Farm Database Management System

Database Design Document

Version 1.0

05/07/2024

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1. Introduction

This technical report for a farm database system aims to provide a centralized platform for managing various aspects of farm operations efficiently. It is designed to streamline data management, facilitate decision-making processes, and enhance productivity across different functional areas of farm management.

The database system is intended to consolidate farm-related data into a single, easily accessible repository to eliminate data silos and ensure data consistency. It will also serve farm managers in optimizing resource allocation by providing insights into field productivity, crop yield, livestock health, and equipment utilization.

The database system will provide a decision support system as the information and analysis will help farm managers make informed decisions about the crop yield, planting schedules, equipment maintenance and livestock management. The intended audience for this document are farm managers, stakeholders, administrative staff and the field employees. The database system is designed to accommodate future scalability plans and expansion as the farm expands operations. User access and data integrity are also addressed in the database design to protect proprietary data and employee details.

2. Overview

The database will store comprehensive information related to farm operations, including details about farms, fields, crops, livestock, employees, equipment, and sales transactions. By capturing and organizing this data in a structured manner, the database will enable farm managers to gain insights into farm performance, optimize resource allocation, track inventory, and monitor financial metrics. This database system will be integrated into previous systems to allow for a seamless change, and to allow for ease of use when storing and capturing data.

3. Literature Review

The purpose of the farm database project is to design a comprehensive database system to manage agricultural operations efficiently. This includes tracking farm details, field management, crop cultivation, livestock rearing, employee management, and equipment maintenance.

Summary of Related Work:

Several studies and projects have explored the development of database systems for agricultural management. These efforts focus on improving productivity, optimizing resource utilization, and enhancing decision-making processes in farming practices. Some key findings and outcomes from related work include:

Integration of Farm Management Systems: Research has emphasized the importance of integrating various farm management functions into a centralized database system. This integration allows for seamless coordination between different aspects of agricultural operations, leading to improved efficiency and productivity.

Data-driven Decision Making: Studies have highlighted the significance of data-driven decision-making in agriculture. By capturing and analyzing data related to crop performance, soil health, weather conditions, and market trends, farmers can make informed decisions to optimize yields and minimize risks.

Precision Agriculture Technologies: The adoption of precision agriculture technologies, such as IoT sensors, drones, and satellite imagery, has been a focus in recent literature. These technologies generate vast amounts of data that can be leveraged to improve farm management practices and resource allocation.

User Interface and Accessibility: User-friendly interfaces and mobile applications have been recommended to enhance accessibility and usability of farm database systems. Providing farmers and farm managers with intuitive tools for data input, visualization, and analysis can facilitate the adoption and usage of the system.

Security and Privacy Considerations: With the increasing digitization of agricultural data, ensuring security and privacy of farm data has become a critical concern. Research emphasizes the implementation of robust security measures, such as encryption, access controls, and data anonymization, to safeguard sensitive information.

Outcome/Recommendations:

Based on the literature review, the farm database project will prioritize the following aspects:

Integration of diverse farm management functionalities into a unified database system.

Emphasis on data collection, analysis, and visualization to support informed decision-making.

Implementation of precision agriculture technologies to enhance productivity and resource efficiency.

Development of user-friendly interfaces and mobile applications for easy access and usability.

Integration of robust security measures to protect farm data from unauthorized access and breaches.

1. Assumptions/Constraints/Risks

1.1 Assumptions

Hardware and Software Compatibility: The farm database design assumes compatibility with standard hardware configurations and common software environments, including operating systems such as Windows, Linux, or macOS, and Oracle SQL.

End-user Characteristics: The design assumes that end-users accessing the system have basic computer literacy and are trained adequately to use the database interface.

Network Connectivity: The availability of stable network connectivity for accessing and updating the database is assumed.

1.2 Constraints

The database system's performance and capabilities may be constrained by factors such as hardware resources, network bandwidth, storage capacity. Security measures such as data encryption and user access control may affect the database system performance.

1.3 Risks

Data Integrity Risks: There may be risks of data loss or data corruption due to human error and hardware and software failures. Data validation procedures can be put in place to reduce the risks.

2. Design Decisions

The design decisions are affected by the current system and some other factors which are discussed below.

2.1 Key Factors Influencing Design

Functional Requirements: Functional requirements such as performance, availability, security, and privacy have a significant impact on the design decisions.

DBMS Selection: Choosing a database management system (DBMS) is crucial to achieving the project's objectives. The selection is influenced by factors such as ease of use, scalability, and compatibility with existing systems.

2.2 Functional Design Decisions

User Interface: The database will be designed to support a user-friendly interface for data entry, retrieval and storage.

Data integrity will be ensured by validating inputs and providing error messages for unallowed inputs.

Inserts, updates, deletes, and queries can be processed either sequentially or randomly, depending on the specific requirements of each operation.

Users will receive data in a structured format, including tables, forms, and reports, to facilitate easy comprehension and analysis.

2.3 Database Management System Decisions

The farm database management system version 1.0 has been selected as the initial implementation platform due to ease of use and the supporting software environment. Flexibility will be built into the database design to adapt to the changing requirements and future migrations as required.

2.4 Security and Privacy Design Decisions

Access Control: Role-based access control for the employees, farm managers and contract staff will be designed to limit access to sensitive data based on user roles and permissions.

Data Encryption: Sensitive data will be encrypted both at rest and in transit to protect against unauthorized access and data breaches.

2.5 Performance and Maintenance Design Decisions

- To facilitate distributed access and improve scalability, a client/server architecture will be implemented.
- To guarantee data consistency and support multiple concurrent transactions, data partitioning and distributed locking mechanisms will be implemented.

- To minimize data loss in case of hardware failures or system crashes, regular backups will be scheduled. Documentation and testing of data restoration procedures will be done to ensure rapid recovery.
- Optimizing storage usage and improving performance will be achieved through the use of automated disk management and space reclamation strategies.
- Data archiving and purging policies will be implemented to manage database growth and achieve performance objectives.

3. Statement of Work

1. Overview

Ethos farm is a 100-acre tract of lush land in the center of Pennsylvania. Ethos farm, with a long and illustrious history spanning several generations, has flourished as a center for agricultural production, animal husbandry, environmental preservation, and community involvement.

1.1. Executive Summary

A database management system will be designed for farms to capture and manage a diverse range of data related to agricultural operations, resource management, inventory tracking, and task scheduling. The database will be created to support the various needs of the farm which include efficient data storage, retrieval, and analysis to facilitate effective farm management.

2. Purpose and Objective

The purpose of this project is to create and implement a complete Database Management System (DBMS) for farms. The technology will make it easier to manage farm operations efficiently. The objectives include the following: tracking resources, reporting, inventory management and monitoring of crops and livestock, resource and personnel allocation, and the streamlining of agricultural operations.

3. Scope

The project scope will cover the database management system design, to enable effective retrieval, storage and reporting of crops, livestock, and resources. Some of the in-scope and out-of-scope work are detailed below.

3.1. In-scope work:

- Project requirements gathering
- Detailed documentation of requirements
- Develop crop management module
- Design module for livestock records
- Develop a design for tracking data on livestock, crops, weather, task scheduling.

3.2. Out-of-scope work:

- Procurement of farm equipment
- Procurement of end-user hardware and tools
- Construction of buildings and infrastructure maintenance
- Development of security or safety plans
- Monitoring of crop health or pest management.

4. **Database Goals, Expectations, and Deliverables**: The goals of the database implementation would be to optimize resources, streamline the work processes and provide proper inventory management on the crops, livestock, and other resources. Some of the deliverables include the following below.

   Deliverables

   - Implemented Farm Management DBMS
   - Database documentation
   - Crop Management Module
   - Livestock Management Module
   - Resource Tracking Module
   - Task Scheduling Module

5. **Database Benefits**: The implementation of the DBMS will provide many benefits. These include enhanced efficiency in agricultural operations at the farm, increased productivity due to efficient scheduling and better resource management, and waste reduction. Farm operations will be streamlined as workflow processes will be coordinated in an efficient manner.

6. **Hardware and Software Tools**:

   Hardware
   - HP Laptop Windows 11 Version 22H2

   Software
   - Oracle SQL Developer
   - Oracle VM VirtualBox 6.1
   - Oracle Database 19c

   Diagramming Tool
   - E-R Assistant

7. **DDL AND DML**

   The data definition language will be used to develop tables for the crops, livestock, resources, tasks, and other agricultural operations. The tables will be normalized and assigned primary and foreign keys to minimize redundancy and errors. The data manipulation language will be used to create queries for managing crop-related data, livestock inventory and equipment tracking. Also, procedures will be stored to show crop growth tracking.

8. **SQL Usage**:

Naming Conventions

- Clear and explanatory names will be used for tables, columns and all database objects.
- A consistent naming convention will be used for enhanced readability.
- Reserved keywords shall not be used as identifiers.
- Primary keys shall be defined for each table.

Data types and storage

- The appropriate data types shall be used for the tables.
- Vendor-specific data types shall be avoided.
- Documentation on the database, usage and relationships shall be stored and maintained.
- Complex queries shall be deconstructed into stored procedures that can be reused.

9. **Student-defined section**

Cloud technology shall be utilized as personnel will have remote access to sections of the DBMS server, allowing work flexibility. The current DBMS infrastructure will be migrated to the cloud environment, specifically Microsoft Azure, to enhance operations and aid scalability.

Reference

Holywell, S. (2019, May 14). SQL style guide by Simon Holywell. Retrieved from https://www.sqlstyle.guide/

4. Requirements Analysis

This document outlines the plan to optimize the farm operations through the ER diagram and the description of the business rules, entities and attributes that will make up the database system.

Business Rules

I. FARM
   a. A farm (mandatory) can have one or more fields (mandatory).
   b. A farm (mandatory) can raise zero, one or more livestock (optional).
   c. A farm (mandatory) can employ one or more employees (mandatory).
   d. A farm (mandatory) possesses one or more pieces of equipment (mandatory).

II. FIELD
   a. One field (mandatory) can grow zero or more crops (optional).
   b. One or more fields (mandatory) must belong to one farm (mandatory).

III. CROP
   a. One or more crops (mandatory) must belong to one field (mandatory).

IV. LIVESTOCK
   a. Zero or more livestock (optional) must belong to one farm (mandatory).

V. EMPLOYEE
   a. One or more employees (mandatory) work for one farm (mandatory).

VI. EQUIPMENT
   a. One or more equipment (mandatory) belongs to one farm (mandatory).

Entity and Attribute Description

Entity Name: **FARM**
Entity Description: Represents details about the agricultural operations of Ethos farm.
Main attributes of FARM:
Attribute Name: FARMID (PK)

Attribute Description: The identification number (integer value) for Ethos Farm (Primary Key).
Attribute Name: FARM_NAME
Attribute Description: The name (character value) of the farm.
Attribute Name: LOCATION
Attribute Description: The address of the farm. This is a variable character value attribute.

Attribute Name: FARM_SIZE
Attribute Description: The total size of the farm in acres. This is in numerical form.
Attribute Name: WEBADDRESS
Attribute Description: The contact web page for the farm. This is a variable character attribute.

Attribute Name: FARMING_TYPE
Attribute Description: The type of farming activities conducted on the farm (Livestock, crop, or mixed farming). This is a character valued entity.

