

# Integrated Smart Water-Focused Irrigation System using IoT and AI/ML

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**Specialization :** Software Engineering

## **Group Members**

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# Integrated Smart Water-Focused Irrigation System using IoT and AI/ML

## PROBLEM & IMPACT

### Background Problem

- Agriculture in Sri Lanka heavily depends on **reservoir-based irrigation**
- Most irrigation decisions are:
  - Manual
  - Experience-based
  - Not supported by real-time data

### Current Issues

- Water is released **without knowing actual crop needs**
- Over-irrigation → water wastage
- Under-irrigation → crop stress and yield loss
- No early forecasting methods

### Impact

- Farmers face economic losses
- Irrigation authorities lack decision support
- Water resources are used inefficiently

# Integrated Smart Water-Focused Irrigation System using IoT and AI/ML

## RESEARCH GAP & MOTIVATION

### Limitations of Existing Systems

- Rule-based irrigation (fixed thresholds)
- No prediction of future water conditions
- Satellite systems lack ground verification
- No integrated crop optimization

### Research Gap

- Lack of an **intelligent, integrated decision-making platform**
- No system combining:
  - IoT data
  - Machine learning
  - Satellite monitoring
  - Optimization

### Motivation

- Enable **data-driven, proactive irrigation**
- Improve crop yield while saving water

# Integrated Smart Water-Focused Irrigation System using IoT and AI/ML

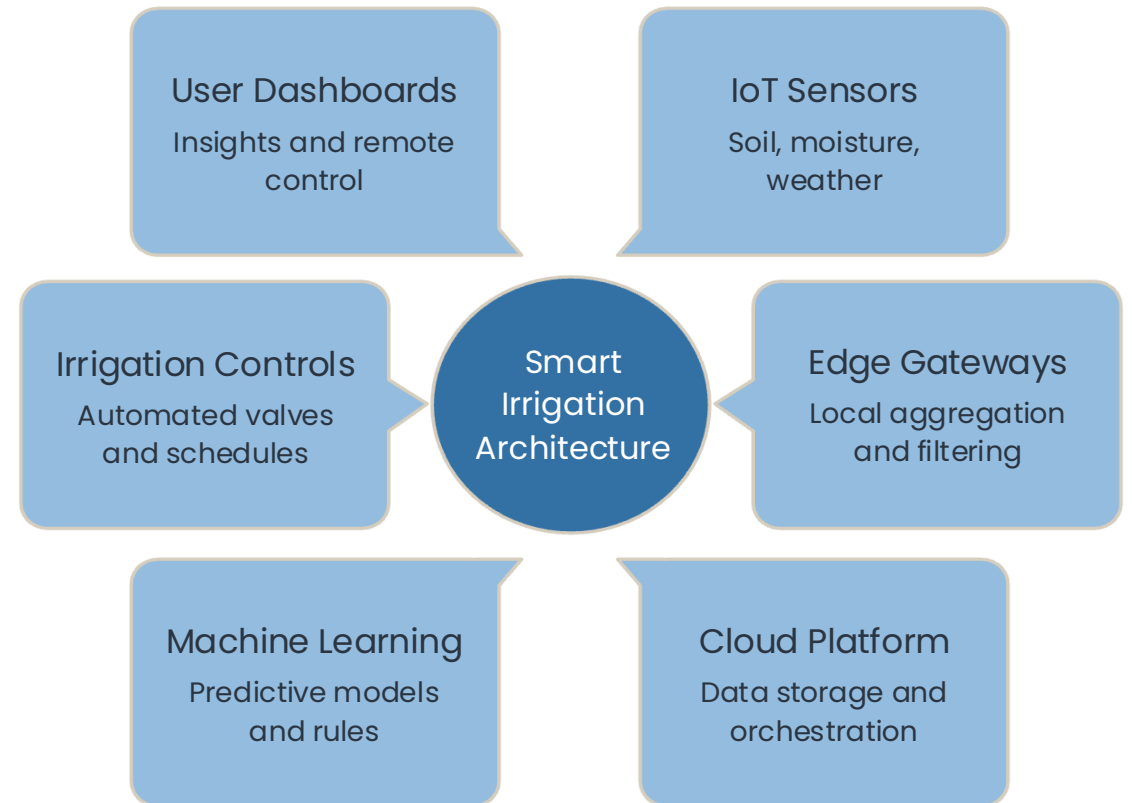
## PROPOSED SOLUTION OVERVIEW

An **intelligent smart irrigation platform** that integrates:

- IoT sensors for real-time data collection
- Machine Learning for prediction and automation
- Satellite imagery for crop health monitoring
- Optimization techniques for crop planning
- Web & mobile dashboards for users

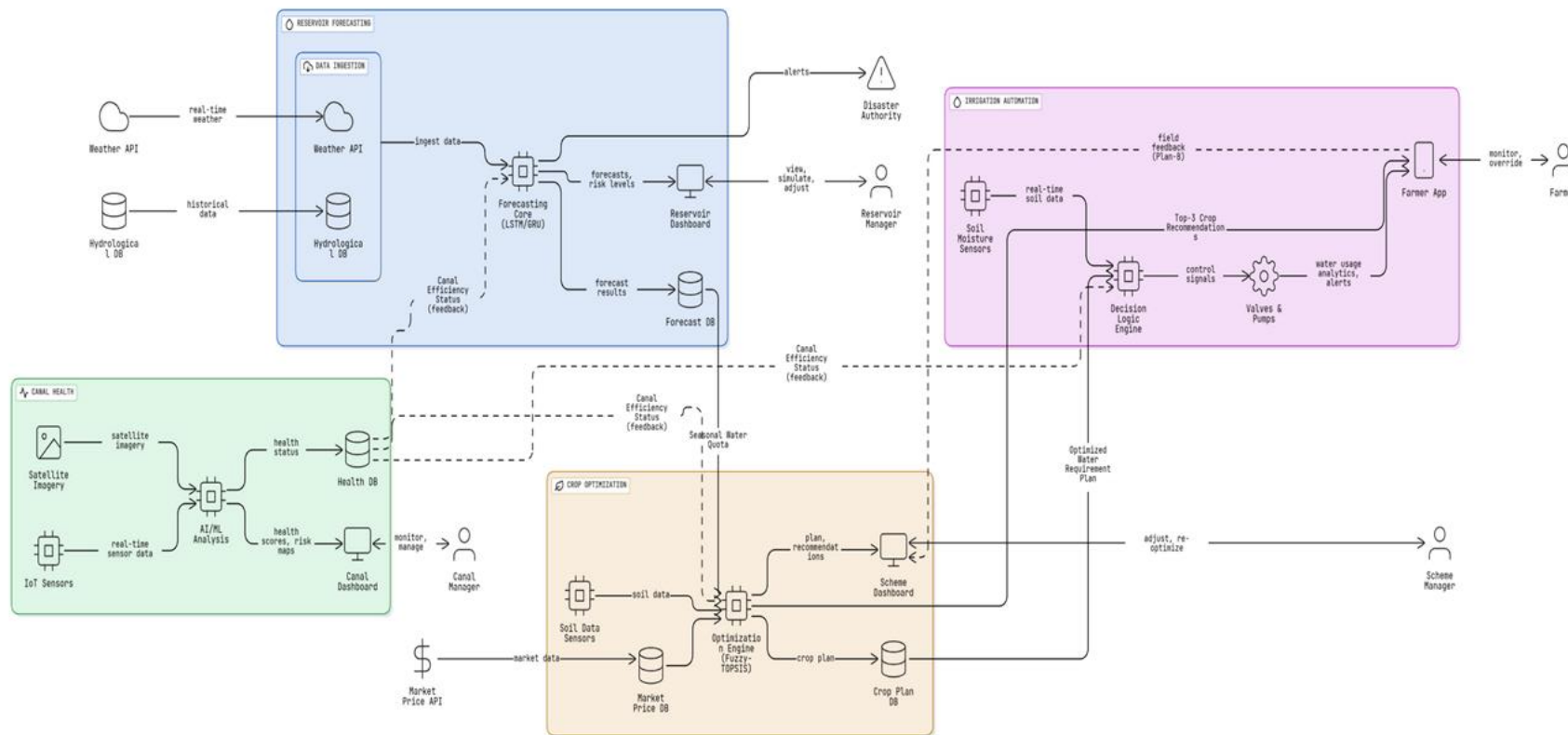
### **Key Idea**

Move from *manual & reactive* irrigation to *automated, predictive & optimized* irrigation

