



required. Next, farmer's unique Simulation-ID is created, which can be used later for executing the simulation in a single step. For each simulation, unique simulation ID is created. The parameters required for generating this ID are:

- ◆ Crop
- ◆ Date of Planting
- ◆ Soil Type
- ◆ Crop Area
- ◆ Duration
- ◆ e-Crop ID
- ◆ Variety
- ◆ Field ID
- ◆ Farmer ID
- ◆ Initial values of N.P.K and water in the soil
- ◆ Location (Latitude, Longitude, Altitude)

**Step 3 Input management:** In this section, the user can add the information regarding the water, N.P and K which were available in soil at the time of planting as well as that added during planting and at later stages.

**Step 4 Results of Simulation:** Each day the crop growth is simulated using the web interface/mobile app using this simulationID. The advisory generated from the simulation is sent to the mobile of the farmer as well as to other mobile numbers included while creating the simulation ID.

#### The advisory contains the information on

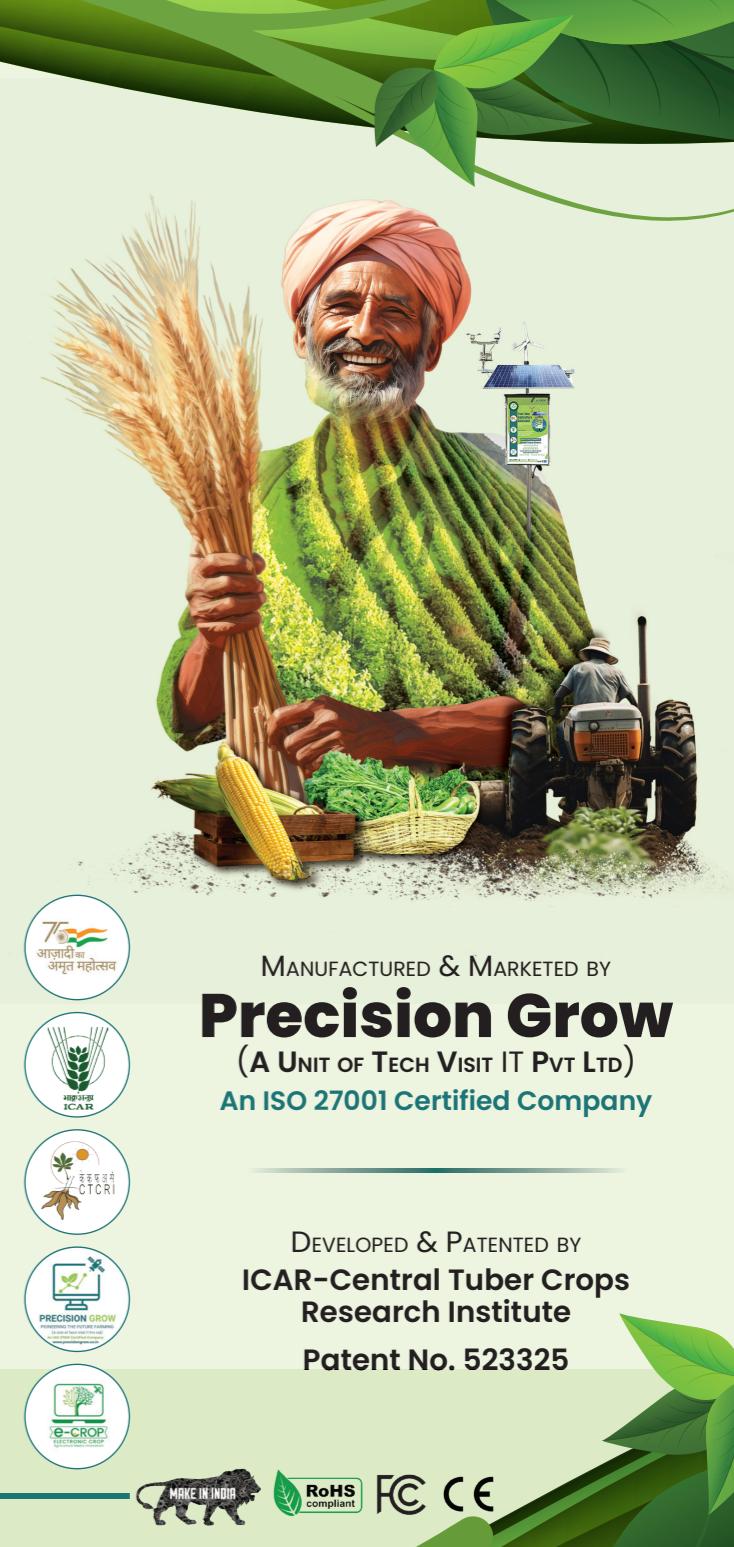
- ◆ Date of Planting
- ◆ Normal yield predicted
- ◆ Variety of crop
- ◆ Cultivated area
- ◆ Potential yield achievable as on date
- ◆ Water, Nitrogen, Phosphorous and Potassium