Entity Name: **FIELD**
Entity Description: This represents a specific area of land on the farm used for livestock, crop or other agricultural production.
Main attributes of FIELD:
Attribute Name: FIELD_ID (PK)

Attribute Description: The identification number for the field in the database (Primary Key). This is an integer value.
Attribute Name: FIELD_NAME
Attribute Description: The name (character value) of the field.

Attribute Name: FIELD_SIZE
Attribute Description: The size of the field in acres (numerical value).

Attribute Name: CROP_TYPE
Attribute Description: The type of crop planted in the field (character value).
Attribute Name: SOIL_TYPE
Attribute Description: The type of soil (character value) used in that field for the crops (E.g., Clay, Sandy).

Attribute Name: IRRIGATION_SYSTEM
Attribute Description: Type of irrigation system (character value) used in the field (E.g., sprinkler, flood)

Attribute Name: FARMID_FK
Attribute Description: This refers to the farm to which the field belongs.

Entity Name: **CROP**
Entity Description: This entity represents the agricultural products cultivated on the farm.

Main attributes of CROP:
Attribute Name: CROPID (PK)

Attribute Description: An identification number for crops within the database (Primary key). This is an integer value.
Attribute Name: CROP_NAME
Attribute Description: The name of the crop being cultivated or planted. This is a character valued attribute.
Attribute Name: VARIETY
Attribute Description: The variety or breed of the crop being cultivated. This is a character valued attribute.

Attribute Name: PLANTING_DATE

Attribute Description: The date of the crop planting or the expected planning date. This is a date value.
Attribute Name: HARVEST_DATE
Attribute Description: The expected date the crop is to be harvested. This is a date value.
Attribute Name: YIELD
Attribute Description: The expected output of the crop being planted. This is a numerical value.

Attribute Name: FIELDID_ FK
Attribute Description: This foreign key links the crop being planted to its field (Foreign key).

Entity Name: **LIVESTOCK**
Entity Description: This entity represents animals raised on the farm for various purposes.
Main attributes of LIVESTOCK:
Attribute Name: LIVESTOCKID (PK)

Attribute Description: Identification number (integer value) for livestock (Primary key).
Attribute Name: LIVESTOCK_TYPE
Attribute Description: The species (character value) of livestock on the farm (E.g., sheep, swine, poultry)

Attribute Name: BREED
Attribute Description: The lineage or specific breed of the livestock (character value).
Attribute Name: AGE
Attribute Description: The age of the livestock. This is a numerical value.

Attribute Name: HEALTH_STATUS
Attribute Description: The health situation of the livestock (E.g., vaccinated/unvaccinated) This is a character value.

Attribute Name: FARMID_FK
Attribute Description: This links the livestock to the farm in which they are raised (Foreign key). This is an integer value.

Entity Name: **EMPLOYEE**
Entity Description: Employee at the farm, who works in various capacities. The Employee entity is a supertype with Permanent_Labor and Seasonal_Labor representing subtypes under the Employee entity.
Main attributes of EMPLOYEE:
Attribute Name: EMPLOYEEID (PK)

Attribute Description: The employee's identification number (Primary key). This is an integer value.
Attribute Name: EMPLOYEE_NAME
Attribute Description: The name (character value) of the employee.

Attribute Name: ROLE
Attribute Description: The employee's position at the farm (E.g., Laborer, Horticulturist, Farm manager). This is a character valued attribute.
Attribute Name: DOB
Attribute Description: The employee's date of birth. This will follow the YYYY-MM-DD format.

Attribute Name: PHONENUMBER
Attribute Description: The employee's phone number. This is a numeric value.

Attribute Name: ADDRESS
Attribute Description: The employee's address. This is a variable character valued attribute.

Attribute Name: WAGES
Attribute Description: The employee's wages. This is a numeric value.

Attribute Name: FARMID_FK
Attribute Description: This links the employees to the farm in which they work (Foreign key).

Entity Name: **EQUIPMENT**
Entity Description: This represents the tools and machines used on the farm.
Main attributes of EQUIPMENT:
Attribute Name: EQUIPMENTID (PK)

Attribute Description: Identification number which distinguishes each equipment (Primary key). This is an integer value.
Attribute Name: EQUIPMENT_TYPE
Attribute Description: The type of equipment used on the farm. This is a character valued attribute, E.g., tractor, plough.

Attribute Name: SERIAL_NUMBER
Attribute Description: The serial number of the equipment attached to a manufacturer. This is a variable character valued attribute.
Attribute Name: CONDITION
Attribute Description: The current state of the equipment. This is a character valued attribute, to be listed as Operable, inoperable, damaged.

Attribute Name: MAINTENANCE_DATE
Attribute Description: The date of the last maintenance date for the equipment. This is a date value.

Attribute Name: ASSIGNED_OPERATOR
Attribute Description: The operator assigned to the equipment. This is a character valued attribute.

Attribute Name: FARMID_FK
Attribute Description: This links the equipment to the farm (Foreign key). This is an integer value.

Relationship and Cardinality Description

I. FARM
    a. Relationship 1: 1:M between Farm and Field
        i. One farm (mandatory) can have one or more fields (mandatory), multiple Fields (mandatory) can belong to one Farm (mandatory).
    b. Relationship 2: 1:M between Farm and Livestock
        i. A farm (mandatory) can raise zero, one or more livestock (optional), zero or more livestock (optional) can be raised in one farm (mandatory).
    c. Relationship 3: 1:M between Farm and Employee
        i. A farm (mandatory) can employ one or more employees (mandatory), one or more employees (mandatory) work for one farm (mandatory).
    d. Relationship 4: 1:M between Farm and Equipment

i. A farm (mandatory) possesses one or more equipment (mandatory), multiple equipment (mandatory) can belong to one farm (mandatory).

II. FIELD

a. Relationship 1: 1:M between Field and Crop

i. One Field (mandatory) can grow zero or more crops (optional), multiple crops (mandatory) can belong to one field (mandatory).

b. Relationship 1: 1:M between Field and Farm

i. One or more Fields (mandatory) can belong to one Farm (mandatory), one farm (mandatory) can have multiple fields (mandatory).

III. CROP

a. Relationship 1: 1:M between Crop and Field

i. One or more crops (mandatory) can be grown in one field (mandatory), a field (mandatory) can grow multiple crops (optional).

IV. LIVESTOCK

a. Relationship 1: 1:M between Livestock and Farm.

i. Zero or more livestock (optional) belong to one farm (mandatory), A farm (mandatory) can raise zero to multiple livestock (optional).

V. EMPLOYEE

a. Relationship1: 1:M between Employee and Farm.

i. One or more employees (mandatory) work for one farm (mandatory), a farm (mandatory) can employ one or more employees (mandatory).

VI. EQUIPMENT

a. Relationship 1: 1:M between Equipment and Farm.

i. One or more Equipment (mandatory) can belong to one Farm (mandatory), a farm (mandatory) possesses one or more equipment (mandatory).

Assumptions and Special Considerations

The Employee entity is a parent entity to the Permanent_Labor and Seasonal_Labor tables which are child entities under the Employee Super class. These specialty attributes exhibit total completeness and are disjoint, as employees are either salaried and permanent all year round, or hourly/ seasonal laborers. These will not be reflected in the ER diagram.

5. Detailed Database Design

5.1 Data Software Objects and Resultant Data Structures

Below are the main data software objects and their resultant data structures:

1. Tables:

Farm Table (FARM):

Attributes: FARMID (PK), FARM_NAME, LOCATION, FARM_SIZE, WEBADDRESS, FARMING_TYPE

Resultant Data Structure:

FARMID (Primary Key): Integer

FARM_NAME: Character String

LOCATION: Variable Character String

FARM_SIZE: Numerical (Integer/Float)

WEBADDRESS: Variable Character String

FARMING_TYPE: Character String

Field Table (FIELD):

Attributes: FIELD_ID (PK), FIELD_NAME, FIELD_SIZE, CROP_TYPE, SOIL_TYPE, IRRIGATION_SYSTEM, FARMID_FK

Resultant Data Structure:

FIELD_ID (Primary Key): Integer

FIELD_NAME: Character String

FIELD_SIZE: Numerical (Integer/Float)

CROP_TYPE: Character String

SOIL_TYPE: Character String

IRRIGATION_SYSTEM: Character String

FARMID_FK (Foreign Key): Integer

Crop Table (CROP):

Attributes: CROPID (PK), CROP_NAME, VARIETY, PLANTING_DATE, HARVEST_DATE, YIELD, FIELDID_FK

Resultant Data Structure:

CROPID (Primary Key): Integer

CROP_NAME: Character String

VARIETY: Character String

PLANTING_DATE: Date

HARVEST_DATE: Date

YIELD: Numerical (Integer/Float)

FIELDID_FK (Foreign Key): Integer

Livestock Table (LIVESTOCK):

Attributes: LIVESTOCKID (PK), LIVESTOCK_TYPE, BREED, AGE, HEALTH_STATUS, FARMID_FK

Resultant Data Structure:

LIVESTOCKID (Primary Key): Integer

LIVESTOCK_TYPE: Character String

BREED: Character String

AGE: Numerical (Integer)

HEALTH_STATUS: Character String

FARMID_FK (Foreign Key): Integer

Employee Table (EMPLOYEE):

Attributes: EMPLOYEEID (PK), EMPLOYEE_NAME, ROLE, DOB, PHONENUMBER, ADDRESS, WAGES, FARMID_FK

Resultant Data Structure:

EMPLOYEEID (Primary Key): Integer

EMPLOYEE_NAME: Character String

ROLE: Character String

DOB: Date

PHONENUMBER: Numeric

ADDRESS: Variable Character String

WAGES: Numeric

FARMID_FK (Foreign Key): Integer

Equipment Table (EQUIPMENT):

Attributes: EQUIPMENTID (PK), EQUIPMENT_TYPE, SERIAL_NUMBER, CONDITION, MAINTENANCE_DATE, ASSIGNED_OPERATOR, FARMID_FK

Resultant Data Structure:

EQUIPMENTID (Primary Key): Integer

EQUIPMENT_TYPE: Character String

SERIAL_NUMBER: Variable Character String

CONDITION: Character String

MAINTENANCE_DATE: Date

ASSIGNED_OPERATOR: Character String

FARMID_FK (Foreign Key): Integer

These tables and their associated data structures form the foundation of the farm database system, facilitating efficient storage, retrieval, and manipulation of agricultural data.

5.2 Database Management System Files

- There are six main database schemas, and these are the Farm, Field, Crop, Livestock, Employee, and Equipment tables. See the ERD in Appendix A.

- The SQL file is grouped into the six main schemas with their associated DML and DDL and scripts, in addition twenty queries have been generated to show how the data can be manipulated.

