to provide his email address or phone number and password. If both of those match, he/she can log in to the system. He/she can log out of the system whenever he/she wants.

If a user forgets his/her password, he/she can recover the password. To recover the password, he/she has to provide the email address or phone number that he/she used to sign up. If the email address or the phone number is valid, his/her password will be send to the email.

User can change his/her password while he/she is logged into his/her account. He/she can change his/her name, password and job title. If he/she changes his/her password it will checked to see if it matched the criteria provided for the passwords. After verifying everything, the information will be updated.

## **Access Permission**

A predefined “admin” account will be provided to the admin user. He/she can grant access to other users as “admin”, “field worker” or “expert”. An “admin” account has access to any data and can perform every operation. He/she can also change type of another account or even block an account. A user without any account can calculate required amount of fertilizer and its cost and see nutrient balance sheet. A “field worker” and an “expert” account can do these too. However, a “field worker” account can also upload data regarding soil sampling. An “expert” account can do this too but this type of accounts also has the privileges to research on the soil sampling data and update any data when necessary.

## **Action Reply**

### **Sign Up**

**Action 1:** User provides credentials.

**Reply 1:** Input verified and stored for approval.

### **Log In**

**Action 1:** User provides email and password.

**Reply 1:** Email and password is verified and if these match user can login.

**Action 2:** User wants to update account.

**Reply 2:** Provide information.

**Action 3:** User provides information.

**Reply 3:** Information is verified and if verified successfully, it is updated.

**Action 4:** User wants to recover password.

**Reply 4:** Provide email and password.

**Action 5:** User provides email and password.

**Reply 6:** If these match, password is sent to the email.



## Access Permission

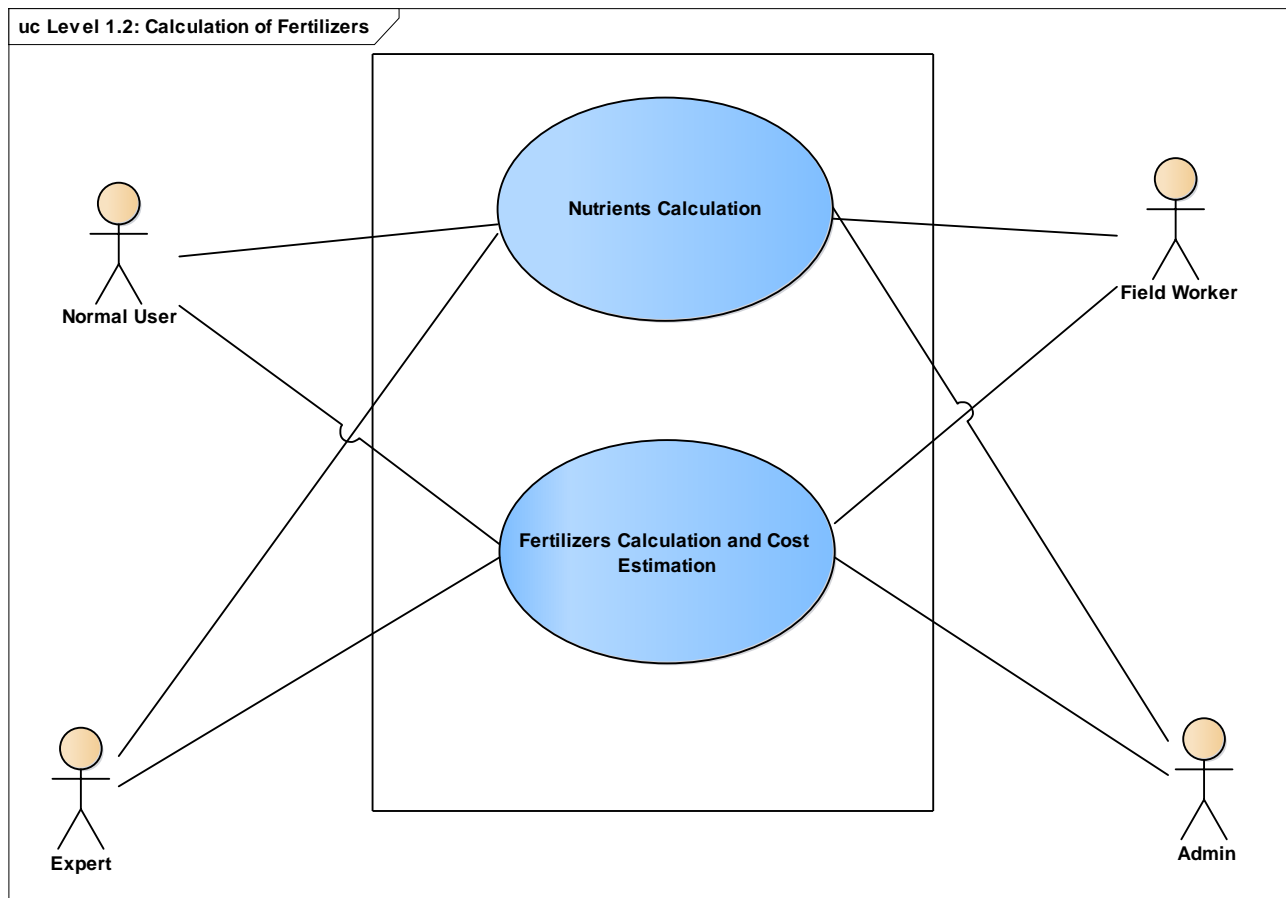
**Action 1:** User sees pending account and changes permission.

**Reply 1:** Account permission changed and updated.

**Action 2:** User wants to block account and provides email.

**Reply 2:** Account blocked.

### 4.3.4 Level 1.2: Required Fertilizer Calculation



*Figure 4: Use Case Level 1.2: Required Fertilizer Calculation*

To calculate the required fertilizer for a specific crop in a particular region, at first the required nutrients for the crop has to be calculated. After that the calculation of the required fertilizers can be conducted. This section will also estimate the cost for the required fertilizers.

## Nutrients Calculation

Required nutrients will be calculated for a particular crop for a specific region. It varies from crop to crop and land to land. So user will give input of the crop's name first. After that the varieties of that crop will be shown. User needs to select one of the varieties. Some varieties of a specific crop requires same nutrient amount while some varieties of the same crop do not. So crop class (if some varieties of the same crop requires similar nutrition, it is kept under the same class) is determined from crop name and its variety. User will then input soil texture. Texture class will be calculated from crop type and soil texture. Then user will give amount of six nutrients including nitrogen (N), phosphorous (P), potassium (K), zinc (Zn), sulfur (S) and boron (B) in the soil. 'Interpretation of the soil' (Very low, low, optimum, medium, high, very high) will be calculated from texture class and nutrient amount. This interpretation is different for each texture class. Each interpretation for a specific nutrient has lower limit, upper limit and range or interval (difference between upper limit and the lower limit). To calculate the required nutrients, the interval ( $C_s$ ) and the lower limit ( $L_s$ ) will be used of the soil interpretation. There is another interpretation called 'interpretation of nutrients for a specific crop class' which is as same as interpretation of soil but related to crop class rather than texture class. Using the interpretation of the soil (Very low, low, optimum, medium, high, very high) and crop class, the upper limit ( $U_f$ ), range ( $C_i$ ) has to be determined from called 'interpretation of nutrients for a specific crop class'. These values will have to be put in the following equation for a specific nutrient:

$$F_r = U_f - C_i / C_s * (S_t - L_s)$$

Where

$F_r$  = Required fertilizer nutrient for the soil test value

$U_f$  = The upper limit of the 'interpretation of nutrients for a specific crop class'

$C_i$  = range 'interpretation of nutrients for a specific crop class'

$C_s$  = range of 'interpretation of soil'

$S_t$  = soil test value given by the user

$L_s$  = lower limit of 'interpretation of soil'

From this equation, the amount for a specific nutrient for a specific crop will be determined.

### **Fertilizers Calculation and Cost Estimation**

Amount of fertilizers will be calculated from nutrients calculation. Inorganic fertilizers including urea, TSP (Triple Super Phosphate), MoP (Muriate of Potash), gypsum, zinc sulphate and Boric Acid amount will be calculated. Each fertilizer is used to supply a certain amount of nutrients to the soil (For example: Urea has x amount of nitrogen per kg. So, if there is a lacking of y kg nitrogen in the soil, (y/x) kg urea has to be used then.). Urea, TSP, MoP, gypsum, zinc sulphate and boric acid are used for lack of nitrogen, phosphorous, potassium, zinc, sulfur and boron respectively. If organic fertilizers including cowdung, FYM (Farm Yard Manure), poultry manure (compost), GM (green manure), brown manure, crop residues are also used, user will need to put the amount that is available for usage and the amount of the inorganic fertilizer will be calculated accordingly.

After calculating the required amount of fertilizers, user will be shown an estimation of total cost for the fertilizers. Cost of the organic fertilizers are assumed to be cost-free and therefore those will not be calculated. If organic manure was used, the cost of the inorganic manure will be calculated accordingly.

### **Action Reply**

**Action 1:** User provides information about nutrients and fertilizer.

**Reply 1:** Required nutrients, fertilizer and cost about crop is calculated and shown.

### **4.3.5 Level 1.3: Nutrients Balance Sheet**

This section is mainly for the soil experts. They will have to provide information about the land type, agro-ecological zone (AEZ), name of three crops in the three seasons (Rabi, Kharif-1 and Kharif-2), the amount of nutrients (nitrogen, phosphorus and potassium) each of the crop got because of the inorganic fertilizer, organic manure name and amount of the organic manure (if organic manure was applied) and percentage of residues removed for each crop. Then the nutrient input, nutrient output and balance sheet will be calculated accordingly. Also for a specific AEZ, its fertility class and average rainfall will also be shown.

#### **Nutrients Inputs**

User will be shown total amount of nutrients that was provided to the crop for the specific AEZ in a particular season. The amount of the nutrients can be provided to the crop by organic and inorganic manure, BNF (fixation), deposition (rain), sedimentation (flood) and irrigation. These are also known as nutrients inputs. After showing all nutrients input information for each crop, the total amount of nutrients that was provided in the year for all three crops will be shown.

BNF varies from crop to crop. For some crops BNF is a fixed value where for others crops it either depends on the nitrogen-addition due to fertilizers or nitrogen-uptake by the crop. Deposition depends on the average annual rainfall of the location (AEZ). The amount of nitrogen, phosphorus and potassium increases due to rainfall ( $N = 0.14 * \text{square root of rainfall}$ ,  $P = 0.023 * \text{square root of rainfall}$ ,  $K = 0.092 * \text{square root of rainfall}$ ). The amount gets divided into three seasons (Rabi, Kharif-1 and Kharif-2).

Sedimentation is based on the land type of the AEZ and irrigation is based on the crop.

### **Nutrients Outputs**

Crop produce, crop residues, leaching, denitrification, volatilization and soil erosion are considered as nutrients outputs. User will be shown the nutrient output for his/her desired crops in the particular season. Total nutrients outputs will also be shown for the year.

Harvested product or crop produce depends on the nutrient concentration and yield of the crop. Crop residues is based on the nutrient concentration, yield and produce-residue ratio of the crop. Leaching depends on the soil fertility of the land, average rainfall, amount of nutrient provided to the crop and nutrient-uptake by the crop. Denitrification is related to the soil fertility, nitrogen provided to the crops and nitrogen-uptake by the crop. Volatilization depends on the crop and soil erosion depends on the AEZ.

### **Balance Sheet**

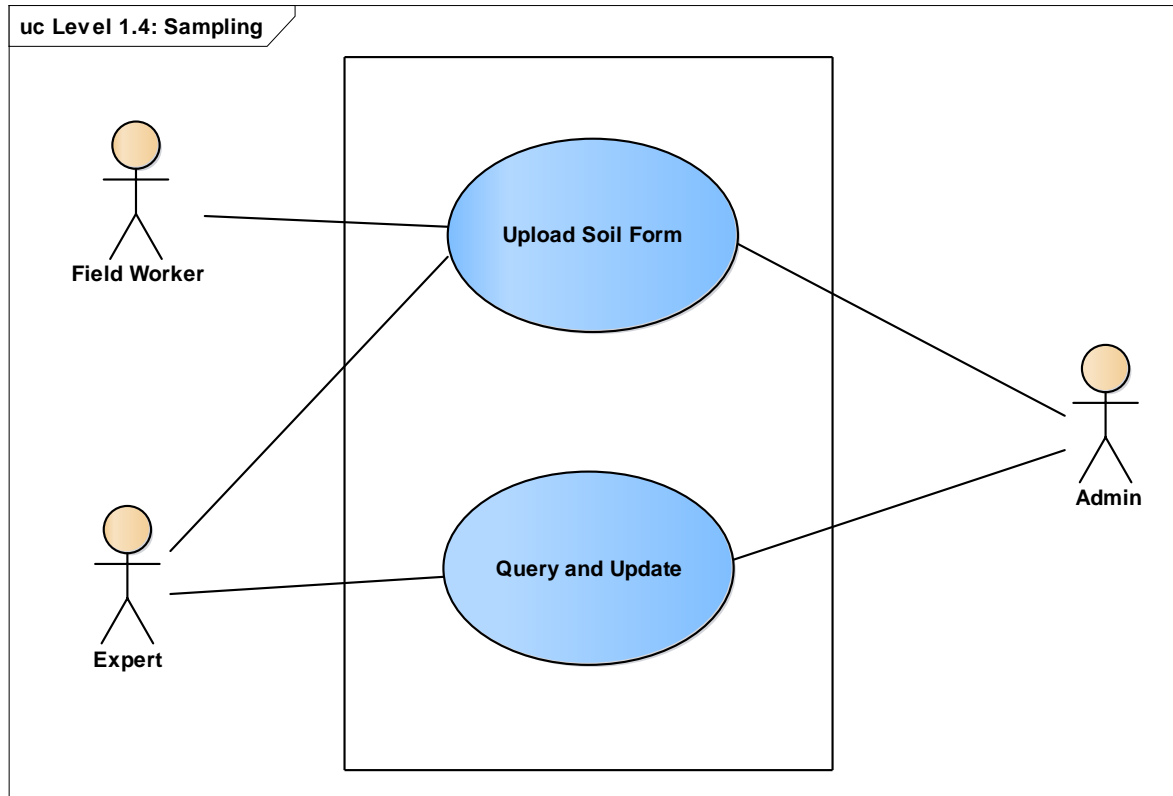
After calculating nutrients input and output, a balance sheet for nutrients will be calculated. There are two kinds of balance sheets: Total balance sheet and partial balance sheet. These are calculated for each nutrient for each crop in a particular season. Total balance sheet is calculated by substituting each nutrient output from each nutrient input for each crop. Partial balance sheet is calculated by adding each nutrient gained from fertilizer and manure and then substituting it by each nutrient that was outputted due to crop produce and crop residues. For both balance sheet, the similar nutrients for each crop is added to get the yearly balance sheet.

### **Action Reply**

**Action 1:** User provides input about nutrients and AEZ.

**Reply 1:** Balance sheet is generated.

### 4.3.6 Level 1.6 - Soil Sampling



*Figure 5: Use Case Level 1.6 - Soil Sampling*

Soil sampling is collecting soil samples and providing details about the sample. The details include sample id, location, latitude, longitude, time, user id, p<sup>h</sup> of the soil and the nutrients amount of the soil.

#### **Upload Sample Data**

A “field worker” or an “expert” will collect soil samples for their purposes. He/she will add details about the sample. The location and the time of collecting the samples will be generated if Internet is available. Otherwise, user will have to give information about the location and time. When Internet becomes available, the sample data will be stored after it is given an id. The phone number of the user who will upload the data will also be stored.

### **Query and Update**

An “expert” or an “admin” can query about the samples by providing a region and date range. He/she can also see the information about each sample and add further details. He/she can also edit the information.

