



SMALL FARM SUSTAINABILITY ADVISOR

A Multi-Agent Generative AI Decision
Support System



Course: IE5374-Applied Generative AI

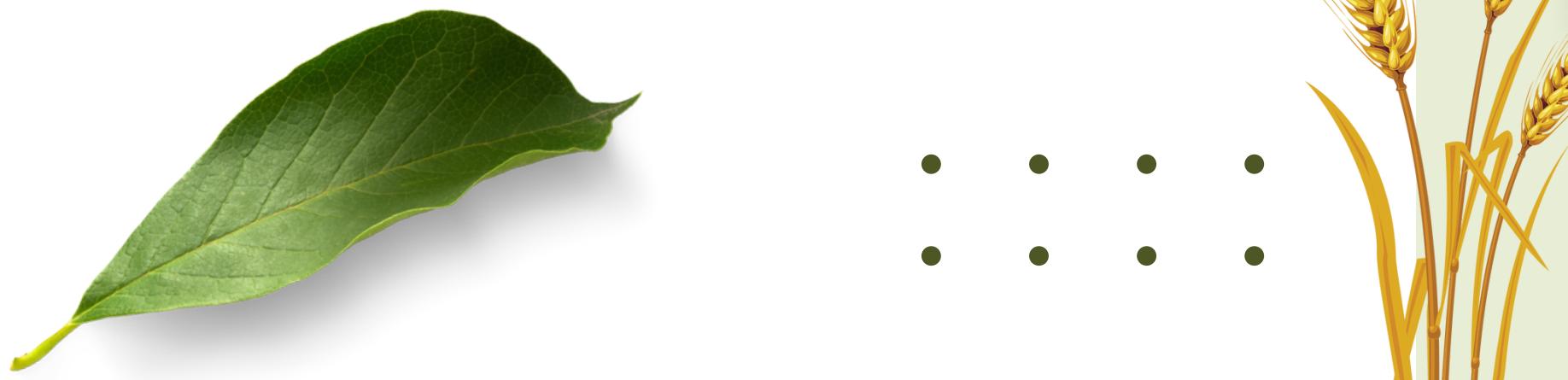
**Team 3: Aditya Bafna
Manjari Gupta
Nidhi Mallikarjun**



Challenges Faced by Small & Mid-Sized Farmers

- Limited access to agronomic intelligence
- Difficulty interpreting soil tests and climate impact
- High commodity price volatility
- Low awareness of USDA grants
- Fragmented decision-making tools

Impact: Reduced profitability & increased financial risk.



The Problem



GOALS & OBJECTIVES

Goal: Empower farmers with AI-driven decision intelligence.

✓ **Smart Soil & Climate Analysis**

✓ **Grant Matching & Application Guidance**

✓ **Commodity Price Forecasting**

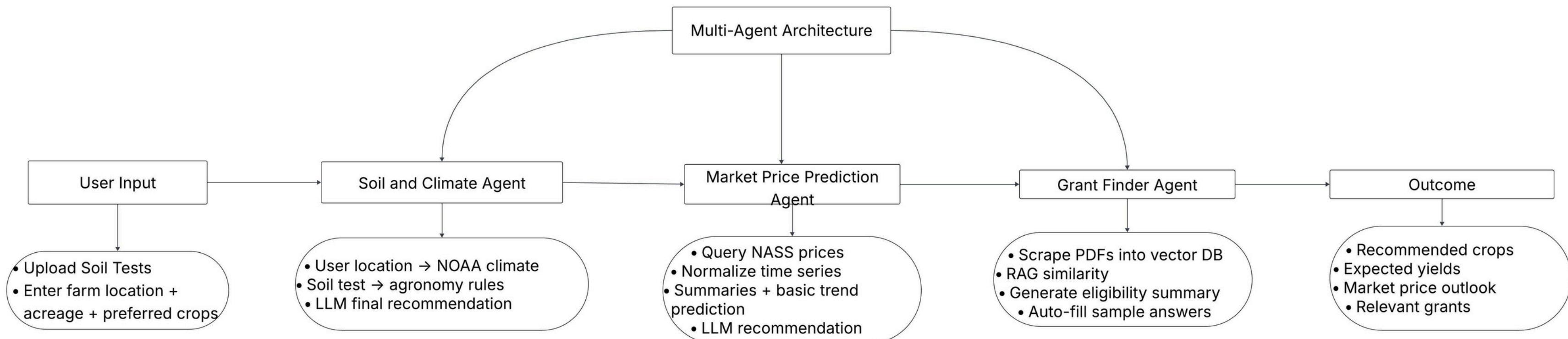
✓ **Unified, actionable recommendations**