SQL OUTPUT FILE

--DDL SCRIPT

```
/*
Technical Report: SQL DDL Script DBST 651
Olamide Luke April 16, 2024

Dr. Rong Shi
University of Maryland Global Campus
*/

/* DROP statements to clean up objects from previous run */

-- Sequences
DROP SEQUENCE SEQ_EQUIPMENTID;
DROP SEQUENCE SEQ_EMPLOYEEID;
DROP SEQUENCE SEQ_LIVESTOCKID;
DROP SEQUENCE SEQ_CROPID;
DROP SEQUENCE SEQ_FIELD_ID;
DROP SEQUENCE SEQ_FARMID;

-- Tables
DROP TABLE EQUIPMENT;
DROP TABLE EMPLOYEE;
DROP TABLE LIVESTOCK;
DROP TABLE CROP;
DROP TABLE FIELD;
DROP TABLE FARM;


/* Create tables based on entities */
```

```
-- Create table for FARM entity
CREATE TABLE FARM (
    FARMID INT PRIMARY KEY,
    FARM_NAME VARCHAR(100),
    LOCATION VARCHAR(255),
    FARM_SIZE NUMERIC,
    WEBADDRESS VARCHAR(255),
    FARMING_TYPE VARCHAR(100)
);

-- Create table for FIELD entity
CREATE TABLE FIELD (
    FIELD_ID INT PRIMARY KEY,
    FIELD_NAME VARCHAR(100),
    FIELD_SIZE NUMERIC,
    CROP_TYPE VARCHAR(50),
    SOIL_TYPE VARCHAR(50),
    IRRIGATION_SYSTEM VARCHAR(50),
    FARMID_FK INT,
    CONSTRAINT FK_FARMID FOREIGN KEY (FARMID_FK) REFERENCES FARM(FARMID)
);

-- Create table for CROP entity
CREATE TABLE CROP (
    CROPID INT PRIMARY KEY,
    CROP_NAME VARCHAR(100),
    VARIETY VARCHAR(100),
    PLANTING_DATE DATE,
    HARVEST_DATE DATE,
    YIELD NUMERIC,
    FIELDID_FK INT,
    CONSTRAINT FK_FIELD_ID FOREIGN KEY (FIELDID_FK) REFERENCES
FIELD(FIELD_ID)
);

CREATE TABLE LIVESTOCK (
    LIVESTOCKID INT PRIMARY KEY,
    LIVESTOCK_TYPE VARCHAR(100),
    BREED VARCHAR(100),
    AGE INT,
```

```
    HEALTH_STATUS VARCHAR(50),
    FARMID_FK INT,
    CONSTRAINT FK_LIVESTOCK_FARMID FOREIGN KEY (FARMID_FK) REFERENCES
FARM(FARMID)
);

-- Create table for EMPLOYEE entity
CREATE TABLE EMPLOYEE (
    EMPLOYEEID INT PRIMARY KEY,
    EMPLOYEE_NAME VARCHAR(100),
    ROLE VARCHAR(100),
    DOB DATE,
    PHONENUMBER VARCHAR(20),
    ADDRESS VARCHAR(255),
    WAGES NUMERIC,
    FARMID_FK INT,
    CONSTRAINT FK_EMPLOYEE_FARMID FOREIGN KEY (FARMID_FK) REFERENCES
FARM(FARMID)
);


-- Create table for EQUIPMENT entity
CREATE TABLE EQUIPMENT (
    EQUIPMENTID INT PRIMARY KEY,
    EQUIPMENT_TYPE VARCHAR(100),
    SERIAL_NUMBER VARCHAR(100),
    CONDITION VARCHAR(50),
    MAINTENANCE_DATE DATE,
    ASSIGNED_OPERATOR VARCHAR(100),
    FARMID_FK INT,
    FOREIGN KEY (FARMID_FK) REFERENCES FARM(FARMID)
);

/* Create indices for natural keys, foreign keys, and frequently-queried columns */

-- FARM
--Frequently-queried column
CREATE INDEX IDX_FARM_LOCATION ON FARM(LOCATION);

-- FIELD
-- Foreign Key
```

```
CREATE INDEX IDX_FIELD_FARMID_FK ON FIELD(FARMID_FK);

--Frequently-queried column
CREATE INDEX crop_type_index ON FIELD(CROP_TYPE);

-- CROP
-- Foreign Key
CREATE INDEX IDX_CROP_FIELDID_FK ON CROP(FIELDID_FK);

--Frequently-queried column
CREATE INDEX IDX_HARVEST_DATE ON CROP(HARVEST_DATE);

-- LIVESTOCK
-- Foreign Key
CREATE INDEX IDX_LIVESTOCK_FARMID_FK ON LIVESTOCK(FARMID_FK);

-- EMPLOYEE
-- Foreign Key
CREATE INDEX IDX_EMPLOYEE_FARMID_FK ON EMPLOYEE(FARMID_FK);

--Frequently-queried column
CREATE INDEX IDX_CONDITION ON EQUIPMENT(CONDITION);


-- EQUIPMENT
-- Foreign Key
CREATE INDEX IDX_EQUIPMENT_FARMID_FK ON EQUIPMENT(FARMID_FK);


/* Alter Tables by adding Audit Columns */
ALTER TABLE FARM ADD
    (CREATED_BY VARCHAR2(100),
    DATE_CREATED DATE,
    MODIFIED_BY VARCHAR2(100),
    DATE_MODIFIED DATE);

ALTER TABLE FIELD ADD
    (CREATED_BY VARCHAR2(100),
    DATE_CREATED DATE,
    MODIFIED_BY VARCHAR2(100),
    DATE_MODIFIED DATE);
```

```
ALTER TABLE CROP ADD
    (CREATED_BY VARCHAR2(100),
    DATE_CREATED DATE,
    MODIFIED_BY VARCHAR2(100),
    DATE_MODIFIED DATE);

ALTER TABLE LIVESTOCK ADD
    (CREATED_BY VARCHAR2(100),
    DATE_CREATED DATE,
    MODIFIED_BY VARCHAR2(100),
    DATE_MODIFIED DATE);

ALTER TABLE EMPLOYEE ADD
    (CREATED_BY VARCHAR2(100),
    DATE_CREATED DATE,
    MODIFIED_BY VARCHAR2(100),
    DATE_MODIFIED DATE);

ALTER TABLE EQUIPMENT ADD
    (CREATED_BY VARCHAR2(100),
    DATE_CREATED DATE,
    MODIFIED_BY VARCHAR2(100),
    DATE_MODIFIED DATE);

/* Create Views */

-- Business purpose: The FarmLivestock_view will be used to display detailed information about each livestock record along with the name and location of the farm where they are raised.
CREATE VIEW FarmLivestock_View AS
SELECT L.LIVESTOCKID, L.LIVESTOCK_TYPE, L.BREED, L.AGE, L.HEALTH_STATUS, F.FARM_NAME, F.LOCATION
FROM LIVESTOCK L
JOIN FARM F ON L.FARMID_FK = F.FARMID;

-- Business purpose: The EmployeeEquipment view will be used to display employees assigned to each equipment.
CREATE VIEW EmployeeEquipment AS
SELECT e.EMPLOYEEID, employee_NAME, e.ROLE, ee.EQUIPMENTID, ee.EQUIPMENT_TYPE
FROM EMPLOYEE e
LEFT JOIN EQUIPMENT ee ON e.FARMID_FK = ee.FARMID_FK;
```

```
/* Create Sequences */

-- Sequence for FARMID in farm table
CREATE SEQUENCE SEQ_FARMID START WITH 1 INCREMENT BY 1;

-- Sequence for FIELD_ID in field table
CREATE SEQUENCE SEQ_FIELD_ID START WITH 1 INCREMENT BY 1;

-- Sequence for CROPID in crop table
CREATE SEQUENCE SEQ_CROPID START WITH 1 INCREMENT BY 1;

-- Sequence for LIVESTOCKID in livestock table
CREATE SEQUENCE SEQ_LIVESTOCKID START WITH 1 INCREMENT BY 1;

-- Sequence for EMPLOYEEID in employee table
CREATE SEQUENCE SEQ_EMPLOYEEID START WITH 1 INCREMENT BY 1;

-- Sequence for EQUIPMENTID in equipment table
CREATE SEQUENCE SEQ_EQUIPMENTID START WITH 1 INCREMENT BY 1;


/* Create Triggers */

/* Business purpose: The equipment_check_trigger is set for the farm when the total number of
equipment exceeds 50. The trigger calculates the total count of equipment for the farm specified
in the FARMID_FK field of the newly inserted or updated row. If the total count exceeds or
equals 50, an application error will be raised, showing that more equipment cannot be added
due to reaching the maximum limit.*/

CREATE OR REPLACE TRIGGER equipment_check_trigger
BEFORE INSERT OR UPDATE ON equipment
FOR EACH ROW
DECLARE
   total_equipment_count INT;
BEGIN
   SELECT COUNT(*) INTO total_equipment_count
   FROM equipment
   WHERE FARMID_FK = :NEW.FARMID_FK;

   IF total_equipment_count >= 50 THEN
```

```
      RAISE_APPLICATION_ERROR(-20001, 'Cannot add more equipment. Maximum limit
reached.');
   END IF;
END;
/

/* Business purpose: The crop_harvest_date trigger is to validate that the harvest date is not
earlier than the planting date.
If the harvest date (:NEW.harvest_date) is less than the planting date (:NEW.planting_date), an
application error will come up with the code -20002 and the message 'Harvest date cannot be
before planting date.'*/

CREATE OR REPLACE TRIGGER crop_harvest_date_trigger
BEFORE INSERT OR UPDATE ON crop
FOR EACH ROW
BEGIN
   IF :NEW.harvest_date < :NEW.planting_date THEN
      RAISE_APPLICATION_ERROR(-20002, 'Harvest date cannot be before planting date.');
   END IF;
END;
/

-- Check the DBMS data dictionary to make sure that all objects have been created successfully
SELECT TABLE_NAME FROM USER_TABLES;

SELECT OBJECT_NAME, STATUS, CREATED, LAST_DDL_TIME FROM USER_OBJECTS;
```

DDL Query output

```
Sequence SEQ_EQUIPMENTID dropped.


Sequence SEQ_EMPLOYEEID dropped.


Sequence SEQ_LIVESTOCKID dropped.


Sequence SEQ_CROPID dropped.


Sequence SEQ_FIELD_ID dropped.
```

Sequence SEQ_FARMID dropped.

Table EQUIPMENT dropped.

Table EMPLOYEE dropped.

Table LIVESTOCK dropped.

Table CROP dropped.

Table FIELD dropped.

Table FARM dropped.

Table FARM created.

Table FIELD created.

Table CROP created.

Table LIVESTOCK created.

Table EMPLOYEE created.

Table EQUIPMENT created.

Index IDX_FARM_LOCATION created.