Results of execution of simulation reach the farmer's mobile through SMS. Fig 6 shows the view of SMS (Crop advisory generated by e- Crop) on 10th June 2022.

This SMS includes date of planting, cultivated area, variety, location of field which includes latitude and longitude, potential yield achieved as on date in Tones. The advisory part of the SMS includes water and fertilizer requirements. It specifies the water requirement (Liters) for that day, next one week and for the remaining crop duration in one dose. The fertilizer advisory includes the required amount (kg) of Nitrogen, Phosphorus and Potassium to be applied on that day, next one week and for the remaining total crop duration in one dose. This device can be used for giving real-time agro advisory of any crop to reduce yield gap and to achieve targeted yield. This helps in the application of fertilizers as per demand and in smaller and frequent doses which helps in reducing the losses and at the same time increasing the yield.

#### Applications of the device

- Forecasting of yield of the crop can be done more accurately at local, regional and national level.
- The forecasts sent by the e-Crop devices installed in different places to the centralized database can be pooled and a national/state/regional level crop yield/status can be obtained by just compiling that information at the desired level for different times in future.
- Device gives information to the farmer in the form of SMS about what is happening to the crop even if he is far away from the field.



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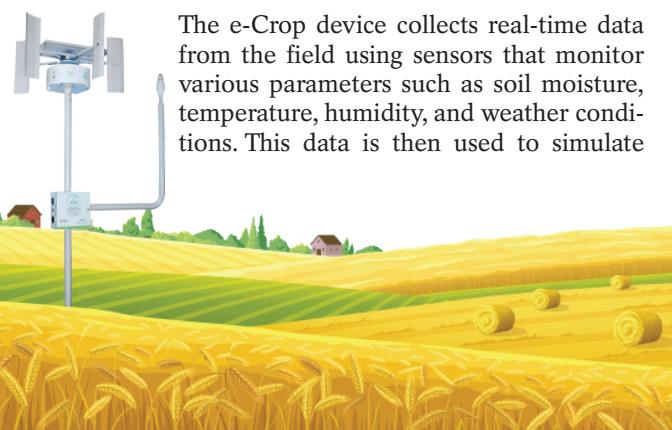
## ADDRESSING FOOD PRODUCTION CHALLENGES WITH SMART FARMING TECHNOLOGY

Present-day food production is insufficient to achieve zero hunger, especially in third-world countries where food demand is continuously increasing due to the ever-growing population. As the cultivable area in these regions is shrinking, achieving higher productivity from the available genetic stock is the only viable solution. Attending to individual crops and applying the necessary inputs in precisely sufficient quantities can significantly increase production and minimize environmental loss.

The gap between potential and achieved yield is generally wide, and narrowing this gap is a challenging task crucial to meeting the increasing food requirements of the future. Smart farming technology, which integrates technological advances in information technology with agriculture, is the best strategy to reduce this gap. One such innovative solution is the Electronic Crop (e-Crop) device developed and patented by ICAR-CTCRI for smart farming is an innovative solution that leverages technology for enhanced agricultural practices. This device, designed to support smart farming, is manufactured and marketed by Tech Visit IT.

## HOW e-CROP WORKS

The e-Crop device aims to improve farming efficiency, crop management, and yield through advanced electronic monitoring and data-driven insights.



