Problem Statement Title :Data Driven AI for Sustainable Farming

Challenge Overview:

Agriculture plays a vital role in sustaining life, but its environmental and economic impact is substantial. With growing challenges like water scarcity, excessive pesticide use, and soil degradation, the need for more sustainable agricultural practices has never been greater. This hackathon aims to leverage AI technologies to create innovative solutions that promote sustainability, optimize resource usage, and improve the livelihoods of farmers.

Develop a multi-agentic AI system that brings together different stakeholders in agriculture—farmers, weather stations, and agricultural experts—to work collaboratively for the optimization of farming practices.

The goals is to reduce environmental impact of farming: Promote practices that lower the carbon footprint, minimize water consumption, and reduce soil erosion.

Current Process:

- **Farmer Advisor**: Provides actionable insights by analyzing input from the farmer about land, crop preferences, and financial goals.
- **Market Researcher** : Analyzes regional market trends, crop pricing, and demand forecasts to suggest the most profitable crops to plant.

Expected Technical Output: Multiagent framework and SQLite Database for long term memory

Team Leader : Ajinkya Kutarmare

Entry Submission Summary

Idea Title (Provide a concise and impactful title for your idea.)	**AgroSakha: A Multi-Agent AI Advisor for Sustainable and Profitable Farming.**
Team Name	**Team AgriMind**
Problem Statement	**Farmers in rural regions face challenges in choosing the right crops due to fluctuating market demands, unpredictable weather patterns, and limited access to personalized, data-driven guidance. There is a critical need for a solution that integrates sustainability with profitability using modern AI tools.**
Proposed Solution	**We propose AgroSakha, a multi-agent AI system powered by lightweight LLMs and SQLite, that assists farmers in crop selection and land use planning. The system integrates a Farmer Advisor, Market Researcher, Weather Analyst, and Sustainability Evaluator to deliver personalized, data-driven recommendations that are environmentally sustainable and economically beneficial.**

Problem Statement:

- Agriculture is essential but faces environmental and economic challenges
- Issues include water scarcity, excessive pesticide use, and soil degradation
- Current practices lack data-driven and collaborative decision-making
- Farmers need personalized, actionable insights for sustainable choices
- There's a gap in using AI to integrate stakeholders like farmers, researchers, and weather analysts
- Goal: Reduce environmental impact while improving profitability and resource efficiency

-Agriculture contributes significantly to food security but also causes:

-🌍 High carbon footprint

-💧 Excessive water usage

-🧪 Overuse of fertilizers & pesticides

-🌱 Soil degradation & erosion

-Lack of integration between:

Farmers

Market analysts

Weather and sustainability experts

-Existing decision-making is manual, isolated, and not data-driven

Farmers struggle to choose:

-The right crops based on market demand

-The best timing for planting and harvesting

The most sustainable practices

Proposed Solution Overview:

Multi-Agent AI System called AgroSakha, designed to empower farmers with sustainable and profitable agricultural decisions using real-time, data-driven insights.

- Multi-Agent AI System to optimize sustainable farming decisions
- Agents Involved:
- Farmer Advisor: Analyzes land, crops, and goals
- Market Researcher: Predicts demand and pricing
- Weather Analyst: Uses weather data for planning
- Sustainability Evaluator: Recommends eco-friendly practices
- Lightweight AI Models (e.g., TinyLlama, Gemma) for fast decision-making
- SQLite Database for long-term memory and insights
- Goal: Maximize profit, reduce carbon footprint, conserve water & soil

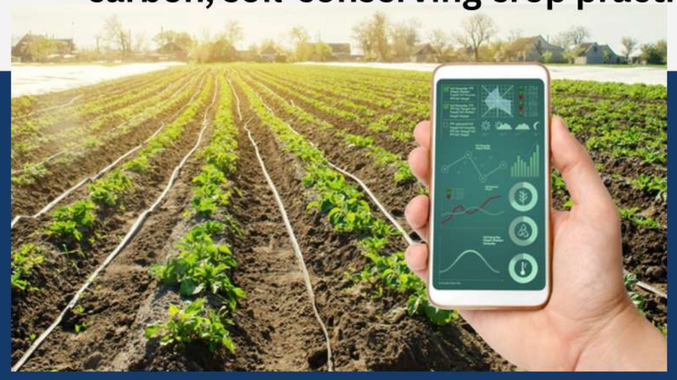
METHODOLOGY:

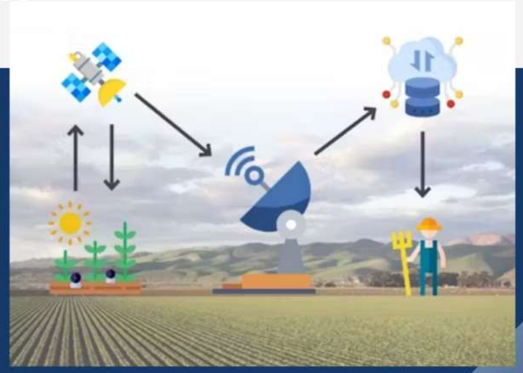
1.Multi-Agent Architecture:
Four AI agents work collaboratively, each handling a key area:
-Farmer Advisor Agent – Gathers farmer's land, soil, and crop input.
-Market Researcher Agent – Analyzes regional market trends, prices, and demand forecasts.
-Weather Analyst Agent – Integrates local weather station data to predict optimal planting windows and irrigation needs.
-Sustainability Evaluator – Recommends low-carbon, soil-conserving crop practices.

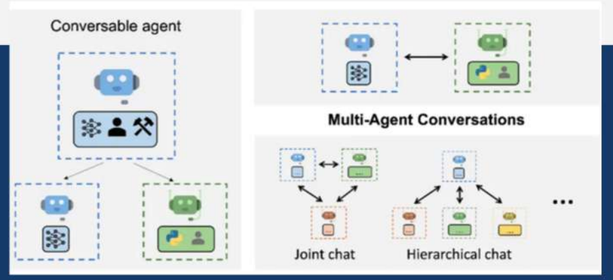
2.LLM-Powered Reasoning:
Lightweight models like TinyLlama-1.1B and Gemma-2B are used for fast, on-device inference and structured data interpretation.

3.Long-Term Memory:
An embedded SQLite database stores historical farmer interactions, crop performance, and market behavior for smarter, evolving recommendations.

4.Outcome:
Farmers receive adaptive, localized guidance that promotes sustainability, maximizes profit, and minimizes environmental degradation







Key Technologies:

1.🤖 Multi-Agent Systems (MAS) – for collaborative decision-making
2.📊 Machine Learning (scikit-learn, XGBoost) – for crop prediction & market forecasting
3.🌐 Geospatial Analysis (Google Earth Engine, QGIS) – for soil & land use data
4. Cloud Computing (AWS / GCP) – for scalable deployment
5.? IoT Integration – real-time sensor data from fields
6.📈 Power BI / Tableau – for interactive data visualization
7.🧠 LLMs (ChatGPT / GPT-4 API) – for farmer advisory & natural language interaction

DESCRIPTION:

1.Multi-Agent Systems (MAS):
Enables distributed agents (like crop advisor, market analyst, irrigation monitor) to collaborate and make intelligent decisions for farmers.
2.Machine Learning (scikit-learn, XGBoost)
3. Used for predictive models – crop yield forecasting, pest/disease detection, and price prediction.
4.Geospatial Analysis (Google Earth Engine, QGIS)
5 .Helps analyze satellite imagery and land data for identifying soil types, crop health, and optimal planting zones.
Cloud Computing (AWS / GCP)
6. Ensures scalability, remote access, and centralized data storage and processing.
IoT Integration
7. Collects real-time data (e.g., soil moisture, temperature) from sensors placed in fields, which informs agent decisions.
8.Power BI / Tableau Converts raw agricultural and market data into interactive dashboards for clear, actionable insights.
9.LLMs (ChatGPT / GPT-4 APIActs as a natural language interface for farmers, enabling queries like "What crop should I plant this season?" with context-aware replies.

Agent Interaction Design:

Farmer → [Farmer Advisor] → Crop Preferences, Land, Goals

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Weather Analyst ← Historical & real-time weather

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Market Researcher ← Market Trends, Demand

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Sustainability Evaluator ← Suggests optimized sustainable strategy

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Final Output to Farmer

Interaction Flow Example:

Farmer → Farmer Agent → Crop Advisor → Weather + Market + Irrigation Agents →Final Suggestion

This layout keeps the system modular, scalable, and responsive to changes in environment and market conditions.