--**DDL_DML SAMPLE DATA**

--SAMPLE DATA FOR FARM TABLE

INSERT INTO FARM (FarmID, Farm_Name, Location, Farm_Size, WebAddress, Farming_Type, CREATED_BY, DATE_CREATED)

VALUES('1', 'EthosFarm', '100 Main st,Town', '100', 'www.Ethosfarm.com', 'Mixedfarming', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FARM (FarmID, Farm_Name, Location, Farm_Size, WebAddress, Farming_Type, CREATED_BY, DATE_CREATED)

VALUES('2', 'Green Acres', '456 Oak Ave, Village', '75', 'www.greenacresfarm.com', 'Crop', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FARM (FarmID, Farm_Name, Location, Farm_Size, WebAddress, Farming_Type, CREATED_BY, DATE_CREATED)

VALUES(3, 'Sunny Ranch', '789 Sunflower Rd', '150', 'www.sunnyranch.com', 'Livestock', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FARM (FarmID, Farm_Name, Location, Farm_Size, WebAddress, Farming_Type, CREATED_BY, DATE_CREATED)

VALUES(4, 'Hilltop Farm', '321 Hilltop Lane', '120', 'www.hilltopfarm.com', 'Crop', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FARM (FarmID, Farm_Name, Location, Farm_Size, WebAddress, Farming_Type, CREATED_BY, DATE_CREATED)

VALUES(5, 'Meadow View', '567 Meadow Lane', '90', 'www.meadowviewfarm.com', 'Livestock', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FARM (FarmID, Farm_Name, Location, Farm_Size, WebAddress, Farming_Type, CREATED_BY, DATE_CREATED)

VALUES(6, 'Maple Grove', '890 Maple Dr', '80', 'www.maplegrovefarm.com', 'Mixed Farming', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FARM (FarmID, Farm_Name, Location, Farm_Size, WebAddress, Farming_Type, CREATED_BY, DATE_CREATED)

VALUES(7, 'River Bend', '432 River Rd', '200', 'www.riverbendfarm.com', 'Crop', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FARM (FarmID, Farm_Name, Location, Farm_Size, WebAddress, Farming_Type, CREATED_BY, DATE_CREATED)

VALUES(8, 'Oak Forest', '987 Oakwood Blvd', '110', 'www.oakforestfarm.com', 'Livestock', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FARM (FarmID, Farm_Name, Location, Farm_Size, WebAddress, Farming_Type, CREATED_BY, DATE_CREATED)

VALUES(9, 'Golden Fields', '654 Sunflower Ave', '180', 'www.goldenfields.com', 'Mixed Farming', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FARM (FarmID, Farm_Name, Location, Farm_Size, WebAddress, Farming_Type, CREATED_BY, DATE_CREATED)

VALUES(10, 'Sunset Farm', '789 Sunset Blvd', '130', 'www.sunsetfarm.com', 'Crop', 'OLAMIDE LUKE', DATE '2024-03-26');

--SAMPLE DATA FOR FIELD TABLE

INSERT INTO FIELD (FIELD_ID, FIELD_NAME, FIELD_SIZE, CROP_TYPE, SOIL_TYPE, IRRIGATION_SYSTEM, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES('1','WHEAT FIELD', '50', 'Wheat', 'Clay', 'Sprinkler', '1', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FIELD (FIELD_ID, FIELD_NAME, FIELD_SIZE, CROP_TYPE, SOIL_TYPE, IRRIGATION_SYSTEM, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES('2', 'Pasture', '30', 'Grass', 'Sandy', 'None', '3', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FIELD (FIELD_ID, FIELD_NAME, FIELD_SIZE, CROP_TYPE, SOIL_TYPE, IRRIGATION_SYSTEM, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES('3', 'Orchard', '20', 'Apple', 'Loamy', 'Drip', '2', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FIELD (FIELD_ID, FIELD_NAME, FIELD_SIZE, CROP_TYPE, SOIL_TYPE, IRRIGATION_SYSTEM, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES('4', 'Corn Field', '40', 'Corn', 'Sandy', 'Pivot', '4', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FIELD (FIELD_ID, FIELD_NAME, FIELD_SIZE, CROP_TYPE, SOIL_TYPE, IRRIGATION_SYSTEM, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES('5', 'Meadow', '25', 'Clover', 'Clay', 'None', '5', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FIELD (FIELD_ID, FIELD_NAME, FIELD_SIZE, CROP_TYPE, SOIL_TYPE, IRRIGATION_SYSTEM, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES('6', 'Vineyard', '35', 'Grapes', 'Loamy', 'Drip', '2', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FIELD (FIELD_ID, FIELD_NAME, FIELD_SIZE, CROP_TYPE, SOIL_TYPE, IRRIGATION_SYSTEM, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES('7', 'Pumpkin Patch', '15', 'Pumpkin', 'Sandy', 'Sprinkler', '7', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FIELD (FIELD_ID, FIELD_NAME, FIELD_SIZE, CROP_TYPE, SOIL_TYPE, IRRIGATION_SYSTEM, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES('8', 'Pasture', '28', 'Grass', 'Loamy', 'None', '8', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FIELD (FIELD_ID, FIELD_NAME, FIELD_SIZE, CROP_TYPE, SOIL_TYPE, IRRIGATION_SYSTEM, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES('9', 'Sunflower Field', '45', 'Sunflower', 'Sandy', 'Sprinkler', '9', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO FIELD (FIELD_ID, FIELD_NAME, FIELD_SIZE, CROP_TYPE, SOIL_TYPE, IRRIGATION_SYSTEM, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES('10', 'Potato field', '32', 'Potato', 'Clay', 'Pivot', '10', 'OLAMIDE LUKE', DATE '2024-03-26');

--SAMPLE DATA FOR CROP TABLE

INSERT INTO CROP (CROPID, CROP_NAME, VARIETY, PLANTING_DATE, HARVEST_DATE, YIELD, FIELDID_FK, CREATED_BY, DATE_CREATED)

VALUES(1,'Wheat', 'Red', DATE '2024-03-15', DATE '2024-06-20', '500', '1', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO CROP (CROPID, CROP_NAME, VARIETY, PLANTING_DATE, HARVEST_DATE, YIELD, FIELDID_FK, CREATED_BY, DATE_CREATED)

VALUES(2, 'Apples', 'Fuji', DATE '2024-04-01', DATE '2024-09-30', '1000', '3', 'OLAMIDE LUKE', DATE '2024-03-26');

```
INSERT INTO CROP (CROPID, CROP_NAME, VARIETY, PLANTING_DATE,
HARVEST_DATE, YIELD, FIELDID_FK, CREATED_BY, DATE_CREATED)
VALUES(3, 'Corn', 'Yellow', DATE '2024-04-10', DATE '2024-09-15', '700', '4', 'OLAMIDE LUKE',
DATE '2024-03-26');
INSERT INTO CROP (CROPID, CROP_NAME, VARIETY, PLANTING_DATE,
HARVEST_DATE, YIELD, FIELDID_FK, CREATED_BY, DATE_CREATED)
VALUES(4, 'Clover', 'White', DATE '2024-03-20', DATE '2024-08-25', '300', '5', 'OLAMIDE
LUKE', DATE '2024-03-26');
INSERT INTO CROP (CROPID, CROP_NAME, VARIETY, PLANTING_DATE,
HARVEST_DATE, YIELD, FIELDID_FK, CREATED_BY, DATE_CREATED)
VALUES(5, 'Grapes', 'Merlot', DATE '2024-04-05', DATE '2024-10-10', '600', '6', 'OLAMIDE
LUKE', DATE '2024-03-26');
INSERT INTO CROP (CROPID, CROP_NAME, VARIETY, PLANTING_DATE,
HARVEST_DATE, YIELD, FIELDID_FK, CREATED_BY, DATE_CREATED)
VALUES(6, 'Pumpkin', 'Jack-O-Lantern', DATE '2024-05-01', DATE '2024-10-31', '400', '7',
'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO CROP (CROPID, CROP_NAME, VARIETY, PLANTING_DATE,
HARVEST_DATE, YIELD, FIELDID_FK, CREATED_BY, DATE_CREATED)
VALUES(7, 'Clover', 'Red', DATE '2024-09-20', DATE '2024-10-31', '250', '5', 'OLAMIDE LUKE',
DATE '2024-03-26');
INSERT INTO CROP (CROPID, CROP_NAME, VARIETY, PLANTING_DATE,
HARVEST_DATE, YIELD, FIELDID_FK, CREATED_BY, DATE_CREATED)
VALUES(8, 'Sunflower', 'Sunbright', DATE '2024-04-20', DATE '2024-09-25', '450', '9',
'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO CROP (CROPID, CROP_NAME, VARIETY, PLANTING_DATE,
HARVEST_DATE, YIELD, FIELDID_FK, CREATED_BY, DATE_CREATED)
VALUES(9, 'Potato', 'Russet', DATE '2024-05-10', DATE '2024-10-15', '350', '10', 'OLAMIDE
LUKE', DATE '2024-03-26');
INSERT INTO CROP (CROPID, CROP_NAME, VARIETY, PLANTING_DATE,
HARVEST_DATE, YIELD, FIELDID_FK, CREATED_BY, DATE_CREATED)
VALUES(10, 'Wheat', 'White', DATE '2024-03-10', DATE '2024-06-15', '550', '1', 'OLAMIDE
LUKE', DATE '2024-03-26');

--SAMPLE DATA FOR LIVESTOCK TABLE
INSERT INTO LIVESTOCK (LIVESTOCKID, LIVESTOCK_TYPE, BREED, AGE,
HEALTH_STATUS, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(1, 'Sheep', 'Merino', 2'', 'Vaccinated', '3', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO LIVESTOCK (LIVESTOCKID, LIVESTOCK_TYPE, BREED, AGE,
HEALTH_STATUS, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(2, 'Swine', 'Duroc', '1', 'Unvaccinated', '1', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO LIVESTOCK (LIVESTOCKID, LIVESTOCK_TYPE, BREED, AGE,
HEALTH_STATUS, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(3, 'Poultry', 'Leghorn', '1', 'Vaccinated', '2', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO LIVESTOCK (LIVESTOCKID, LIVESTOCK_TYPE, BREED, AGE,
HEALTH_STATUS, FARMID_FK, CREATED_BY, DATE_CREATED)
```

```
VALUES(4, 'Cattle', 'Angus', '3', 'Vaccinated', '4', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO LIVESTOCK (LIVESTOCKID, LIVESTOCK_TYPE, BREED, AGE,
HEALTH_STATUS, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(5, 'Sheep', 'Suffolk', '2', 'Vaccinated','5', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO LIVESTOCK (LIVESTOCKID, LIVESTOCK_TYPE, BREED, AGE,
HEALTH_STATUS, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(6, 'Swine', 'Hampshire', '1', 'Unvaccinated','6', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO LIVESTOCK (LIVESTOCKID, LIVESTOCK_TYPE, BREED, AGE,
HEALTH_STATUS, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(7, 'Poultry', 'Rhode Island Red', '1', 'Vaccinated', '7', 'OLAMIDE LUKE', DATE '2024-
03-26');
INSERT INTO LIVESTOCK (LIVESTOCKID, LIVESTOCK_TYPE, BREED, AGE,
HEALTH_STATUS, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(8, 'Cattle', 'Hereford', '2', 'Vaccinated', '8', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO LIVESTOCK (LIVESTOCKID, LIVESTOCK_TYPE, BREED, AGE,
HEALTH_STATUS, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(9, 'Sheep', 'Dorper', '3', 'Vaccinated', '9', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO LIVESTOCK (LIVESTOCKID, LIVESTOCK_TYPE, BREED, AGE,
HEALTH_STATUS, FARMID_FK, CREATED_BY, DATE_CREATED )
VALUES(10, 'Swine', 'Berkshire', '1', 'Unvaccinated','10', 'OLAMIDE LUKE', DATE '2024-03-26');

--SAMPLE DATA FOR EMPLOYEE TABLE
INSERT INTO EMPLOYEE (EMPLOYEEID, EMPLOYEE_NAME, ROLE, DOB,
PHONENUMBER, ADDRESS, WAGES, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(1, 'John Smith', 'Farm Manager', DATE '1980-05-20', '1234567890', '456 Farm Rd',
'50000', '1', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO EMPLOYEE (EMPLOYEEID, EMPLOYEE_NAME, ROLE, DOB,
PHONENUMBER, ADDRESS, WAGES, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(2, 'Emily Brown', 'Laborer', DATE '1995-10-15', '9876543210', '789 Ranch Ave',
'30000', '3', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO EMPLOYEE (EMPLOYEEID, EMPLOYEE_NAME, ROLE, DOB,
PHONENUMBER, ADDRESS, WAGES, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(3, 'Michael Green', 'Horticulturist', DATE '1988-03-10', '4567891230', '101 Orchard
Lane', '45000', '2', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO EMPLOYEE (EMPLOYEEID, EMPLOYEE_NAME, ROLE, DOB,
PHONENUMBER, ADDRESS, WAGES, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(4, 'Sarah Johnson', 'Veterinarian', DATE '1985-08-28', '3216549870', '321 Vet Blvd',
'60000', '4', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO EMPLOYEE (EMPLOYEEID, EMPLOYEE_NAME, ROLE, DOB,
PHONENUMBER, ADDRESS, WAGES, FARMID_FK, CREATED_BY, DATE_CREATED)
VALUES(5, 'David Lee', 'Ranch Hand', DATE '1990-12-03', '7891234560', '567 Ranch Rd',
'35000', '5', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO EMPLOYEE (EMPLOYEEID, EMPLOYEE_NAME, ROLE, DOB,
PHONENUMBER, ADDRESS, WAGES, FARMID_FK, CREATED_BY, DATE_CREATED)
```

