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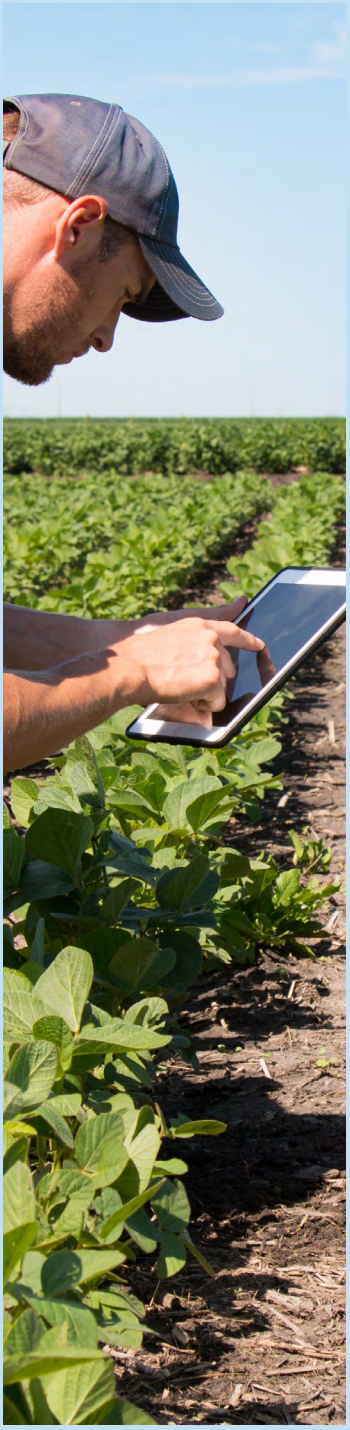

INFOSYS DIGITAL AGRICULTURE PLATFORM

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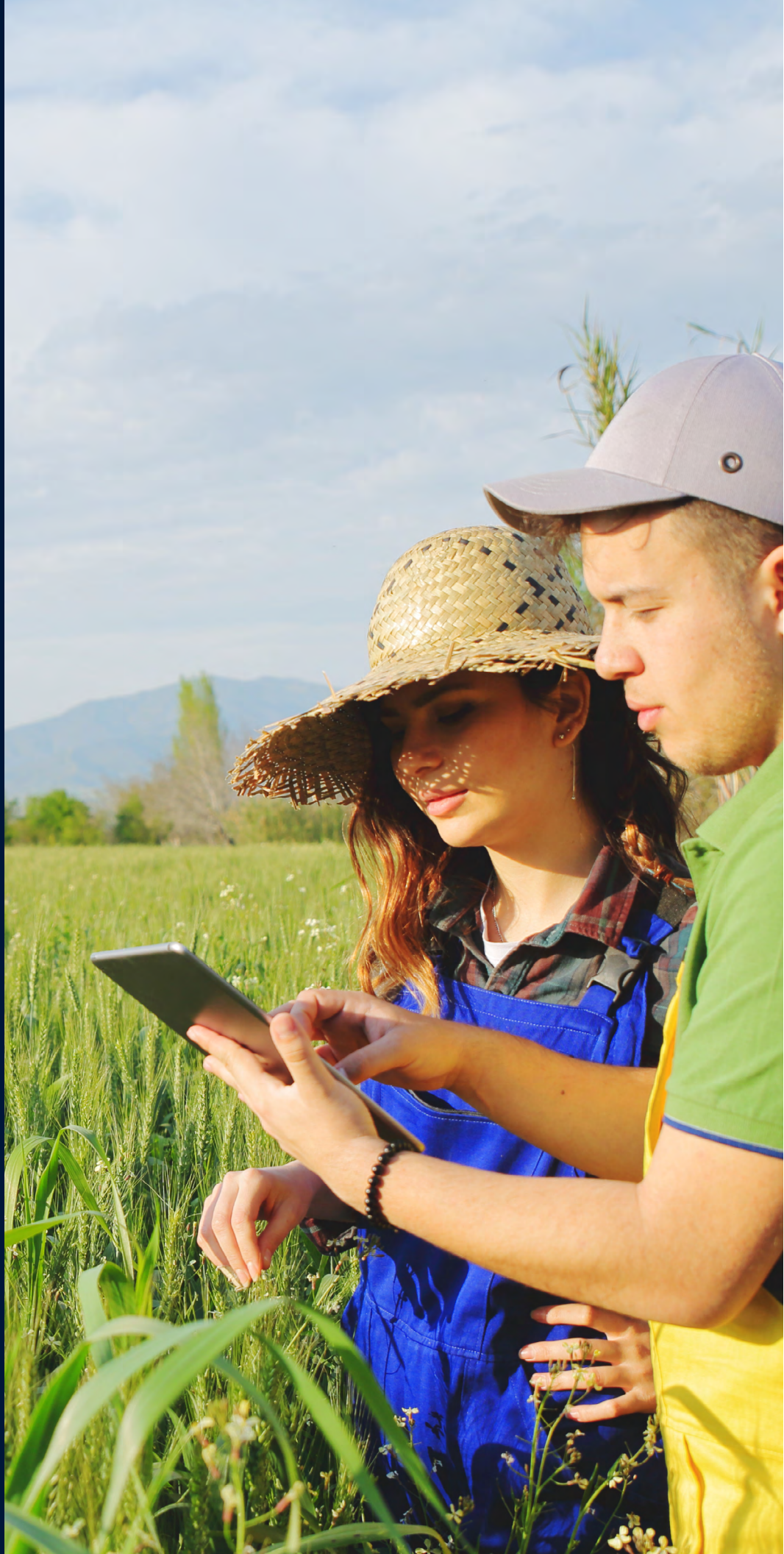
Introduction

