



AGROSPHERE

SEEDS OF CHANGE: TRANSFORMING GLOBAL
FOOD SYSTEMS FROM FARM TO FORK

Seeds of Change: Transforming Global Food Systems from Farm to Fork

Database Management System Project

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Abstract:

The global food system faces critical challenges including climate change, food insecurity, and unsustainable practices. Seeds of Change introduces an innovative SQL-based database system that reimagines the food value chain—from production and distribution to consumption and waste.



By emphasizing sustainability, traceability, and smart resource management, this project fosters regenerative agriculture, local consumption, and food equity. It highlights how data-driven solutions can empower farmers, reduce loss, and support global food security goals.

KEYWORDS & CORE CONCEPTS

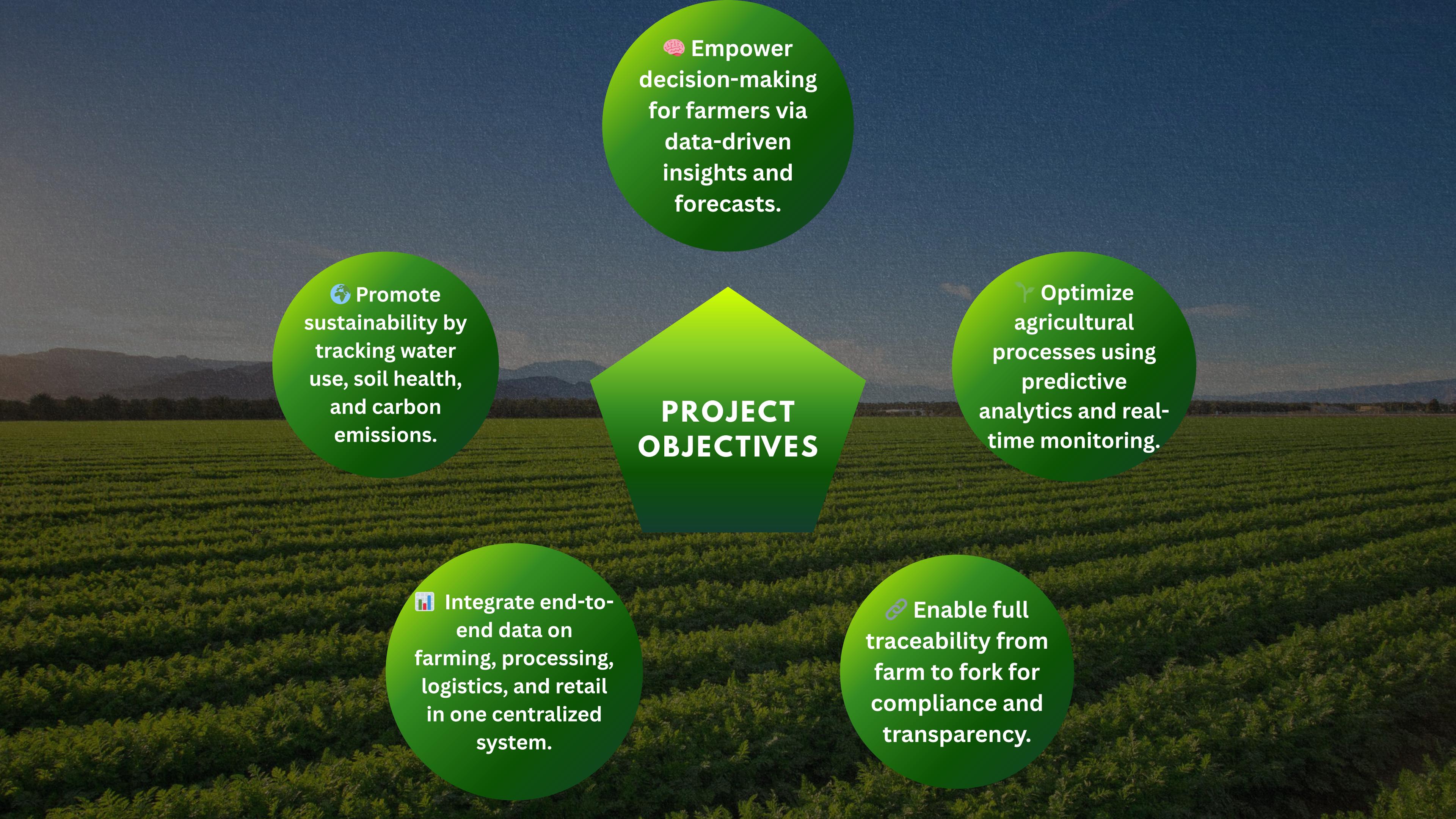
- Smart Agriculture
- Crop Yield Prediction
- Soil Health Monitoring
- Water Usage Optimization
- Traceability System
- SQL Database Design
- Farm Management System
- Carbon Footprint Tracking
- Sustainable Farming
- Food Supply Chain Optimization
- Agricultural Data Analytics
- Regenerative Agriculture



