

Soil-Crop

1. Introduction

This report presents a Soil-Crop database system designed to assist agricultural engineers and administrators in storing, managing, and analyzing soil tests and recommending suitable crops. The system includes user roles, soil test records, crop information, and recommendation mappings between soil tests and suitable crops.

2. Client Needs Analysis

The client needs a system to recommend suitable crops based on soil analysis. Users (e.g., agricultural engineers or admins) should be able to input soil data (pH, N, P, K), and the system should suggest appropriate crops. It should also support user management and record previous tests.

➤ Functional Requirements

- User registration and login.
- Enter and manage soil test data.
- Store crop and soil suitability info.
- Generate crop recommendations.
- Admin controls for managing users and data.
- View history of recommendations.

➤ Main Entities

- **User** – System users (engineers/admins).
- **SoilTest** – Contains pH, nitrogen, phosphorus, potassium.
- **Crop** – Crop data and suitable soil conditions.
- **Recommendation** – Links soil test to a suggested crop.

ERD

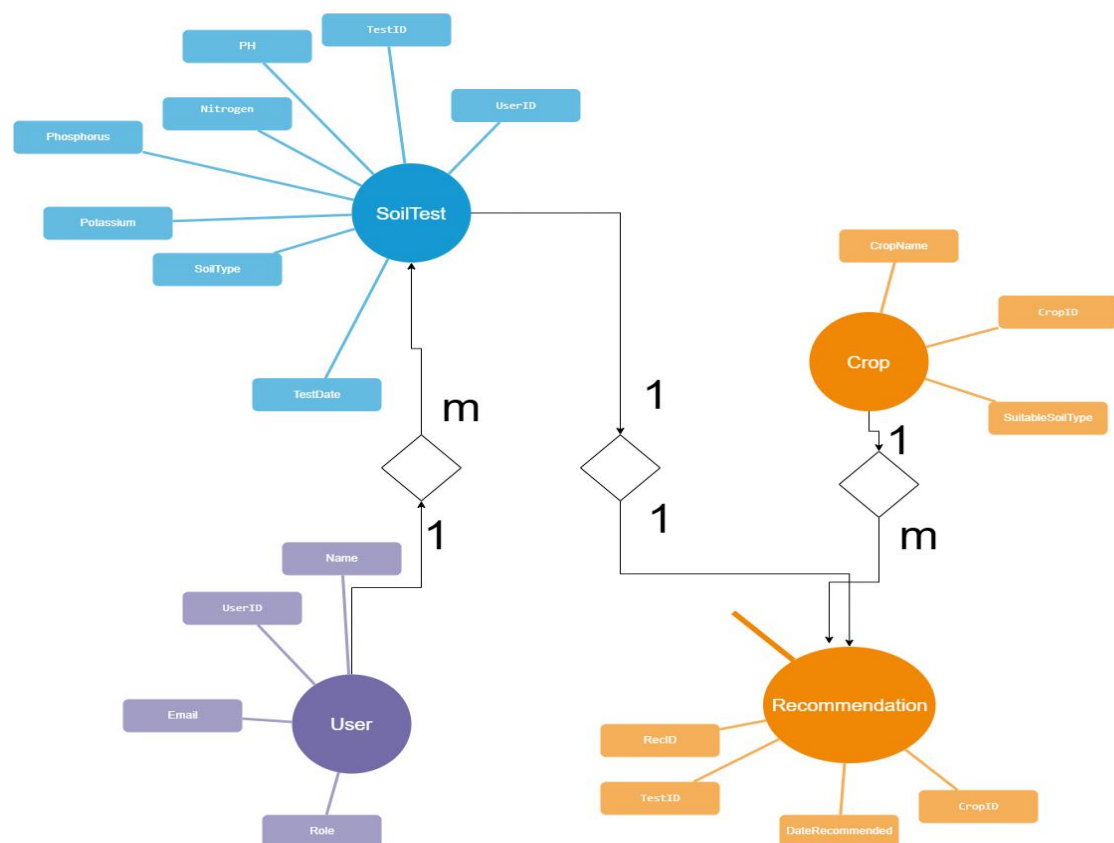
User			
<u>UserID</u>	Name	Email	Role

SoilTest							
<u>TestID</u>	PH	Nitrogen	Phosphorus	Potassium	SoilType	TestDate	<u>UserID</u>