The United Nations projects that the world's population will reach 9.7 billion by 2050. Feeding this population will require global agricultural production to rise by 69% between 2010 and 2050. How do we make this happen?

The agricultural supply chain currently needs to address several concerns faced by farmers and distributors, such as rapid climate change, and land and water scarcity.

Many of the concerns of farmers and other stakeholders in the agricultural industry can also be addressed by empowering stakeholders with Information and Communication Technologies (ICT). For instance, IoT offers farmers an opportunity to view their environment - fields, resources, storage facilities, etc. - in a new way through connected devices, automation, analytics, and mobile apps.

Data analytics can identify various risks along the supply chain such as degrading crop conditions, livestock management, loss of products during transit, and more. A database of satellite images can help to access and monitor crop conditions across a farm. Data collected from sensors placed on animals can monitor fertility, lactation, and general health. Unlike other goods, food products are perishable and can pose a health risk if they are not transported at a predefined temperature. Real-time information about the products can be accessed as they make their way from the fields to markets around the world. Distributors can identify and address inefficiencies in their supply chain and enable agricultural products to get to their destinations faster and cost-effectively. Retailers can use sales and inventory data to minimize waste and avoid excess inventory while staying a step ahead of market demands.



Infosys Digital Agriculture Platform

The IoT-powered Infosys Digital Agriculture Platform aims to address the challenges faced by agri-businesses considering the local, relevant, and individual characteristics of the supply chain and operations. To help farmers make informed decisions, increase productivity, and profitability, digital technologies such as IoT, big data analytics, visualization capabilities, and industry domain expertise are used to build the Digital Farm model.

The platform leverages the potential of data and insights to address concerns in farming. It considers the impact of local conditions, climate, and planning inputs across a farmer's business cycle.

Focus Areas

Infosys Digital Agriculture Platform focuses on integrating 'parts' of agricultural knowledge, which makes the technology of farming applicable to different regions and closely connects with the economics of farm to fork.

The decision support extended by the Digital Farm models spans right from planning to post-harvest viz. planning inputs for the crop season, seed variety recommendation, type of farm equipment and resource planning, crop cultivation insights for best yield and output, crop protection recommendations, and post-harvest planning and distribution.

