



USING AI TO ADDRESS **AGRICULTURAL EFFICIENCY** IN THE AFTERMATH OF DISASTER

Extensive AI Researchers



Agriculture Today

Climate change is a growing global crisis,
marked by rising temperatures, shifting rainfall patterns, and extreme weather events
such as droughts, floods, hurricanes and wildfires.

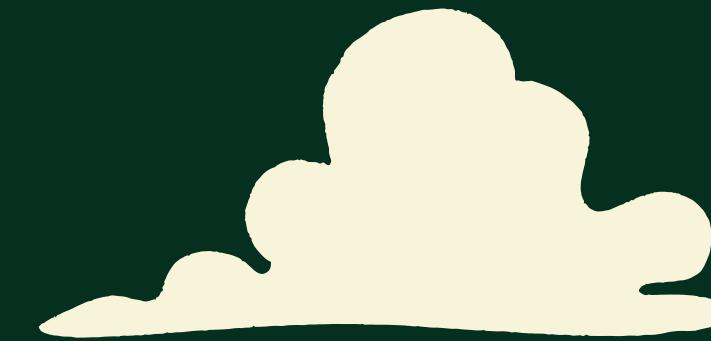
These changes profoundly impact **agriculture, a sector highly dependent on stable environmental conditions.**

PROBLEM STATEMENT

As traditional growing regions face increasing stress,
crop yields are declining, water and soil resources are depleting, and pests and diseases
are becoming more prevalent.

These challenges jeopardize food security, destabilize markets, and hit vulnerable communities hardest.
Innovative solutions are essential to make agriculture more resilient and sustainable in an uncertain future.

Current Issues



Unpredictable Weather Patterns

Erratic rainfall, prolonged droughts, and extreme temperatures disrupt crop growth cycles, reducing yields and threatening food security.



Crop Vulnerability

Traditional crops are struggling to adapt to changing climates, leading to widespread failures in staple crops like rice, cocoa, and olive oil.

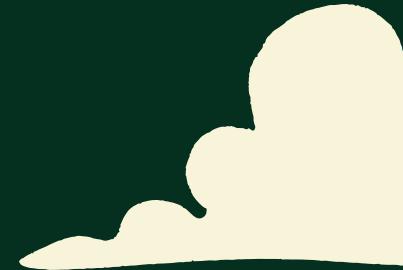


Resource Scarcity

Rising temperatures increase water evaporation and soil salinization, while floods and droughts deplete essential farming resources like water and fertile land.

Economic Instability

Food shortages drive price volatility, disrupt markets, and deepen inequalities, with vulnerable communities bearing the brunt of these impacts.



Motivation

Farmers are under **immense pressure to feed** a growing global population while facing:

- Unpredictable weather patterns
- Resource shortages
- Rising crop failures



Traditional systems are **reactive**, focusing on **damage control** after disasters, instead of **preventing losses**.

These issues **lead to**:

- Food insecurity
- Economic instability
- Social challenges



A Needed Shift

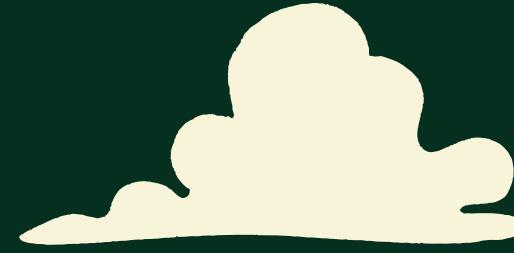
Real time data is being used to craft disaster management

Issues

- Covers a **huge scope** outside of agriculture
- Second and third level losses are not accounted for

Pivot

- **Targeted** and **personalized** approach that focuses not only on post-disaster help but also **preventative measures** to optimize crop management and improve agricultural **efficiency**



Our Application Value



An app that utilizes **AI** to understand the bandwidth of previous disasters in order to **predict** the area of damage for an approaching extreme weather phenomenon and offer **tailored** solutions to farmers