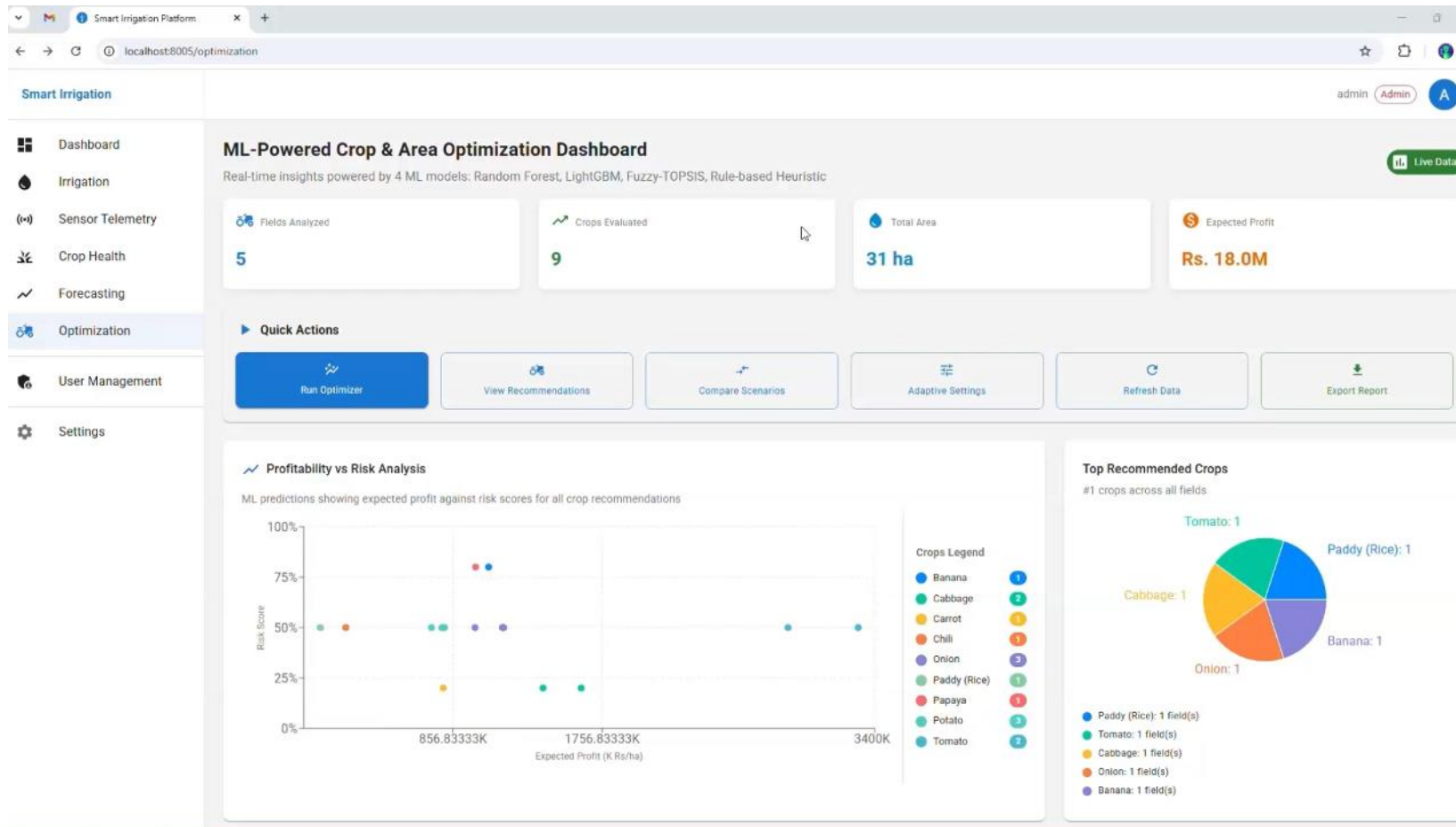


# Integrated Smart Water-Focused Irrigation System using IoT and AI/ML

## System Overview Diagram



# Integrated Smart Water-Focused Irrigation System using IoT and AI/ML



# **ADAPTIVE CROP RECOMMENDATION & AREA OPTIMIZATION**



**IT22561770 | Dilruksha A.G.C.D.**

**BSc (Hons) in Information Technology Specializing in Software Engineering**

# ADAPTIVE CROP RECOMMENDATION & AREA OPTIMIZATION

## Sub-Problem Addressed

- Crop selection under water constraints is difficult
- No tool to balance profit, risk, and water use