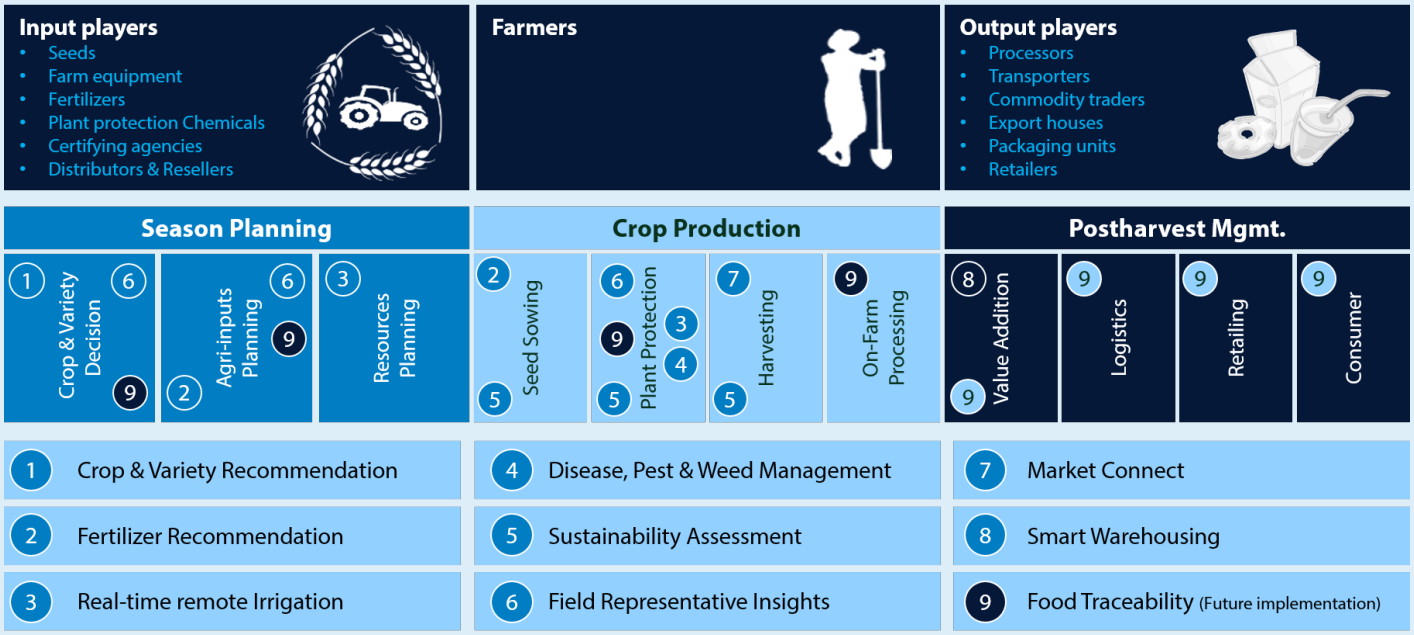


Figure 1 Digital Farm – Focus areas

The platform is deployed at our farm in Hyderabad, India and the cultivation site is known as a digital farm. The fundamental driver for the digital farm is the availability of smart machines and sensors that provide real-time data of the object of interest, for instance, soil moisture, nutrient, machinery location, sprayers, and more. the core of the Digital Farm, sensors and the rest of the infrastructure enables insights and ensures the farming processes are data-driven and data-enabled. Extrapolated, the potential of data sharing and infrastructure integration along the supply chain as well as across the industry can provide significant benefits to the farming community.

Digital Farm Overview

Infosys started its digital farm in 2015. The one-acre farm was divided into three sub-plots to equip each sub-plot with IoT equipment such as weather sensors to monitor temperature and relative humidity, and leaf wetness sensors. There were also soil moisture sensors, water level sensors for monitoring water levels in water tanks, automatic solenoid values, 4G Wi-Fi, and more. The crop varieties grown in these sub-plots are based on the Digital Agri Farm App advisory considering agro-ecological zones and other preferences. Crops of corn, chickpea, soya bean, sunflower, and capsicum have been successfully grown by using this platform.