- Traditional forecasting systems **lack the personalization** that is based on a farmer's region and crops
 - Using **predictive analytics** and looking at historical data
 - AI can look at environmental data from previous natural disasters in real-time
 - It would then **give warnings ahead of time** for these severe conditions and recommend the **best course of action** for protecting crops
 - The farmers would have more information to help them decide whether or not they should harvest their crops earlier than expected or **make a change to their irrigation schedule**
 - Combines with their domain expertise
- 

App Logistics

Partnership with Farmers

- Ensures Familiarity
- Ease of Use



Recommendations Based on Crop Cycles

- Early
 - Example: Crop Transplant
- Middle
 - Example: Management Direction
- Late
 - Example: Early Harvest or Crop Protection
 - US Department of Agriculture Disaster Assistance



Data Strategy



Agricultural Data

- National Agricultural Statistics Service QuickStats
- United States Department of Agriculture Geospatial Datasets



Weather Data

- National Centers for Environmental Information



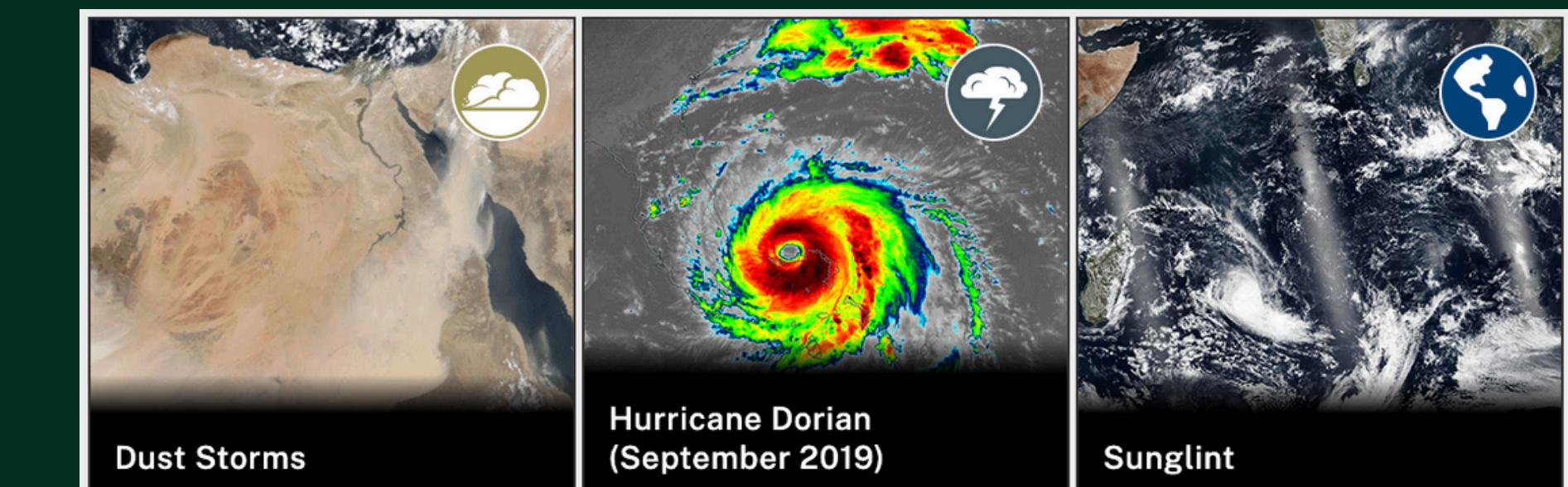
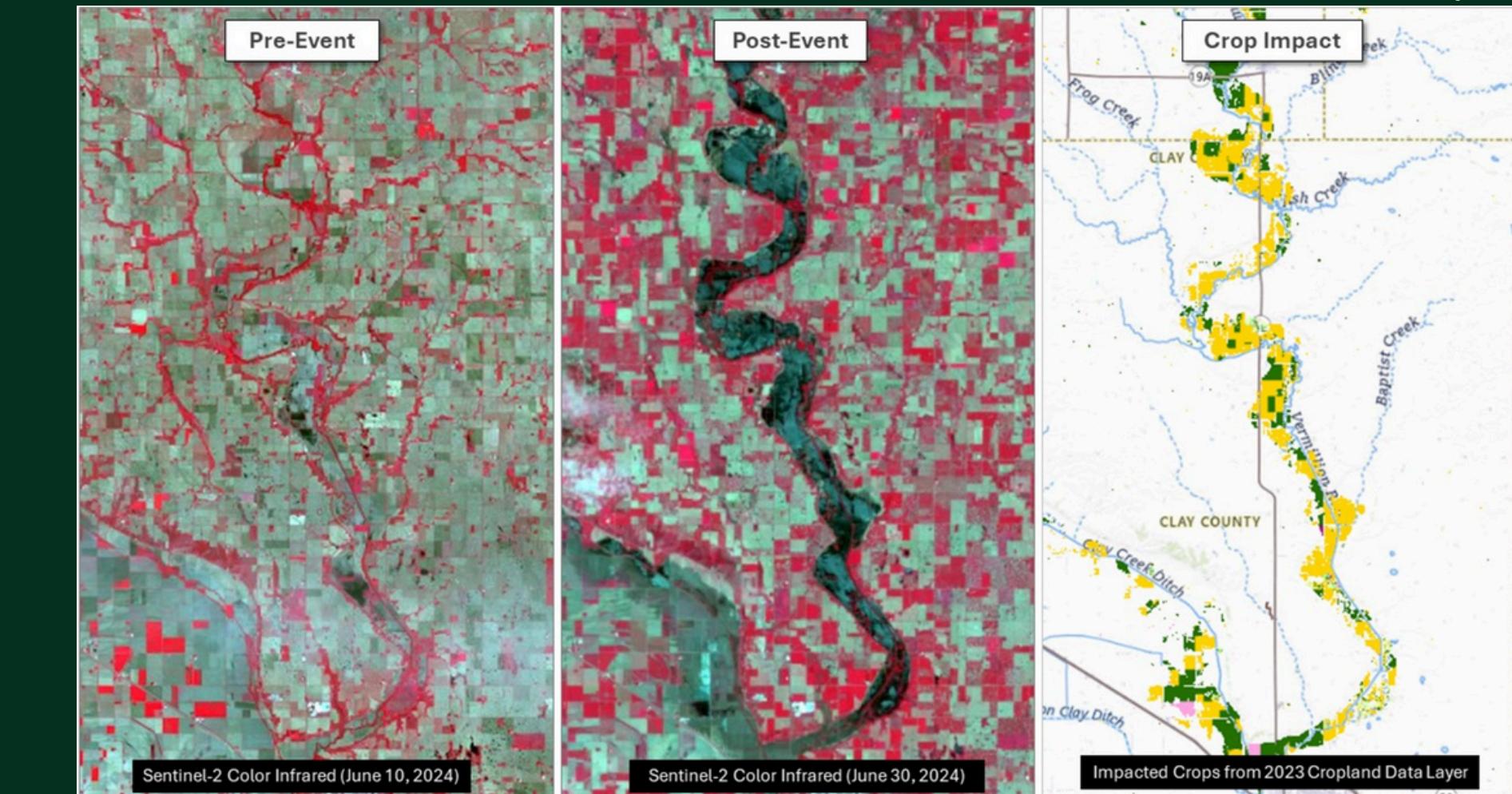
Disaster Data

- United States Department of Agriculture Risk Management Agency Data
- Federal Emergency Management Agency Data
- National Agricultural Statistics Disaster Analysis Data