VALUES(6, 'Jessica White', 'Field Worker', DATE '1992-07-17', '6543217890', '890 Field Ave', '32000', '6', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO EMPLOYEE (EMPLOYEEID, EMPLOYEE_NAME, ROLE, DOB, PHONENUMBER, ADDRESS, WAGES, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES(7, 'Matthew Taylor', 'Poultry Keeper', DATE '1987-04-22', '9871234560', '432 Coop Rd', '38000', '7', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO EMPLOYEE (EMPLOYEEID, EMPLOYEE_NAME, ROLE, DOB, PHONENUMBER, ADDRESS, WAGES, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES(8, 'Olivia Clark', 'Cattle Rancher', DATE '1983-11-12', '1237894560', '789 Pasture Ave', '55000', '8', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO EMPLOYEE (EMPLOYEEID, EMPLOYEE_NAME, ROLE, DOB, PHONENUMBER, ADDRESS, WAGES, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES(9, 'Ryan Wilson', 'Shepherd', DATE '1993-09-08', '4561237890', '654 Sheep Ln', '33000', '9', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO EMPLOYEE (EMPLOYEEID, EMPLOYEE_NAME, ROLE, DOB, PHONENUMBER, ADDRESS, WAGES, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES(10,'Emma Garcia', 'Swine Keeper', DATE '1991-06-25', '7894561230', '321 Piglet Rd', '36000', '10', 'OLAMIDE LUKE', DATE '2024-03-26');

--SAMPLE DATA FOR EQUIPMENT TABLE

INSERT INTO EQUIPMENT (EQUIPMENTID, EQUIPMENT_TYPE, SERIAL_NUMBER, CONDITION, MAINTENANCE_DATE, ASSIGNED_OPERATOR, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES(1, 'Tractor', 'TRAC123', 'Operable', DATE '2024-01-10', 'John Smith', '1', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO EQUIPMENT (EQUIPMENTID, EQUIPMENT_TYPE, SERIAL_NUMBER, CONDITION, MAINTENANCE_DATE, ASSIGNED_OPERATOR, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES(2, 'Plough', 'PLOU456', 'Inoperable', DATE '2024-02-05', 'Emily Brown', '3', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO EQUIPMENT (EQUIPMENTID, EQUIPMENT_TYPE, SERIAL_NUMBER, CONDITION, MAINTENANCE_DATE, ASSIGNED_OPERATOR, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES(3, 'Harvester', 'HARV789', 'Operable', DATE '2024-03-20', 'Michael Green', '2', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO EQUIPMENT (EQUIPMENTID, EQUIPMENT_TYPE, SERIAL_NUMBER, CONDITION, MAINTENANCE_DATE, ASSIGNED_OPERATOR, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES(4, 'Seeder', 'SEED789', 'Operable', DATE '2024-02-15', 'Sarah Johnson', '4', 'OLAMIDE LUKE', DATE '2024-03-26');

INSERT INTO EQUIPMENT (EQUIPMENTID, EQUIPMENT_TYPE, SERIAL_NUMBER, CONDITION, MAINTENANCE_DATE, ASSIGNED_OPERATOR, FARMID_FK, CREATED_BY, DATE_CREATED)

VALUES(5, 'Sprinkler', 'SPRK654', 'Operable', DATE '2024-04-05', 'David Lee', '5', 'OLAMIDE LUKE', DATE '2024-03-26');

```
INSERT INTO EQUIPMENT (EQUIPMENTID, EQUIPMENT_TYPE, SERIAL_NUMBER,
CONDITION, MAINTENANCE_DATE, ASSIGNED_OPERATOR, FARMID_FK, CREATED_BY,
DATE_CREATED)
VALUES(6, 'Fence Plower', 'FPLW321', 'Inoperable', DATE '2024-03-10', 'Jessica White', '6',
'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO EQUIPMENT (EQUIPMENTID, EQUIPMENT_TYPE, SERIAL_NUMBER,
CONDITION, MAINTENANCE_DATE, ASSIGNED_OPERATOR, FARMID_FK, CREATED_BY,
DATE_CREATED)
VALUES(7, 'Milking Machine', 'MILK987', 'Operable', DATE '2024-05-15', 'Matthew Taylor', '7',
'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO EQUIPMENT (EQUIPMENTID, EQUIPMENT_TYPE, SERIAL_NUMBER,
CONDITION, MAINTENANCE_DATE, ASSIGNED_OPERATOR, FARMID_FK, CREATED_BY,
DATE_CREATED)
VALUES(8, 'Feeder', 'FEED456', 'Operable', DATE '2024-03-25', 'Olivia Clark', '8', 'OLAMIDE
LUKE', DATE '2024-03-26');
INSERT INTO EQUIPMENT (EQUIPMENTID, EQUIPMENT_TYPE, SERIAL_NUMBER,
CONDITION, MAINTENANCE_DATE, ASSIGNED_OPERATOR, FARMID_FK, CREATED_BY,
DATE_CREATED)
VALUES(9, 'Shearing Machine', 'SHEAR789', 'Inoperable', DATE '2024-04-20', 'Ryan Wilson',
'9', 'OLAMIDE LUKE', DATE '2024-03-26');
INSERT INTO EQUIPMENT (EQUIPMENTID, EQUIPMENT_TYPE, SERIAL_NUMBER,
CONDITION, MAINTENANCE_DATE, ASSIGNED_OPERATOR, FARMID_FK, CREATED_BY,
DATE_CREATED)
VALUES(10, 'Incubator', 'INCB123', 'Operable', DATE '2024-02-28', 'Emma Garcia', '10',
'OLAMIDE LUKE', DATE '2024-03-26');
COMMIT;
```

--20 query statements

```
-- Query 1: select all columns and all rows from one table
-- Business purpose: this query selects all information about the field table.
SELECT * FROM FIELD;
```

	FIELD_ID	FIELD_NAME	FIELD_SIZE	CROP_TYPE	SOIL_TYPE	IRRIGATION_SYSTEM	FARMID_FK	CREATED_BY	DATE_CREATED	MODIFIED_BY	DATE_MODIFIED
1	1	WHEAT FIELD	50	Wheat	Clay	Sprinkler	1	OLAMIDE LUKE	26-MAR-24	(null)	(null)
2	2	Pasture	30	Grass	Sandy	None	3	OLAMIDE LUKE	26-MAR-24	(null)	(null)
3	3	Orchard	20	Apple	Loamy	Drip	2	OLAMIDE LUKE	26-MAR-24	(null)	(null)
4	4	Corn Field	40	Corn	Sandy	Pivot	4	OLAMIDE LUKE	26-MAR-24	(null)	(null)
5	5	Meadow	25	Clover	Clay	None	5	OLAMIDE LUKE	26-MAR-24	(null)	(null)
6	6	Vineyard	35	Grapes	Loamy	Drip	2	OLAMIDE LUKE	26-MAR-24	(null)	(null)
7	7	Pumpkin Patch	15	Pumpkin	Sandy	Sprinkler	7	OLAMIDE LUKE	26-MAR-24	(null)	(null)
8	8	Pasture	28	Grass	Loamy	None	8	OLAMIDE LUKE	26-MAR-24	(null)	(null)
9	9	Sunflower Field	45	Sunflower	Sandy	Sprinkler	9	OLAMIDE LUKE	26-MAR-24	(null)	(null)
10	10	Potato field	32	Potato	Clay	Pivot	10	OLAMIDE LUKE	26-MAR-24	(null)	(null)

```
--Query 2: Select five columns and all rows from one table
--Business purpose: this query selects  employee information from the employee table.
SELECT EMPLOYEEID, EMPLOYEE_NAME, ROLE, DOB, PHONENUMBER
FROM EMPLOYEE;
```

	EMPLOYEEID	EMPLOYEE_NAME	ROLE	DOB	PHONENUMBER
1	1	John Smith	Farm Manager	20-MAY-80	1234567890
2	2	Emily Brown	Laborer	15-OCT-95	9876543210
3	3	Michael Green	Horticulturist	10-MAR-88	4567891230
4	4	Sarah Johnson	Veterinarian	28-AUG-85	3216549870
5	5	David Lee	Ranch Hand	03-DEC-90	7891234560
6	6	Jessica White	Field Worker	17-JUL-92	6543217890
7	7	Matthew Taylor	Poultry Keeper	22-APR-87	9871234560
8	8	Olivia Clark	Cattle Rancher	12-NOV-83	1237894560
9	9	Ryan Wilson	Shepherd	08-SEP-93	4561237890
10	10	Emma Garcia	Swine Keeper	25-JUN-91	7894561230

--Query 3: Select all columns from all rows from one view

--Business purpose: This query selects information from the employeeequipment view.

SELECT * FROM EmployeeEquipment;

	EMPLOYEEID	EMPLOYEE_NAME	ROLE	EQUIPMENTID	EQUIPMENT_TYPE
1	1	John Smith	Farm Manager	1	Tractor
2	2	Emily Brown	Laborer	2	Plough
3	3	Michael Green	Horticulturist	3	Harvester
4	4	Sarah Johnson	Veterinarian	4	Seeder
5	5	David Lee	Ranch Hand	5	Sprinkler
6	6	Jessica White	Field Worker	6	Fence Plower
7	7	Matthew Taylor	Poultry Keeper	7	Milking Machine
8	8	Olivia Clark	Cattle Rancher	8	Feeder
9	9	Ryan Wilson	Shepherd	9	Shearing Machine
10	10	Emma Garcia	Swine Keeper	10	Incubator

--Query 4: Using a join on 2 tables, select all columns and all rows from the tables without the use of a Cartesian product

--Business purpose: This query joins the farm and field tables and retrieves the details.