Figure 2 Digital Farm (Crops: Sunflower and Corn)

Digital Farm Model Layout

- The digital farm provides a view of the field - seed, soil, crop, resources - through an interactive web or mobile application
- This solution is embedded with a host of sensing devices to capture field data - weather data, warehouse data, and aerial imagery - from drones and satellites
- A layer of business rules/ logic is written to process and analyze historic and transactional data residing on Infosys Information Platform (IIP) and provides actionable insights through a user interface and dashboards

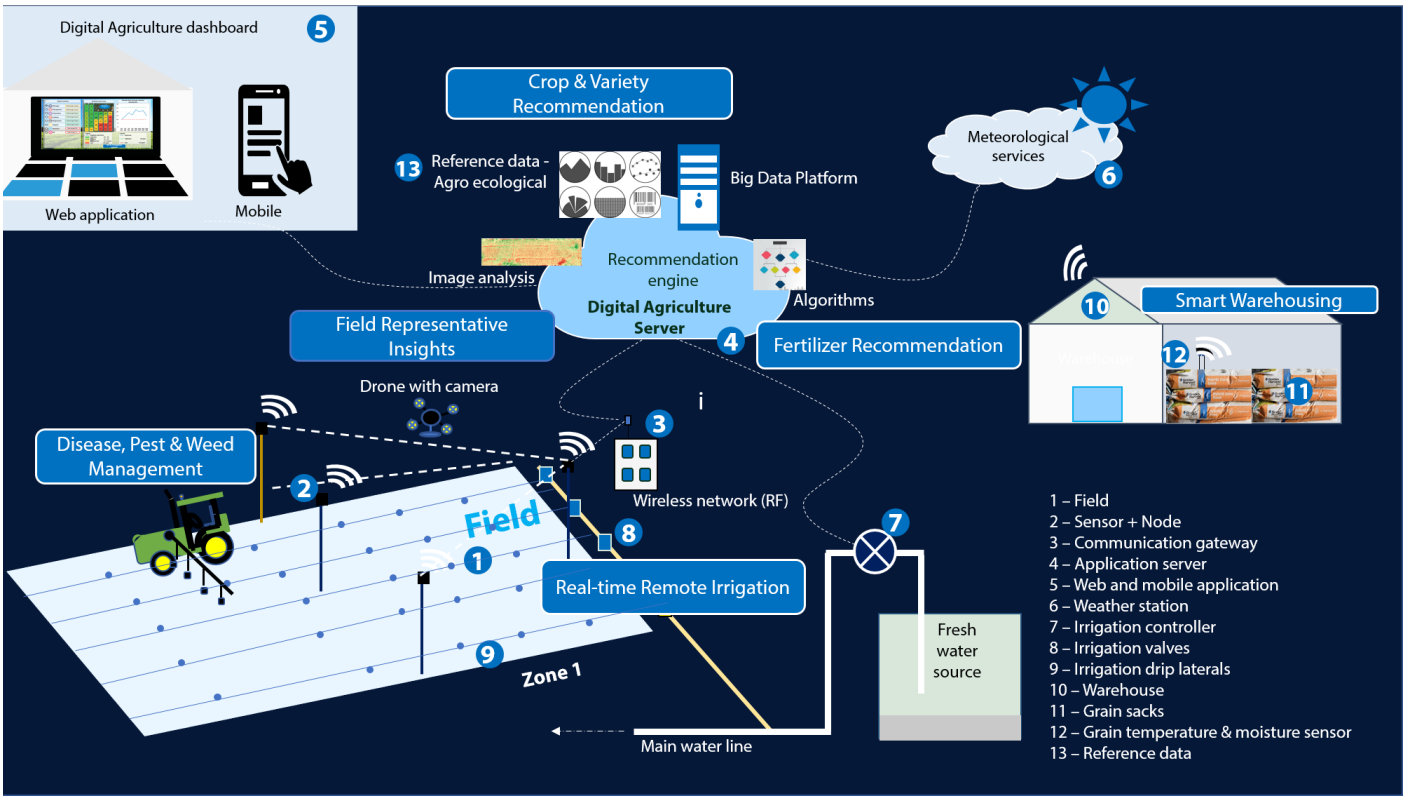


Figure 3 Digital Farm model layout

Digital Farm Model Layout

A typical digital farm operates by assimilating the necessary inputs from the field. This data is typically layered with weather history and forecasts from certain reliable, local third-party data providers to introduce more intelligence while processing.