### **Action – Reply**

#### **Upload Sample Data**

**Action 1:** User provides input on sample form.

**Reply 1:** If internet is available, form is uploaded. Else the information is stored in the system.

### **Query and Update**

**Action 1:** User gives location and date range.

**Reply 1:** Soil samples are shown.

**Action 2:** User provides information to update.

**Reply 2:** Information is updated.

## 4.4 Activity Diagram

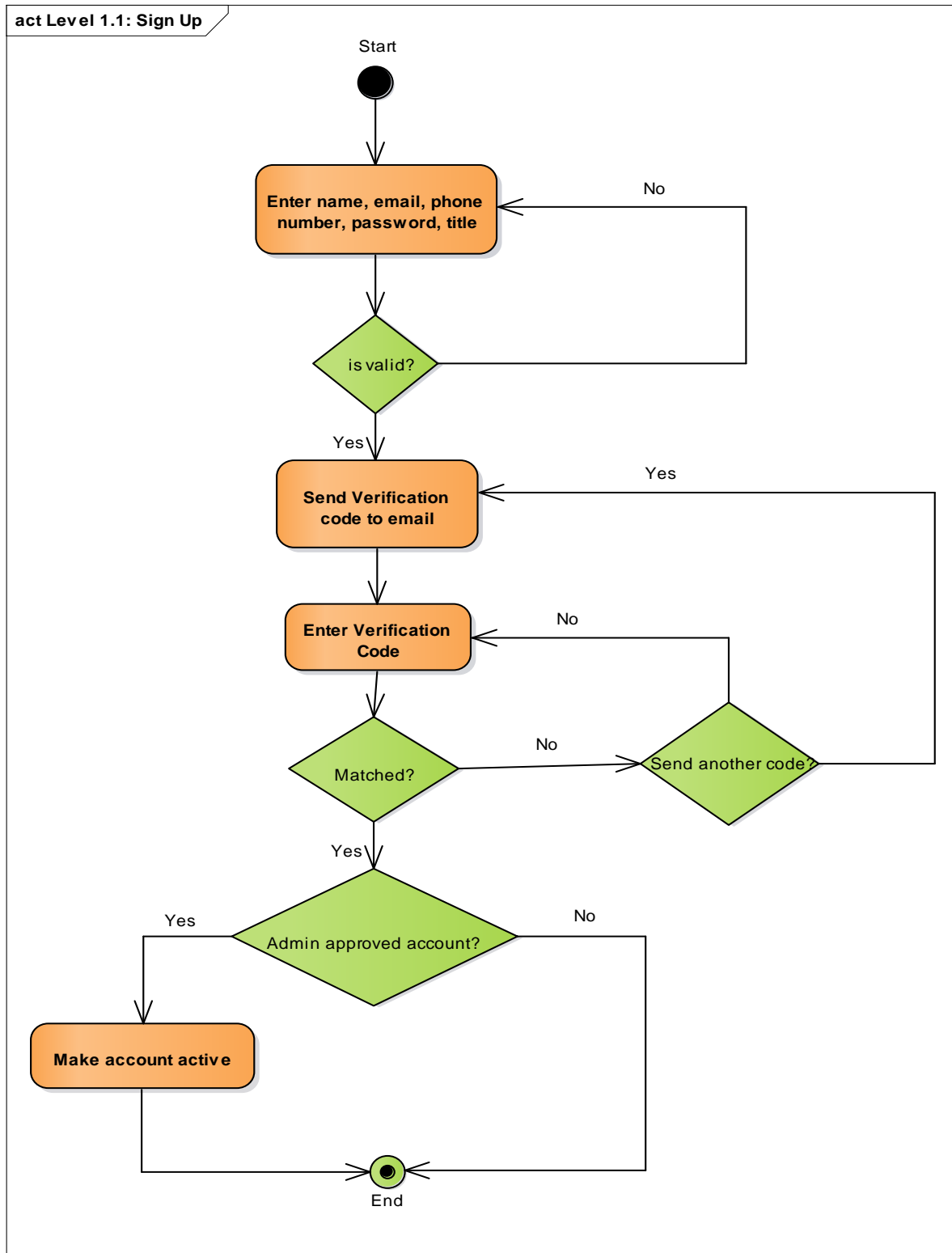


Figure 6: Activity Diagram Level 1.1.1: Sign Up



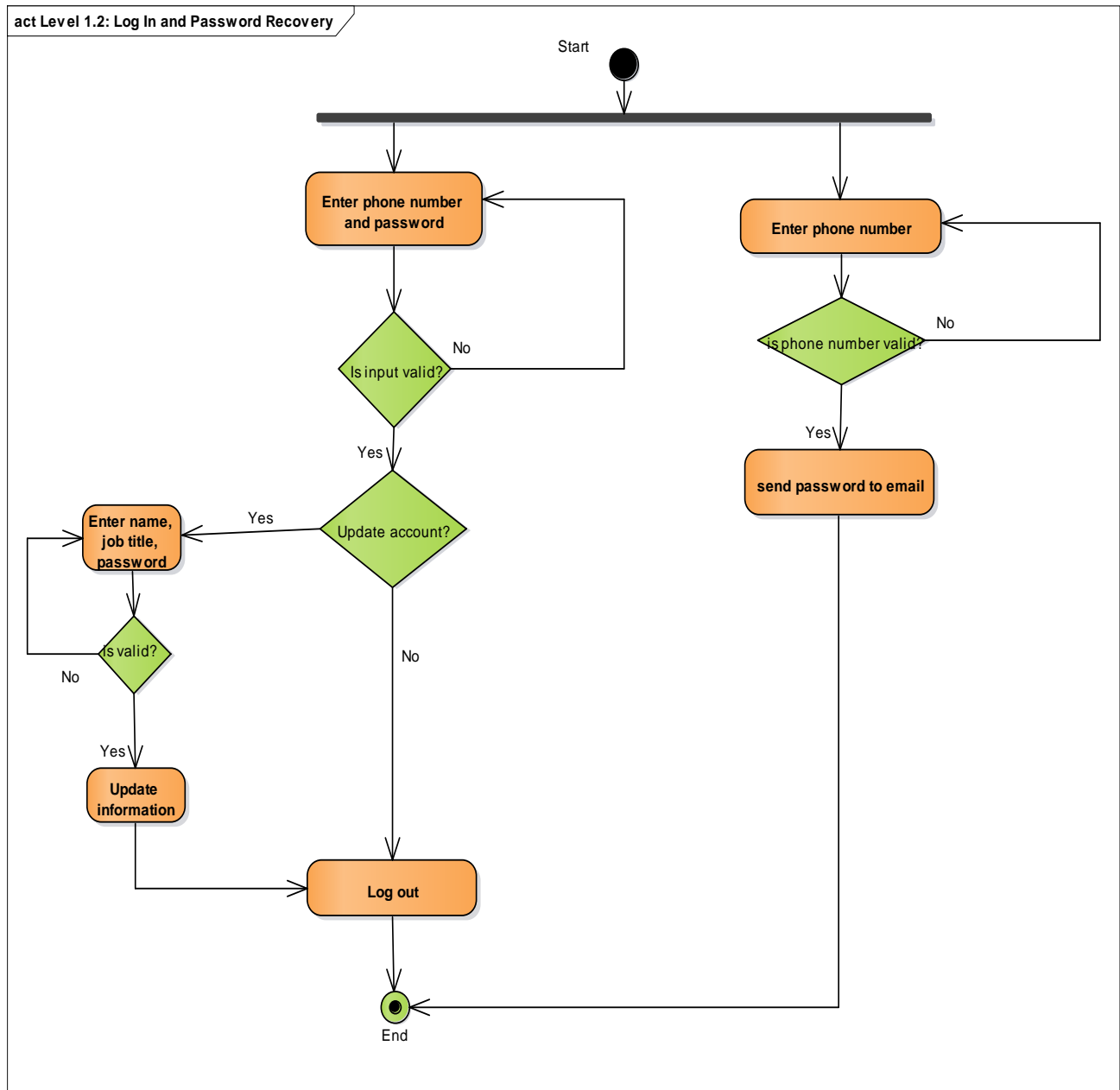


Figure 7: Activity Diagram Level 1.1.2: Login and password recovery

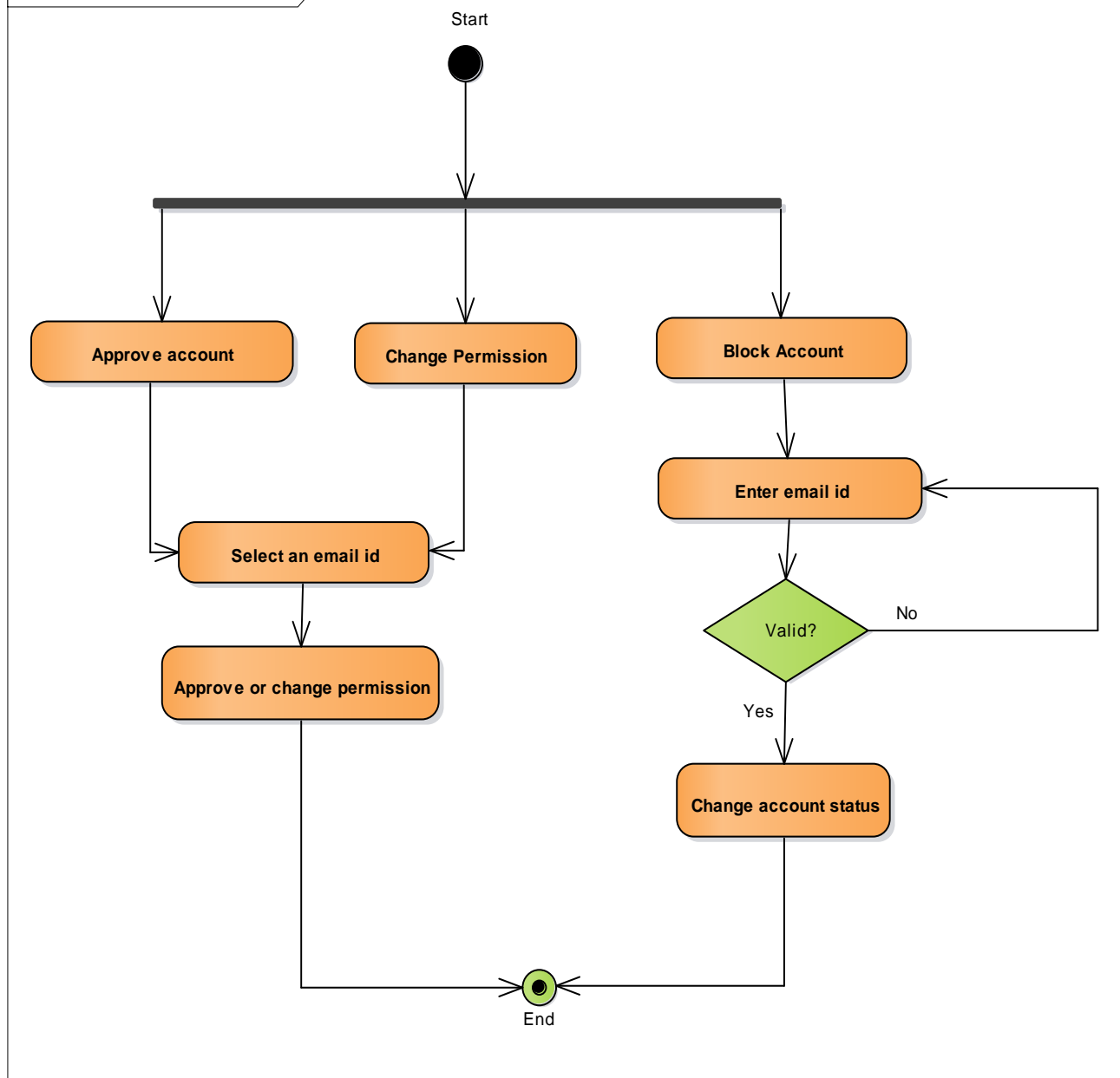


Figure 8: Activity Diagram Level 1.1.3: Access Permission

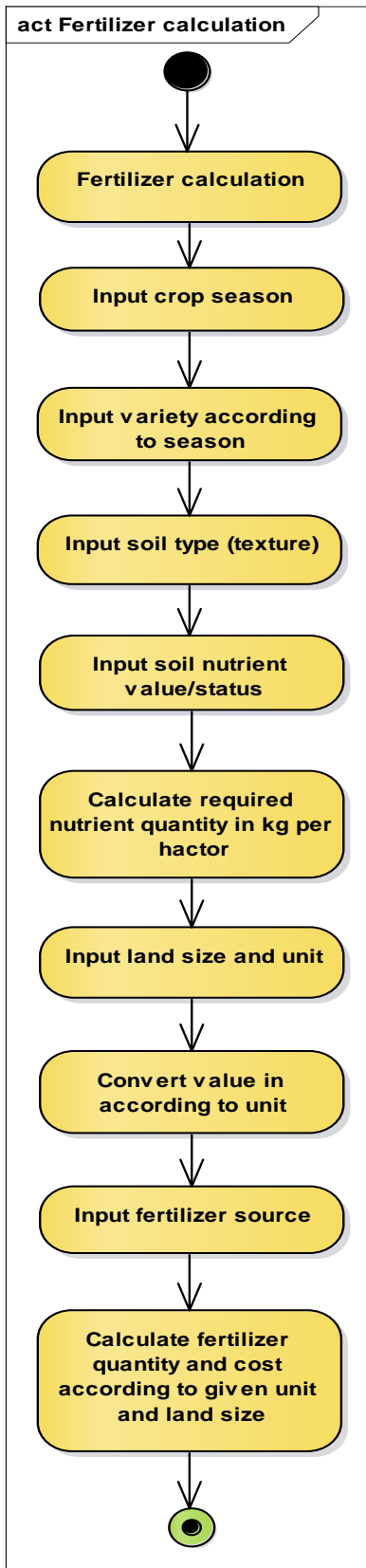


Figure 9: Activity Diagram Level 1.2 - Required Fertilizer Calculation

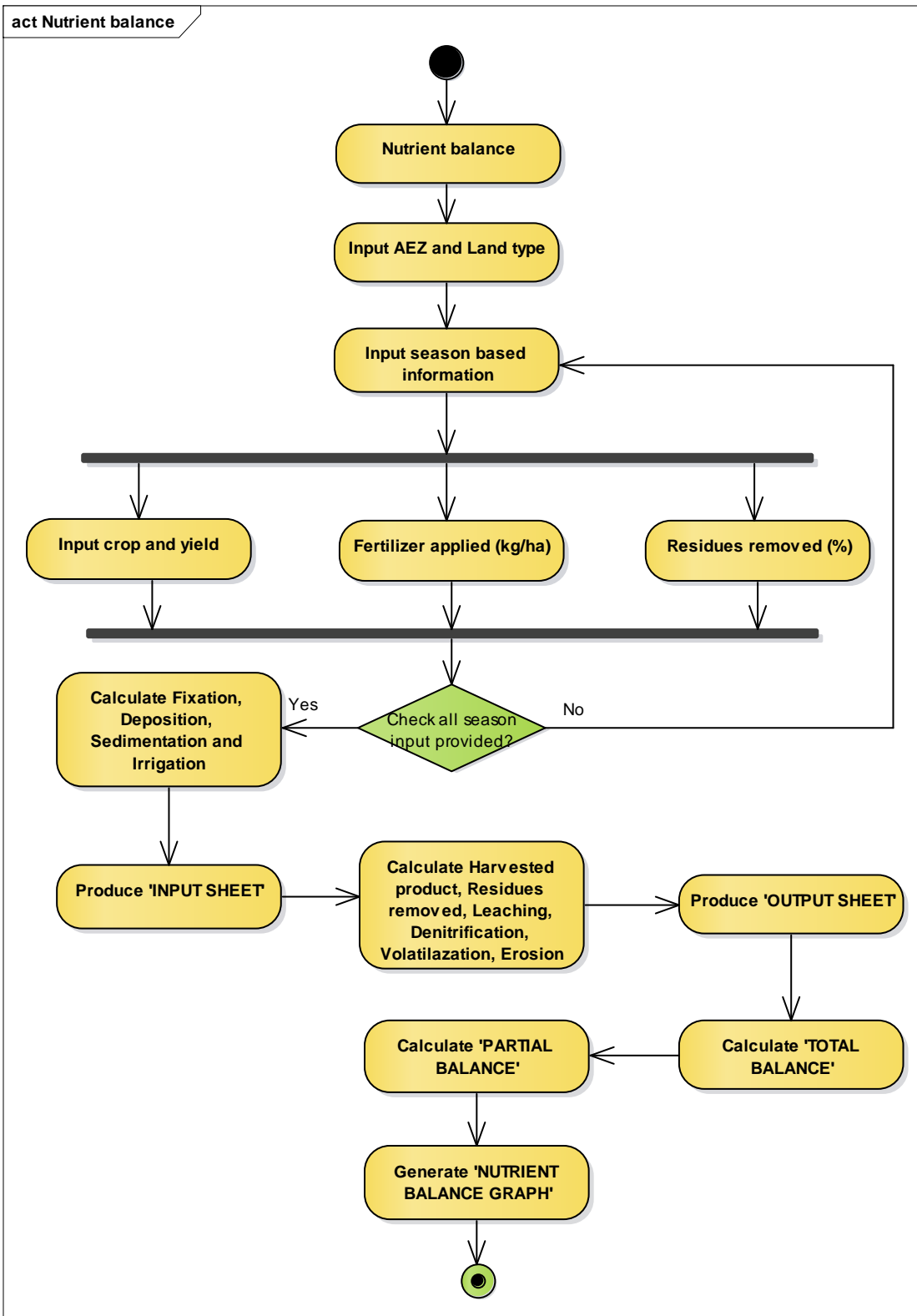


Figure 10: Activity Diagram Level 1.3 – Nutrients Balance Sheet

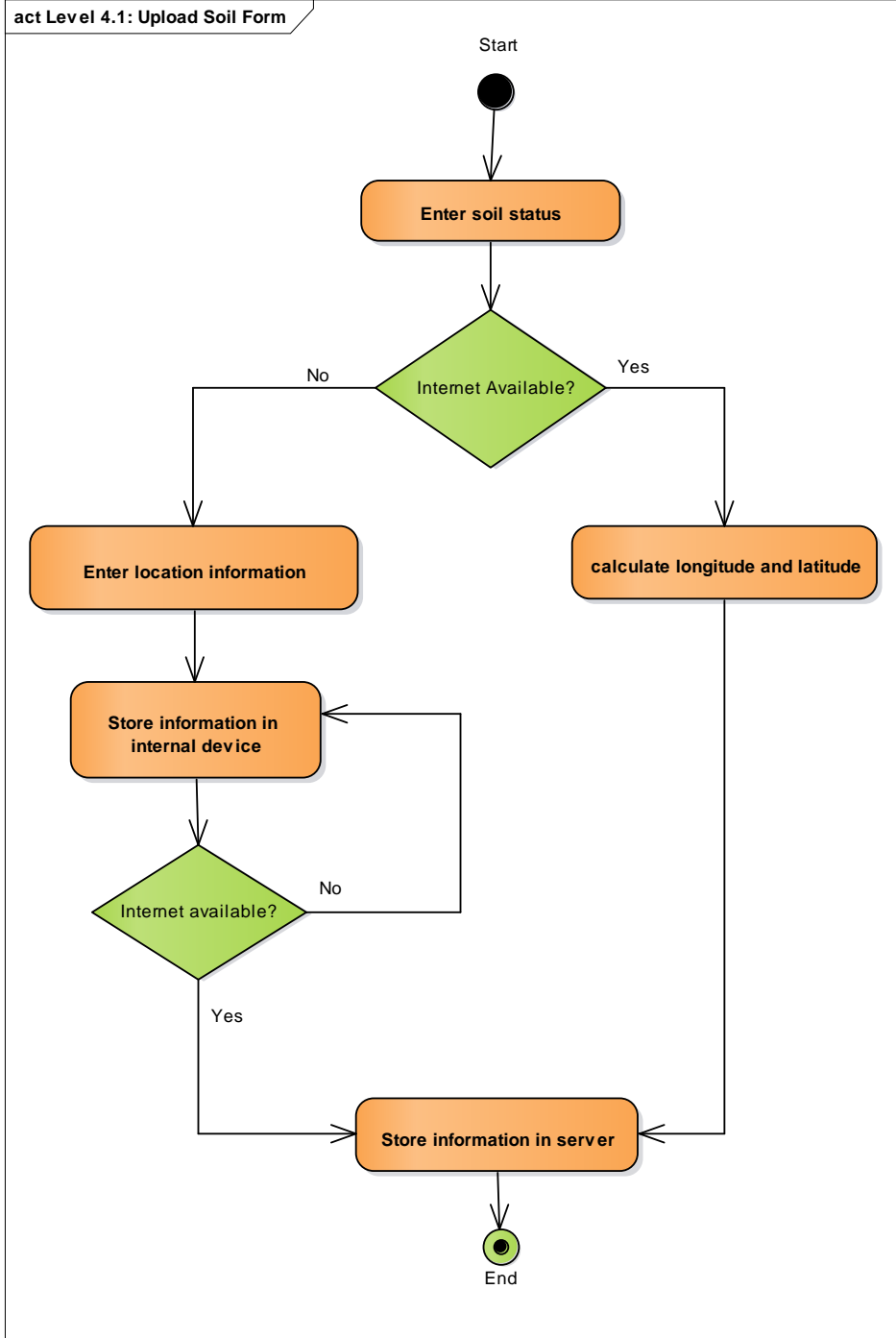


Figure 11: Activity Diagram Level 1.4.1 – Upload Soil Form

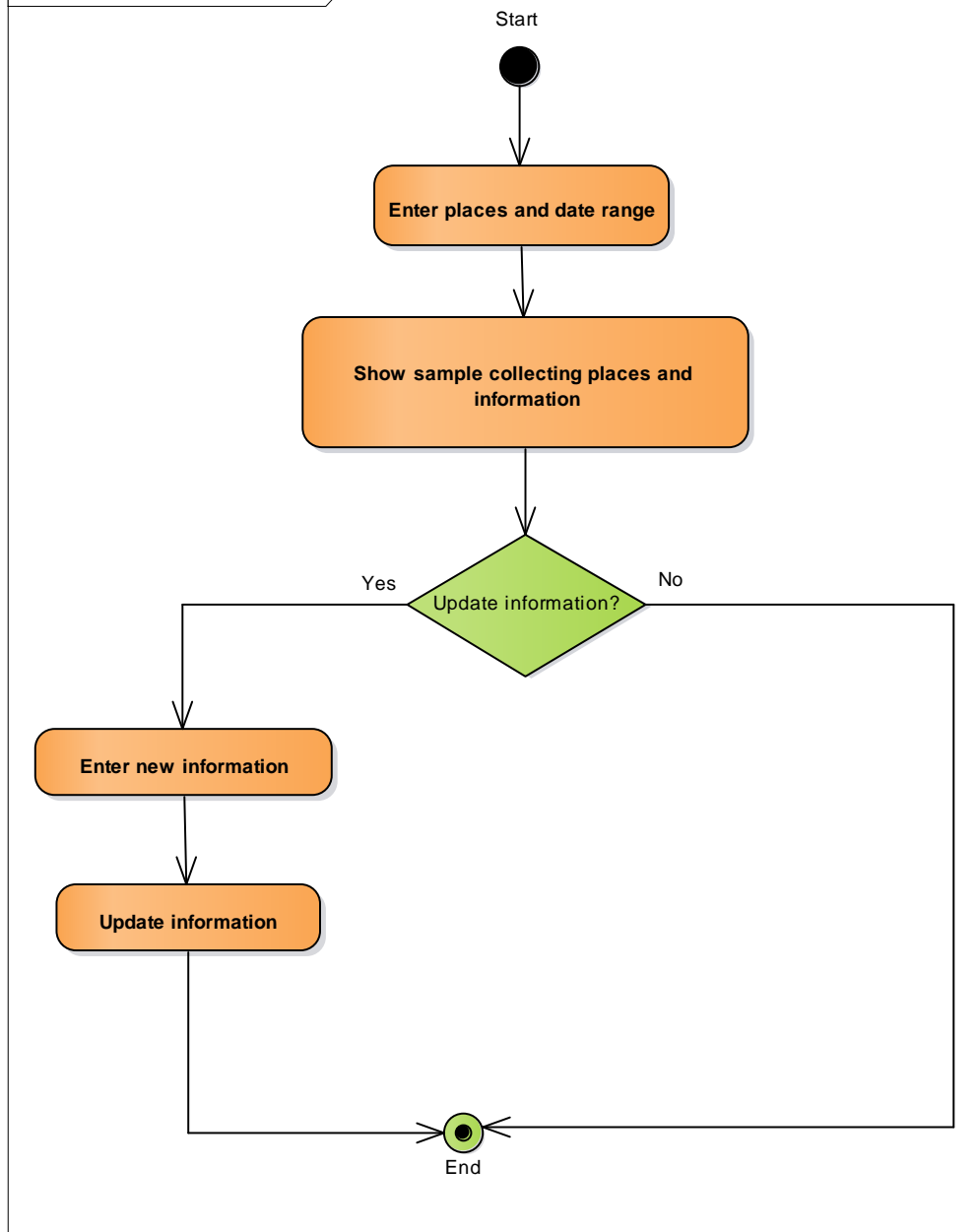


Figure 12: Activity Diagram Level 1.4.2 – Query and Update

## 4.5 Swim-lane Diagram

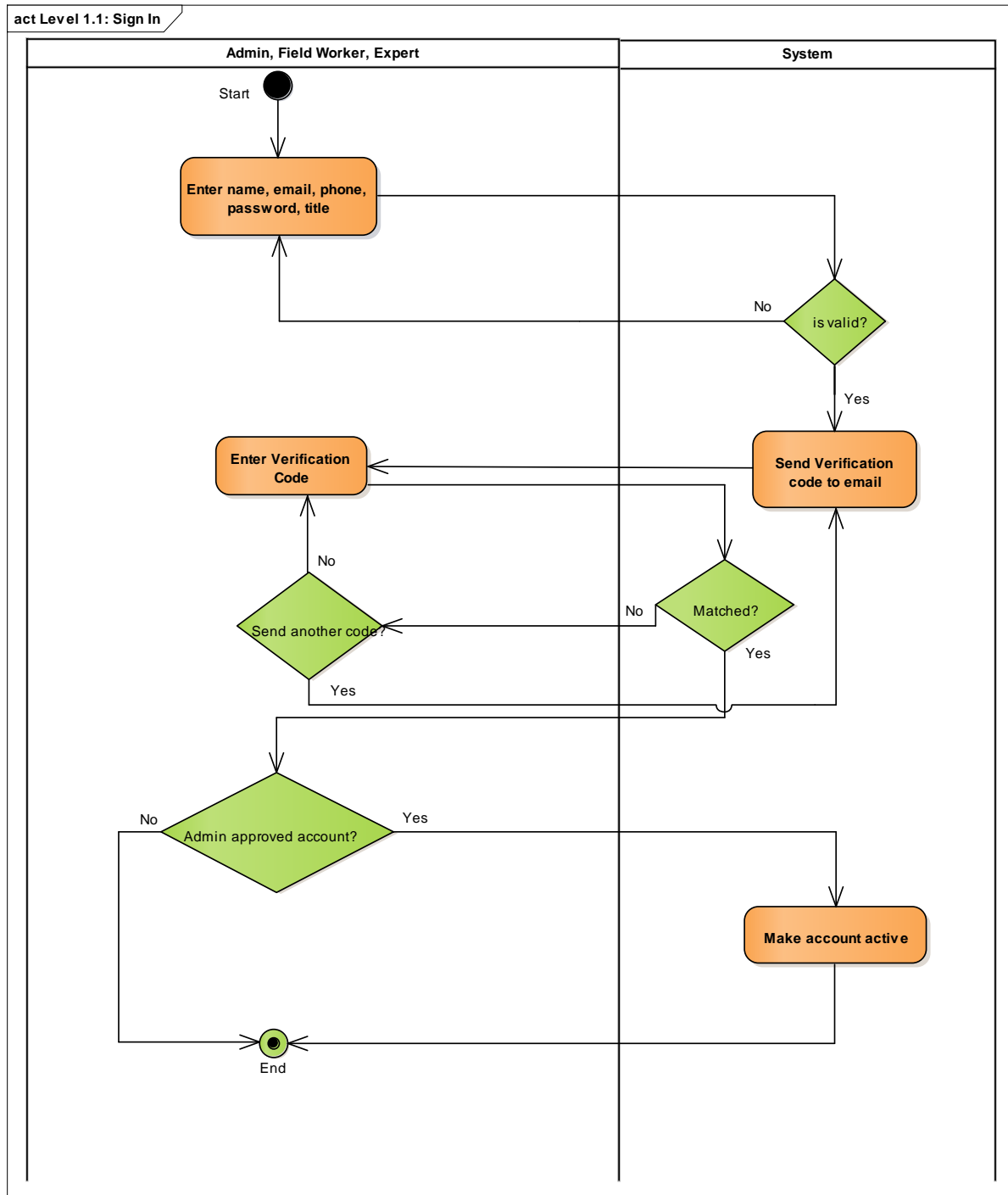


Figure 13: Swim-Lane Level 1.1.1: Sign Up

act Level 1.2: Login and Password Recovery

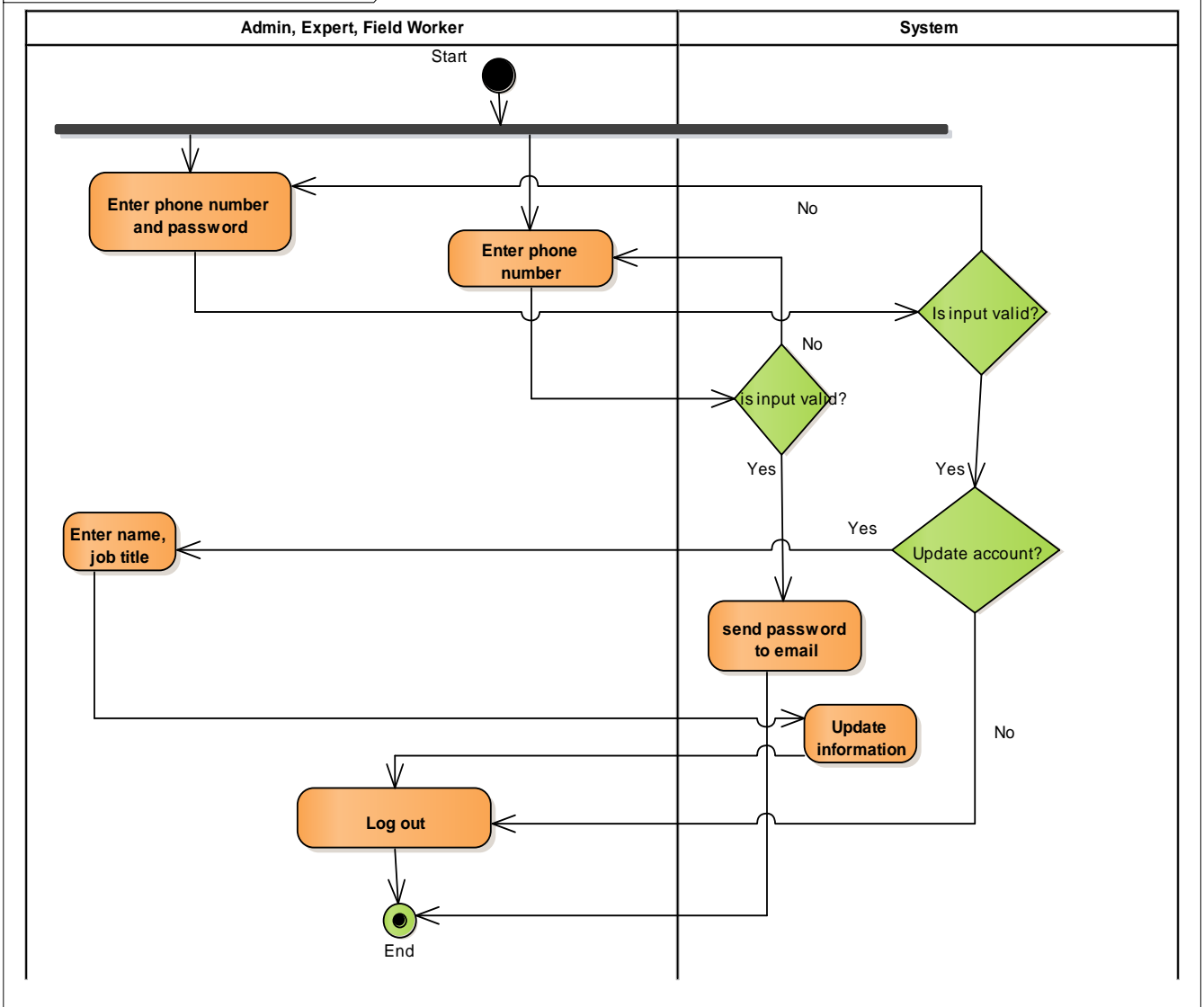


Figure 14: Swim-Lane Level 1.1.2 – Login and Password Recovery



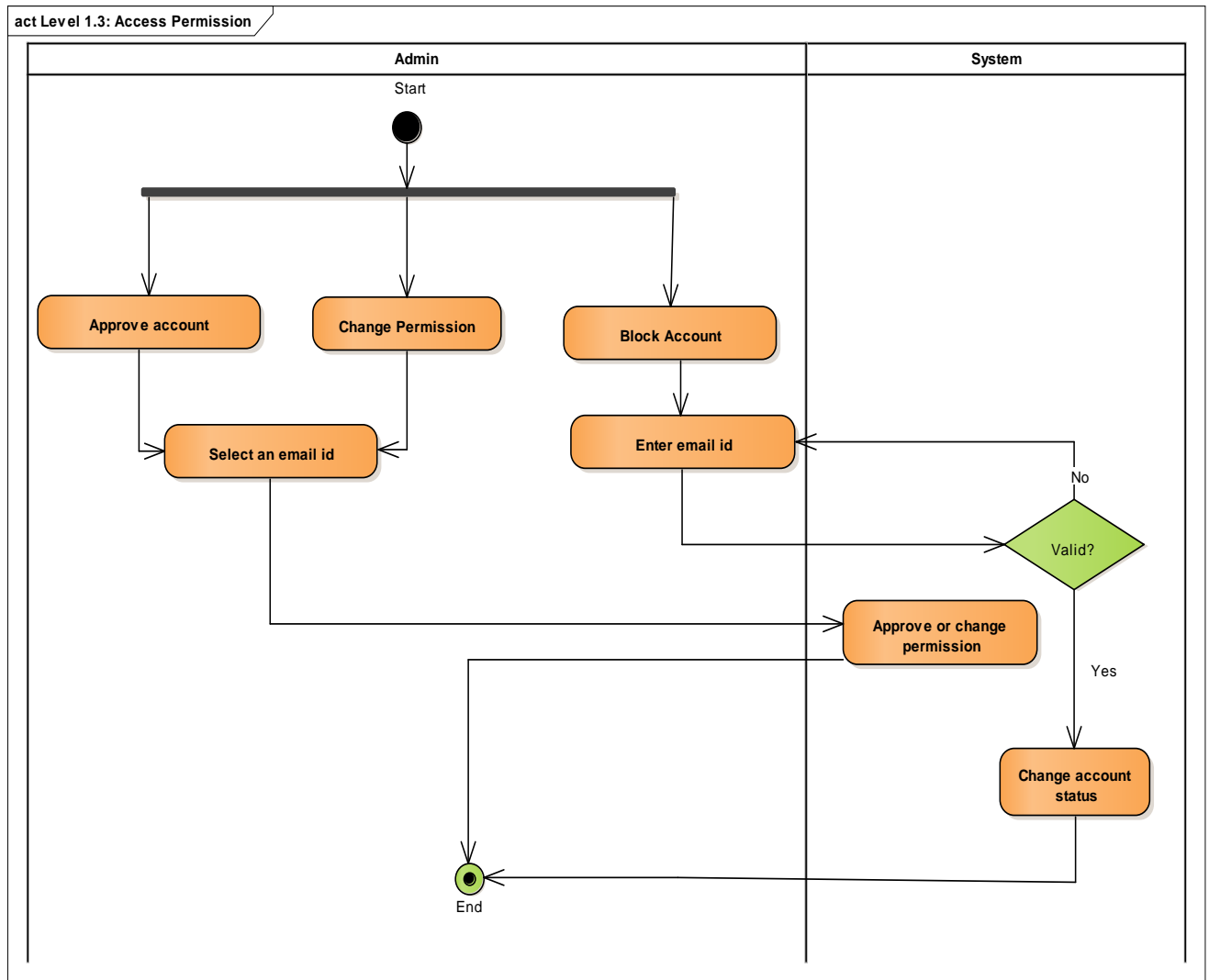


Figure 15: Swim-Lane Level 1.1.3: Access Permission

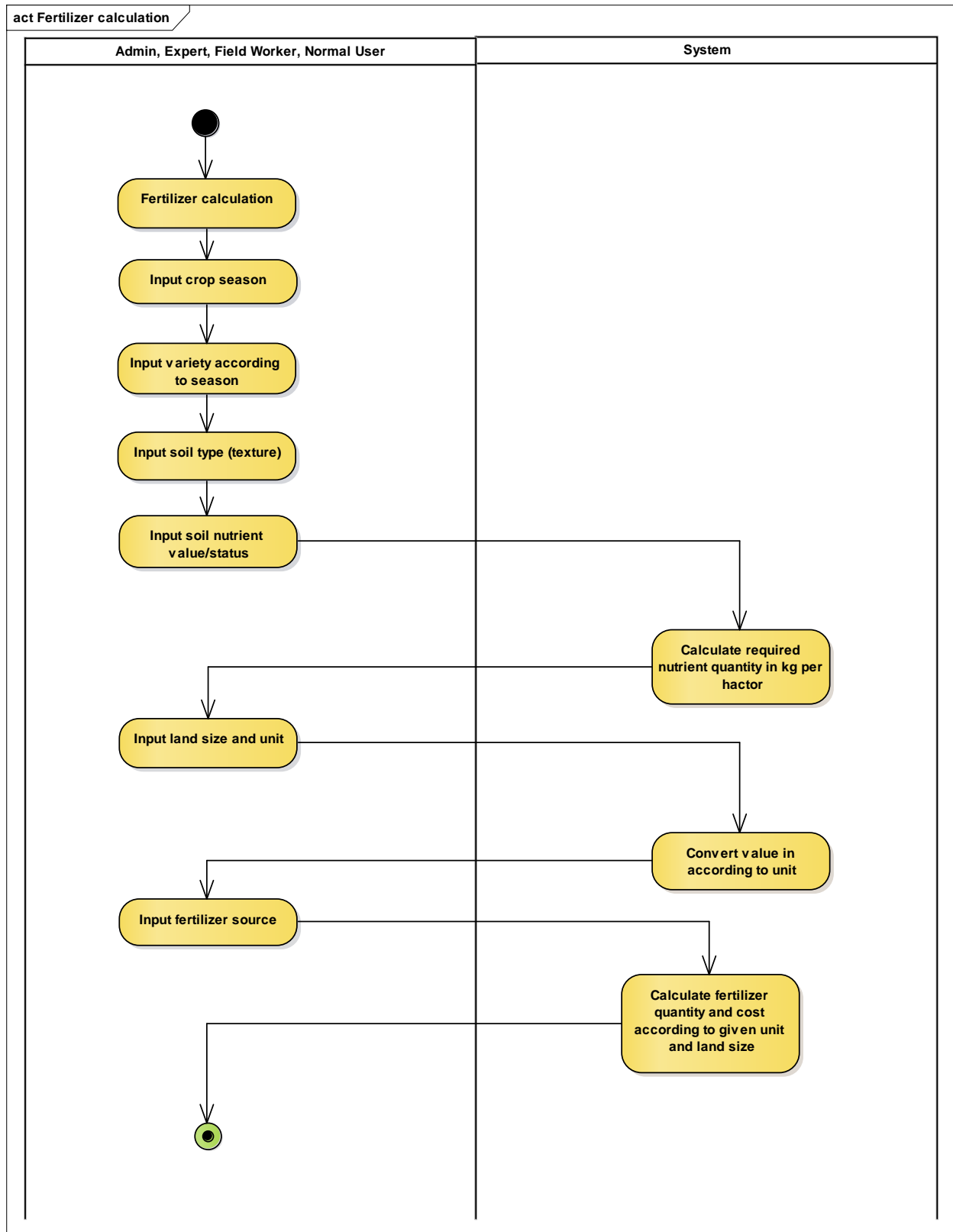


Figure 16: Swim-Lane Level 1.2: Required Fertilizer Calculation

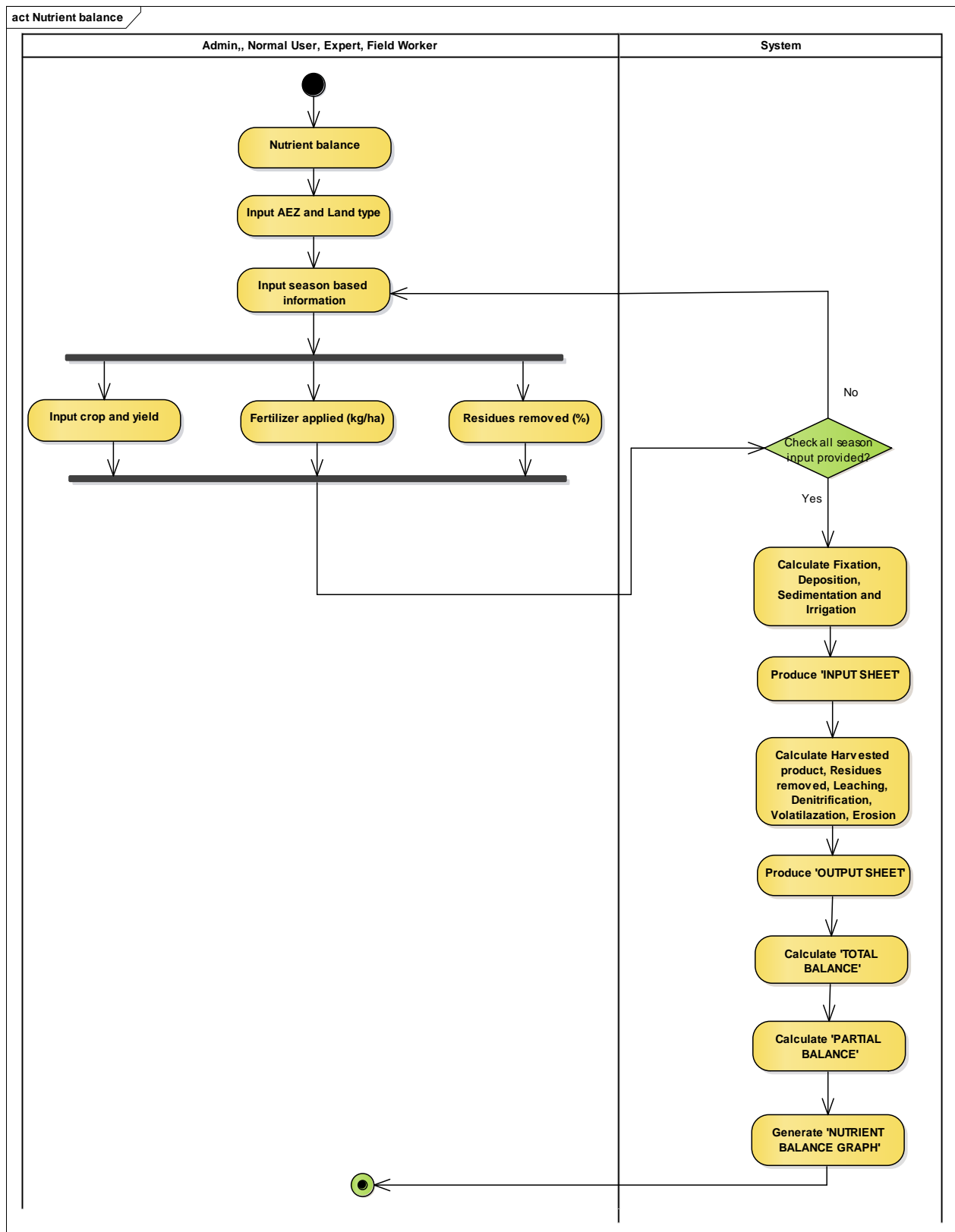


Figure 17: Swim-Lane Level 1.3: Nutrients Balance Sheet