SELECT * FROM FARM

INNER JOIN FIELD ON FARM.FARMID = FIELD.FARMID_FK;

FARMID	FARM_NAME	LOCATION	FARM_SIZE	WEBADDRESS	FARMING_TYPE	CREATED_BY	DATE_CREATED	MODIFIED_BY	DATE_MODIFIED	FIELD_ID	FIELD_NAME	FIELD_SIZE	CROP_TYPE	SOIL_TYPE	IRRIGATION_SYSTEM	FARMID_FK	CREATED_BY_1	DATE_CREATED_1	MODIFIED_BY_1	DATE_MODIFIED_1
1	EthosFarm	100 Main st,Town	100	www.Ethosfarm.com	Mixedfarming	OLAMIDE LUKE	26-MAR-24	(null)	(null)	1	WHEAT FIELD	50	Wheat	Clay	Sprinkler	1	OLAMIDE LUKE	26-MAR-24	(null)	(null)
2	Green Acres	456 Oak Ave, Village	75	www.greenacresfarm.com	Crop	OLAMIDE LUKE	26-MAR-24	(null)	(null)	3	Orchard	20	Apple	Loamy	Drip	2	OLAMIDE LUKE	26-MAR-24	(null)	(null)
2	Green Acres	456 Oak Ave, Village	75	www.greenacresfarm.com	Crop	OLAMIDE LUKE	26-MAR-24	(null)	(null)	6	Vineyard	35	Grapes	Loamy	Drip	2	OLAMIDE LUKE	26-MAR-24	(null)	(null)
3	Sunny Ranch	789 Sunflower Rd	150	www.sunnyranch.com	Livestock	OLAMIDE LUKE	26-MAR-24	(null)	(null)	2	Pasture	30	Grass	Sandy	None	3	OLAMIDE LUKE	26-MAR-24	(null)	(null)
4	Hilltop Farm	321 Hilltop Lane	120	www.hilltopfarm.com	Crop	OLAMIDE LUKE	26-MAR-24	(null)	(null)	4	Corn Field	40	Corn	Sandy	Pivot	4	OLAMIDE LUKE	26-MAR-24	(null)	(null)
5	Meadow View	567 Meadow Lane	90	www.meadowviewfarm.com	Livestock	OLAMIDE LUKE	26-MAR-24	(null)	(null)	5	Meadow	25	Clover	Clay	None	5	OLAMIDE LUKE	26-MAR-24	(null)	(null)
7	River Bend	432 River Rd	200	www.riverbendfarm.com	Crop	OLAMIDE LUKE	26-MAR-24	(null)	(null)	7	Pumpkin Patch	15	Pumpkin	Sandy	Sprinkler	7	OLAMIDE LUKE	26-MAR-24	(null)	(null)
8	Oak Forest	987 Oakwood Blvd	110	www.oakforestfarm.com	Livestock	OLAMIDE LUKE	26-MAR-24	(null)	(null)	8	Pasture	28	Grass	Loamy	None	8	OLAMIDE LUKE	26-MAR-24	(null)	(null)
9	Golden Fields	654 Sunflower Ave	180	www.goldenfields.com	Mixed Farming	OLAMIDE LUKE	26-MAR-24	(null)	(null)	9	Sunflower Field	45	Sunflower	Sandy	Sprinkler	9	OLAMIDE LUKE	26-MAR-24	(null)	(null)
10	Sunset Farm	789 Sunset Blvd	130	www.sunsetfarm.com	Crop	OLAMIDE LUKE	26-MAR-24	(null)	(null)	10	Potato field	32	Potato	Clay	Pivot	10	OLAMIDE LUKE	26-MAR-24	(null)	(null)

--Query 5: Select and order data retrieved from one table

--Business purpose: This query arranges data from the employee table.

```
SELECT * FROM EMPLOYEE
ORDER BY EMPLOYEE_NAME;
```

	EMPLOYEEID	EMPLOYEE_NAME	ROLE	DOB	PHONENUMBER	ADDRESS	WAGES	FARMID_FK	CREATED_BY	DATE_CREATED	MODIFIED_BY	DATE_MODIFIED
1	5	David Lee	Ranch Hand	03-DEC-90	7891234560	567 Ranch Rd	35000	5	OLAMIDE LUKE	26-MAR-24	(null)	(null)
2	2	Emily Brown	Laborer	15-OCT-95	9876543210	789 Ranch Ave	30000	3	OLAMIDE LUKE	26-MAR-24	(null)	(null)
3	10	Emma Garcia	Swine Keeper	25-JUN-91	7894561230	321 Piglet Rd	36000	10	OLAMIDE LUKE	26-MAR-24	(null)	(null)
4	6	Jessica White	Field Worker	17-JUL-92	6543217890	890 Field Ave	32000	6	OLAMIDE LUKE	26-MAR-24	(null)	(null)
5	1	John Smith	Farm Manager	20-MAY-80	1234567890	456 Farm Rd	50000	1	OLAMIDE LUKE	26-MAR-24	(null)	(null)
6	7	Matthew Taylor	Poultry Keeper	22-APR-87	9871234560	432 Coop Rd	38000	7	OLAMIDE LUKE	26-MAR-24	(null)	(null)
7	3	Michael Green	Horticulturist	10-MAR-88	4567891230	101 Orchard Lane	45000	2	OLAMIDE LUKE	26-MAR-24	(null)	(null)
8	8	Olivia Clark	Cattle Rancher	12-NOV-83	1237894560	789 Pasture Ave	55000	8	OLAMIDE LUKE	26-MAR-24	(null)	(null)
9	9	Ryan Wilson	Shepherd	08-SEP-93	4561237890	654 Sheep Ln	33000	9	OLAMIDE LUKE	26-MAR-24	(null)	(null)
10	4	Sarah Johnson	Veterinarian	28-AUG-85	3216549870	321 Vet Blvd	60000	4	OLAMIDE LUKE	26-MAR-24	(null)	(null)

--Query 6: Using a join on 3 tables, select 5 columns from the 3 tables. Use syntax that would limit the output to 10 rows

```
SELECT FARM_NAME, FIELD_NAME, EQUIPMENT_TYPE, EMPLOYEE_NAME, LIVESTOCK_TYPE
FROM (
   SELECT FARM.FARM_NAME, FIELD.FIELD_NAME, EQUIPMENT.EQUIPMENT_TYPE, EMPLOYEE.EMPLOYEE_NAME, LIVESTOCK.LIVESTOCK_TYPE,
        ROW_NUMBER() OVER (ORDER BY FARM.FARMID) AS row_num
   FROM FARM
   INNER JOIN FIELD ON FARM.FARMID = FIELD.FARMID_FK
   INNER JOIN EQUIPMENT ON FARM.FARMID = EQUIPMENT.FARMID_FK
   INNER JOIN EMPLOYEE ON FARM.FARMID = EMPLOYEE.FARMID_FK
   INNER JOIN LIVESTOCK ON FARM.FARMID = LIVESTOCK.FARMID_FK
)
WHERE row_num <= 10;
```

In this query:

	FARM_NAME	FIELD_NAME	EQUIPMENT_TYPE	EMPLOYEE_NAME	LIVESTOCK_TYPE
1	EthosFarm	WHEAT FIELD	Tractor	John Smith	Swine
2	Green Acres	Orchard	Harvester	Michael Green	Poultry
3	Green Acres	Vineyard	Harvester	Michael Green	Poultry
4	Sunny Ranch	Pasture	Plough	Emily Brown	Sheep
5	Hilltop Farm	Corn Field	Seeder	Sarah Johnson	Cattle
6	Meadow View	Meadow	Sprinkler	David Lee	Sheep
7	River Bend	Pumpkin Patch	Milking Machine	Matthew Taylor	Poultry
8	Oak Forest	Pasture	Feeder	Olivia Clark	Cattle
9	Golden Fields	Sunflower Field	Shearing Machine	Ryan Wilson	Sheep
10	Sunset Farm	Potato field	Incubator	Emma Garcia	Swine

--Query 7: Select distinct rows using joins on 3 tables
--Business purpose: This query joins the equipment, field and farm tables.

```
SELECT DISTINCT FARM.FARM_NAME, FIELD.FIELD_NAME,
EQUIPMENT.EQUIPMENT_TYPE
FROM FARM
INNER JOIN FIELD ON FARM.FARMID = FIELD.FARMID_FK
INNER JOIN EQUIPMENT ON FARM.FARMID = EQUIPMENT.FARMID_FK;
```

	FARM_NAME	FIELD_NAME	EQUIPMENT_TYPE
1	EthosFarm	WHEAT FIELD	Tractor
2	Green Acres	Orchard	Harvester
3	Hilltop Farm	Corn Field	Seeder
4	Sunny Ranch	Pasture	Plough
5	Meadow View	Meadow	Sprinkler
6	Golden Fields	Sunflower Field	Shearing Machine
7	Green Acres	Vineyard	Harvester
8	Oak Forest	Pasture	Feeder
9	River Bend	Pumpkin Patch	Milking Machine
10	Sunset Farm	Potato field	Incubator

--Query 8: Use GROUP BY and HAVING in a select statement using one or more tables
--Business purpose: This query obtains information on equipment inventory.

```
SELECT FARMID_FK, COUNT(*) AS Equipment_Count
FROM EQUIPMENT
GROUP BY FARMID_FK
HAVING COUNT(*) > 2;
```

--Query 9: Use IN clause to select data from one or more tables

--Business purpose: This query obtains the FARMID values for farms named "Sunny Ranch" or "Maple Grove" from the "FARM" table.

```
SELECT *
FROM FIELD
WHERE FARMID_FK IN (
   SELECT FARMID
   FROM FARM
   WHERE FARM_NAME IN ('Sunny Ranch', 'Maple Grove')
);
```

	FIELD_ID	FIELD_NAME	FIELD_SIZE	CROP_TYPE	SOIL_TYPE	IRRIGATION_SYSTEM	FARMID_FK	CREATED_BY	DATE_CREATED	MODIFIED_BY	DATE_MODIFIED
1	2	Pasture	30	Grass	Sandy	None	3	OLAMIDE LUKE	26-MAR-24	(null)	(null)

--Query 10: Select length of one column from one table (use LENGTH function)

--Business purpose: This query obtains the length of the field name attribute.

```
SELECT LENGTH(FIELD_NAME) AS Name_Length
FROM FIELD;
```

	NAME_LENGTH
1	11
2	7
3	7
4	10
5	6
6	8
7	13
8	7
9	15
10	12

/* Query 11: Delete one record from one table. Use select statements to demonstrate the table contents before and after the DELETE statement. Make sure you use ROLLBACK afterwards so that the data will not be physically removed. */

--Business purpose: This query deletes one Employee record from the "EMPLOYEE" table:

```
SELECT * FROM EMPLOYEE;
DELETE FROM EMPLOYEE
WHERE EMPLOYEEID = 1;
SELECT * FROM EMPLOYEE;
ROLLBACK;
```