The e-Crop device collects real-time data from the field using sensors that monitor various parameters such as soil moisture, temperature, humidity, and weather conditions. This data is then used to simulate

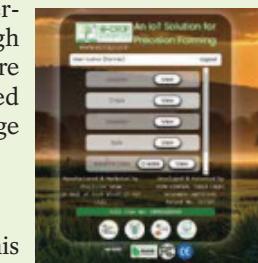
crop growth, providing farmers with actionable insights into the optimal conditions for their crops.

### Benefits of e-Crop for Smart Farming

- 1. Increased Productivity:** By optimizing input use and closely monitoring crop growth, farmers can achieve higher yields from their available genetic stock.
- 2. Environmental Sustainability:** Precise application of inputs reduces waste and minimizes the negative impact on the environment.
- 3. Cost Efficiency:** Targeted input use can lower costs for farmers, making agriculture more economically viable.
- 4. Real-time Monitoring:** Continuous data collection and analysis enable farmers to make informed decisions, enhancing their ability to respond to changing conditions.
- 5. Bridging the Yield Gap:** The e-Crop device helps narrow the gap between potential and achieved yields, addressing the pressing need for increased production.

### e-Crop Interface

e-Crop web interface is the platform which facilitates the management of farming. This interface can also be operated through "Krishi Krithya" mobile app. There are different types of users based on the rights assigned to manage e-Crop.



#### a. Admin

Admin is the super user of this system, having complete access to all the modules. The rights of Admin are:

- ➔ View and add new e-Crops, locations, users, crops, varieties, soil types and its composition and fertigation devices.
- ➔ Set up simulation for crops like cassava, sweet potato, elephant foot yam and any other crop which is added to the system.

#### b. Device Owner

Rights of Device Owner are:

- ➔ View the entire features as shown in Fig 2.



- ➔ Add new Farmer type users
- ➔ Set up simulation
- ➔ Add or update the fertigation system

#### c. Farmer

Rights of Farmer are:

- ➔ View the entire features as shown in the Fig 4 and
- ➔ Set up simulation.

#### d. Manager

The smart farming at a farmer's field can be monitored at different levels of hierarchy from Director of Agriculture at the state level upto the Agricultural Officer at Panchayat level. The Director of Agriculture can view the details of e-Crop based smart farming being performed in every farmer's field of the state. Similarly the Principal Agriculture Officer can monitor every farmer's field of the concerned district performing e-Crop based smart farming.

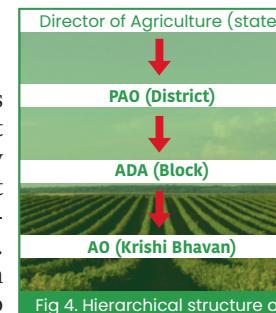


Fig 4. Hierarchical structure of Manager user to monitor e-Crop based smart farms

The Assistant Director of Agriculture and Agriculture Officer can view the details in every farmer's field under their jurisdiction at the block and panchayat levels respectively.

Agriculture Officer is the device owner who has the right to add new farmers under his jurisdiction to the interface.

### Management of Farm Using e-Crop

**Step 1 Addition of New Farmer:** Device Owner adds new farmers for the e-Crop device coming under his purview. Then set up a new simulation for these farmers for their scenarios of crops, soils, varieties, devices etc which were already added by the Admin.

#### Step 2 Creation of SimulationID:

When a new simulation needs to be done, inputs like the crop, crop variety, location, date of planting, e-Crop device, cultivated area are

## KEY FEATURES OF e-CROP

- Crop Management Dashboard**
- Real-Time Weather Data & Field Insights**
- Financial Management**
- Predictive Disease Detection & Prevention**
- Market Insights & Mandi Prices**
- Community Features for Farmers**

## ADVANTAGES OF e-CROP

- Simplifies Crop Management
- Accurate Weather Insights
- Boosts Profitability
- Disease Prevention
- Customised Solutions
- Market Guidance
- Community Support

## WHY CHOOSE e-CROP

- Data-Driven Decisions
- Predictive Disease Management
- Farm & Financial Planning
- Access to Market Data
- Collaborative Farming Community