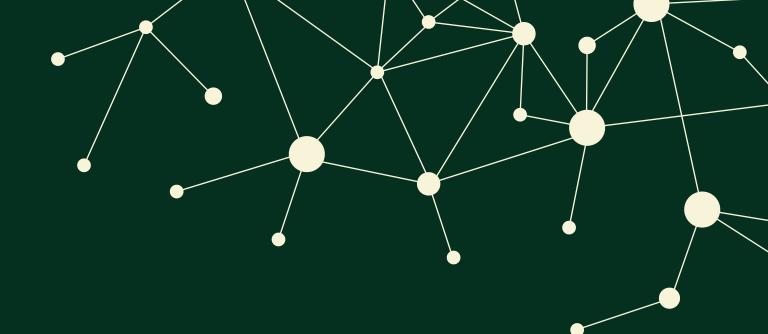


Satellite Images

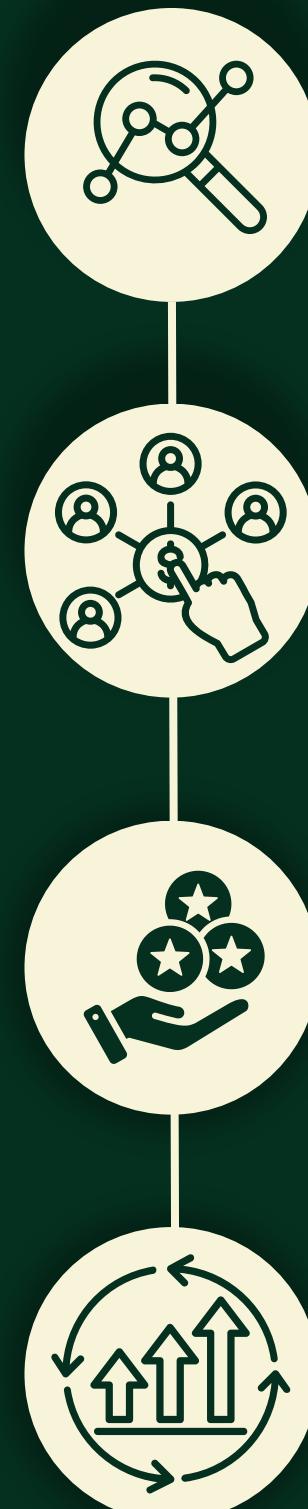
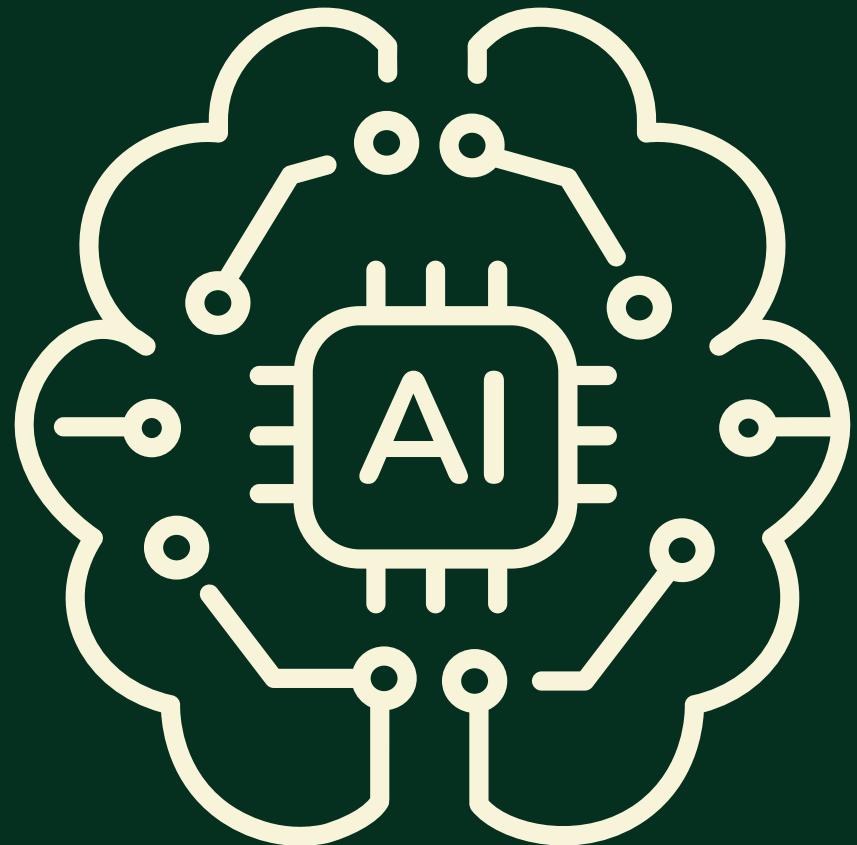
- NASA'S Earth Science Data



Top: Midwest Floods (National Agricultural Statistics Disaster Analysis Data)
Bottom: NASA Earth Science Data



AI Model Development



Disaster Prediction and Impact Assessment

- Train machine learning models (Random Forest or Deep Neural Network) using historical FEMA disaster data NCEI weather data
- Incorporate MERRA-2 and Landsat 8 satellite data to improve the spatial resolution and accuracy of predictions.