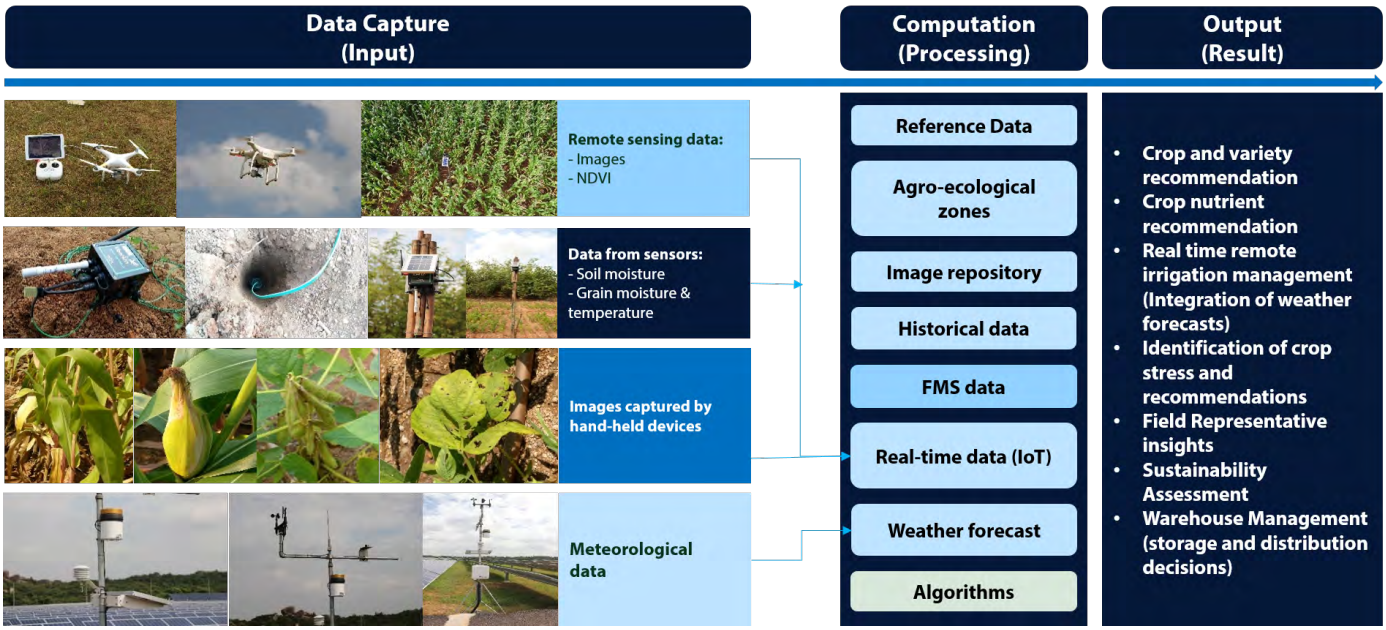


Figure 4 Digital Farm in action

The computation layer of the digital farm processes the inputs based on defined business rules and logic and generates specific outputs for the understanding of the problem being addressed.

The application can be accessed through the web or mobile applications. Below are some screenshots of the web application of the Infosys Digital Agri Platform:

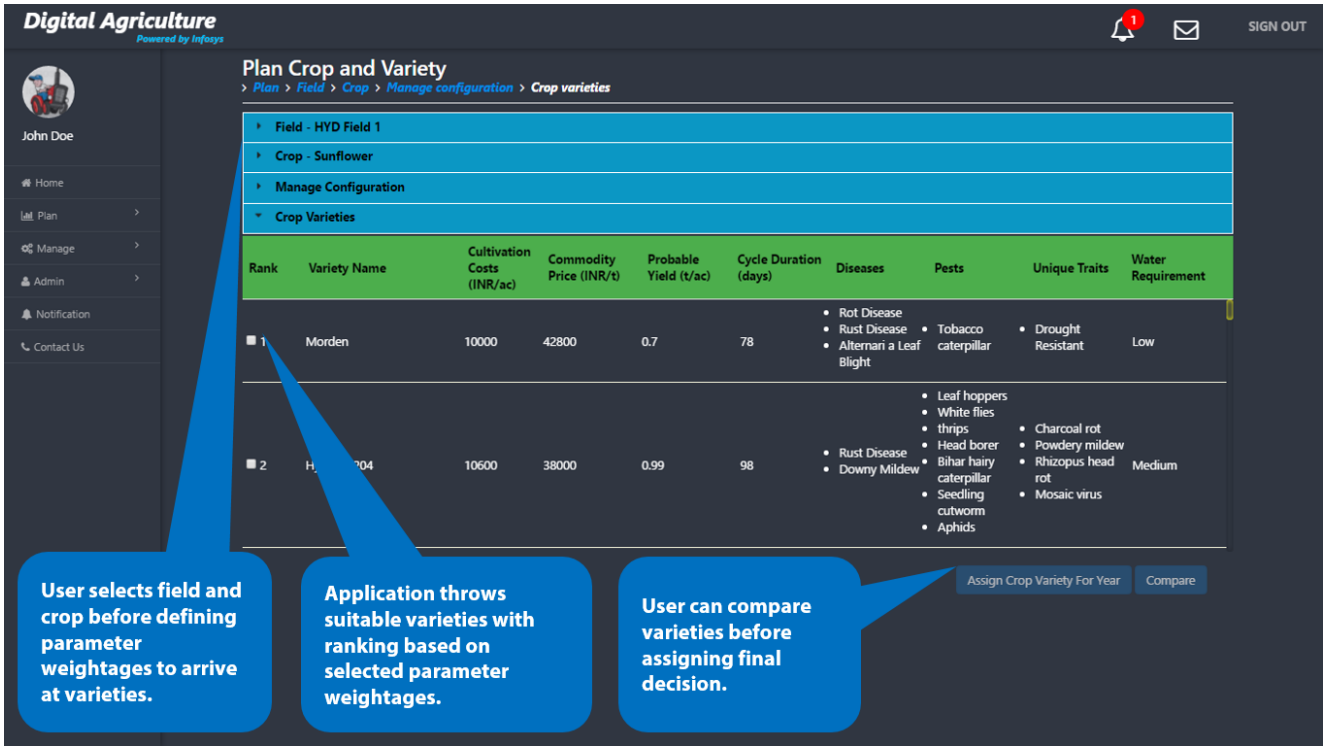


Figure 5 Crop and Variety Selection

Figure 6 Crop and Variety Selection

Figure 7 Real-time irrigation

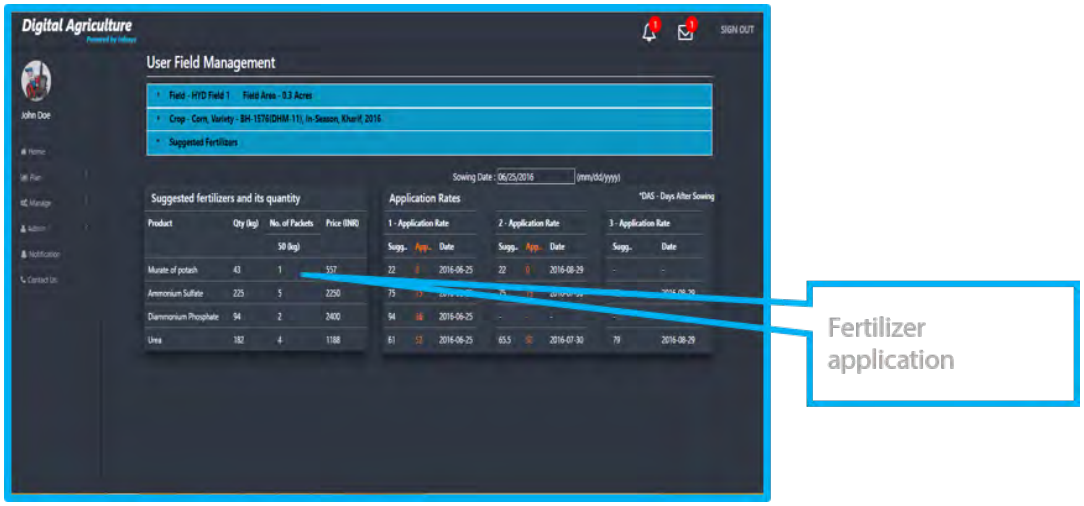


Figure 8 Fertilizer application

Solution capabilities and benefits

The expertise of Infosys in providing consultancy and solutions in digital agricultural domain has led to the identification of the below use cases which in many ways can be referred to as modern agricultural practices with the application of novel technologies such as Industrial Internet of Things (IIOTs), data analysis, drones image analysis, and more.