Problem Statement



Today's global food system is under pressure from growing populations, climate change, resource scarcity, and inefficient farming practices. These challenges lead to food insecurity, environmental degradation, and economic inequalities. Traditional agricultural methods often fail to meet modern sustainability demands. There's a pressing need for an integrated, data-driven approach that optimizes productivity, enhances traceability, and supports decision-making to build a resilient and equitable food ecosystem.



 Empower decision-making for farmers via data-driven insights and forecasts.

 Promote sustainability by tracking water use, soil health, and carbon emissions.

PROJECT OBJECTIVES

 Integrate end-to-end data on farming, processing, logistics, and retail in one centralized system.

 Enable full traceability from farm to fork for compliance and transparency.

 Optimize agricultural processes using predictive analytics and real-time monitoring.

Scope of the Project

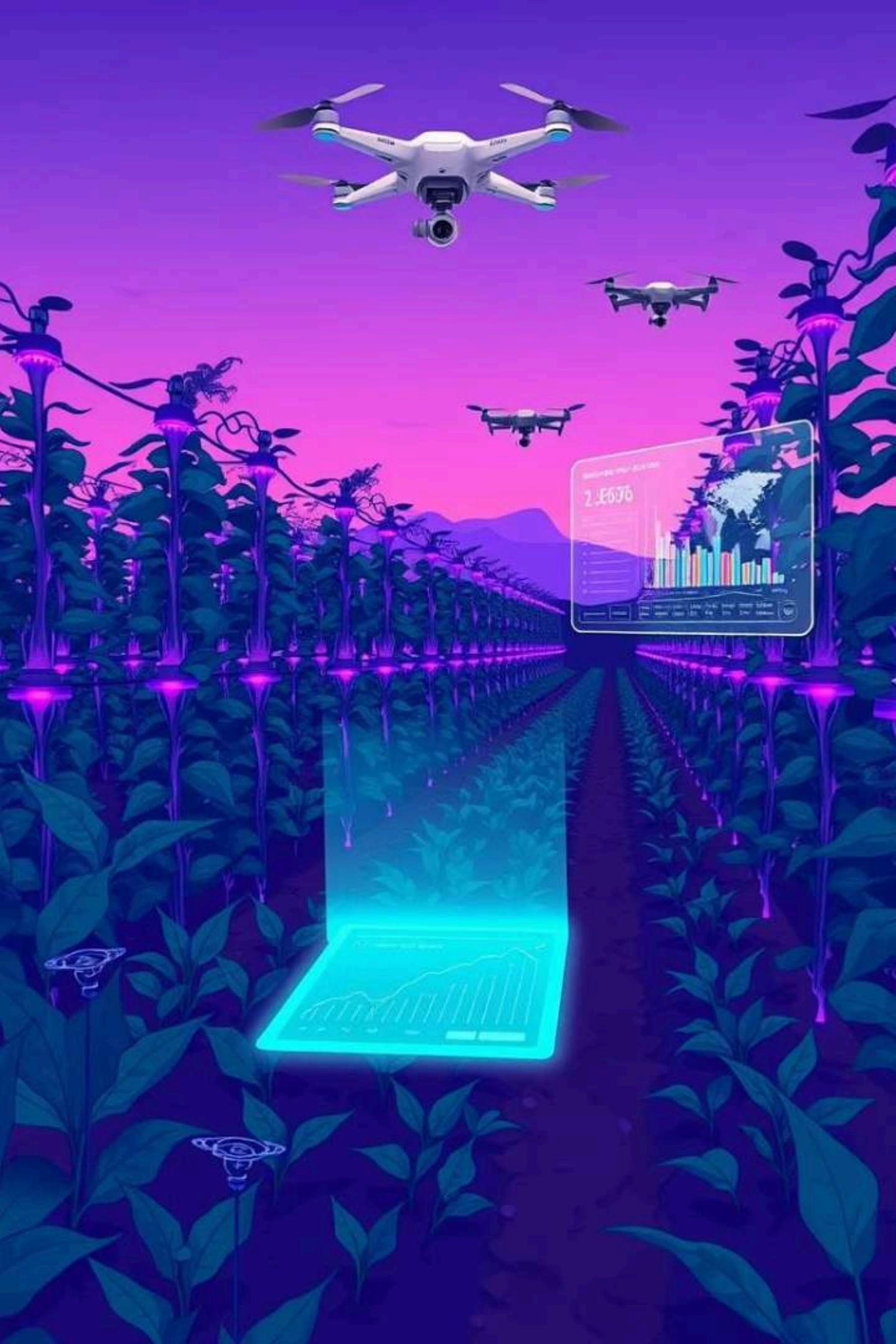
- 👤 Farmers – Crop planning, yield prediction, and soil health monitoring
- 🌾 Farm Operations – Irrigation, pesticide usage, and harvesting records
- 🏭 Processing Units – Certification management and food safety compliance
- 🚚 Distribution & Logistics – Storage tracking and shipment traceability
- 🛒 Retail Outlets – Sales data and product lifecycle visibility





