AI4SU Hackathon Challenge 2: AI for Climate Risk Modelling and Market Intelligence for Smallholder Farmers

Problem Statement

Smallholder farmers across Africa operate under extreme climate uncertainty and volatile markets. Irregular rainfall, prolonged droughts, and flash floods threaten yields. At the same time, limited access to timely agronomic and market information leads to poor planting choices, low farm-gate prices, and post-harvest losses.
Traditional advisory and insurance systems depend on manual data collection and delayed assessments, leaving farmers reactive rather than prepared. Without predictive insights or rapid compensation, every climate shock erodes their ability to invest in the next season.

How Might We...

How might we use geospatial data and AI-powered analytics to help farmers anticipate, plan, and adapt by linking early-warning systems, parametric insurance triggers, and localized market forecasts into one agricultural intelligence platform?

Beneficiaries & Context

- **Primary:** Rain-fed smallholder farmers cultivating staple and horticultural crops in counties such as Nakuru, Nyandarua, Narok, and Kajiado.
- **Secondary:** Cooperatives, producer organizations, input suppliers, off-takers, and agricultural extension services that rely on spatial data for real-time decision-making.

User Stories

(These user stories were collected during the design phase of the hackathon challenge, and they are intended to serve as design profiles for the hackathon participants.)

- *As a maize farmer,* I want to receive early warnings about upcoming dry spells so I can adjust my planting schedule.
- *As a vegetable grower,* I want spatial market forecasts to decide where to send my produce for better prices.

- *As a cooperative leader,* I want yield-risk maps and rainfall indices to negotiate fairer insurance premiums for my members.
- *As an extension officer,* I want to overlay soil moisture and vegetation data to provide farmers with accurate, localized advice.

AI & Geospatial Opportunity

1. **Climate-Risk Mapping and Prediction**
    - Use AI models trained on satellite imagery (NDVI, soil moisture, rainfall anomalies) to detect early signs of drought or flood stress.
    - Generate farm-level or sub-county maps showing the probability of crop failure and optimal planting windows.
2. **Parametric Crop Insurance Automation**
    - Deploy machine-learning algorithms to trigger payouts when rainfall or vegetation indices cross risk thresholds.
    - Continuously retrain models using cooperative and extension field data to reduce *basis risk* and improve fairness.
3. **Spatial Market Intelligence**
    - Integrate remote-sensing yield estimates with regional market-price data to predict seasonal demand and oversupply zones.
    - Deliver actionable insights via SMS, WhatsApp, or community radio for accessible decision-making.
4. **Adaptive Agronomic Advisory**
    - Fuse weather radar, soil sensor, and remote-sensing data to issue dynamic agronomic advisories.
    - Use voice-AI chatbots for multilingual, literacy-inclusive dissemination.

Technical Development Tracks

1. **Track 1: AI for Climate-Risk Modelling & Insurance Triggers**
    - Develop machine-learning models using satellite and weather datasets (e.g., NDVI, CHIRPS, ERA5) to monitor rainfall anomalies, vegetation stress, or soil moisture deficits.
    - Simulate parametric insurance triggers that automatically activate when pre-set thresholds are breached.

- Participants may explore tools like Google Earth Engine, Sentinel Hub, or TensorFlow for spatio-temporal model training.
- Expected outputs: a working model that visualizes climate indicators, predicts crop loss probability, and demonstrates a payout logic.

2. **Track 2: AI-Powered Market & Yield Intelligence**
   - Build a data pipeline and forecasting model that combines historical price data, yield estimates, and satellite-derived acreage to predict future market dynamics.
   - Apply predictive analytics or LSTM time-series forecasting to determine likely prices and surpluses by crop and location.
   - Visualize outcomes on a map dashboard or SMS interface showing where and when to sell for optimal returns.
   - Expected outputs: a model prototype with a farmer-facing interface delivering geospatial market forecasts or advisories.

Equity & Inclusion

- Engage women's and youth farmer groups in co-design and field testing.
- Ensure low-bandwidth and offline functionality for regions with limited connectivity.
- Build voice-first and multilingual tools (Swahili, Kalenjin, Kikuyu, Maasai, etc.) to bridge literacy gaps.
- Maintain open data principles to democratize access and prevent exclusion.

Data & Ethics

This challenge requires teams to use responsible, fair, and transparent approaches to data.
Teams must show:

- **Ethical Data Use:** Use open or appropriately sourced datasets and clearly state where the data comes from.
- **Privacy & Consent:** If farmer or cooperative data is used, explain how privacy is protected and consent would be obtained.
- **Fairness & Bias Awareness:** Identify any potential bias in the model and show how the solution ensures fair outcomes across regions and farmer groups.
- **Transparency:** Provide simple, understandable explanations of how predictions, alerts, or insurance triggers are generated.

In short: Every solution must be ethical, explainable, and fair — this is a core requirement of the challenge, not an optional add-on.