Using the Infosys Digital Agriculture Platform, we have successfully grown multiple crops for seven consecutive seasons. We have observed a 10-20% increase in yield while reducing the cost of cultivation by 5%. The platform has reduced water inputs by 20%. Sustainability indicators have also shown improvement.

Use Cases	Capabilities	Benefits
Crop and variety recommendation	Recommend crop and variety based on user's preference for predefined parameters and on agro-ecological zone.	Selection of suitable crop and variety results in higher yield thereby increasing the profitability.
Fertilizer recommendation	Recommend fertilizer and its application rate and time based on crop nutrient requirement, soil type and available package sizes.	Personalized fertilizer recommendation and optimization of application rate thereby reducing the cost of cultivation.
Real time remote irrigation	Schedule irrigation based on real-time data of parameters such as soil moisture content, soil type, crop growth stage and weather forecast.	Optimization of water usage thereby growing more with less.
Disease, pest, weed and nutrient deficiency	Identify the crop stress area and assess overall crop health and recommend suitable corrective measures.	Timely intervention to resolve crop stress and recommendation of most suitable corrective action thereby reducing yield losses and increasing profitability.
Market connect	Provide complete visibility of anitcipated raw material yield across the post-harvest supply chain.	Refined procurement strategy and improved efficiency of the field staff of procurement companies.
Smart Warehousing	Monitor post-harvest output remotely to prevent storage losses and assess their perishability based on moisture and temperature data.	Effective control of post-harvest losses during storage thereby reducing financial losses of procurement companies.

Figure 9 Digital Farming Use cases

Customers' visit the Digital Farm

Several of our customers from Europe, America, Singapore, Australia and government officials from Singapore and India have visited the Infosys Digital Farm. The customers including BASF, AGCO, Bosch und Siemens Hausgeräte G, Olam international, Syngenta, CDK global, Zahnradfabrik, Pepsi-co, and others. Visitors were impressed to see the real-time lab-like set-up of the farmsunflower, and capsicum have been successfully grown by using this platform.

Figure 10 Digital Farm – Customer Visits'

Digital Farm – future steps

Digital technologies and analytics-based solutions have the potential to revolutionize agriculture practices, making farm operations more insight-driven and efficient. Age-old farming practices can be transformed with IoT, by collecting data. Farmers can now reduce waste and bolster productivity to improve the financial performance of their operations.

The current Digital Farm model has numerous technological and functional touchpoints:

Use Cases \ Capabilities	GIS/GPS	Predictive Analysis	Image Processing	Sensors' Integration	Decision Making	Automated Actions	Personalized Recommendations	API integration	Algo/Optimization	Master Data Management
Crop & Variety Recommendation	●				●		●	●		●
Fertilizer Recommendation					●		●	●	●	●
Real-time Remote Irrigation	●			●	●	●	●	●	●	●
Disease/Pest/Weed Management	●		●	●	●		●			●
Sustainability Assessment					●		●			●
Field Rep. Insights	●		●		●		●			●
Smart Warehouse Management	●	●		●	●		●		●	●

Additional opportunities for digital farming lie in the below use cases that are being explored by various technology companies around the world in collaboration with farmers and Agribusinesses:

- **Precision farming coupled with prescriptive analytics**
  - Crop variety planning, harvesting, and disease protection ultimately leads to better yield and output
  - Variable Rate Applications (VRA) can pave the way for automated application of materials like herbicides, chemicals, and seeds to specific farm zones based on granular insights about the landscape
  - Application of nanoparticles in farming and use of biosensors for advanced monitoring throughout the crop cycle
- Vertical farming technology – the enabler to any-season-farming for a secure business
- Farm operations and management through insights-driven data analytics - connected farm equipment and resources
- Farm Management Information Systems (FMIS) – allows for automated financial analysis based on all farm transactions and estimating farming KPI for monitoring and control
- Blockchain technology – Track and trace farm to fork lifecycle leading to increased food security, compliance, and sustainability quotient

An Intelligent Farm can not only intuitively help farmers to automate their farming but also shift to precise cultivation for higher crop yield and better quality while using fewer resources.

For more information, contact askus@infosys.com

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