Crop		
<u>CropID</u>	CropName	SuitableSoilType

Recommendation			
<u>RecID</u>	<u>TestID</u>	<u>CropID</u>	DateRecommended

Mapping:



3. SQL Script to Build the Database and Define User Privileges:

```
mysql> CREATE DATABASE SoilCropDB;
Query OK, 1 row affected (0.145 sec)

mysql> USE SoilCropDB;
Database changed
mysql>
mysql> CREATE TABLE User (
  ->   UserID INT PRIMARY KEY AUTO_INCREMENT,
  ->   Name VARCHAR(100),
  ->   Email VARCHAR(100),
  ->   Role ENUM('Admin', 'Engineer')
  -> );
Query OK, 0 rows affected (0.299 sec)

mysql> CREATE TABLE SoilTest (
  ->   TestID INT PRIMARY KEY AUTO_INCREMENT,
  ->   PH FLOAT,
  ->   Nitrogen FLOAT,
  ->   Phosphorus FLOAT,
  ->   Potassium FLOAT,
  ->   SoilType VARCHAR(50),
  ->   TestDate DATE,
  ->   UserID INT,
  ->   FOREIGN KEY (UserID) REFERENCES User(UserID)
  -> );
Query OK, 0 rows affected (0.550 sec)

mysql> CREATE TABLE Crop (
  ->   CropID INT PRIMARY KEY AUTO_INCREMENT,
  ->   CropName VARCHAR(100),
  ->   SuitableSoilType VARCHAR(50)
  -> );
Query OK, 0 rows affected (0.184 sec)

mysql> CREATE TABLE Recommendation (
  ->   RecID INT PRIMARY KEY AUTO_INCREMENT,
  ->   TestID INT,
  ->   CropID INT,
  ->   DateRecommended DATE,
  ->   FOREIGN KEY (TestID) REFERENCES SoilTest(TestID),
  ->   FOREIGN KEY (TestID) REFERENCES SoilTest(TestID),
  ->   FOREIGN KEY (CropID) REFERENCES Crop(CropID)
  -> );
Query OK, 0 rows affected (0.459 sec)

mysql> CREATE USER 'admin'@'localhost' IDENTIFIED BY 'adminpass';
Query OK, 0 rows affected (0.357 sec)

mysql> CREATE USER 'engineer'@'localhost' IDENTIFIED BY 'engpass';
Query OK, 0 rows affected (0.049 sec)

mysql> GRANT ALL PRIVILEGES ON SoilCropDB.* TO 'admin'@'localhost';
Query OK, 0 rows affected (0.074 sec)

mysql> GRANT SELECT, INSERT ON SoilCropDB.SoilTest TO 'engineer'@'localhost';
Query OK, 0 rows affected (0.076 sec)

mysql> GRANT SELECT ON SoilCropDB.Recommendation TO 'engineer'@'localhost';
Query OK, 0 rows affected (0.063 sec)
```