	EMPLOYEEID	EMPLOYEE_NAME	ROLE	DOB	PHONENUMBER	ADDRESS	WAGES	FARMID_FK	CREATED_BY	DATE_CREATED	MODIFIED_BY	DATE_MODIFIED
1	1	John Smith	Farm Manager	20-MAY-80	1234567890	456 Farm Rd	50000	1	LAMIDE LUKE	26-MAR-24	(null)	(null)
2	2	Emily Brown	Laborer	15-OCT-95	9876543210	789 Ranch Ave	30000	3	LAMIDE LUKE	26-MAR-24	(null)	(null)
3	3	Michael Green	Horticulturist	10-MAR-88	4567891230	101 Orchard Lane	45000	2	LAMIDE LUKE	26-MAR-24	(null)	(null)
4	4	Sarah Johnson	Veterinarian	28-AUG-85	3216549870	321 Vet Blvd	60000	4	LAMIDE LUKE	26-MAR-24	(null)	(null)
5	5	David Lee	Ranch Hand	03-DEC-90	7891234560	567 Ranch Rd	35000	5	LAMIDE LUKE	26-MAR-24	(null)	(null)
6	6	Jessica White	Field Worker	17-JUL-92	6543217890	890 Field Ave	32000	6	LAMIDE LUKE	26-MAR-24	(null)	(null)
7	7	Matthew Taylor	Poultry Keeper	22-APR-87	9871234560	432 Coop Rd	38000	7	LAMIDE LUKE	26-MAR-24	(null)	(null)
8	8	Olivia Clark	Cattle Rancher	12-NOV-83	1237894560	789 Pasture Ave	55000	8	LAMIDE LUKE	26-MAR-24	(null)	(null)
9	9	Ryan Wilson	Shepherd	08-SEP-93	4561237890	654 Sheep Ln	33000	9	LAMIDE LUKE	26-MAR-24	(null)	(null)
10	10	Emma Garcia	Swine Keeper	25-JUN-91	7894561230	321 Piglet Rd	36000	10	LAMIDE LUKE	26-MAR-24	(null)	(null)

1 row deleted.

Script Output | Query Result

SQL | All Rows Fetched: 9 in 0.003 seconds

	EMPLOYEEID	EMPLOYEE_NAME	ROLE	DOB	PHONENUMBER	ADDRESS	WAGES	FARMID_FK	CREATED_BY	DATE_CREATED	MODIFIED_BY	DATE_MODIFIED
1	2	Emily Brown	Laborer	15-OCT-95	9876543210	789 Ranch Ave	30000	3	LAMIDE LUKE	26-MAR-24	(null)	(null)
2	3	Michael Green	Horticulturist	10-MAR-88	4567891230	101 Orchard Lane	45000	2	LAMIDE LUKE	26-MAR-24	(null)	(null)
3	4	Sarah Johnson	Veterinarian	28-AUG-85	3216549870	321 Vet Blvd	60000	4	LAMIDE LUKE	26-MAR-24	(null)	(null)
4	5	David Lee	Ranch Hand	03-DEC-90	7891234560	567 Ranch Rd	35000	5	LAMIDE LUKE	26-MAR-24	(null)	(null)
5	6	Jessica White	Field Worker	17-JUL-92	6543217890	890 Field Ave	32000	6	LAMIDE LUKE	26-MAR-24	(null)	(null)
6	7	Matthew Taylor	Poultry Keeper	22-APR-87	9871234560	432 Coop Rd	38000	7	LAMIDE LUKE	26-MAR-24	(null)	(null)
7	8	Olivia Clark	Cattle Rancher	12-NOV-83	1237894560	789 Pasture Ave	55000	8	LAMIDE LUKE	26-MAR-24	(null)	(null)
8	9	Ryan Wilson	Shepherd	08-SEP-93	4561237890	654 Sheep Ln	33000	9	LAMIDE LUKE	26-MAR-24	(null)	(null)
9	10	Emma Garcia	Swine Keeper	25-JUN-91	7894561230	321 Piglet Rd	36000	10	LAMIDE LUKE	26-MAR-24	(null)	(null)

Rollback complete.

/*Query 12: Update one record from one table. Use select statements to demonstrate the table contents before and after the UPDATE statement. Make sure you use ROLLBACK afterwards so that the data will not be physically removed */

--Business purpose: This query updates the condition of one record in the EMPLOYEE table.

```
SELECT * FROM EMPLOYEE;
UPDATE EMPLOYEE
SET WAGES = ‘50000’
WHERE EMPLOYEEID = 5;
SELECT * FROM EMPLOYEE;
ROLLBACK;
```

Script Output | Query Result | Query Result 1 | Query Result 2

SQL | All Rows Fetched: 10 in 0.006 seconds

	EMPLOYEEID	EMPLOYEE_NAME	ROLE	DOB	PHONENUMBER	ADDRESS	WAGES	FARMID_FK	CREATED_BY	DATE_CREATED	MODIFIED_BY	DATE_MODIFIED
1	1	John Smith	Farm Manager	20-MAY-80	1234567890	456 Farm Rd	50000	1	LAMIDE LUKE	26-MAR-24	(null)	(null)
2	2	Emily Brown	Laborer	15-OCT-95	9876543210	789 Ranch Ave	30000	3	LAMIDE LUKE	26-MAR-24	(null)	(null)
3	3	Michael Green	Horticulturist	10-MAR-88	4567891230	101 Orchard Lane	45000	2	LAMIDE LUKE	26-MAR-24	(null)	(null)
4	4	Sarah Johnson	Veterinarian	28-AUG-85	3216549870	321 Vet Blvd	60000	4	LAMIDE LUKE	26-MAR-24	(null)	(null)
5	5	David Lee	Ranch Hand	03-DEC-90	7891234560	567 Ranch Rd	35000	5	LAMIDE LUKE	26-MAR-24	(null)	(null)
6	6	Jessica White	Field Worker	17-JUL-92	6543217890	890 Field Ave	32000	6	LAMIDE LUKE	26-MAR-24	(null)	(null)
7	7	Matthew Taylor	Poultry Keeper	22-APR-87	9871234560	432 Coop Rd	38000	7	LAMIDE LUKE	26-MAR-24	(null)	(null)
8	8	Olivia Clark	Cattle Rancher	12-NOV-83	1237894560	789 Pasture Ave	55000	8	LAMIDE LUKE	26-MAR-24	(null)	(null)
9	9	Ryan Wilson	Shepherd	08-SEP-93	4561237890	654 Sheep Ln	33000	9	LAMIDE LUKE	26-MAR-24	(null)	(null)
10	10	Emma Garcia	Swine Keeper	25-JUN-91	7894561230	321 Piglet Rd	36000	10	LAMIDE LUKE	26-MAR-24	(null)	(null)

1 row updated.

Script Output | Query Result

SQL | All Rows Fetched: 10 in 0.003 seconds

	EMPLOYEEID	EMPLOYEE_NAME	ROLE	DOB	PHONENUMBER	ADDRESS	WAGES	FARMID_FK	CREATED_BY	DATE_CREATED	MODIFIED_BY	DATE_MODIFIED
1	1	John Smith	Farm Manager	20-MAY-80	1234567890	456 Farm Rd	50000	1	LAMIDE LUKE	26-MAR-24	(null)	(null)
2	2	Emily Brown	Laborer	15-OCT-95	9876543210	789 Ranch Ave	30000	3	LAMIDE LUKE	26-MAR-24	(null)	(null)
3	3	Michael Green	Horticulturist	10-MAR-88	4567891230	101 Orchard Lane	45000	2	LAMIDE LUKE	26-MAR-24	(null)	(null)
4	4	Sarah Johnson	Veterinarian	28-AUG-85	3216549870	321 Vet Blvd	60000	4	LAMIDE LUKE	26-MAR-24	(null)	(null)
5	5	David Lee	Ranch Hand	03-DEC-90	7891234560	567 Ranch Rd	50000	5	LAMIDE LUKE	26-MAR-24	(null)	(null)
6	6	Jessica White	Field Worker	17-JUL-92	6543217890	890 Field Ave	32000	6	LAMIDE LUKE	26-MAR-24	(null)	(null)
7	7	Matthew Taylor	Poultry Keeper	22-APR-87	9871234560	432 Coop Rd	38000	7	LAMIDE LUKE	26-MAR-24	(null)	(null)
8	8	Olivia Clark	Cattle Rancher	12-NOV-83	1237894560	789 Pasture Ave	55000	8	LAMIDE LUKE	26-MAR-24	(null)	(null)
9	9	Ryan Wilson	Shepherd	08-SEP-93	4561237890	654 Sheep Ln	33000	9	LAMIDE LUKE	26-MAR-24	(null)	(null)
10	10	Emma Garcia	Swine Keeper	25-JUN-91	7894561230	321 Piglet Rd	36000	10	LAMIDE LUKE	26-MAR-24	(null)	(null)

Rollback complete.

/*Query 13: This query uses JOIN operations for multiple tables to gather information from different parts of the database.

--Business purpose: The query obtains the employee name, the type of equipment they operate, the name and location of the farm where the equipment is used, and the name of the crop grown on each field of the farm.

```
SELECT EMPLOYEE.EMPLOYEE_NAME, EQUIPMENT.EQUIPMENT_TYPE,
FARM.FARM_NAME, FARM.LOCATION, CROP.CROP_NAME
FROM EMPLOYEE
JOIN EQUIPMENT ON EMPLOYEE.FARMID_FK = EQUIPMENT.FARMID_FK
JOIN FARM ON EQUIPMENT.FARMID_FK = FARM.FARMID
JOIN FIELD ON FIELD.FARMID_FK = FARM.FARMID
JOIN CROP ON CROP.FIELDID_FK = FIELD.FIELD_ID;
```

	EMPLOYEE_NAME	EQUIPMENT_TYPE	FARM_NAME	LOCATION	CROP_NAME
1	John Smith	Tractor	EthosFarm	100 Main st,Town	Wheat
2	John Smith	Tractor	EthosFarm	100 Main st,Town	Wheat
3	Michael Green	Harvester	Green Acres	456 Oak Ave, Village	Apples
4	Michael Green	Harvester	Green Acres	456 Oak Ave, Village	Grapes
5	Sarah Johnson	Seeder	Hilltop Farm	321 Hilltop Lane	Corn
6	David Lee	Sprinkler	Meadow View	567 Meadow Lane	Clover
7	David Lee	Sprinkler	Meadow View	567 Meadow Lane	Clover
8	Matthew Taylor	Milking Machine	River Bend	432 River Rd	Pumpkin
9	Ryan Wilson	Shearing Machine	Golden Fields	654 Sunflower Ave	Sunflower
10	Emma Garcia	Incubator	Sunset Farm	789 Sunset Blvd	Potato

/*Query 14: This query uses a subquery to find the maximum value within each group (in this case, each farm) and then filters the results based on that maximum value.*/

--Business purpose: This query is used to obtain the maximum wages of employees on each farm.

```
SELECT E1.EMPLOYEE_NAME, E1.WAGES, E1.FARMID_FK
FROM EMPLOYEE E1
WHERE E1.WAGES = (
   SELECT MAX(E2.WAGES)
   FROM EMPLOYEE E2
   WHERE E2.FARMID_FK = E1.FARMID_FK
```