Our Contributions

- 🕒 Designed 15 interrelated SQL tables covering everything from farms to retail
- 📈 Introduced predictive features like crop yield forecasting and market price estimation
- 🌿 Embedded sustainability metrics including carbon footprint and soil health scoring
- 🔍 Built-in end-to-end traceability from farm to retail for transparency and compliance
- 📅 Added food safety certification tracking for processing and retail units
- 🚜 Enabled a farm-to-fork model with optimized logistics and reduced waste



Tech Stack & Tools Used



SQL Database

Core relational database for schema design and query execution



Predictive Analytics

Features predictive analytics for better planning.



Data Synthesis Tools

Created over 10,000 records across 15 tables



Traceability

End-to-end traceability of products.



Sustainability

Sustainability metrics for environmental impact.



Database Design Philosophy

- 🔗 **Normalization & Integrity** – Structured tables with strong relationships
- 🧩 **Modularity** – Specific tables for crops, livestock, weather, and more
- 🔍 **Scalability** – Ready to grow with future feature additions
- 📈 **Analytics Ready** – Supports complex queries and decision tools
- 🧠 **Decision Support** – Powers smart farming tools and dashboards

Entity-Relationship (ER) Diagram

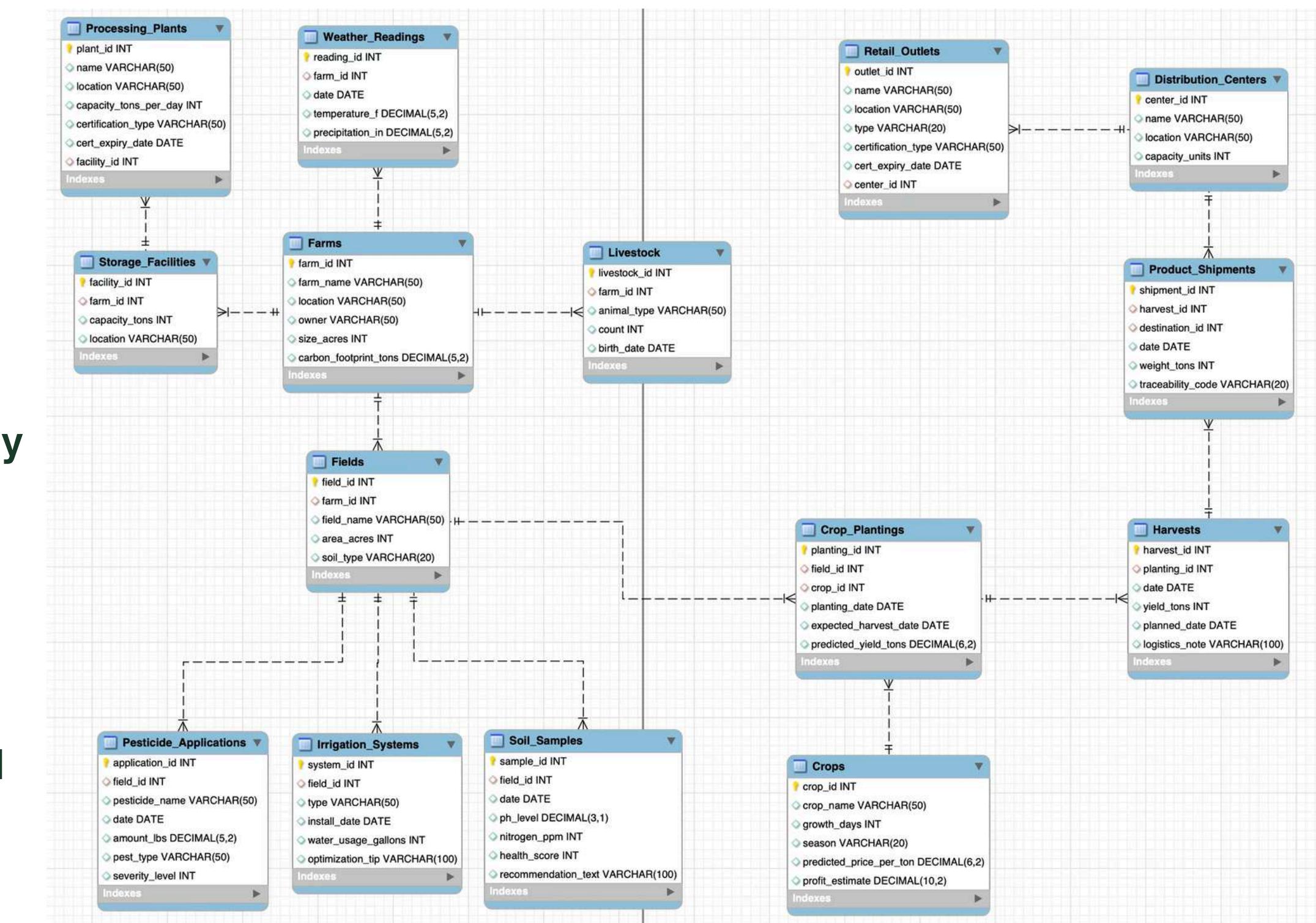
📌 15 interconnected entities including Farms, Crops, Fields, Irrigation, etc.

🔗 Relationships ensure integrity and traceability across the system

🔍 Foreign key mapping connects harvests to retail and beyond

📦 Logistics and traceability tracked end-to-end

📊 Predictive features like yield and profit supported via SQL design



TABLES OVERVIEW (PART 1)