Resource Allocation and Crop Substitution

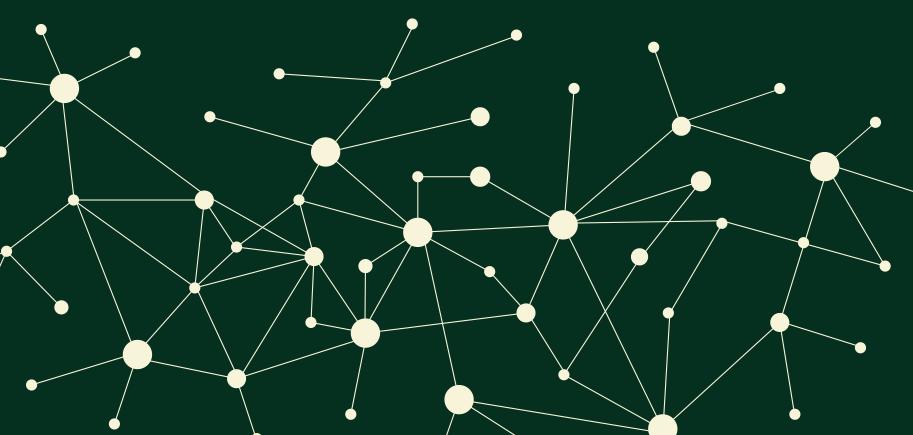
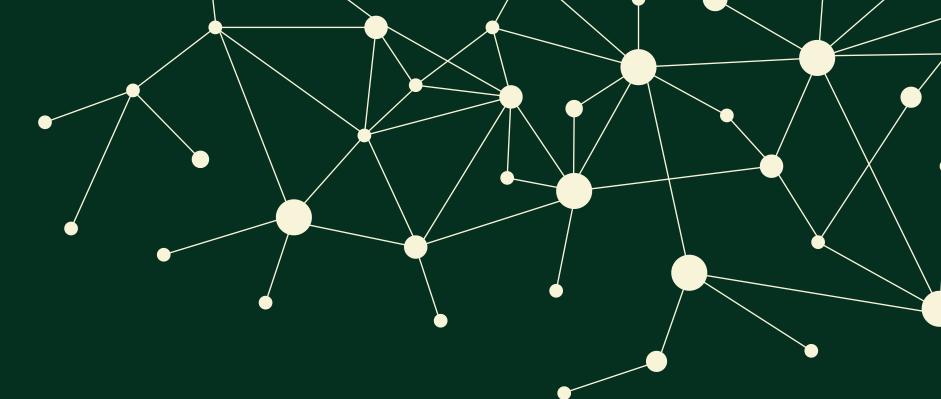
- Utilize computer vision with deep learning (CNNs) to analyze satellite imagery for assessing crop damage, and apply ensemble methods (Random Forest) to forecast resource allocation based on disaster type and scale.
- Develop AI-powered recommendation system for alternative crops based on Suitability to post-disaster conditions and market demand and economic factors