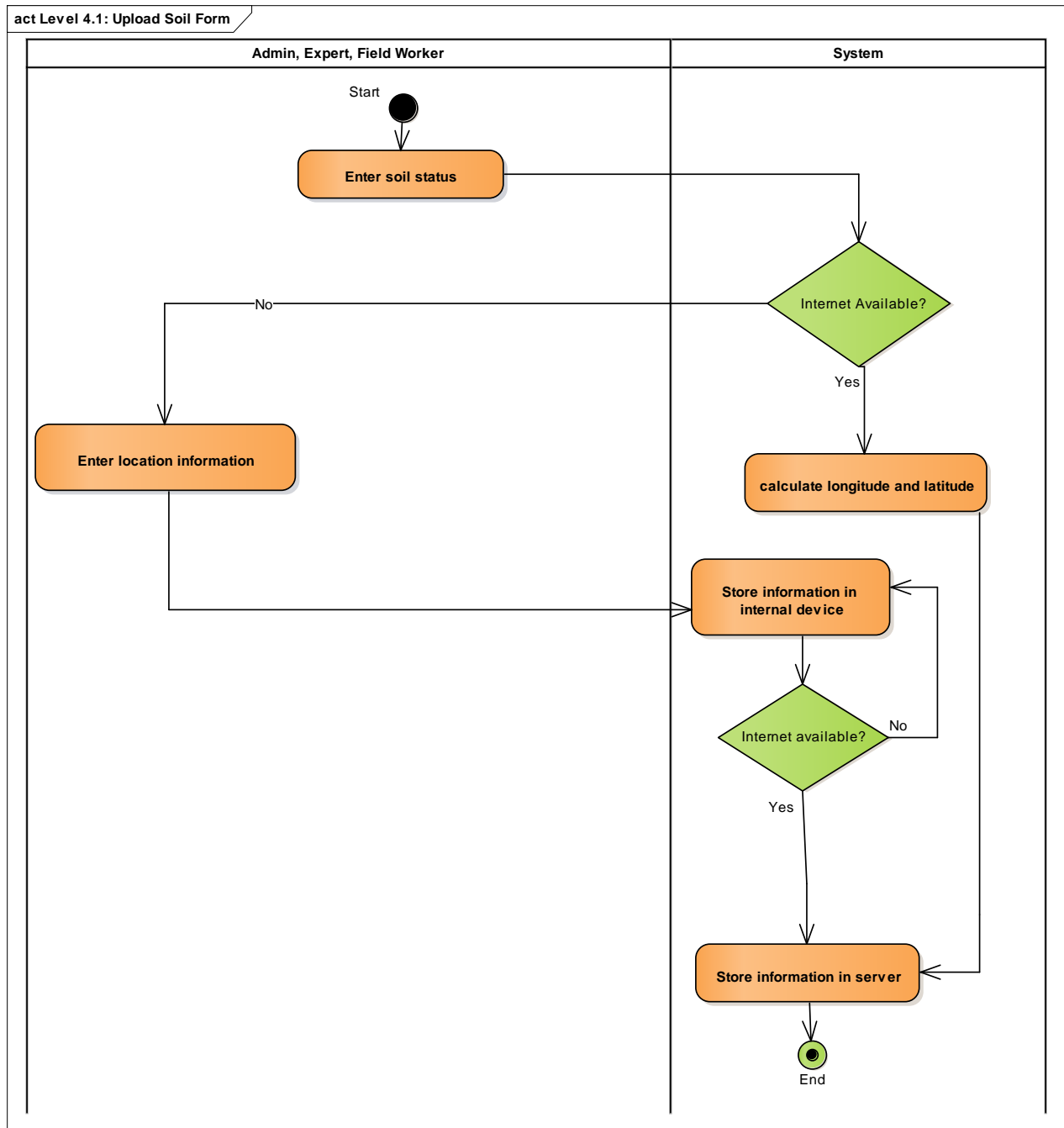


Figure 18: Swim-Lane Level 1.4.1 – Upload Soil Form

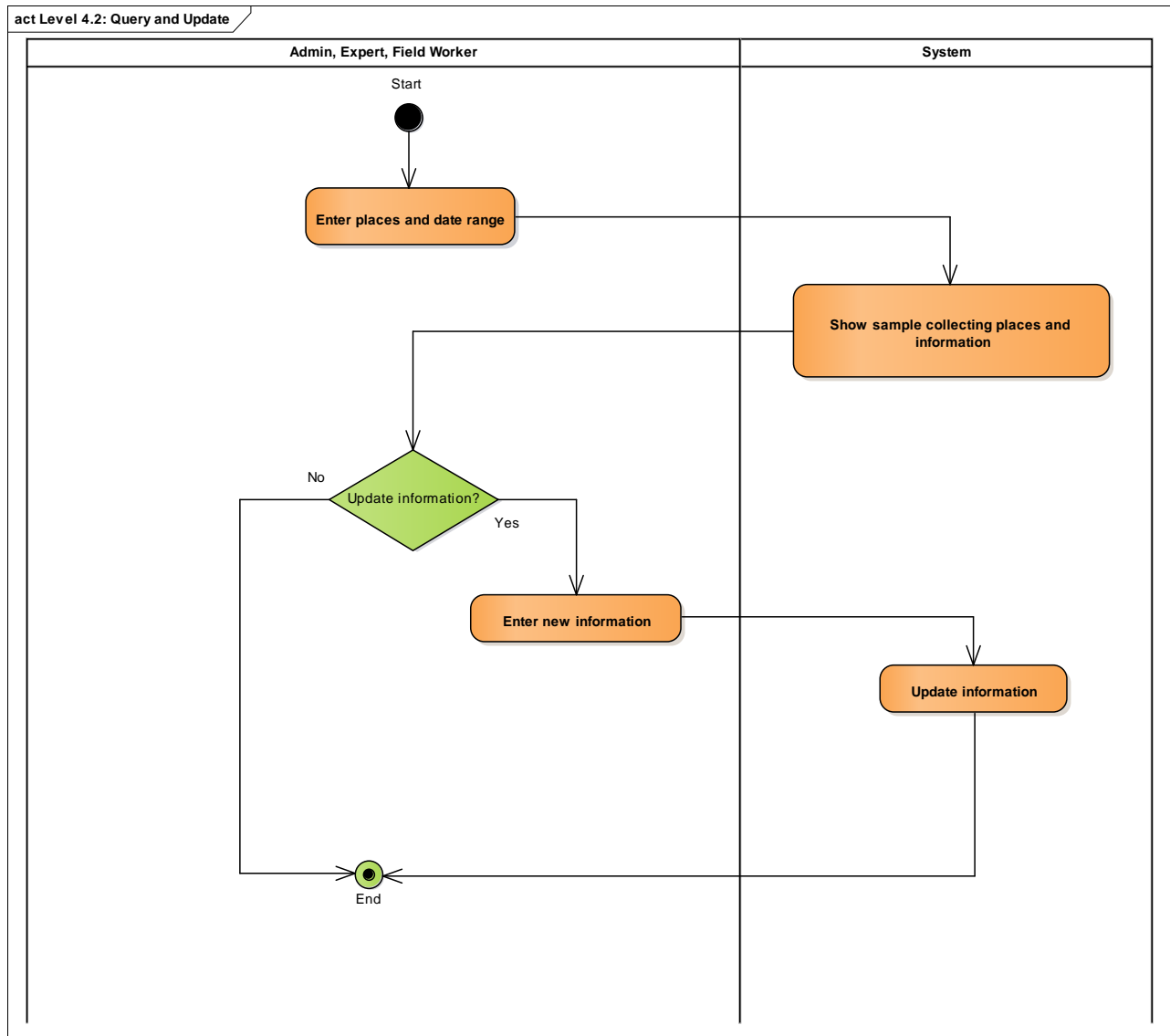


Figure 19: Swim-Lane Level 1.4.2 – Query and Update

# Chapter 5

## Data Modeling

### 5.1 Data modeling concept

If software requirements include the necessity to create, extend or interact with a database or complex data structures need to be constructed and manipulated, then the software team chooses to create data models as part of overall requirements modeling. The entity-relationship diagram (ERD) defines all data objects that are processed within the system, the relationships between the data objects and the information about how the data objects are entered, stored, transformed and produced within the system.

### 5.2 Data objects

A data object is a representation of composite information that must be understood by the software. Here, composite information means an information that has a number of different properties or attributes. A data object can be an external entity, a thing, an occurrence, a role, an organizational unit, a place or a structure.

#### 5.2.1 Noun Identification

All the nouns in the scenario were identified.

No.	Noun	P/S	Attributes
1	User	S	5, 6, 7, 11, 12, 13
2	Data	P	
3	Server	P	

4	Account	P	
5	Email address	S	
6	Phone number	S	
7	Password	S	
8	Eight	P	
9	Characters	P	
10	Digit	P	
11	Name	S	
12	Job title	S	
13	Type	S	
14	Field worker	S	5, 6, 7, 11, 12, 13
15	Expert	S	5, 6, 7, 11, 12, 13
16	Admin	S	5, 6, 7, 11, 12, 13
17	Verification code	P	
18	Information	P	
19	System	S	
20	Operation	P	
21	Fertilizer	S	11, 13, 30, 64
22	Nutrient balance sheet	S	
23	Soil sampling	S	5, 97, 98, 99, 100, 101, 102
24	Crop	S	28, 78, 81, 84, 85, 87, 90, 92
25	Region	P	