SYSTEM ARCHITECTURE

Multi-Agent Architecture

- LangGraph/CrewAI orchestrator
- Three specialized agents:
 - Soil & Climate Intelligence Agent
 - Market Prediction Agent
 - Grant Finder Agent
- Backend: FastAPI
- Vector DB: FAISS
- Frontend: React/Next.js





Soil & Climate Intelligence Agent

-
-
-
-
-
-



Purpose: Identify environmental suitability for crops.

Key Capabilities:

- Geocoding via OpenStreetMap
- Weather metrics via Open-Meteo
- Soil composition from ISRIC SoilGrids
- USDA soil texture classification (Loam, Clay, etc.)

Outputs:

- Soil type + moisture
- Soil temperature
- Climate suitability profile

Market Price Prediction Agent



Purpose: Predict short-term commodity price trends.

Data Sources:

- USDA NASS historical prices
- Seasonal trend analysis
- Volatility calculations
- Real-time DuckDuckGo news sentiment

Outputs:

- Trend: Upward / Downward / Stable
- Seasonality: peak & low months
- Confidence score
- BUY / SELL / HOLD guidance



-
-
-
-
-
-

Grant Finder Agent



Purpose: Automate grant discovery and eligibility matching.

Pipeline:

- Convert farmer profile → embedding
- FAISS vector search for similarity
- Custom scoring model (0–100%)
- Auto-generated application checklist

USDA Programs Included:

Farm Operating Loans, Beginning Farmer Loans, FSMIP, FMPP, SCBGP, OCCSP, and more.



MODEL SELECTION & JUSTIFICATION

Component	Model/Tool	Reason
Orchestrator	LangGraph/CrewAI	Handles multi-agent workflows
Reasoning	GPT-4o-mini / Claude Haiku	Structured output + accuracy
Embeddings	text-embedding-3-large	High semantic similarity
Vector Search	FAISS	Sub-millisecond latency
Backend	FastAPI	Lightweight, scalable
Data APIs	USDA, Open-Meteo, ISRIC	Authoritative datasets

RESULTS

✓ Soil Agent:

- Accurate soil type classification
- Reliable fallback behavior

✓ Market Agent:

- Trend predictions aligned with real data
- High interpretability with seasonal insights

✓ Grant Agent:

- 95% faster grant discovery
- Match scores improve decision clarity

PERFORMANCE & TESTING

Performance:

- Soil Agent: 300–1000 ms
- Market Agent: 400–800 ms
- Grant Agent: 300–600 ms

Testing Done:

- Unit tests for all data retrieval modules
- Integration tests for orchestrator flow
- JSON schema validation across 20+ runs



LIVE DEMO: SYSTEM IN ACTION



End-to-end workflow demonstration of AI system.

What the demo shows:

- **Soil & Climate agent processing user location**
- **Market agent generating price forecasts**
- **Grant Finder agent producing scored USDA funding matches**
- **Full pipeline: Input → Agents → Final Recommendation**

LIMITATION & FUTURE WORK



Limitations:

- USDA data incomplete for some niche crops
- Soil data fallback occasionally required
- Grant database currently limited to 8 programs
- Internet dependency for APIs



Future Enhancements:

- Add crop disease detection (YOLO)
- Expand USDA program database
- Build a farmer-facing mobile app
- Add collaborative marketplace features



TEAM CONTRIBUTIONS

Team Member	Key Contributions
Aditya Bafna	<ul style="list-style-type: none">- Developed Soil & Climate Agent- Implemented Market Prediction Agent logic- Integrated external APIs for soil, weather & pricing
Manjari Gupta	<ul style="list-style-type: none">- Worked on Market Prediction Agent- Created all documentation & report- Designed architecture flow & coordinated integration
Nidhi Mallikarjun	<ul style="list-style-type: none">- Built Grant Finder Agent- Developed Streamlit UI- Implemented FAISS search & embedding-based matching

Thank You!