4. Data Insertion :

```
mysql> INSERT INTO User (Name, Email, Role) VALUES
-> ('Ahmed Ali', 'ahmed@example.com', 'Admin'),
-> ('Fatma Hassan', 'fatma@example.com', 'Engineer'),
-> ('Mohamed Salah', 'mohamed@example.com', 'Engineer'),
-> ('Sara Youssef', 'sara@example.com', 'Admin'),
-> ('Khaled Nabil', 'khaled@example.com', 'Engineer'),
-> ('Laila Samir', 'laila@example.com', 'Engineer'),
-> ('Youssef Ibrahim', 'youssef@example.com', 'Engineer'),
-> ('Hana Omar', 'hana@example.com', 'Admin'),
-> ('Ali Gamal', 'ali@example.com', 'Engineer'),
-> ('Mona Tarek', 'mona@example.com', 'Engineer');
Query OK, 10 rows affected (0.203 sec)
Records: 10 Duplicates: 0 Warnings: 0

mysql> INSERT INTO Crop (CropName, SuitableSoilType) VALUES
-> ('Wheat', 'Clay'),
-> ('Corn', 'Loamy'),
-> ('Rice', 'Silty'),
-> ('Potato', 'Sandy'),
-> ('Beans', 'Loamy'),
-> ('Cotton', 'Clay'),
-> ('Cotton', 'Clay'),
-> ('Beet', 'Silty'),
-> ('Onion', 'Loamy'),
-> ('Tomato', 'Sandy'),
-> ('Pepper', 'Sandy');
Query OK, 10 rows affected (0.078 sec)
Records: 10 Duplicates: 0 Warnings: 0

mysql> INSERT INTO SoilTest (PH, Nitrogen, Phosphorus, Potassium, SoilType, TestDate, UserID) VALUES
-> (6.5, 20, 10, 30, 'Clay', '2024-03-01', 2),
-> (6.8, 22, 12, 28, 'Loamy', '2024-03-02', 3),
-> (7.0, 18, 15, 25, 'Silty', '2024-03-03', 4),
-> (6.4, 19, 11, 26, 'Sandy', '2024-03-04', 5),
-> (6.7, 21, 13, 29, 'Clay', '2024-03-05', 6),
-> (6.3, 17, 9, 27, 'Loamy', '2024-03-06', 7),
-> (6.6, 23, 14, 31, 'Silty', '2024-03-07', 8),
-> (6.9, 24, 16, 32, 'Sandy', '2024-03-08', 9),
-> (6.2, 15, 8, 24, 'Loamy', '2024-03-09', 10),
-> (6.0, 16, 7, 23, 'Clay', '2024-03-10', 1);
Query OK, 10 rows affected (0.096 sec)
Records: 10 Duplicates: 0 Warnings: 0

mysql>
mysql> INSERT INTO Recommendation (TestID, CropID, DateRecommended) VALUES
-> (1, 1, '2024-03-11'),
-> (2, 2, '2024-03-12'),
-> (3, 3, '2024-03-13'),
-> (4, 4, '2024-03-14'),
-> (5, 5, '2024-03-15'),
-> (6, 6, '2024-03-16'),
-> (7, 7, '2024-03-17'),
-> (8, 8, '2024-03-18'),
-> (9, 9, '2024-03-19'),
-> (10, 10, '2024-03-20');
Query OK, 10 rows affected (0.056 sec)
Records: 10 Duplicates: 0 Warnings: 0
```