Query Result

SQL | All Rows Fetched: 10 in 0.003 seconds

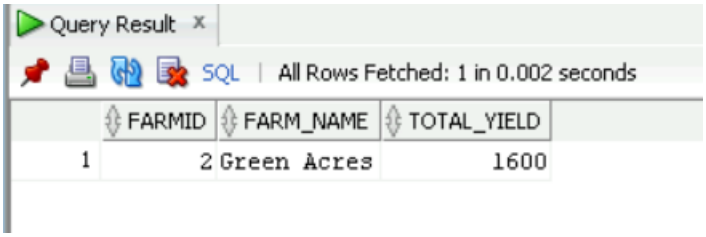
	EMPLOYEE_NAME	WAGES	FARMID_FK
1	Ryan Wilson	33000	9
2	Emma Garcia	36000	10
3	Sarah Johnson	60000	4
4	Jessica White	32000	6
5	John Smith	50000	1
6	David Lee	35000	5
7	Emily Brown	30000	3
8	Michael Green	45000	2
9	Matthew Taylor	38000	7
10	Olivia Clark	55000	8

/* Query 15: This query uses multiple joins and the group functions to select the farm with the highest total yield.*/

--Business purpose: Thus query obtains information on the farm with the highest total yield.

```
SELECT FARMID, FARM_NAME, TOTAL_YIELD
FROM (
```

```
    SELECT FARM.FARMID, FARM.FARM_NAME, SUM(CROP.YIELD) AS TOTAL_YIELD
    FROM FARM
    JOIN FIELD ON FARM.FARMID = FIELD.FARMID_FK
    JOIN CROP ON FIELD.FIELD_ID = CROP.FIELDID_FK
    GROUP BY FARM.FARMID, FARM.FARM_NAME
    ORDER BY TOTAL_YIELD DESC
) FarmTotal_Yield
WHERE ROWNUM = 1;
```



	FARMID	FARM_NAME	TOTAL_YIELD
1	2	Green Acres	1600

```
/*Query 16: This query selects farms where the equipment is inoperable and the maintenance date is in the past, using the join function.*/
--Business purpose: This query obtains information for the equipment that is overdue for maintenance.
SELECT F.FarmID, F.FarmName, E.Equipment_Type, E.Maintenance_Date
FROM Farm F
JOIN Equipment E ON F.FarmID = E.FarmID_FK
WHERE E.Condition = 'Inoperable' AND E.Maintenance_Date < SYSDATE;
```

	FARMID	FARM_NAME	EQUIPMENT_TYPE	MAINTENANCE_DATE
1	3	Sunny Ranch	Plough	05-FEB-24
2	6	Maple Grove	Fence Plower	10-MAR-24
3	9	Golden Fields	Shearing Machine	20-APR-24

```
/*Query 17: This query selects the age of livestock over the age of 1 using aggregate functions.
--Business purpose: This query obtains information on the age of livestock in the farm.
SELECT F.FarmID, F.Farm_Name
FROM Farm F
JOIN Livestock L ON F.FarmID = L.FarmID_FK
GROUP BY F.FarmID, F.Farm_Name
HAVING AVG(L.Age) > 1;
```

Query Result

SQL | All Rows Fetched: 5 in 0.006 seconds

	FARMID	FARM_NAME
1	9	Golden Fields
2	8	Oak Forest
3	4	Hilltop Farm
4	5	Meadow View
5	3	Sunny Ranch

/*Query 18: This query selects the field with the highest yield of wheat using the join and group functions.

--Business purpose: This query obtains information on the crop and the field producing the highest yield of the crop.

```
SELECT FD.Field_ID, FD.Field_Name, MAX(C.Yield) AS MaxWheatYield
FROM Field FD
JOIN Crop C ON FD.Field_ID = C.FieldID_FK
WHERE C.Crop_Name = 'Wheat'
GROUP BY FD.Field_ID, FD.Field_Name;
```

Query Result

SQL | All Rows Fetched: 1 in 0.011 seconds

	FIELD_ID	FIELD_NAME	MAXWHEATYIELD
1	1	WHEAT FIELD	550

/*Query 19: This query selects employees who are assigned to more than one farm using the count function.*/

--Business purpose: This query obtains information on employees assigned to work on multiple farms.

```
SELECT E.EmployeeID, E.EmployeeName, COUNT(DISTINCT E.FarmID_FK) AS NumAssignedFarms
FROM Employee E
GROUP BY E.EmployeeID, E.EmployeeName
HAVING COUNT(DISTINCT E.FarmID_FK) > 1;
```

Query Result

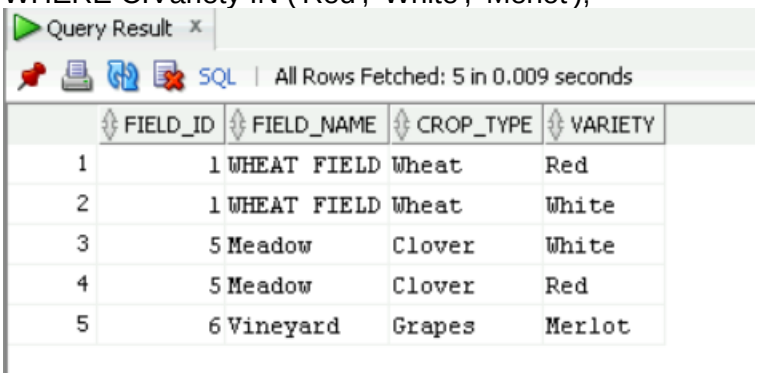
SQL | All Rows Fetched: 0 in 0.002 seconds

	EMPLOYE...	EMPLOYE...	NUMASSI...

/*Query 20: This query selects the variety of crops, "red", "white" and "merlot" joining the field and crop tables.*/

--Business purpose: This query identifies fields with specific varieties of crops.

```
SELECT FD.Field_ID, FD.Field_Name, C.Crop_Type, C.Variety
FROM Field FD
JOIN Crop C ON FD.Field_ID = C.FieldID_FK
WHERE C.Variety IN ('Red', 'White', 'Merlot');
```



	FIELD_ID	FIELD_NAME	CROP_TYPE	VARIETY
1	1	WHEAT FIELD	Wheat	Red
2	1	WHEAT FIELD	Wheat	White
3	5	Meadow	Clover	White
4	5	Meadow	Clover	Red
5	6	Vineyard	Grapes	Merlot

9. Database Administration and Monitoring

9.1 Roles and Responsibilities

Database Administrator (DBA): Will be responsible for database design, implementation, maintenance, performance tuning, backup and recovery, and security management.

System Administrator: The personnel will be responsible for managing hardware, operating system configurations, network infrastructure, and ensuring the availability and reliability of the database server.

Security Administrator: Responsible for implementing and maintaining access controls, encryption, and other security measures to protect the confidentiality, integrity, and availability of the data.

9.2 System Information

Hardware

- HP Laptop Windows 11 Version 22H2

9.2.1 Database Management System Configuration

Software

- Oracle SQL Developer
- Oracle VM VirtualBox 6.1
- Oracle Database 19c

9.2.2 Database Support Software

9.2.3 Security and Privacy

Role-Based Access Control (RBAC): Role-based access control will be implemented to restrict access to sensitive data based on users' roles and responsibilities within the organization. Roles such as "Administrator," "Employee," and "Guest," will be created in the system with corresponding privileges.

Encryption: Encryption techniques to safeguard sensitive data both at rest and in transit will be implemented. Encryption algorithms such as AES (Advanced Encryption Standard) for data protection will be embedded into the database management system.

9.3 Performance Monitoring and Database Efficiency

9.3.1 Operational Implications

Daily Data Refresh: Each day, data from sensors monitoring crop growth and livestock health will be transferred from field devices to the central farm database system. This data refresh ensures that the database contains up-to-date information on crop conditions and livestock status.

Security Considerations: Data transfer will be encrypted using SSL/TLS protocols to protect sensitive information from interception during transit.

9.3.2 Data Transfer Requirements

Content: Data transferred will include sensor readings for temperature, humidity, soil moisture, and livestock health metrics.

Format: Data will be transferred in JSON format to facilitate easy parsing and integration with the farm database system.

Sequence: Data transfer will occur in batches, with each batch containing readings from a specific time interval (e.g., hourly or daily).

9.3.3 Data Formats

The farm database system will accept JSON-formatted sensor data and parse it into corresponding database tables.

9.4 Backup and Recovery

Daily Incremental Backups: Incremental backups of the farm database will be performed daily to capture changes made since the last full backup.

Weekly Full Backups: Weekly full backups will be conducted to ensure comprehensive data recovery capabilities.

Recovery: A centralized backup catalog will be maintained to track backup sets, the details, and retention policies.

Appendix A: Suggested Appendices

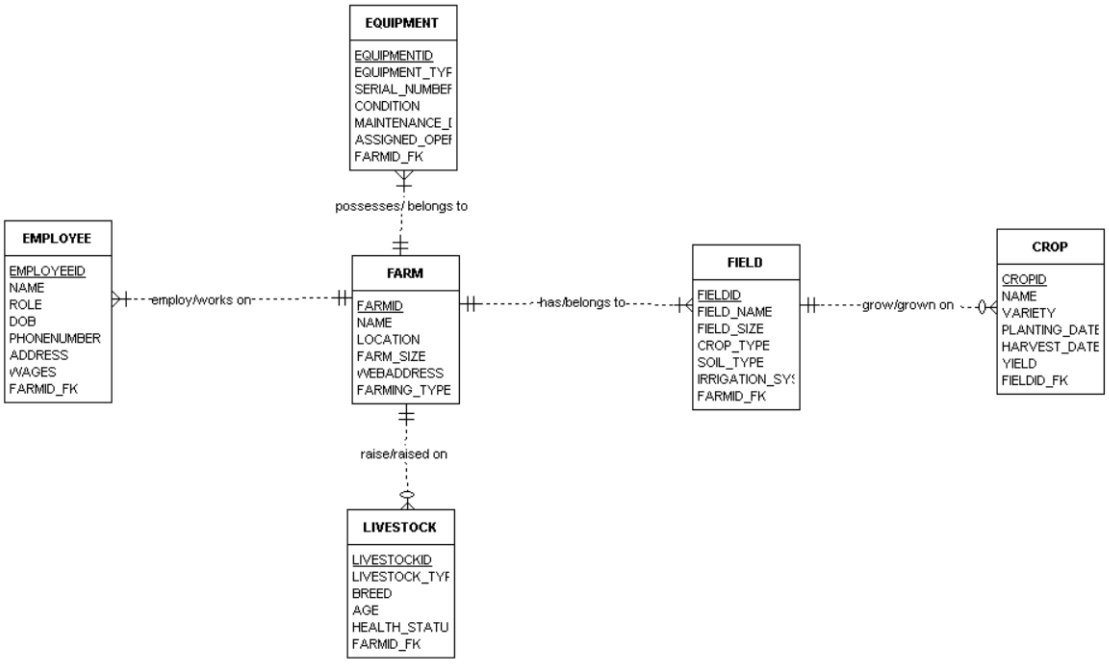


Figure 1. ERD for the Farm Database System

Appendix B: Acronyms

Table 2 - Acronyms

Acronym	Literal Translation

Appendix C: Glossary

Instructions: Provide clear and concise definitions for terms used in this document that may be unfamiliar to readers of the document. Terms are to be listed in alphabetical order.

Table 3 - Glossary

Term	Acronym	Definition

Appendix D: Additional Appendices