SMART INDIA HACKATHON 2025

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TITLE PAGE

- **Problem Statement ID –** 25010
- **Problem Statement Title-** Smart Crop Advisory System for Small and Marginal Farmers
- **Theme-** Agriculture, FoodTech & Rural Development
- **PS Category-** Software
- **Team ID-**

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1.Introduction

- Small & marginal farmers = 86% of India's farming community, produces only 50% of output

Key challenges:

- Limited access to accurate crop advisory
- Vulnerability to climate risks
- Poor access to market data & financial service

Digital divide persistsdue to:

- Low literacy rates
- Language diversity
- Lack of localized, user-friendly tools
- **Our solution**: A multilingual, AI-powered mobile app & chat bot that:
- Provides real-time, location-specific farm advisory
- Supports crop selection, soil health, pest/disease detection, fertilizer guidance
- Offers voice support for low-literate users
- Aligned with SIH goals: Inclusive tech, scalable architecture, sustainable agriculture

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2. Problem Statement

- Knowledge Gaps: Reliance on tradition/local dealers; lack of timely, scientific advice
- Low Yields, High Costs: Poor crop/pest guidance → 83% overuse fertilizers
- Climate & Market Risk: 80% hit by erratic weather; 75% lack fair market access
- Digital Divide: 70% low literacy; prefer local languages
- Survey Stats:
- 76.3% → Financial stress
- 75.6% → Market issues
- 51.1% → Lack of training
- Only 12.5% saw income > costs

3. Impact of Limited Advisory: Yield, Costs, and Environment

- **Yield Losses:** Without science-based crop planning or timely pest alerts, yield losses can reach up to 30% annually. For example, crop diseases alone are responsible for 20–40% loss annually in India.
- **High Input Expenditures:** Overuse or incorrect use of fertilizers/pesticides is common due to lack of soil data—83.6% of surveyed Indian farmers use synthetic fertilizers, often inefficiently.
- **Environmental Degradation:** Blind fertilizer usage increases soil and water contamination, while limited irrigation advisory leads to wastage of precious water resources. Flood irrigation (used by 62.5% of smallholders) is linked to soil erosion and salinity issues.
- **Market/Price Exploitation:** Poor access to market rates forces distress sales; ~75% report market difficulties and low price realization. Many must sell to local intermediaries at prices 15–20% below market value.

Case Studies/Impact Papers:

Ama Krushi-Large-Scale Digital Advisory Impact
IAMAI 2025: AI in Agriculture-Impact and Market Trends

4. Proposed Solution: Multilingual AI-Powered Mobile App/Chatbot

- **A unified, AI-powered mobile platform** designed to provide real-time, personalized agricultural advisory to small and marginal farmers by integrating multiple features into a single app or voice-chatbot.
- **Key attributes:** Multilingual (Indian languages), text and voice support, smartphone and basic phone accessible, scalable API integration.

Key Functional Modules

- **Market Prices and Notifications:** Synchronization with Agmarknet and eNAM for daily Mandi/market rates; price-trend alerts and location-wise insights.
- **Weather Alerts and Climate Risk:** Real-time, hyperlocal weather forecasting and push notifications for impending events such as rain, frost, or heatwaves—fed by IMD/APIs and in-field IoT sensors
- **Pest and Disease Detection:** Image-based diagnosis via smartphone camera, chatbot upload, or WhatsApp, returning AI-driven analysis with recommended interventions (organic and chemical).
- **Location-specific Crop Advisory**: AI recommendations on which crops to sow, considering soil type, previous crops, market demand, weather, and available resources.
- **Voice Support for Low-Literate Farmers:** Chatbot listens and responds in regional languages (Hindi, Punjabi, Bengali, Marathi, etc.) using advanced speech recognition and text-to-speech synthesis.

5. Methodology & Build Approach

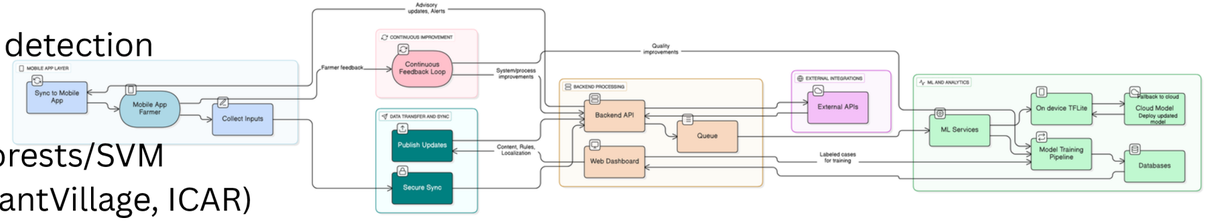
- Frontend: Android/iOS app (Flutter/React Native), chatbot web version, WhatsApp & IVR support.
- Multilingual NLP: AI models (Llama 3, GPT-4, etc.) fine-tuned on agri-domain data; supports 8+ languages
- Voice Support: STT/TTS via Google Cloud APIs + offline fallback