## Solution Approach

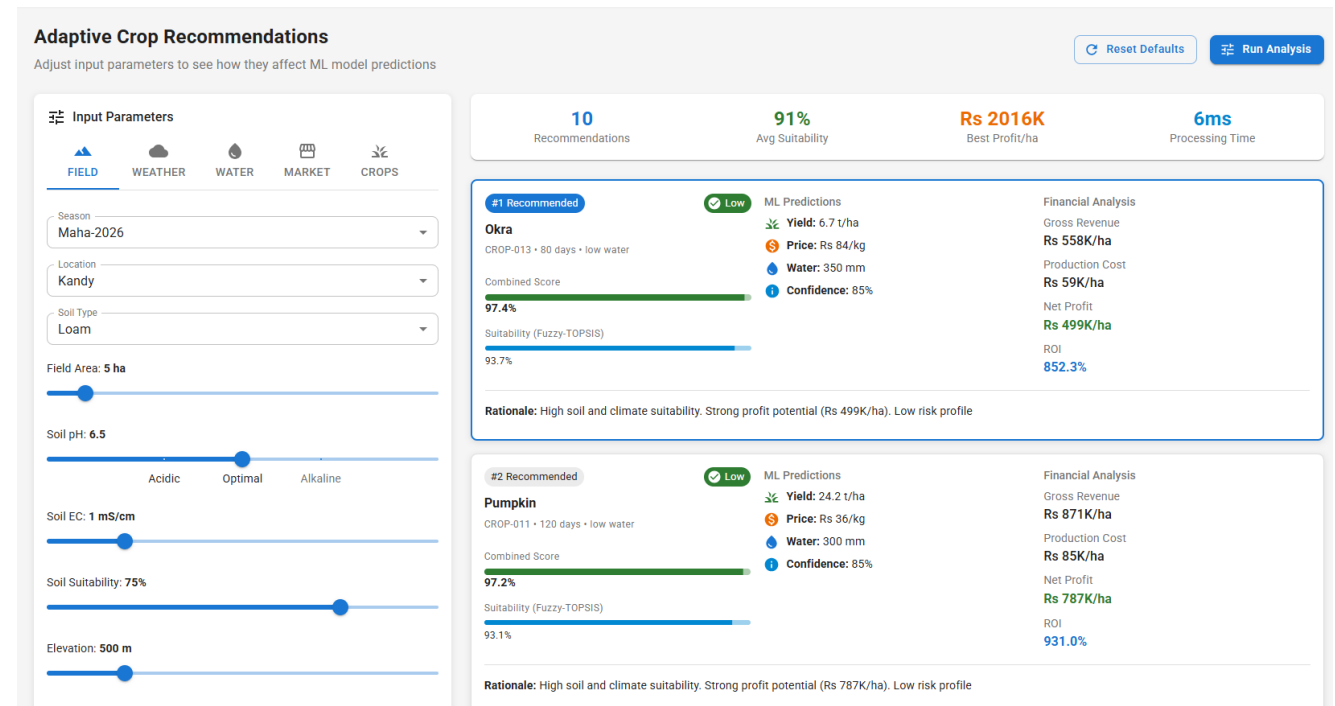
Combine:

- Field data
- Water forecasts
- Market prices

Recommend Top-5 crops per field

## User Benefits

- Profit-aware decisions
- Sustainable water usage



# ADAPTIVE CROP RECOMMENDATION & AREA OPTIMIZATION

## DESIGN & CURRENT PROGRESS

Design Contribution

**Fuzzy-TOPSIS** for suitability

**ML-based** yield & price

prediction

**Linear Programming**

optimization

Current Progress

**APIs** fully implemented

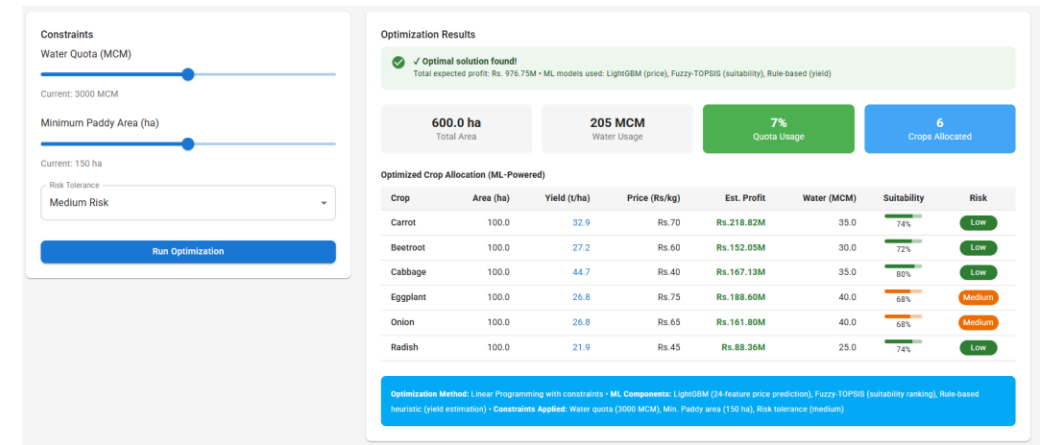
**Models** integrated

**Dashboard** visualization ready

Business Value

**Improves** farmer income

**Supports** policy-level planning



# AI-DRIVEN FORECASTING AND EARLY WARNING SYSTEM



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# AI-DRIVEN FORECASTING AND EARLY WARNING SYSTEM

## Sub-Problem Addressed

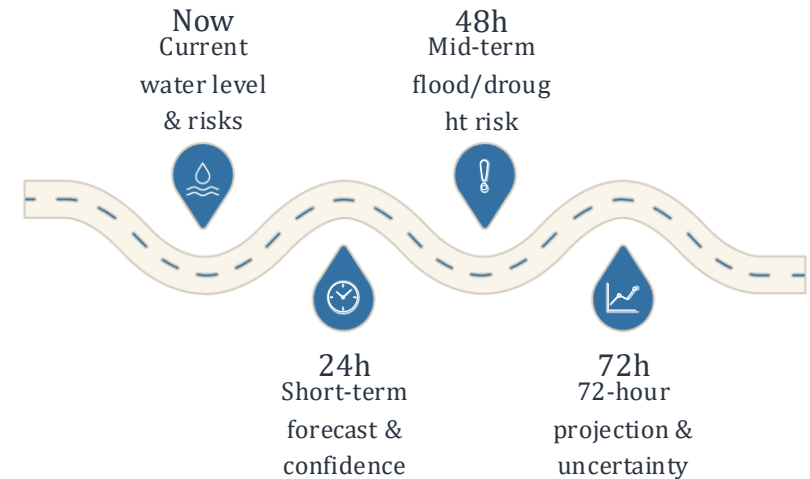
- Farmers cannot predict floods, droughts, or water shortages
- Decisions are reactive, not proactive

## Solution Approach

- Forecast water levels up to 72 hours ahead
- Use ML models:
  - Random Forest
  - Gradient Boosting
  - LSTM

## Outputs

- Water level forecasts
- Flood & drought risk levels
- Confidence intervals



# AI-DRIVEN FORECASTING AND EARLY WARNING SYSTEM

## DESIGN & CURRENT PROGRESS

### Design Contribution

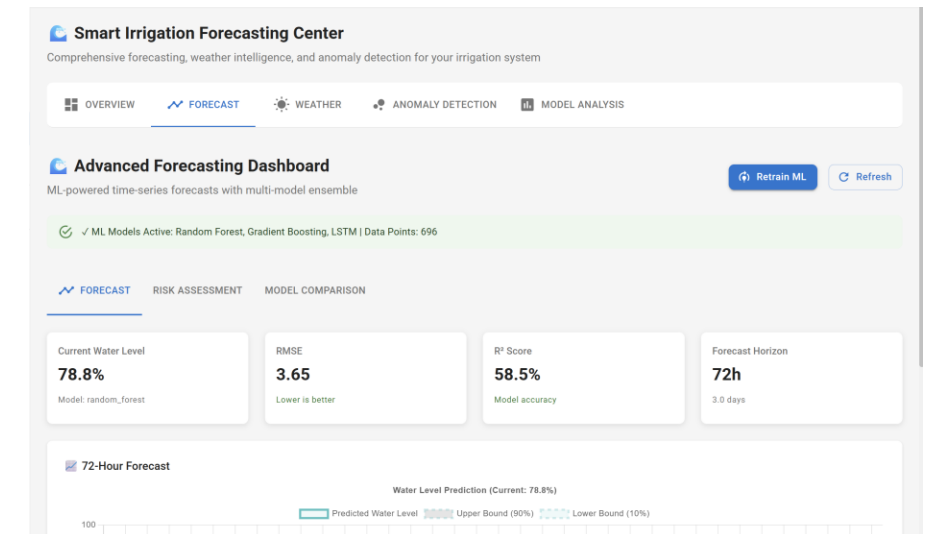
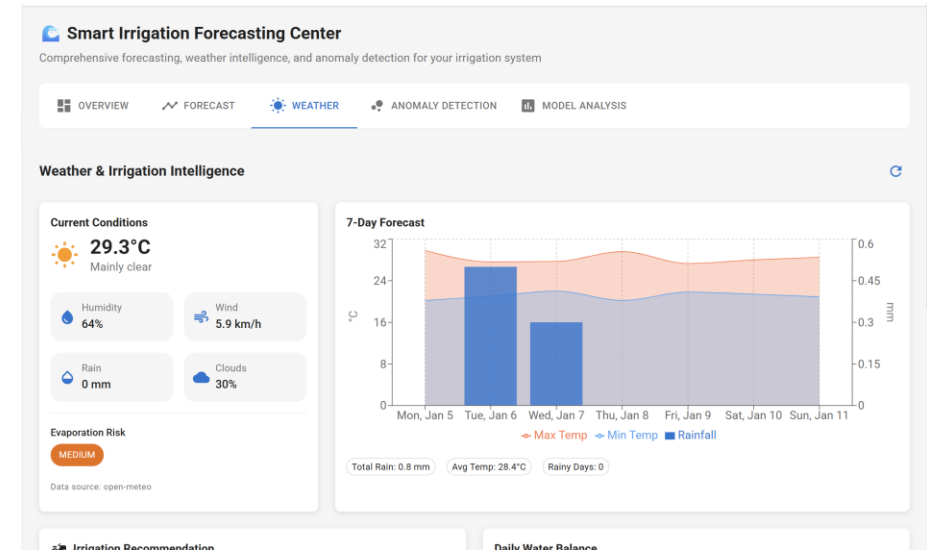
- Time-series ML pipeline
- Ensemble model selection
- REST API-based integration

