

Chapter 17

Farming 4.0: Technological Advances That Enable Smart Farming

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ABSTRACT

Generally, the rate of technological advancement is increasing with time. Specifically, the technologies that are the building blocks of Farming 4.0 are now advancing at a rapid pace never witnessed before. In this chapter, the authors study the advances of major core technologies and their applicability to creating a smart farm system. Special emphasis is laid on cost of the technology; for, expensive technology will still keep small farmers at bay as major population of farmers inherently are new to technology, if not averse. The authors also present the pros and cons of alternatives in each of the subsystems in the smart farm system.

INTRODUCTION

Farming, one of the oldest occupations of mankind, has undergone several refinements all through the history of human civilization, but had never been perfected though. Farming in itself is a conglomeration of multiple sciences like Botany, Zoology, Chemistry, Geology and Meteorology. Traditional farming practises involved leveraging knowledge on these disciplinary fields and applying them on agricultural field (pun!) subjectively. Though these scientific disciplines are at the core of farming, technological aids come from other disciplines of science. Until last decade most of the technological aids came in the form of mechanical engineering which without doubt did contribute primarily to mechanize most of the hard work that demanded muscle power.

In the past decades, powered machinery had replaced many farm tasks erstwhile performed by humans or animals. The current era of farming partially incorporates multiple aspects of automation

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through computer technology. For example, semi-automated farm irrigation system irrigates the farm with minimal manual intervention as required, by employing timers and solenoid valves.

The next revolution in this sector, appropriately termed as Farming 4.0, is a culmination of several complex sciences and technologies and has immense potential to revolutionize farming. Farming 4.0 would certainly unleash the true potential of this amalgamation of technologies to come up with innovative solutions to farming problems with the objective of doing more with less. In other words, Farming 4.0 would increase the quantity and quality of farm produce and reduce the application of nutrients and pesticides. To be more precise, it attempts to optimize fertilizer and pesticide application by identifying which section of the field needs what inputs and how much and applying the same accordingly. This is called Precision Farming and the technologies that make this possible are Variable Rate Technology, Wireless Sensor Network, Drone technology, Computer Vision, Artificial Intelligence, Robotics, Cloud Computing, Big Data, etc. Strictly speaking, many of these are cross disciplinary themes and very much lie at the heart of Smart Farming.

The technology that lies at the forefront of making the paradigm shift from traditional open field cultivation to closed, protected and controlled cultivation is Green House Technology. Moreover, sensors, microcontrollers and actuators are increasingly being used in protected cultivation to bring in a degree of automation wherein each of the above said parameters may be precisely controlled to create optimal growth conditions for the crops. Further, in this chapter, we will explore how technology can help increase the efficiency of some of the major farm activities in the growth stage of crop management like:

- Water management
- Nutrient management
- Pest management
- Crop Stress management

The objective of the chapter is twofold:

- Help farmers realize that technology has arrived at their doorsteps (farm gates?!) and it is just waiting for them to invite with both hands into their farms
- Get the new researchers up to speed on the technological advances in smart farming, so as to help them steer further researches in the right direction

Table 1. Interplay of various Technologies as part of Farming 4.0

Functional Areas	Farm Activities	Technologies Enabling Automation	Interface for Farmers
Water management	Borewell motor operation, Irrigation valve controls	Sensors, Robotics, Cloud, AI/ML	ChatBots, mobile apps, web interfaces
Nutrient management	Crop monitoring, Deficiency identification, Fertigation	Computer vision, Imaging, Sensors, Drones, Cloud, AI/ML	
Pest management	Pest monitoring, Disease identification, Pesticide application	Computer vision, Imaging, Sensors, Drones, Cloud, AI/ML	
Crop stress management / micro-climate maintenance	Crop monitoring, stress identification, Actuating Shade-nets, Foggers, Misters, Fans, Side-curtains, etc.	Computer vision, Imaging, Sensors, Drones, Robotics, Cloud, AI/ML	

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