Application Features

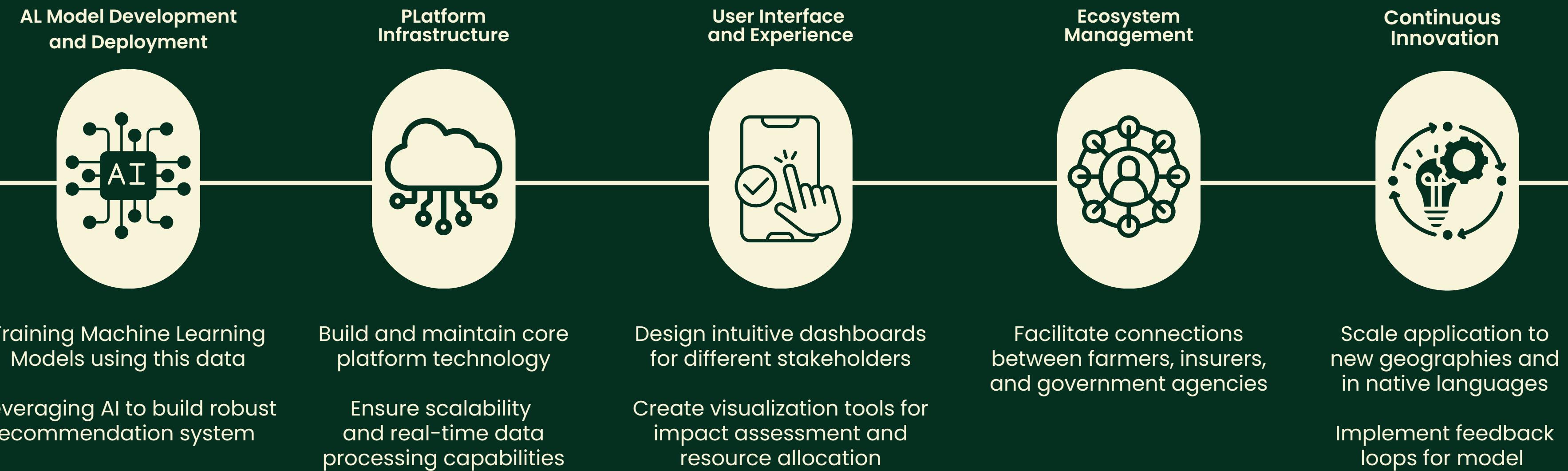
- Early Warning System
- Impact Visualization using Landsat 8 imagery and NASA Earth
- Resource Allocation Dashboard
- Crop Substitution Advisor (Chatbot)

Reinforcement Learning

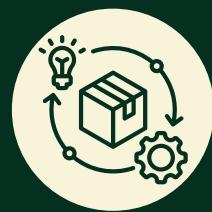
- Implement feedback loops to compare predictions with actual impacts
- Regularly update AI models with new climate and disaster data



Value Chain



Cost Analysis



Product Development Expense

Component	Cost
Data Collection and Preparation	\$400 K
Infrastructure	\$1 M
Model Development	\$2 M
Deployment	\$1 M
Personnel Wages	\$500 K
Total	\$4.9 M



Indemnity Value

Process		Prevented Loss
Agricultural Loss	Annual	\$21.94 B
Application Adoption (Conservative)	5%	\$1.09 B
Model Accuracy (Conservative)	70%	\$768 M
Loss due to Incorrect Predictions	80%	\$(-263.28) M
Total Crop Loss Indemnity	Annual	\$504.72 M

Market Potential

Farmers

- Pay for premium crop management tailored to their specific needs
- Access data-driven solutions for crop selection and risk management
- Utilize early warning systems and impact visualization tools



Governement

- Purchase Application as a service to enhance risk management and budget allocations
- Utilize the platform's AI models for disaster prediction and impact assessment to ensure impactful policy decisions and budget allocations

Insurance Companies

- Pay for access to advanced risk assessment models and data
- Utilize the platform's AI-powered recommendation systems for policy pricing
- Purchase services for claims processing and fraud detection

Application Impact

Mitigating Weather-Related Losses:

Predictive analytics and early warnings to prepare farmers, reducing potential losses.

- Total U.S. agricultural losses in 2023: \$21.94 billion
 - 75.6% (\$16.59 billion) from drought, heat, and wildfires
 - 18.2% (\$3.99 billion) from excessive precipitation, flooding, and hurricanes
 - 6.2% (\$1.37 billion) from hailstorms

Crop-Specific Benefits:

Predict shortages and suggest food substitutions to stabilize supply chains and reduce waste.