### Current Progress

- Forecast APIs implemented
- Risk assessment working
- Live Swagger documentation

### Importance

Enables proactive irrigation planning



# **IOT-ENABLED ML-DRIVEN SMART WATER MANAGEMENT SYSTEM**



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# IOT-ENABLED ML-DRIVEN SMART WATER MANAGEMENT SYSTEM

## Sub-Problem Addressed

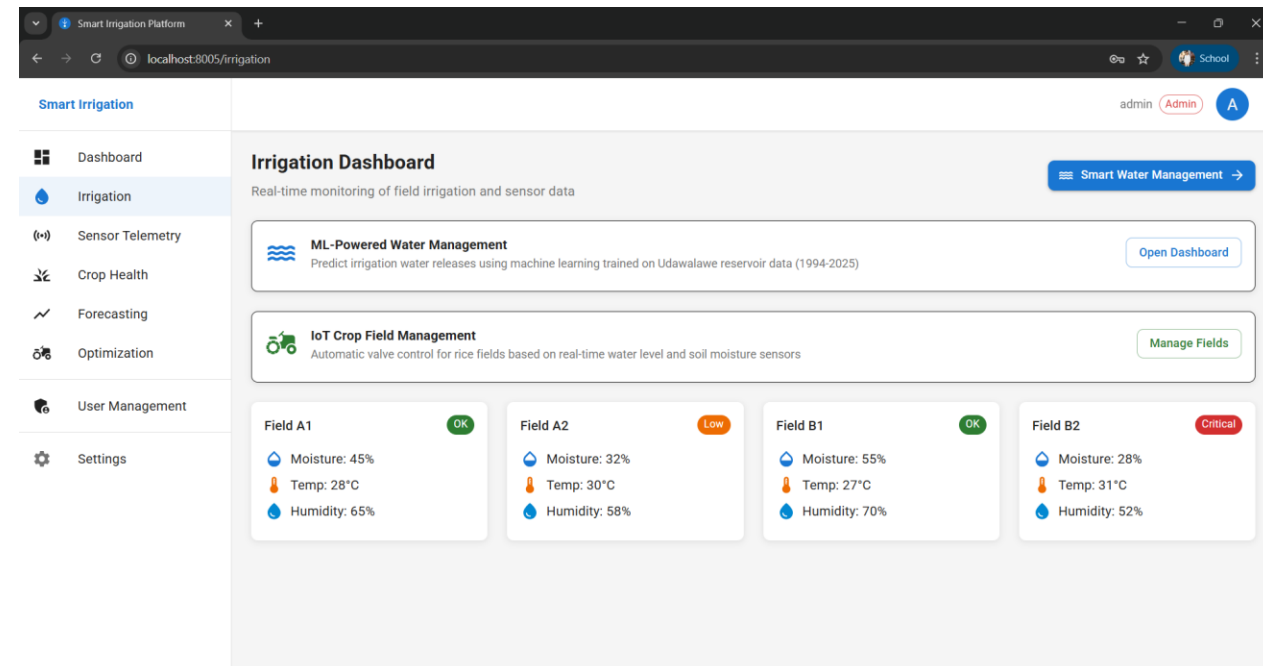
- Irrigation is manually controlled and inefficient
- No intelligent link between sensor data and irrigation actions