CORE TABLES

FARMS

**Stores location,
ownership, and
carbon
footprint data.**

FIELDS

**Linked to farms;
contains size,
soil type, and
coordinates.**

CROPS

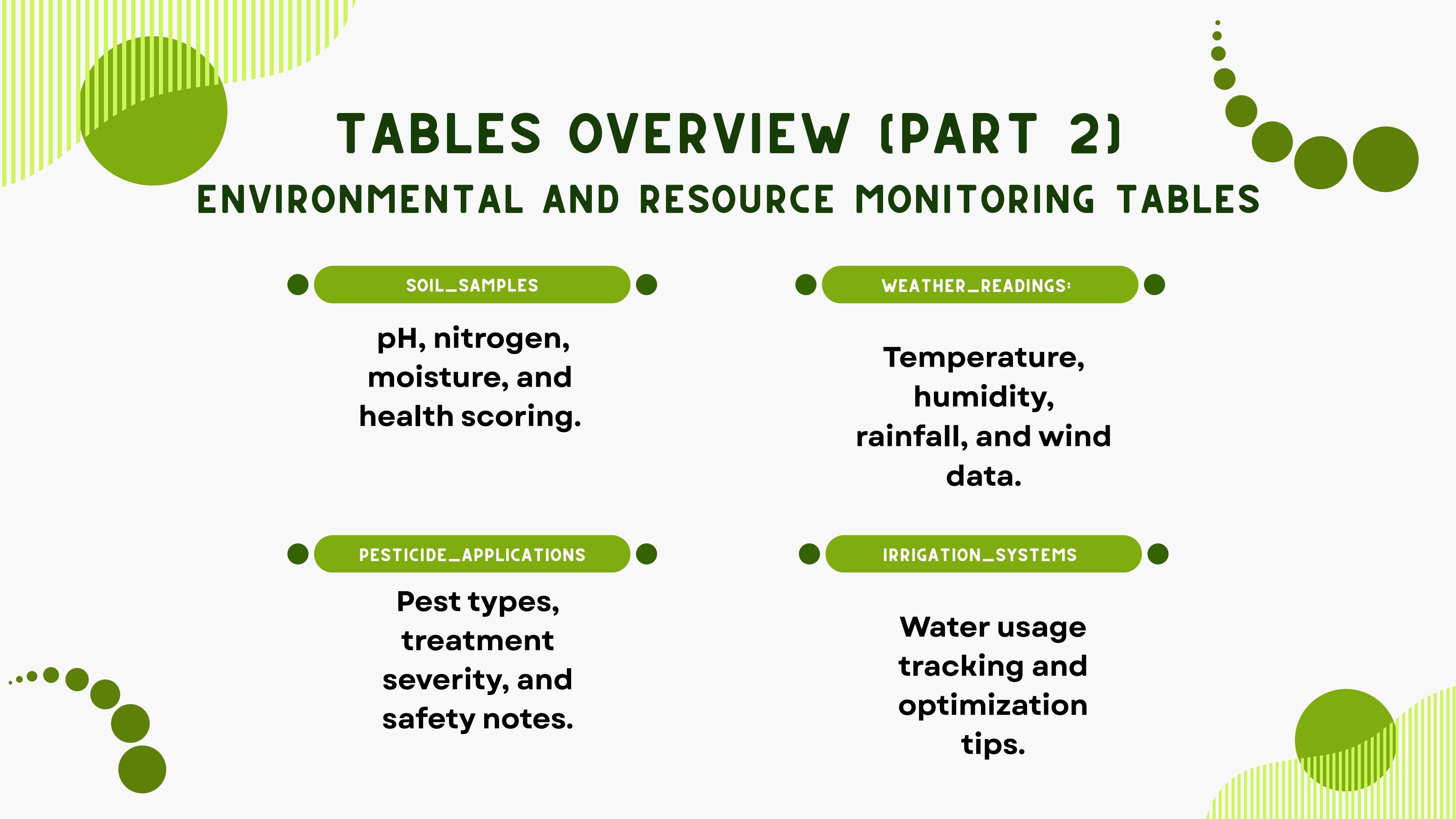
**Includes type,
season, and
market details.**

CROP_PLANTINGS

**Forecast yield,
estimated profit,
planting/harvest
schedules.**

LIVESTOCK

**Manages
animals on the
farm – type,
count, health,
and age.**



TABLES OVERVIEW (PART 2)

ENVIRONMENTAL AND RESOURCE MONITORING TABLES

SOIL_SAMPLES

pH, nitrogen, moisture, and health scoring.

WEATHER_READINGS:

Temperature, humidity, rainfall, and wind data.

PESTICIDE_APPLICATIONS

Pest types, treatment severity, and safety notes.

IRRIGATION_SYSTEMS

Water usage tracking and optimization tips.

TABLES OVERVIEW (PART 3)

LOGISTICS, PROCESSING, AND RETAIL TABLES

HARVESTS

Links crops and fields to actual yield and dates.

STORAGE_FACILITIES

Tracks stored crops with capacity and temperature.