5. SQL Queries :

```
mysql> SELECT * FROM Crop WHERE CropName LIKE '%Tomato%';
+-----+-----+-----+
| CropID | CropName | SuitableSoilType |
+-----+-----+-----+
| 9      | Tomato  | Sandy            |
+-----+-----+-----+
1 row in set (0.093 sec)

mysql> SELECT AVG(PH) AS AveragePH FROM SoilTest;
+-----+
| AveragePH |
+-----+
| 6.540000009536743 |
+-----+
1 row in set (0.085 sec)

mysql> SELECT * FROM SoilTest ORDER BY TestDate ASC;
+-----+-----+-----+-----+-----+-----+-----+
| TestID | PH      | Nitrogen | Phosphorus | Potassium | SoilType | TestDate | UserID |
+-----+-----+-----+-----+-----+-----+-----+
| 1      | 6.5     | 20       | 10          | 30         | Clay     | 2024-03-01 | 2      |
| 2      | 6.8     | 22       | 12          | 28         | Loamy    | 2024-03-02 | 3      |
| 3      | 7       | 18       | 15          | 25         | Silty    | 2024-03-03 | 4      |
| 4      | 6.4     | 19       | 11          | 26         | Sandy    | 2024-03-04 | 5      |
| 5      | 6.7     | 21       | 13          | 29         | Clay     | 2024-03-05 | 6      |
| 6      | 6.3     | 17       | 9           | 27         | Loamy    | 2024-03-06 | 7      |
| 7      | 6.6     | 23       | 14          | 31         | Silty    | 2024-03-07 | 8      |
| 8      | 6.9     | 24       | 16          | 32         | Sandy    | 2024-03-08 | 9      |
| 9      | 6.2     | 15       | 8           | 24         | Loamy    | 2024-03-09 | 10     |
| 10     | 6       | 16       | 7           | 23         | Clay     | 2024-03-10 | 1      |
+-----+-----+-----+-----+-----+-----+-----+
10 rows in set (0.044 sec)

mysql> SELECT * FROM Crop ORDER BY CropName DESC;
+-----+-----+-----+
| CropID | CropName | SuitableSoilType |
+-----+-----+-----+
| 1      | Wheat    | Clay             |
| 9      | Tomato  | Sandy            |
| 3      | Rice     | Silty            |
+-----+-----+-----+
10 rows in set (0.019 sec)

mysql> SELECT SoilType, COUNT(*) AS TestCount FROM SoilTest GROUP BY SoilType;
+-----+-----+
| SoilType | TestCount |
+-----+-----+
| Clay     | 3         |
| Loamy    | 3         |
| Silty    | 2         |
| Sandy    | 2         |
+-----+-----+
4 rows in set (0.055 sec)

mysql> SELECT User.Name AS UserName, Crop.CropName, Recommendation.DateRecommended
-> FROM Recommendation
-> INNER JOIN SoilTest ON Recommendation.TestID = SoilTest.TestID
-> INNER JOIN User ON SoilTest.UserID = User.UserID
-> INNER JOIN Crop ON Recommendation.CropID = Crop.CropID;
+-----+-----+-----+
| UserName | CropName | DateRecommended |
+-----+-----+-----+
| Fatma Hassan | Wheat | 2024-03-11 |
| Mohamed Salah | Corn | 2024-03-12 |
| Sara Youssef | Rice | 2024-03-13 |
| Khaled Nabil | Potato | 2024-03-14 |
| Laila Samir | Beans | 2024-03-15 |
| Youssef Ibrahim | Cotton | 2024-03-16 |
| Hana Omar | Beet | 2024-03-17 |
| Ali Gamal | Onion | 2024-03-18 |
| Mona Tarek | Tomato | 2024-03-19 |
| Ahmed Ali | Pepper | 2024-03-20 |
+-----+-----+-----+
10 rows in set (0.014 sec)

mysql> SELECT * FROM SoilTest WHERE PH BETWEEN 6.5 AND 7.0;
+-----+-----+-----+-----+-----+-----+-----+
| TestID | PH      | Nitrogen | Phosphorus | Potassium | SoilType | TestDate | UserID |
+-----+-----+-----+-----+-----+-----+-----+
| 1      | 6.5     | 20       | 10          | 30         | Clay     | 2024-03-01 | 2      |
| 2      | 6.8     | 22       | 12          | 28         | Loamy    | 2024-03-02 | 3      |
| 3      | 7       | 18       | 15          | 25         | Silty    | 2024-03-03 | 4      |
| 5      | 6.7     | 21       | 13          | 29         | Clay     | 2024-03-05 | 6      |
| 7      | 6.6     | 23       | 14          | 31         | Silty    | 2024-03-07 | 8      |
| 8      | 6.9     | 24       | 16          | 32         | Sandy    | 2024-03-08 | 9      |
+-----+-----+-----+-----+-----+-----+-----+
6 rows in set (0.009 sec)

mysql> SELECT * FROM Crop WHERE SuitableSoilType IN ('Loamy', 'Sandy');
+-----+-----+-----+
| CropID | CropName | SuitableSoilType |
+-----+-----+-----+
| 2      | Corn     | Loamy            |
| 4      | Potato   | Sandy            |
| 5      | Beans    | Loamy            |
| 8      | Onion    | Loamy            |
| 9      | Tomato   | Sandy            |
| 10     | Pepper   | Sandy            |
+-----+-----+-----+
6 rows in set (0.009 sec)

mysql> UPDATE SoilTest SET SoilType = 'Loamy' WHERE TestID = 1;
Query OK, 1 row affected (0.055 sec)
Rows matched: 1 Changed: 1 Warnings: 0

mysql> DELETE FROM Recommendation WHERE RecID = 1;
Query OK, 1 row affected (0.055 sec)
```