1. Crop Advisor Agent: Analyzes soil, weather, and historical data to recommend optimal crops.
Communicates with Weather Agent & Market Analyst.
2. Weather Agent:
Provides real-time and forecasted weather conditions.
Supports Irrigation Agent and Crop Advisor.
3. Market Analyst Agent:
Analyzes market trends and predicts demand/prices for crops.
Advises Farmer Agent and Crop Advisor.
4. Irrigation Agent:
Uses IoT data (e.g., soil moisture) and weather forecasts to automate irrigation schedules.
Syncs with Weather Agent and Crop Advisor.
5. Pest/Disease Monitor Agent:
Uses image recognition and environmental conditions to detect threats.
Alerts Farmer Agent and Crop Advisor.
6. Farmer Agent (Interface Agent):
Central user-facing agent that gathers inputs from the user (farmer) and presents decisions from other agents in a simple format.

Basic Code Structure:

1.Agent Base Class:

```python
class BaseAgent:
    def __init__(self, name):
        self.name = name

    def process(self, input_data):
        raise NotImplementedError
```

2.Farmer Advisor:

```python
class FarmerAdvisor(BaseAgent):
    def process(self, input_data):
        return {
            "recommended_crops": ["Millet", "Pulses"],
            "financial_plan": "Low investment, high yield crops"
        }
```

3.Market Researcher:

```python
class MarketResearcher(BaseAgent):
    def process(self, region):
        # Placeholder for actual ML model prediction
        return {
            "high_demand_crops": ["Pulses", "Tomatoes"],
            "market_price_forecast": "Tomatoes to rise by 15%"
        }
```

4.SQLite Integration:

```python
import sqlite3

def store_data(agent_name, data):
    conn = sqlite3.connect("farming_ai.db")
    c = conn.cursor()
    c.execute('''CREATE TABLE IF NOT EXISTS agent_logs
                 (agent TEXT, data TEXT)''')
    c.execute("INSERT INTO agent_logs (agent, data) VALUES (?, ?)",
              (agent_name, str(data)))
    conn.commit()
    conn.close()
```

5.Final Output Example:

python Copy Edit

```python
def orchestrate():
    fa = FarmerAdvisor("Advisor")
    mr = MarketResearcher("Market")

    input_data = {"land": "2 acres", "region": "South India", "goal": "maximize profit"}
    advisor_result = fa.process(input_data)
    market_result = mr.process(input_data["region"])

    store_data(fa.name, advisor_result)
    store_data(mr.name, market_result)

    # Combine for final output
    return {
        "advisor": advisor_result,
        "market": market_result,
        "final_suggestion": list(set(advisor_result['recommended_crops']) & set(market_result['hig
    }
```

6.Main Code:

```python
from db import init_db
from farmer_advisor import analyze_farmer_input
from market_researcher import find_best_crop
from ai_model import ai_analysis

def run_system():
    print(" Multi-Agent AI System for Sustainable Agriculture")
    init_db()

    farmer_data = analyze_farmer_input()
    if farmer_data:
        find_best_crop(farmer_data)
        ai_advice = ai_analysis(farmer_data)
        print(" AI Advice for Farmers:", ai_advice)
    else:
        print(" Please add farmer input to proceed.")

if __name__ == "__main__":
    run_system()
```

Github Link : https://github.com/Aj22122003/Data-Driven-AI-for-Sustainable-Farming_Accenture

Demo Video Links:1. https://youtube.com/shorts/JceJ6_jooPA?si=Gap-8RTLVitxCu59
2.https://youtu.be/5jr3cZOtug0?si=q-wPCh9fwPcVCXPA
3.https://youtu.be/NYELiwVoXK4?si=OfT8W9OJQjPN_GIj

Conclusion:

✅ **Conclusion On Our Proposed Solution:**

-Solves critical challenges in modern farming: low productivity, resource inefficiency, and lack of insights.

-Provides an intelligent multi-agent system for real-time decision-making.

-Leverages data from weather, soil, and market trends to guide -actions.

-Improves sustainability through optimized irrigation, fertilization, and pest control.

-Empowers farmers with tech-driven, easy-to-use solutions.

-Promotes long-term impact on food security, environment, and farmer income.

Thank You