## Solution Approach

- Collect soil moisture, humidity, and reservoir data
- Use ML models to decide:
  - When to irrigate
  - How much water to release

## User Needs Covered

- Automated irrigation
- Real-time monitoring
- Safe water release control



# IOT-ENABLED ML-DRIVEN SMART WATER MANAGEMENT SYSTEM

## DESIGN & CURRENT PROGRESS

### Design Contribution

FastAPI-based microservice

ML models:

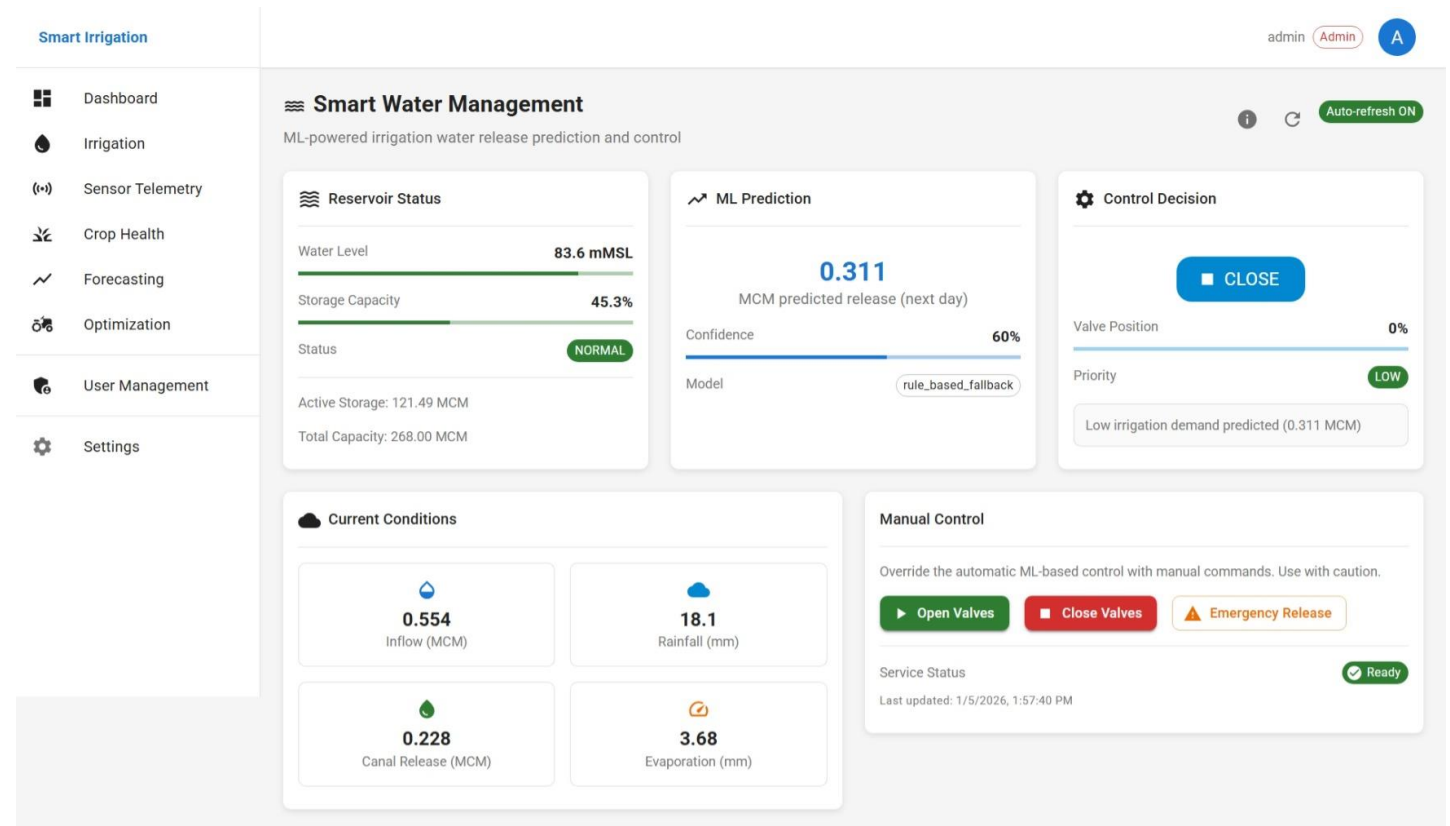
- Random Forest (irrigation decision)
- Gradient Boosting (water release)
- Manual override for safety