26	Nutrient	S	11
27	Land	P	
28	Crop name	S	
29	Variety	S	11, 91
30	Nutrient amount	S	
31	Crop class	S	
32	Soil texture	S	65, 108
33	Texture class	S	
34	Nitrogen	P	
35	Phosphorous	P	
36	Potassium	P	

37	Zinc	P	
38	Sulphur	P	
39	Boron	P	
40	Interpretation of the soil	S	33, 41, 42, 43, 44
41	Interpretation	S	42, 43, 44
42	Lower limit	S	
43	Upper limit	S	
44	Interval	S	
45	Soil interpretation	P	
46	Interpretation of nutrients for a specific crop class	S	31, 41, 42, 43, 44
47	Equation	P	
48	Soil test value	S	
49	Inorganic fertilizer	S	11, 30
50	Urea	P	
51	TSP	P	
52	MoP	P	
53	Gypsum	P	
54	Zinc sulphate	P	
55	Boric acid	P	
56	Kg	P	
57	Organic fertilizer	S	11, 30
58	Cowdung	P	
59	FYM	P	
60	Poultry manure	P	
61	GM	P	
62	Brown manure	P	
63	Crop residues	P	
64	Cost	S	
65	Land type	S	
66	AEZ	S	76, 77, 89, 109
67	Three	P	
68	Season	P	
69	Rabi	P	



70	Kharif-1	P	
71	Kharif-2	P	
72	Manure	P	
73	Residues removed	P	
74	Nutrient input	S	
75	Nutrient output	S	
76	Fertility class	S	
77	Average rainfall	S	
78	BNF	S	
79	Deposition	S	
80	Sedimentation	S	
81	Irrigation	S	
82	Value	P	
83	Nitrogen-addition	S	
84	Nitrogen-uptake	S	
85	Crop produce	S	
86	Leaching	S	
87	Denitrification	S	
88	Volatilization	S	
89	Soil erosion	S	
90	Nutrient concentration	S	
91	Yield	S	
92	Produce-residue ratio	S	
93	Two	P	
94	Total balance sheet	P	
95	Partial balance sheet	P	
96	Yearly balance sheet	P	
97	Sample id	S	
98	Location	S	
99	Time	S	
100	Latitude	S	

101	Longitude	S	
102	Ph	S	
103	Soil	P	
104	Samples	P	
105	Details	P	
106	Internet	P	
107	Date range	P	
108	Crop type	S	
109	Aez no	S	
110	Database	S	
111	Crop Pattern	S	

*Table 1: Noun Identification for Data Modelling*

### 5.2.2 Potential Data Objects

- User: 5, 6, 7, 11, 12, 13