- 2023 Crop Losses
 - Crops: Highest losses
 - Fruit and nuts: Increased from \$400M (2022) to nearly \$1.6B (2023)
 - Examples: Oranges - \$350M, Grapes - \$220M, Almonds - \$200M



Economic Impact

Financial Benefits:

Potential mitigation of a significant portion of the \$21.94 billion losses (23.6% of the \$92.9 billion total economic impact from weather disasters in 2023). Even a small reduction could save billions annually.

Market Opportunity:

Global agri-tech market projected to reach \$49.2 billion by 2031.

- Long-term disasters (last 30 years):
 - \$3.8 trillion in agricultural losses globally
 - \$123 billion annual average.

Improved Productivity:

Proactive planning with AI reduces crop losses (e.g., \$21 billion in U.S. crop losses from weather disasters in 2022).



Social Impact

Global Food Security:

Stabilizing food supply chains can make a profound impact on reducing hunger and waste.

Job Creation:

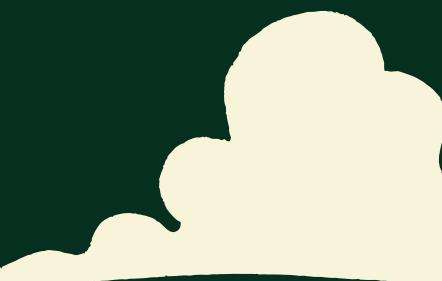
Opportunities in data collection, model deployment, technical support, etc.

- **New players:** Sensor and IoT providers, insurance firms for weather risk products.
- **Existing actors:** Agribusiness corporations optimizing supply chains; government agencies improving disaster response.



Drawbacks: Regulations

- Our recommendations would follow regulations that are in place for farmers
- **EX.** Before a storm, the app might suggest postponing fertilizer to prevent runoff into nearby water sources
 - Ensure compliance with environmental laws while simultaneously saving resources



Drawbacks: Accountability for ERROR

- Farmers could suffer financial losses and property damage if we warn about harsh weather that does not occur, or if we fail to warn about severe weather conditions
- It is important to establish clear boundaries and regulations on who would be responsible for the application's inaccuracies
 - These boundaries need to be very clear in every instance
 - EX. **What to do if the application gave a warning but the farmer decided to ignore it and faces severe crop damage**
- Insurance policies regarding AI need to be implemented

Drawbacks: AI's Environmental Impact

- Using AI to predict the severity of weather conditions is simultaneously causing harm to the environment
- AI:
 - Uses a lot of energy
 - Creates e-waste
 - Needs natural raw materials like lithium and cobalt
 - Requires a large amount of water usage
- Ways to offset the environmental impact:
 - Adopting renewable energy sources
 - Optimizing AI algorithms for efficiency
 - Minimizing unnecessary AI usage



Looking Towards the Future

- Higher Yields
 - Boosts crop production and reduces waste during extreme weather.
- Better Decisions
 - Real-time data helps farmers make informed choices.
- Resilient Farming
 - Encourages climate-adaptive practices and techniques.
- Upskilling
 - Provides training in precision agriculture, creating new job opportunities.
- Local Support
 - Strengthens local economies through collaboration and fair pricing.



Future Applications: In-app Marketplace

Our app's marketplace integrates real-time weather and spatial data with AI-powered tools to support farmers and local suppliers, enhancing sustainability and resilience in agriculture.

Key features include:

- **Emergency Preparedness:** Predicts extreme weather and provides access to supplies like water, tarps, and flashlights.
- **Farmer-to-Buyer Connections:** Allows farmers to list surplus or at-risk crops for purchase by local stores or distributors, reducing losses.
- **Crop and Seed Exchange:** Enables trade of seeds, saplings, and crops among farmers to adapt to changing conditions.
- **AI Inventory Management:** Tracks inventory, analyzes demand trends, and optimizes resource allocation to reduce waste.
- **Expanded Market Access:** Links farmers with wholesalers and niche buyers to diversify income streams.





**Our app empowers farmers with tools to thrive,
strengthens communities through collaboration,
and drives sustainable, climate-resilient agriculture
for a connected and thriving future.**

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