### Current Progress

APIs fully implemented

ML models integrated

Dockerized and Kubernetes-ready



# CROP HEALTH & WATER STRESS MONITORING



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# CROP HEALTH & WATER STRESS MONITORING

## Sub-Problem Addressed

- Crop stress is detected only after visible damage
- Satellite data alone may be inaccurate

## Solution Approach

- Use satellite imagery (NDVI, NDWI, EVI) for early detection
- Allow farmers to upload field images
- AI verifies and improves predictions

## User Benefits

- Early warnings
- Visual stress maps
- Increased trust in system decisions

**Color Legend:** Green (Healthy), Yellow (Moderate Stress), Red (Severe Stress)

# CROP HEALTH & WATER STRESS MONITORING

## DESIGN & CURRENT PROGRESS

### Design Contribution

Hybrid satellite + AI approach

Cloud-based processing

Visual dashboard integration

### Current Progress

Vegetation index computation

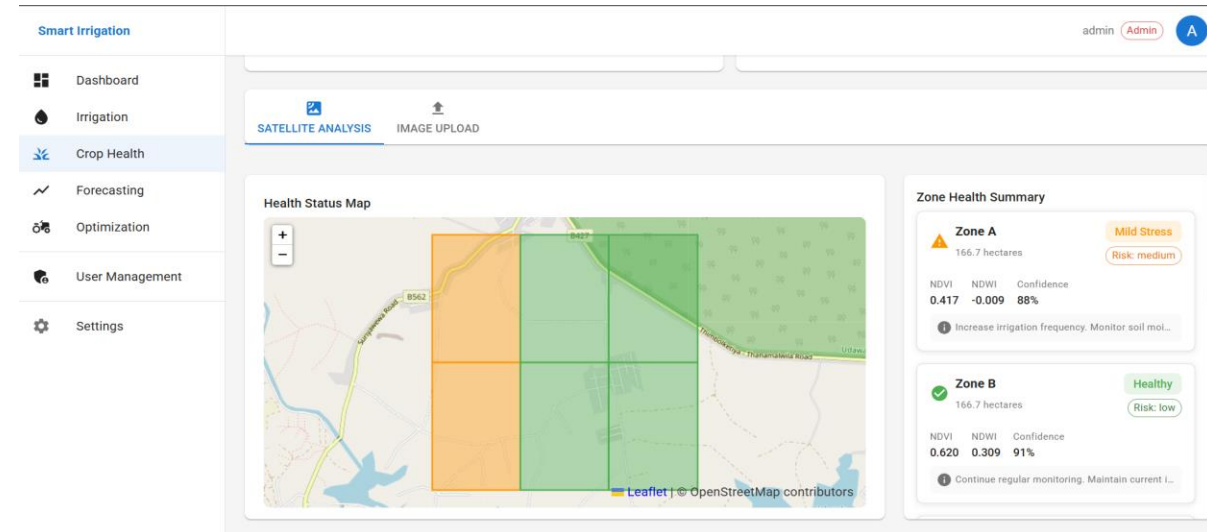
completed

Stress classification logic implemented

Image upload & verification flow ready

### Value

Prevents crop loss through early intervention



# COMMERCIALIZATION & SUSTAINABILITY

## Target Users

- Smallholder farmers
- Irrigation authorities
- Government & agribusiness

## What Makes It Unique

- End-to-end intelligent irrigation platform
- Integrates IoT, ML, satellite, and optimization

## Cost Recovery

- Subscription-based SaaS
- Government and PPP deployments
- Scalable cloud infrastructure

# Integrated Smart Water-Focused Irrigation System using IoT and AI/ML

## Customer Persona

- Smallholder farmers
- Irrigation authorities
- Agribusiness & government

## Market Potential

- Large reservoir-based farming sector in Sri Lanka
- Expandable to South Asia

# Integrated Smart Water-Focused Irrigation System using IoT and AI/ML

## What Makes It Unique

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- Subscription-based SaaS
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# **Integrated Smart Water-Focused Irrigation System using IoT and AI/ML**

**Q & A**

**Thank You!**