- Expert: 5, 6, 7, 11, 12, 13
- Field Worker: 5, 6, 7, 11, 12, 13
- Admin: 5, 6, 7, 11, 12, 13
- Fertilizer: 11, 13, 30, 64
- Soil sampling: 5, 97, 98, 99, 100, 101, 102
- Crop: 28, 78, 81, 84, 85, 87, 90, 92
- Variety: 11, 91
- Soil Texture: 65, 108
- Interpretation of soil: 33, 41, 42, 43, 44
- Interpretation: 42, 43, 44
- Interpretation of nutrients for a specific crop class: 31, 41, 42, 43, 44
- Inorganic fertilizer: 11, 30
- Organic Fertilizer: 11, 30
- AEZ: 76, 77, 89, 109

### 5.2.3 Analysis for finalizing Data objects

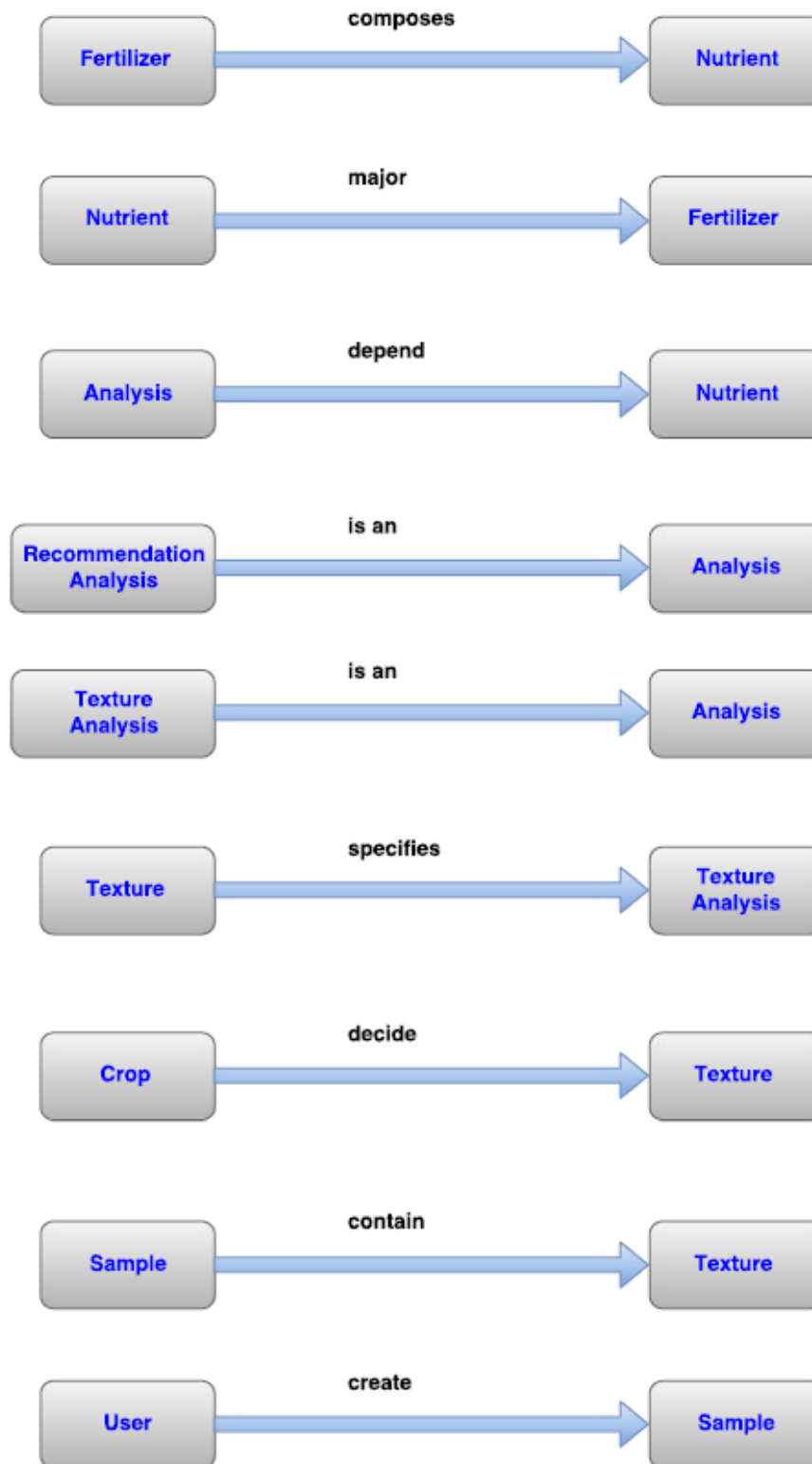
- ❖ Expert, user, field worker, admin can be merged into user.
- ❖ Fertilizer, inorganic fertilizer, organic fertilizer can be merged into fertilizer. Fertilizer will have an additional attribute 'type'.
- ❖ Interpretation of nutrients for a specific crop, interpretation of soil is generalized to Analysis. Recommendation analysis and Texture analysis will have an 'is a' relationship with Analysis.
- ❖ Crop pattern and Nutrient will be added as a data object.

### 5.2.4 Finalizing Data Objects

No	Data Objects and attributes
1	User: <u>email</u> , phone number, job title, type, password, user name
2	Sample: <u>sample id</u> , longitude, latitude, time
3	Nutrient: <u>nutrient id</u> , name
4	Fertilizer: <u>name</u> , type, cost
5	Analysis: <u>analysis id</u> , status
6	Recommendation Analysis: <u>crop class</u> , upper limit, lower limit, interval
7	Texture Analysis: <u>texture class</u> , upper limit, lower limit, interval
8	Texture: <u>texture id</u> , soil type, land type
9	Variety: <u>name</u> , yield goal
10	Crop: <u>name</u> , type, bnf, produce-residue ratio
11	Crop pattern: <u>pattern id</u> , season
12	AEZ: <u>aez no</u> , average rainfall, fertility class