PROCESSING_PLANTS

Manages food safety certification and product handling

DISTRIBUTION_CENTERS

Handles shipment logistics and volume.

RETAIL_OUTLETS

Monitors sales, food safety, and certification expiry.

Traceability from Farm to Fork

System-Driven Transparency

Crop tracked from planting → harvesting → storage → processing → shipping → retail

Traceability_Code ensures chain-of-custody integrity

Helps meet regulatory compliance and consumer demand for food origin

Enables audits, product recalls, and data-driven trust in the food supply



Sustainability Metrics



Built-In Eco Intelligence

🌿 **Carbon Tracking:**
Measured at the farm level
(tons of CO₂e).

💧 **Water Monitoring:**
Tracks gallons used and flags
inefficiencies.

🧪 **Soil Health:**
pH, nitrogen levels, health_score
recommendations.

📊 **Waste Reduction:**
Monitors post-harvest losses and
spoilage.



Predictive Analytics Features

Smart Forecasting in Agriculture

📊 Yield Prediction: Estimates tons per crop using weather, soil, and history

💰 Market Price Forecasting: Predicted_price_per_ton for better profit planning

💰 Profit Estimates: Combines cost, yield, and price data

🧠 Field Intelligence: Analytics detect underperforming zones for remediation

FOOD SAFETY & COMPLIANCE

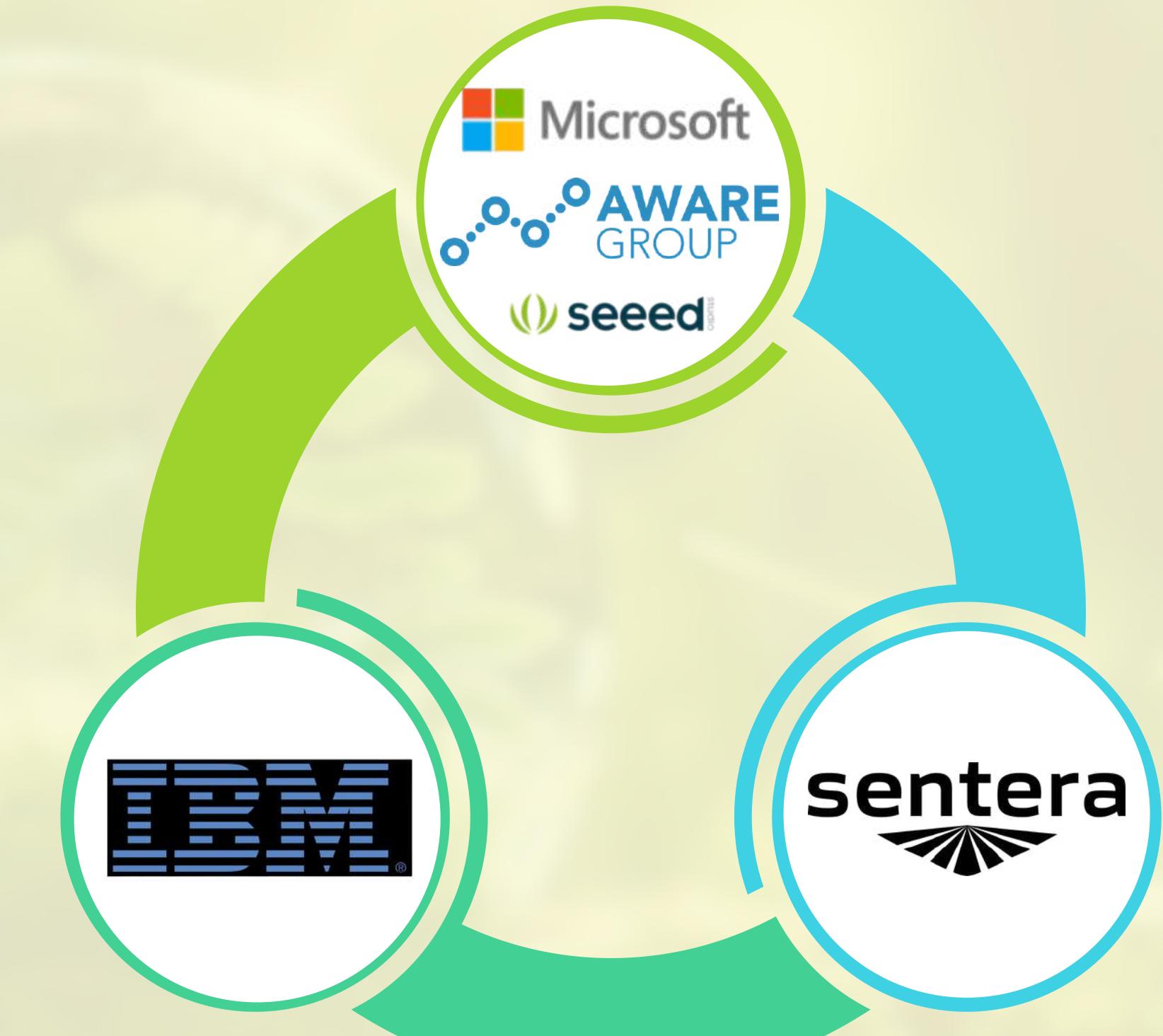
Built-in Certification Tracking

- Processing_Plants and Retail_Outlets include:
 - Certification type
 - Expiry dates
 - Audit flags
- Helps meet international food safety standards
- Enables alerts for expiring certifications and proactive compliance



