# Sustainable Crop Recommendation System using AI/ML

## Introduction

Agriculture is the backbone of most economies, but modern farming faces serious challenges such as soil degradation, declining productivity, water scarcity, and climate change. Farmers often select crops based on traditional practices rather than scientific evidence, which can lead to poor yield, excessive fertilizer use, and environmental damage.  
  
To address this, we propose a Machine Learning-based Crop Recommendation System that suggests the most sustainable and suitable crops for a farmer’s soil and climatic conditions. This project aligns with the goals of sustainable agriculture, which means producing more with fewer resources while protecting the environment.

## How the System Works

The system takes multiple input features related to soil and environment, then applies ML algorithms (e.g., Random Forest, Decision Tree, or SVM) to recommend the best crop.

### Input Data Features:

* Nitrogen (N): Essential for leaf growth and photosynthesis.
* Phosphorus (P): Supports root development and flowering.
* Potassium (K): Helps in disease resistance and fruit quality.
* Soil pH: Determines nutrient availability.
* Temperature (°C): Influences crop growth cycle.
* Humidity (%): Impacts transpiration and disease spread.
* Rainfall (mm): Vital for irrigation planning.

## How Farmers Access NPK and Soil Data

* Soil Health Card Scheme (India Example): Farmers send soil samples to government labs. Reports include NPK levels, pH, and fertilizer recommendations.
* Portable Soil Testing Kits / IoT Sensors: Low-cost digital devices give real-time readings of pH, moisture, and basic nutrients.
* Government / Research Data: Agriculture departments publish regional soil fertility and crop suitability maps.
* Remote Sensing & AI Tools: Satellite imagery + AI estimates soil health and weather conditions.

For this project, we simulate soil test reports using the Kaggle Crop Recommendation Dataset, which has realistic soil-climate data.

## Why This Project Supports Sustainability

* Soil Fertility: Recommends nitrogen-fixing crops (e.g., pulses) to naturally replenish soil nutrients.
* Water Conservation: Suggests drought-tolerant crops in dry regions.
* Reduced Fertilizer Usage: Prevents excess use by matching crops to actual soil nutrient profiles.
* Climate Adaptation: Ensures crop choices match temperature, rainfall, and humidity patterns.
* Biodiversity & Rotation: Encourages diversity in farming rather than mono-cropping.

Thus, the project helps achieve higher yields, lower input costs, and environmental protection — all pillars of sustainable agriculture.