*Table 2: Final Data Objects*

## 5.2.5 Data Object Relations



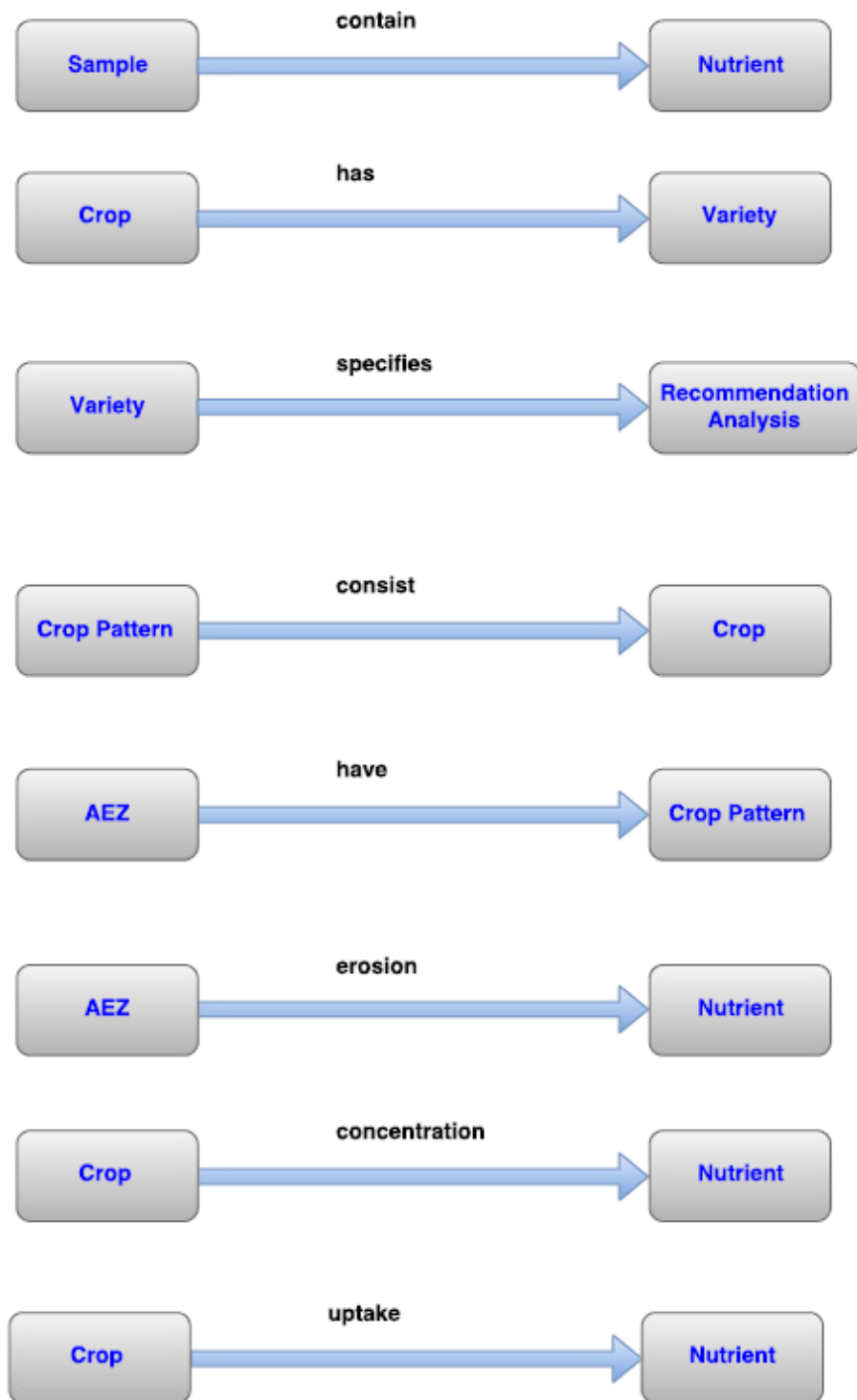


Figure 20: Relation between data objects

## 5.3 Entity Relationship Diagram

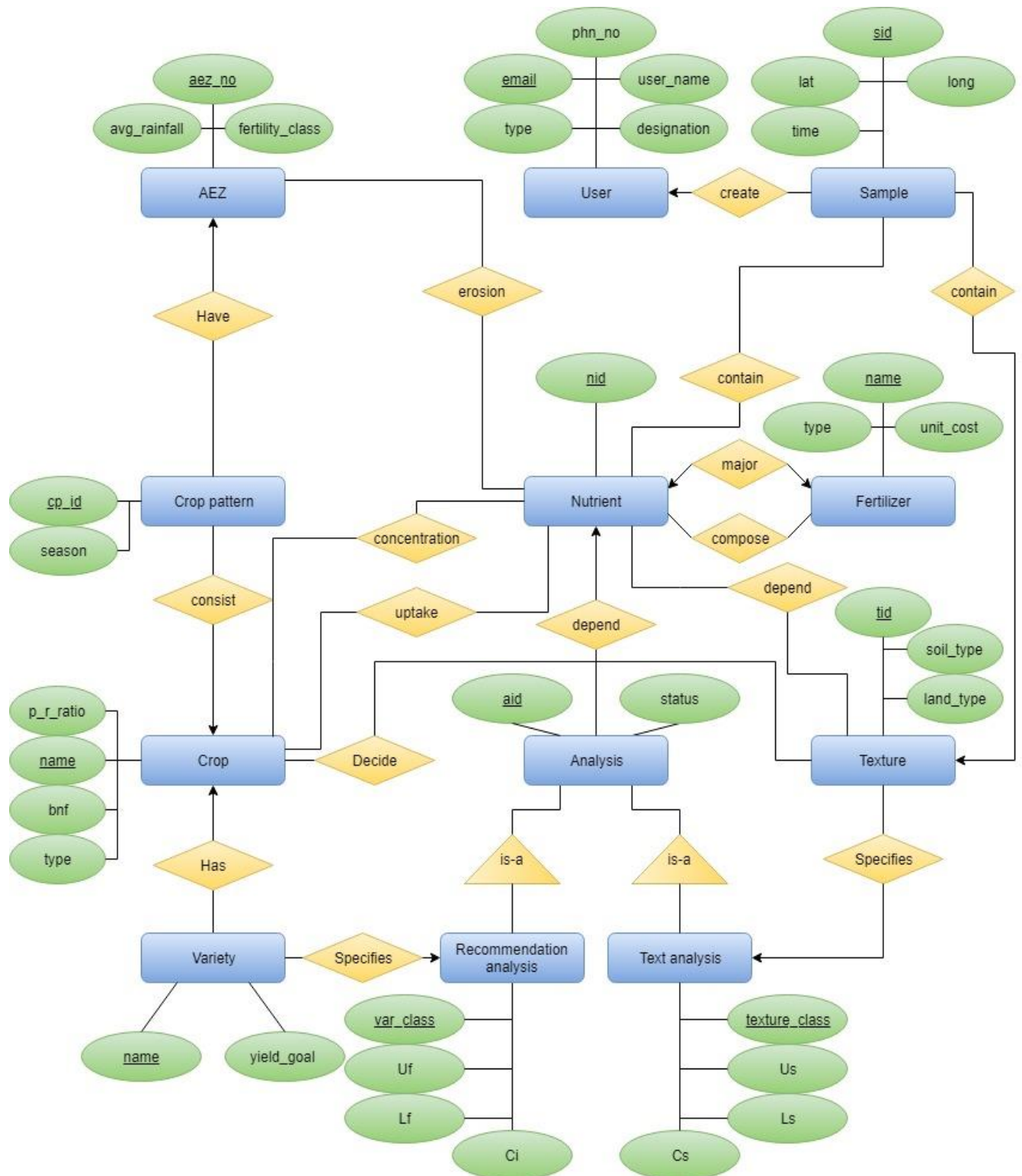


Figure 21: Entity Relationship Diagram

## 5.4 Schema Diagram

\*Database schema has been added to the end of the document.

# Chapter 6

## Class Based Modeling

This chapter is intended to describe class based modeling of the Grocery Management System.

### 6.1 Class Based Modeling Concept

Class-based modeling represents the objects that the system will manipulate, the operations that will applied to the objects, relationships between the objects and the collaborations that occur between the classes that are defined.

### 6.2 General Classification

To identify the potential classes, nouns were selected from the solution space of the story. These were then characterized in seven general classifications. The seven general characteristics are as follows:

1. External entities
2. Things
3. Events
4. Roles
5. Organizational units
6. Places
7. Structures

Following are the specifications of the nouns according to the general classifications.

No.	Noun	GC
1	User	4, 5, 7



2	Email address	
3	Phone number	
4	Password	
5	Name	
6	Job title	
7	Type	
8	Field worker	4, 5, 7
9	Expert	4, 5, 7
10	Admin	4, 5, 7
11	System	2, 5
12	Fertilizer	2, 5, 7
13	Nutrient balance sheet	
14	Soil sampling	3, 7
15	Crop	2, 5, 7
16	Nutrient	2, 5, 7
17	Crop name	
18	Variety	
19	Nutrient amount	
20	Crop class	
21	Soil texture	
22	Texture class	
23	Interpretation of the soil	2, 6, 7
24	Interpretation	2, 6, 7
25	Lower limit	
26	Upper limit	
27	Interval	
28	Interpretation of nutrients for a specific crop class	2, 6, 7
29	Soil test value	
30	Inorganic fertilizer	2, 5, 7
31	Organic fertilizer	2, 5, 7
32	Cost	
33	Land type	

34	AEZ	4, 5, 7
35	Residues removed	
36	Nutrient input	
37	Nutrient output	
38	Fertility class	
39	Average rainfall	
40	BNF	
41	Deposition	
42	Sedimentation	
43	Irrigation	
44	Nitrogen-addition	
45	Nitrogen-uptake	
46	Crop produce	
47	Leaching	
48	Denitrification	
49	Volatilization	
50	Soil erosion	
51	Nutrient concentration	
52	Yield	
53	Produce-residue ratio	
54	Sample id	
55	Location	
56	Time	
57	Latitude	
58	Longitude	
59	Ph	
60	Crop type	
61	Aez no	
62	Database	1, 6
63	Crop Pattern	

*Table 3: General Classifications of nouns*

## 6.3 Selection Criteria

The potential classes were then selected as classes by six Selection Criteria.

A potential class becomes a class when it fulfills all six characteristics.

1. Retained Information
2. Needed Services
3. Multiple Attributes
4. Common attributes
5. Common operations
6. Essential requirements

No.	Noun	GC
1	User	1, 2, 3, 4, 5
2	Field worker	1, 2, 3, 4, 5
3	Expert	1, 2, 3, 4, 5
4	Admin	1, 2, 3, 4, 5
5	System	6
6	Fertilizer	1, 3, 4, 5
7	Soil sampling	1, 3, 4, 5
8	Crop	1, 3, 4, 5
9	Nutrient	1, 3, 4, 5
10	Interpretation of the soil	1, 3, 4, 5
11	Interpretation	1, 3, 4, 5
12	Interpretation of nutrients for a specific crop class	1, 3, 4, 5
13	Inorganic fertilizer	1, 3, 4, 5
14	Organic fertilizer	1, 3, 4, 5
15	AEZ	1, 3, 4, 5
16	Database	6

*Table 4: Selection Criteria for potential classes*

## 6.4 Associate Noun and Verb Identification

No	Potential Class	Noun	Verb
1	User	Name, job title, password, email, phone number	Validate, verify
2	Expert	Name, job title, password, email, phone number	Validate, verify, upload, create sample, view, update
3	Admin	Name, job title, password, email, phone number	Validate, verify, upload, approve, view, update
4	Field Worker	Name, job title, password, email, phone number	Validate, verify, upload, create sample
5	Crop	Name, variety, class	Get class, calculate seasonal balance, get interpretation, calculate bnf, calculate sedimentation, calculate irrigation, calculate total input, calculate harvested product, calculate leeching, calculate gaseous, calculate residues, calculate total output
6	Fertilizer	Name, quantity, unit cost	Calculate fertilizer, get nutrient ratio
7	Organic Fertilizer	Name, quantity, unit cost	Calculate fertilizer, get nutrient ratio
8	Inorganic Fertilizer	Name, quantity, unit cost	Calculate fertilizer, get nutrient ratio
9	AEZ	Aez no, average rainfall, fertility class, season, land type	Calculate deposition, calculate erosion, Calculate balance graph
10	Sample	Id, location, longitude, latitude, time, texture, ph	Get location, calculate Ph

11	Nutrient	Name, quantity	Calculate nutrient, get composition
12	Interpretation	Status, lower limit, higher limit, range	
13	Interpretation of nutrients for a specific crop		Get recommendation
14	Interpretation of soil		Get recommendation
15	Database		
16	System		

*Table 5: Associated nouns and verbs of the potential class*

## 6.5 Attribute Selection

No	Class	Attributes
1	User	name email phone password title
2	Admin	name email phone password title
3	Expert	name email phone password title
4	Field Worker	name email phone password title
5	Crop	name variety nutrient recommendor harvestedProduct leeching gaseous residues bnf manure sedimentation irrigation
6	Fertilizer	name commercialName unitCost quantity

7	OrganicFertilizer	name unitCost quantity
8	InorganicFertilizer	name commercialName unitCost quantity
9	AEZ	aezNo season landType avgRainFall crop erosion deposition
10	Sample	id location time nutrient texture ph
11	Nutrient	name quantity requiredNutrient cropName
12	Interpretation	Status, lower limit, higher limit, range
13	Interpretation of nutrients for a specific crop	
14	Interpretation of soil	
15	Database	
16	System	

*Table 6: Attribute selection of classes*

## 6.6 Methods Identification

No	Class	Methods
1	User	validate() verify()
2	Admin	approve() createSample() validate() verify()
3	Expert	createSample() validate() verify()
4	Field Worker	createSample() validate() verify()
5	Crop	getClass() getRecommendation() calculateHarvestedProduct() calculateLeeching() calculateGaseous() calculateResidues() calculateBnf() calculateManure() calculateSedimentation() calculateIrrigation()
6	Fertilizer	calculateFertilizer() getNutrientRatio() calculateTotalCost()
7	OrganicFertilizer	calculateFertilizer() getNutrientRatio()
8	InorganicFertilizer	calculateFertilizer() getNutrientRatio() calculateTotalCost()
9	AEZ	getAvgRainFall() calculateErosion() calculateDeposition() calculateBalance() showBalanceGraph()
10	Sample	generateLocation()



		calculatePH()
11	Nutrient	calculateNutrient() getComposition() calculateTotalBalance()
12	Interpretation	
13	Interpretation of nutrients for a specific crop	getFertilizerRecommendation() getNutrientRecommendation()
14	Interpretation of soil	getNutrientRecommendation()
15	Database	
16	System	

*Table 7: Method Selection of classes*

## 6.7 Finalizing Classes

- User, Admin, Expert and Field Worker classes are merged into User as these share same attributes and methods.
- Crop class has become big. So, some of its attributes and methods have been transferred to two new classes: Input and Output. Input class refers to all the nutrients that get absorbed by the crop and Output class refers to all the nutrients released by the crop.
- Interpretation, Interpretation for soil and Interpretation of nutrients for specific crops have been merged and a new class Recommender has been created. Also, Interpretation class will be used as a data class which will have lower limit, upper limit, interval and status as its attributes.
- Rest of the classes have been created.

## 6.8 Class Relation Collaboration


<b>Crop</b>	
<b>Super Classes:</b>	
<b>Sub Classes:</b>	
<b>Description:</b> Hold info of crop season and have some operations to calculate recommendation and balance sheet	
<b>Attributes:</b>	
Name	Description
name	The name of the crop which uniquely identified the crop with season
variety	A crop can have one or more variety
nutrient	For growing properly a crop required some amount of nutrient
recommndator	A instants of Remmendator class which provide require amount of nutrient as well as fertilizer.
<b>Responsibilities:</b>	
Name	Collaborator
Provide analysis class for calculating required nutrient	Recommndator
Provide Nutrients and their attributes which requires for preparing	AEZ, Nutrient
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Figure 22: CRC Crop



<b>Nutrient</b>	
<b>Super Classes:</b>	
<b>Sub Classes:</b>	
<b>Description:</b> This class contains some attributes of a particular nutrient element and some responsibility to calculate required quantity of nutrient and estimating nutrient balance of SOIL PLANT SYSTEM.	
<b>Attributes:</b>	
Name	Description
name	Name of the nutrient such as 'Nitrogen'
quantity	Soil test value
input	Instance of a 'Input' structure which contain 'INPUT' of SOIL PLANT SYSTEM
output	Instance of a 'Output' structure which contain OUTPUT of SOIL PLANT SYSTEM
<b>Responsibilities:</b>	
Name	Collaborator
Calculating required nutrient for specific status	Recommendor, Database
Calculating percent nutrient composition in a fertilizer	Fertilizer, Database
Calculating partial and final balance for a specific crop and nutrient	Crop, Input, Output
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Figure 23: CRC Nutrient

AEZ	
Super Classes:	
Sub Classes:	
Description: Holds some information about an AEZ which requires to estimate nutrient balance	
Attributes:	
Name	Description
aezno	'Agro Economic Zone' which describe the location
season	Robi, Kharif1 , Kharif2
landType	Land type of particular locationg
avgRainFall	Average rainfall of 30 years of the particular AEZ
crop	Instance of Crop class
Responsibilities:	
Name	Collaborator
Estimating the nutrit balance of SOIL PLANT SYSTEM for a specific location	Crop
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Figure 24: CRC AEZ

Fertilizer	
Super Classes:	
Sub Classes:	
Description: Proves the quantity and cost for required nutrient amount.	
Attributes:	
Name	Description
name	Name of fertilizer
commercialName	Commercial name can be different
quantity	Required quantity of fertilzer
Responsibilities:	
Name	Collaborator
Calculating fertilizer for required nutrient	Recommendator
Estimating the cost for required fertilizer	Recommendator
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Figure 25: CRC Fertilizer