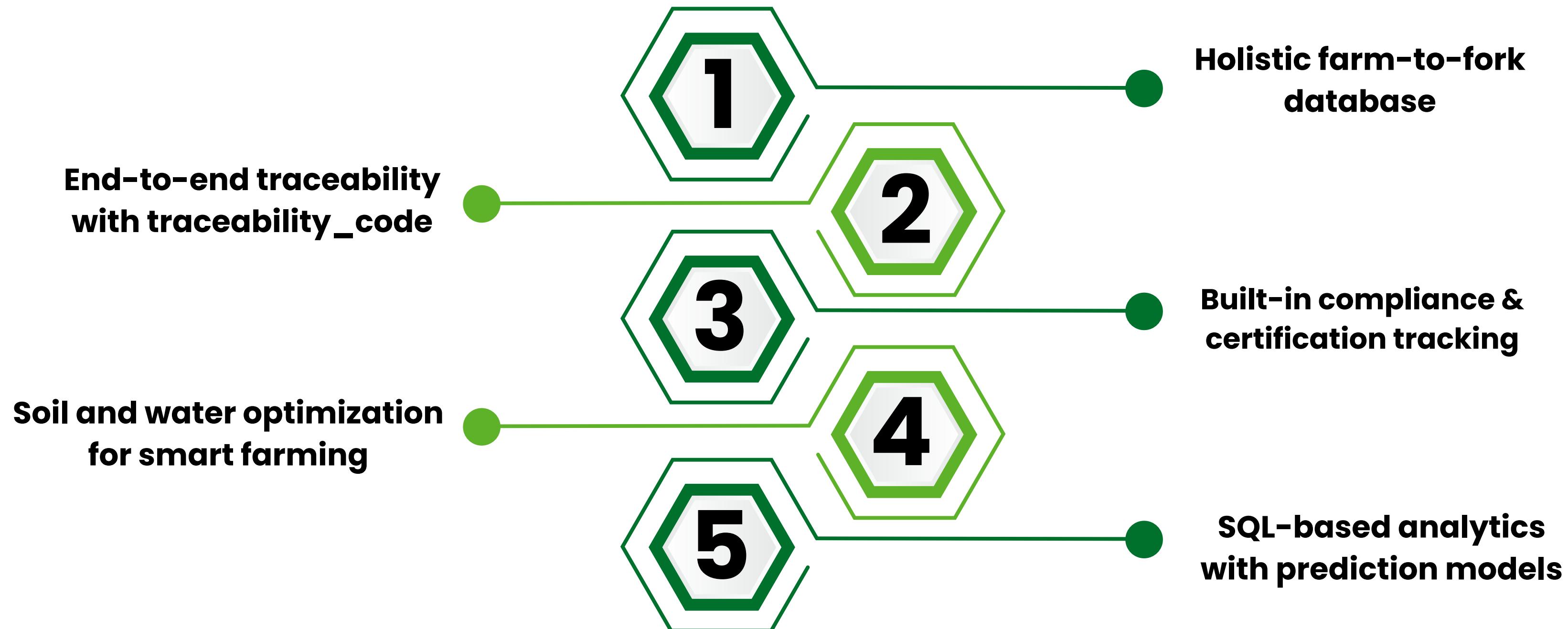
LITERATURE REVIEW

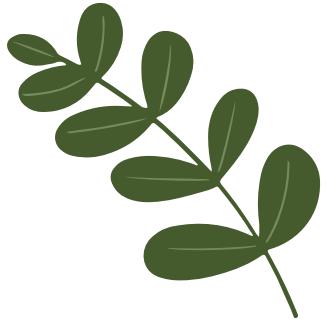
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HOW WE IMPROVED EXISTING SYSTEMS

INNOVATIONS BEYOND INDUSTRY STANDARDS





EXPERIMENTAL SETUP & ANALYSIS

How We Tested the System

🔧 **Environment: MySQL 8.0 + MySQL Workbench**

📁 **Data: 10,028 records across 15 tables**

🧪 **Testing:**
Referential integrity and cascading
Query speed benchmarks (<0.05s for 5000 records)
JOIN-based traceability queries
Alerts for certification expiry



Analytical Query Demonstrations



Soil Health Analysis:

Aggregated health_score to find weak zones



Water Optimization:

Totaled water_usage_gallons and flagged excessive fields



Market Forecasting:

Queried predicted_price_per_ton for profitability



Traceability JOINS:

Crop_Plantings → Harvests → Product_Shipments → Retail



COMPLIANCE SIMULATION

AUTOMATED ALERTS & TRACKING

- Queried cert_expiry_date for expiration alerts in Processing and Retail
- Simulated regulatory alerts with warnings for overdue renewals
- Compliance reports support food safety audits and certification tracking



Comparative Feature Analysis Table

AgroSphere vs Others

Feature	AgroSphere	Azure FarmBeats	IBM Food Trust	Sentera Ag	GitHub DBs
Full Supply Chain	✓	✗	✓	✗	✗
SQL Traceability	✓	✗	✗	✗	✓ (Basic)
Compliance Tracking	✓	✗	Partial	✗	✗
Soil/Water Monitoring	✓	✓	✗	Partial	✗
Predictive Analytics	✓	✓	✗	✗	✗
Carbon Footprint Tracking	✓	✗	✗	✗	✗

Future Work & Expansion

What's Next for AgroSphere