Backend: FastAPI/Flask microservices integrating:

- Soil health APIs
- IMD weather data
- Agmarknet mandi prices
- AI models for pest/disease detection

AI/ML Models:

- Crop advisory: Random Forests/SVM
- Pest scan: CNNs/YOLO (PlantVillage, ICAR)
- Weather alerts: LSTM/RNN
- Federated learning for privacy



End-to-end system data flow

- Personalization: Farmer profile includes crop history, soil data, language, and usage patterns.
- Security: AES-256 encryption; GPS/income data stays on-device; strict consent model.
- Continuous Learning: Real-time model tuning via federated Q&A/image feedback.
- Accessible & Inclusive: Visual/audio UI, offline caching, gender-sensitive & low-literacy design.
- Scalable: Modular APIs for fast rollout, FPO/FPC integration, easy feature expansion.

References/Resources:

AgriVoice Voice & Text Assistant
Agri Bot with LangChain
GitHub - Project Kisan: Open Source AI Agri Assistant
Soil Nutrient Sensing Device at IIT Kanpur

6.Technology Stack and Key Tools

Layer / Purpose	Technology / Tool	Role / Function	Notes / Justification
Frontend	React.js / HTML / CSS	UI/UX interface	Responsive, modular design
Backend	Node.js / Express	Server-side logic	Scalable, fast API handling
Database	MongoDB / Firebase	Data storage & retrieval	NoSQL, real-time sync
Hosting / Deployment	Vercel / Heroku	App hosting	Easy CI/CD integration
Authentication	Firebase Auth / JWT	User login & security	Secure, flexible auth
APIs / Integration	OpenWeather / Twilio	External data & messaging	Real-time weather/SMS
Version Control	Git / GitHub	Code management	Collaboration & tracking
Design / Prototyping	Figma / Canva	UI mockups & visuals	Fast iteration
Communication	Slack / Discord	Team coordination	Real-time updates
Documentation	Notion / Google Docs	Project notes & guides	Centralized knowledge base

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7. System Functionality: User Journey and Modules

Stepwise Experience:

- Login & Onboarding: Mobile-based, via OTP, WhatsApp, or FPO/FPC support.
- Profile Setup: Guided entry of farm size, crops, soil test (manual/photo/QR), voice sample for language.

Home Screen Modules:

- Ask Crop Doctor (chat/image)
- My Soil Health
- Weather Alerts
- Market Prices
- Govt Schemes

- **Advisory Interaction**: Multilingual chat/voice/image input; AI gives read-aloud or text response.
- **Voice Support**: Full audio guidance for non-literate users.
- **Smart Alerts:** Push notifications for irrigation, weather, pests, market dips
- **Offline Mode:** Caches key info; syncs when online
- **Feedback Loop**: Farmer rates advice; chatbot adapts.

Use Cases:

- Crop Planning:
- Disease Diagnosis:
- Market Strategy:
- Extension Updates: Voice alerts on PMFBY deadlines & SHC subsidies.

References/Resources:

Smart India Hackathon 2025 Official Portal

ICRISAT ISAT Advisory Tool Case

Agri Bot: Al Chatbot for Farmers

CropSathi Smart Agriculture Platform

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Impact & Feasibility

- Yield & Productivity: +20–30% yield through data-driven cropping & timely inputs
- Loss Reduction: Early pest/disease detection cuts losses 10–25%, lowers input cost 20%
- Resource Efficiency: Fertilizer waste ↓ 30%, water saved 15–40% with precision irrigation
- Farmer Income: Seasonal earnings ↑ 4–6% via better market timing & direct buyer linkages
- Inclusion: Voice + local language → empowers women, elderly, low-literate farmers
- Proven Tech: AI/ML models already validated in agri-advisory pilots (CropIn, Plantix, Ama Krushi)
- Data Backbone: Integration with KVK, ICAR, ICRISAT, weather APIs, eNAM ensures reliability
- Farmer-Centric Design: Offline caching, voice-first UX, low-bandwidth optimization
- Scalable Model: Modular architecture, easy to replicate across states & crops
- Adoption Drivers: Govt schemes, NGO partnerships, FPO/FPC networks accelerate trust & uptake

Key Benefits of the Solution

For Farmers

Yield ↑ 20–30% through data-driven cropping

Input cost ↓ 20–30% (fertilizer, water, pesticides)

Income ↑ 4–6% via better market timing & direct linkages

Reduced risk from early weather & pest alerts

Inclusive access with voice + local language support

For Society & Environment

Food security boost through higher productivity

Sustainable farming: less chemical overuse, lower GHG emissions

Water conservation: 15–40% savings via precision irrigation

Soil health protection through optimized fertilizer use