<b>Recommendor</b>	
<b>Super Classes:</b>	
<b>Sub Classes:</b>	
<b>Description:</b> Provides recommendation of fertilizer for the particular nutrient status, crop variety and texture	
<b>Attributes:</b>	
Name	Description
cropClass	Specifies crop
textureClass	Specifies texture
interpretation	Structure which provide data to calculate
nutrient	Instance of Nutrient
fertilizer	
<b>Responsibilities:</b>	
Name	Collaborator
Calculating required nutrient	Nutrient
Providing required ferlizer and cost	Fertilizer
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Figure 26: CRC Recommendor


<b>Input</b>	
<b>Super Classes:</b>	
<b>Sub Classes:</b>	
<b>Description:</b> Store and calculate input parameter of Soil Plant System(Nutrient balance)	
<b>Attributes:</b>	
Name	Description
bnf	
fertilizer	
manure	
sedimentation	
irrigation	
<b>Responsibilities:</b>	
Name	Collaborator
Calculating bnf, fertilizer, nutrient, sedimentation,	Database
Adding total input values	Nutrient
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Figure 27: CRC Input





<b>Output</b>	
<b>Super Classes:</b>	
<b>Sub Classes:</b>	
<b>Description:</b> Store and calculate output parameters of Soil Plant System(Nutrient Balance)	
<b>Attributes:</b>	
Name	Description
harvestedProduct	Remaining nutrint after production
leaching	
gaseous	
rasidues	
erosion	
<b>Responsibilities:</b>	
Name	Collaborator
Calculate harvested product, leaching, gaseous, residues, erosion	Nutrient
Adding input value .	Nutrient
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Figure 28: CRC Output



<b>Sample</b>	
<b>Super Classes:</b>	
<b>Sub Classes:</b>	
<b>Description:</b> Holds the quantitative and qualitative status of nutrient and soil and calculate some of to parameter.	
<b>Attributes:</b>	
Name	Description
id	Unique id of sample
location	latitude and lagnitude
time	Time
nutrient	Quantity of nutrients found from test result
texture	Qualitative status of soil
ph	PH
<b>Responsibilities:</b>	
Name	Collaborator
Specifing location	Database
Updating value	User
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*Figure 29: CRC Sample*


<b>User</b>	
<b>Super Classes:</b>	
<b>Sub Classes:</b>	
<b>Description:</b> Hold the information about different type of users and verify these information	
<b>Attributes:</b>	
Name	Description
name	Name of user
email	Email of user
password	Password of user
phoneno	User's phone
designation	User's designation
<b>Responsibilities:</b>	
Name	Collaborator
Validate name, email, password	UserInterface
Verify name, password	UserInterface
Uploading sample	Sample
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Figure 30: CRC User

## 6.9 Class Diagram

\*Class diagram has been added to the end of the document separately.

# Chapter 7

## Behavioral Modeling

### 7.1 State Transition Diagram

State diagram represents active states for each class the events (triggers). For this we identified all the events, their initiators and collaborators.

#### Identifying Events

No	Event	Initiator	Collaborator
1	Verify	User: verify()	Database: query()
2	Approve	User: approve()	Database: insert()
3	Upload Soil Sample	User: upload()	Database: insert()
4	Validate	User: validate()	
5	Identify location	Sample: generateLocation()	
6	Calculate pH	Sample: calculatePH()	
7	Update value	Sample: updateValue	Database: update()
8	Show balance graph	AEZ: calulateBalance(), showBalanceGraph()	Crop: calculateSeasonalBalance()
9	Get crop class	Crop: getCropClass()	Database: query()
10	Calculate Recommendation	Crop: calculateRecommendation()	Recommendator: Recommendator()
11	Set interpretation	Recommendation: setInterpretation()	Database: query()
12	Get Nutrient Recommendation	Recommendation: getNutrientRecommendation()	Nutrient: calculateNutrient()

13	Get fertilizer recommendation	Recommendation: getFertilizerRecommendation()	Fertilizer: calculateFertilizer()
14	Calculate Fertilizer	Fertilizer: calculateFertilizer()	Database: query()
15	Calculate Cost	Fertilizer: calculateTotalCost()	Database: query()
16	Get nutrient ratio	Fertilizer: getNutrientRatio()	Nutrient: getComposition()
17	Calculate Nutrient	Nutrient: calculateNutrient()	Database: query()
18	Calculate composition	Nutrient: getComposition()	Database: query()
19	Calculate Seasonal Balance	Crop: calculateSeasonalBalance()	Nutrient: calculateTotalBalance() )
20	Calculate total balance	Nutrient: calculateTotalBalance()	Input: calculateTotal() Output: calculateTotal()
21	Calculate Total Nutrient Input	Input: calculateTotal() calculateBnf() calculateSedimentation() calculateIrrigation()	Database: query()
22	Calculate Total Nutrient Output	Output: calculateTotal() calculateHP() calculateLeeching() calculateGaseous() calculateResidues() calculateErosion()	Database: query()