- 🌐 IoT Integration: Connect sensors for live soil and irrigation data
- 🤖 Machine Learning: Disease prediction and price fluctuation models
- 📱 Mobile App Development: Field-level access for farmers
- ☁️ Cloud Deployment: Global scalability on AWS or Azure SQL
- 🌐 Multi-language Support: Accessibility for regional and global users



Alignment with UN SDGs

Sustainable Development Goals (SDGs)

- **Goal 2 – Zero Hunger:** Optimizes production and reduces waste
- **Goal 12 – Responsible Consumption & Production:** Traceability and loss prevention
- **Goal 13 – Climate Action:** Tracks emissions and promotes eco-efficiency
- **Goal 9 – Industry, Innovation & Infrastructure:** A digital backbone for smart farming

Conclusion

“Seeds of Change: Transforming Global Food Systems from Farm to Fork” – Ensuring a Sustainable Future



Developed a structured SQL-based database system that captures every stage of the agricultural lifecycle—from farm to fork



Integrated sustainability metrics, predictive analytics, and compliance tracking to promote smart and ethical farming



Ensured end-to-end traceability and transparency across 15 interconnected tables supporting real-world agri-logistics



Positioned AgroSphere as a scalable solution for governments, NGOs, and agri-tech innovators tackling food security and climate challenges

Thank You!





Seeds of Change: Transforming Global Food Systems

A database-driven approach to revamp the entire food value chain. From agricultural production and distribution to consumption and waste management.