*Table 8: Event Identification*

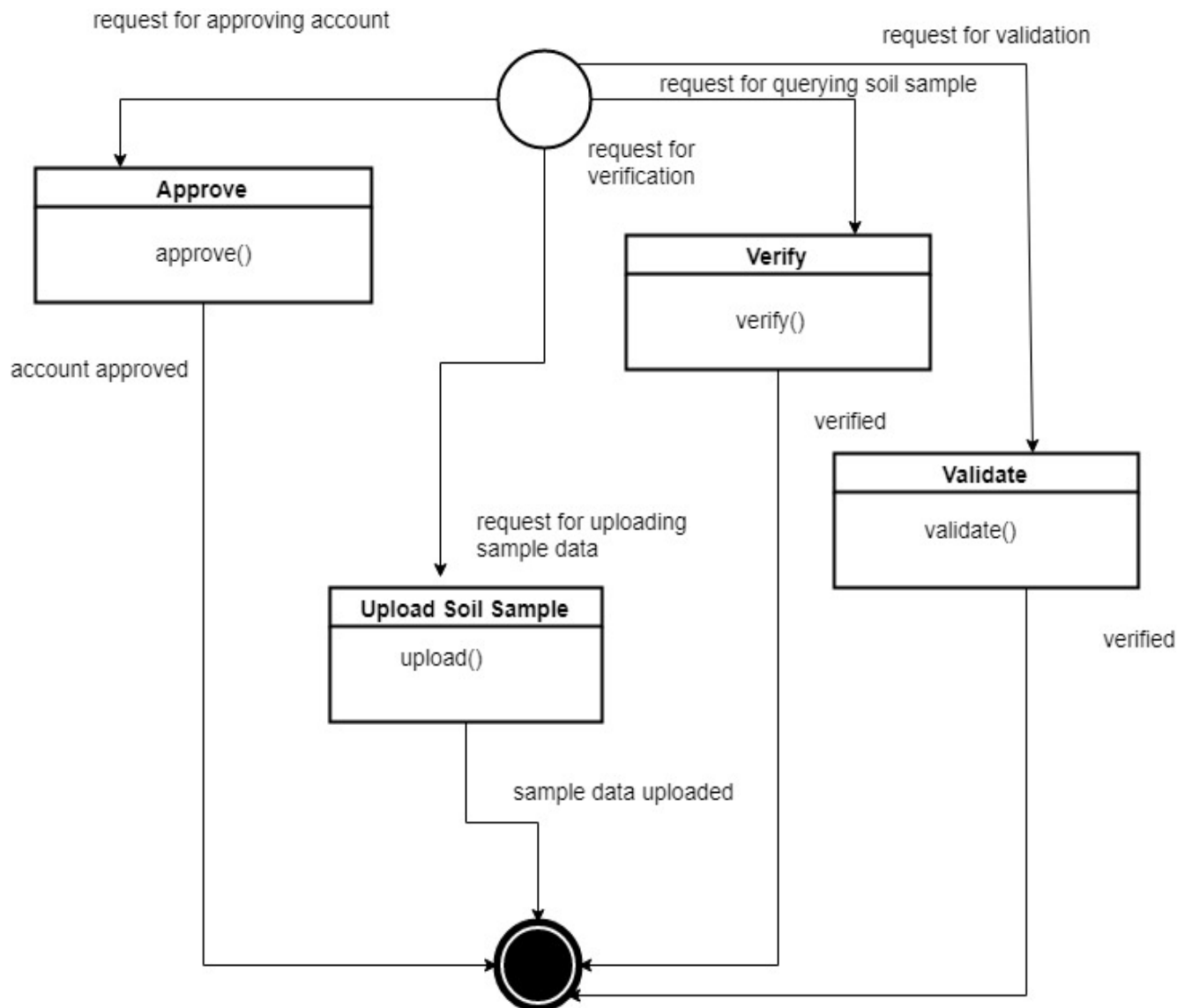


Figure 31: State Transition User

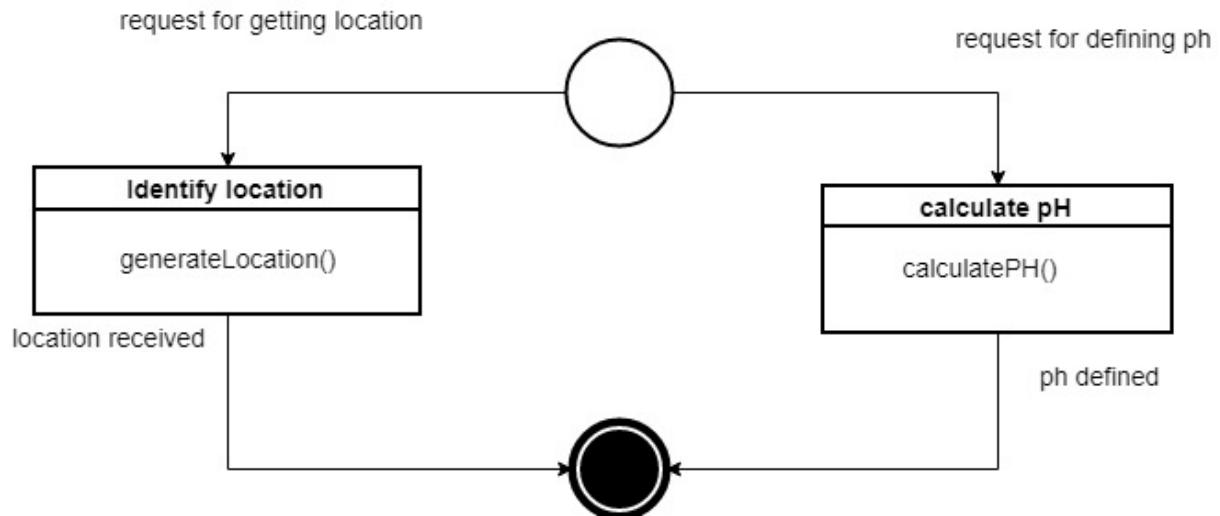


Figure 32: State Transition Sample

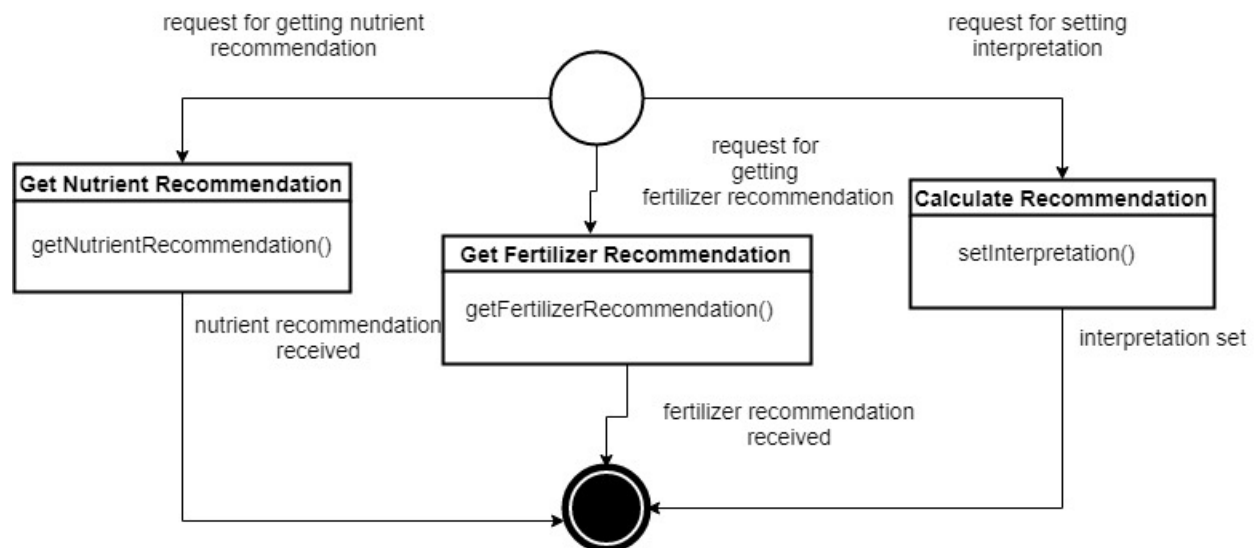


Figure 33: State Transition Recommendation

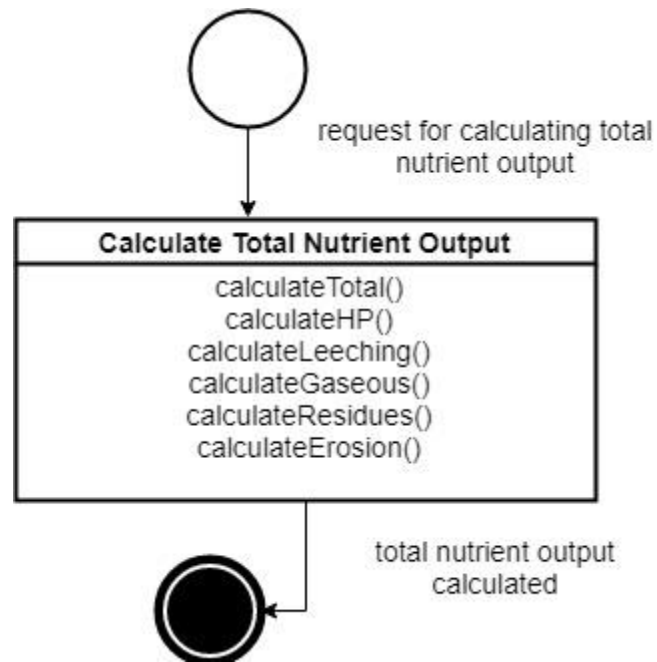


Figure 34: State Transition Output

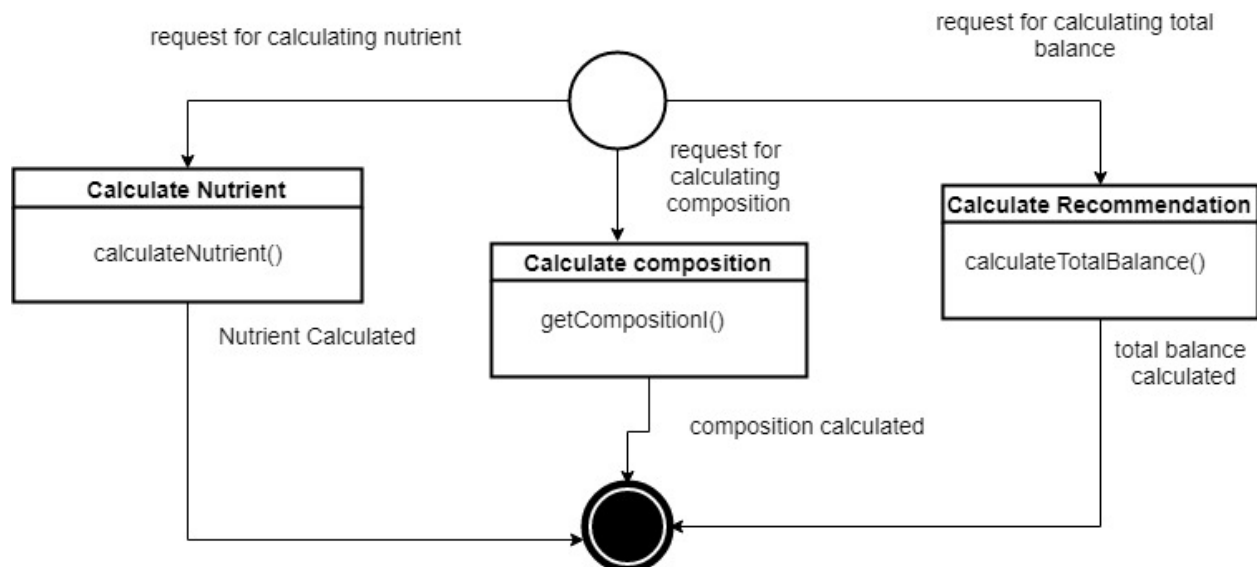


Figure 35: State Transition Nutrient



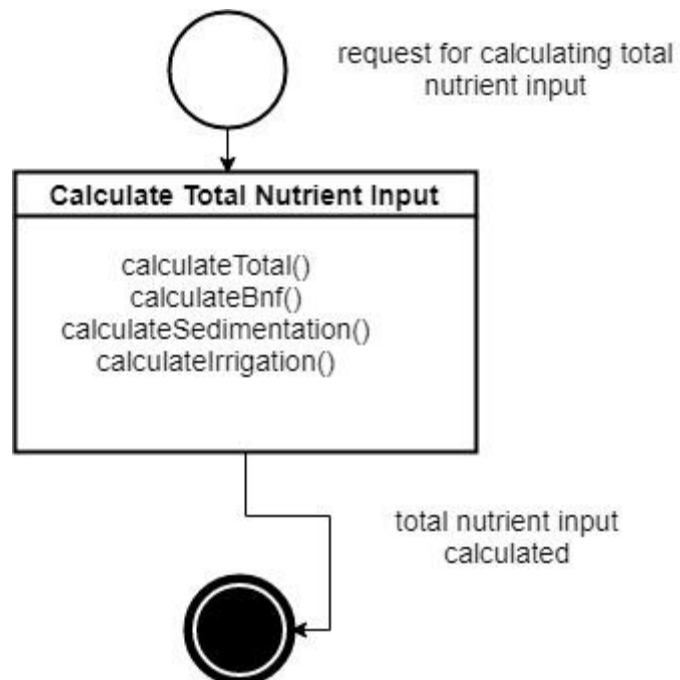


Figure 36: State Transition Input

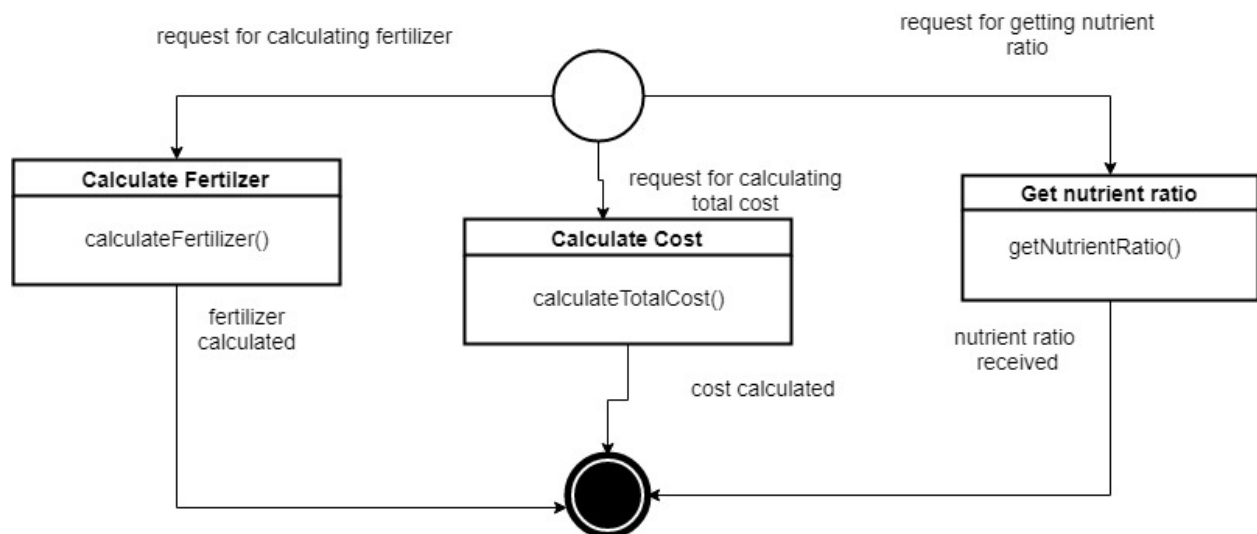


Figure 37: State Transition Fertilizer

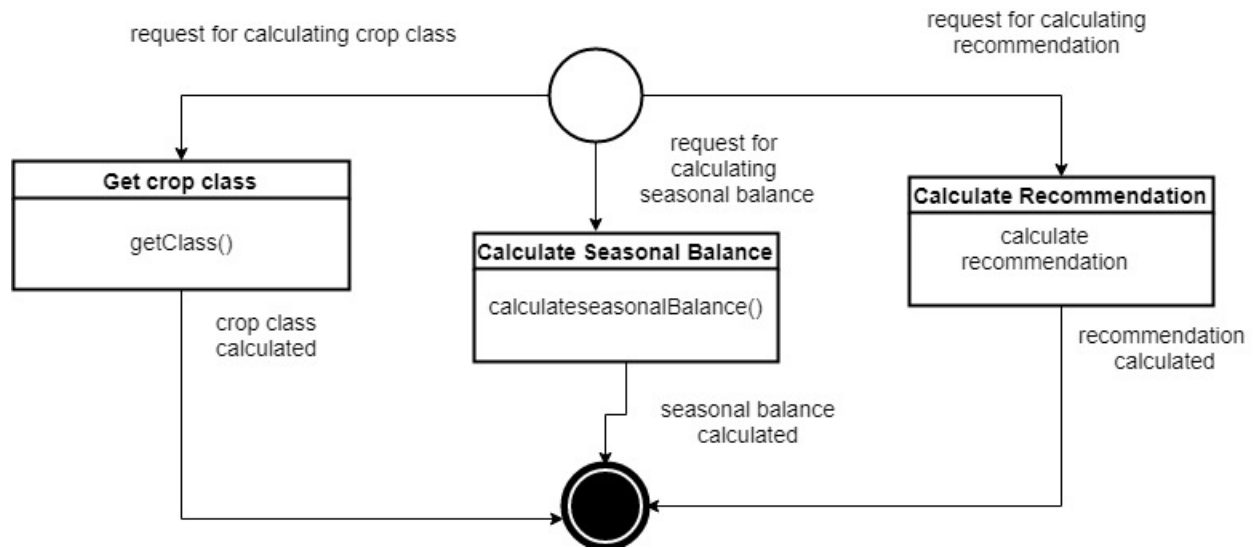


Figure 38: State Transition Crop

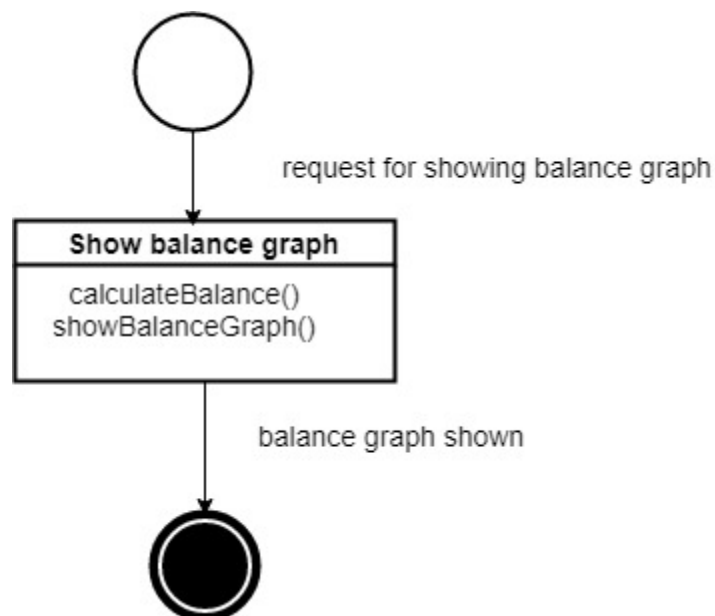


Figure 39: State Transition AEZ

## 7.2 Sequence Diagram

\*Sequence has been added to the end of the document.

# Chapter 8

## Data Flow Diagram

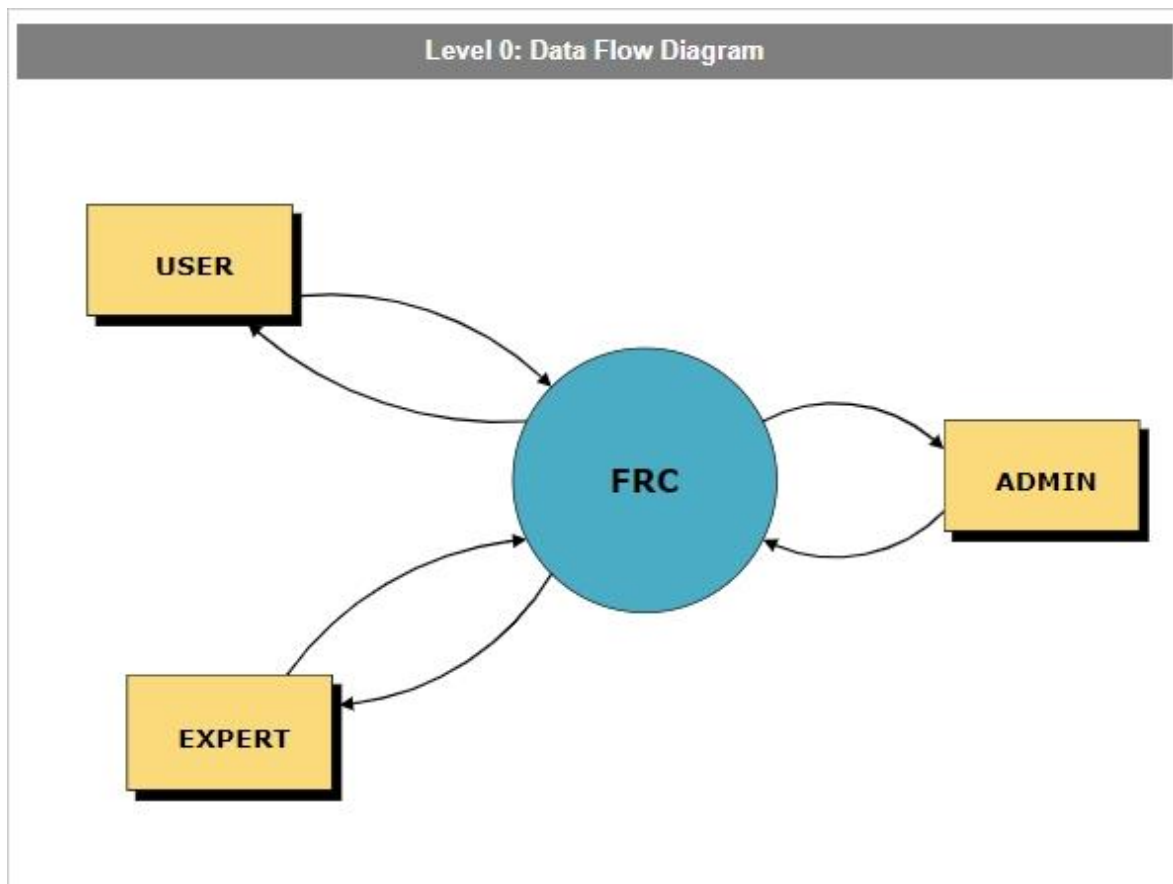


Figure 40: Data Flow Diagram Level 0

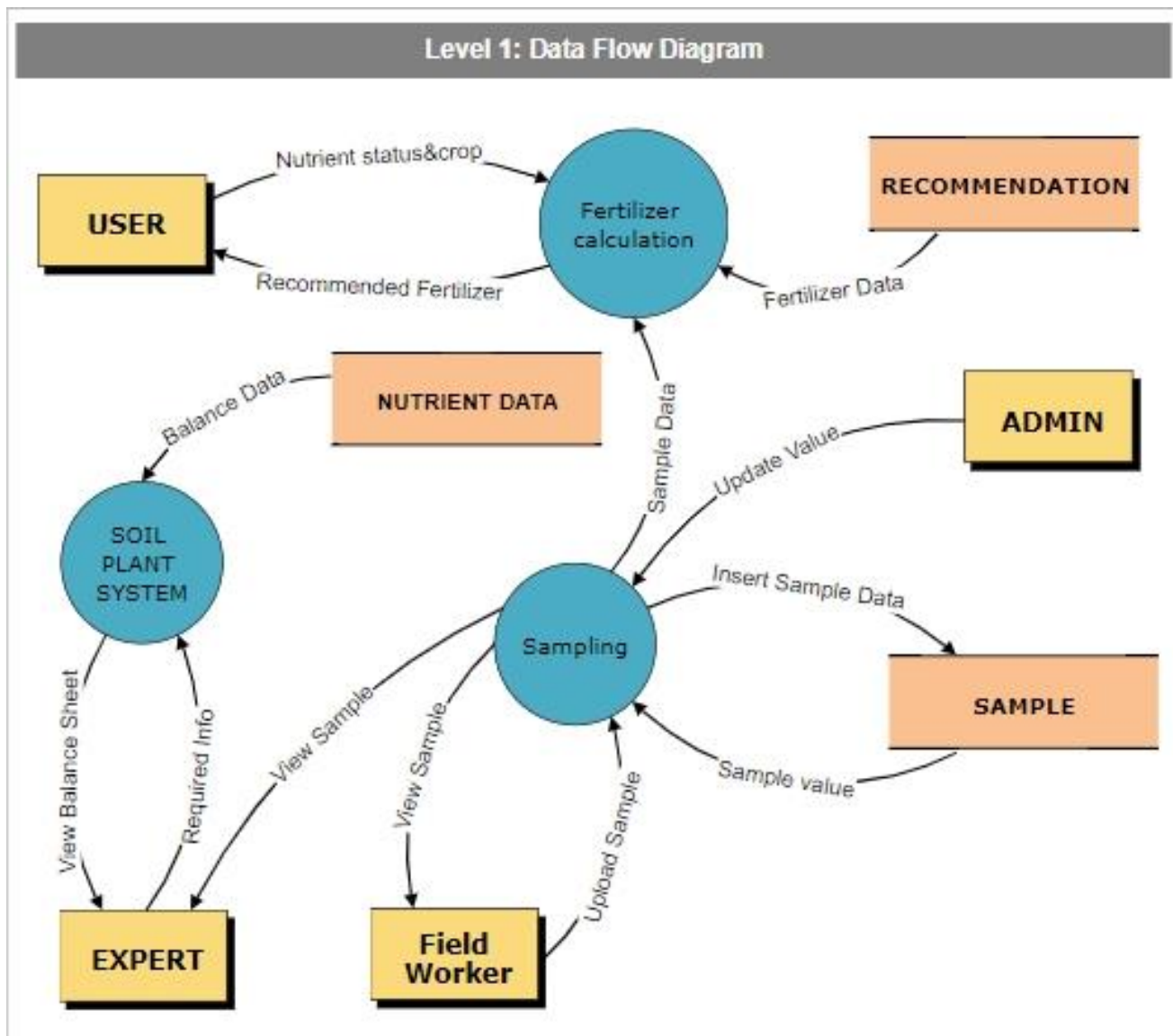


Figure 41: Data Flow Diagram Level 1

# Chapter 9

## Conclusion

From this SRS report on Fertilizer Recommendation Calculation, the readers will get a clear and easy view of the overall system of management system of the regular grocery shops. This SRS document can be used effectively to maintain the software development cycle. It will be very easy to conduct the whole project using SRS. Hopefully, this document can also help the junior BSSE students. We tried best to remove all dependencies and make an effective and fully designed SRS.