

## Smart Farming: Concept and Potential

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### Abstract

Smart farming provides an integrated approach to dealing with various crops according to Spatio-temporal of soil variability with the aim of minimizing inputs, maximizing profitability, improving fruit quality, and improving yield. Adoption of smart agriculture implements various practice management and increases crop yield, there are different steps required for the adoption of smart agriculture particularly understanding the transferring data pathways to the control unit to monitor the farm via automatic control support on-time sensor to make the right decision in proper time. There are many tools used in smart farming to support farmers and help them to modernize various practice management including site-specification tools, wired and wireless sensors, weather stations that monitor environmental conditions, in addition using agricultural drones that have an essential role in smart farming.

**Keywords:** Drones; Fruit quality; Smart farming; Spatio-temporal; Wireless sensors, Yield

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### Introduction

#### Background

Farmers face more challenges and struggle to increase their productivity, such as shortening in labor and fluctuation in climate conditions, which causes lack of rainfall, soil decline, and various environmental stresses, besides that, production costs are expensive due to the high price of various inputs [1,2]. Furthermore, infection with Pests, insects, and different pathogens cause drastic losses to reach billions of dollars annually worldwide. Previous elements reduce farmers' profits and could eventually destroy the orchards industry. Smart agriculture is considered the fourth green revolution, which depends on data collecting and analysis by using computerized technologies to increase the efficiency of different resources, reduce inputs, and increase productivity. Internet of Things technology is the backbone of smart agriculture, it is represented by information technology services, followed by software, and specialized equipment [3]. There is a crucial role for farmers in increasing various applications of smart agriculture, like using data collectors to collect and analyze data, spreading various sensors, and using automation machines to improve their production [4]. Adoption of smart agriculture required replacing the manual equipment with automatic machinery to increase the efficiency of the various inputs and increase farmers' profits [5]. Smart machinery helps farmers to reduce manual machines and increase profitability. Therefore, understanding features of precision agriculture and related digital technology for the consideration of increasing crop

yields is very essential. Smart agriculture is characterized by its ability to raise the economic efficiency of the farm, via minimizing inputs, maximizing yields, and enhancing the provision of environmental resources, in addition to its positive impact on reducing climate change [6].

#### What Is The Aim of Smart Agriculture?

Smart agriculture aims to use the optimal amounts of inputs such as water, fertilizers, and pesticides according to huge data that collecting by the sensor networks and from IoT devices. In other words, Smart agriculture aims to save different natural resources, particularly water and soil, which reflects in decreasing inputs costs, healthier products, and sustained natural resources [7]. The main objective of Smart agriculture is to increase crop yield and reduce inputs by precisely determining the required steps to be followed at an adequate time. Furthermore, there are more opportunities to lessen greenhouse gas emissions from agricultural activities by adopting smart agriculture, by using various techniques such as site-specific applications, which target using of specific inputs according to the Spatio-temporal requirements of the farm. Smart agriculture requires a high level of technical skills to manage the huge amount of information that is collected through various tools and analyzes it to make the right decision according to crop requirements [7].

#### Adoption of Smart Farm

Adoption of smart agriculture implements various practice management and increases crop yield, while, there are different sequential steps are required as follows:

- Establishing a local framework for the orchard to identify and locate all units, to monitor the farm.
- Understanding the Transferring data pathways to the control unit to make the right decision.
- Automatic control support on-time sensor to make the right decision.

The main components of smart farming are considered as follows:

- Sensing technology
- Software applications
- Communication system
- Telematics, positioning technology
- Hardware and software system
- Data analytic solutions

There are different types of smart farming techniques available depending on their purposes such as the application of agrochemicals like fertilizers and pesticides, tillage systems, and irrigation systems, which aim to save different inputs. In addition to applicable technologies such as GIS, remote sensing, and smart equipment [8]. The application of smart agriculture requires a high level of technical skills to manage the huge amount of information that is collected through various tools and analyzes it to make the right decision in a timely manner for the needs of the crop [7,9].

### Adoption of Smart Agriculture

There are different steps required to Adoption of smart agriculture that include:

- Forecasting weather conditions.
- Using site specifications to analyze soil.
- Determine the quantity and timing of various nutrients
- Use pesticides and herbicides at the infection spots only.
- Saving water by irrigating crops due to humidity levels in the soil.
- Applicable technologies such as GIS, remote sensing, and smart machinery.

### Smart Farming Tools

There are numerous tools (Figure 1) used in smart farming to help farmers and assist them to streamline their work including:

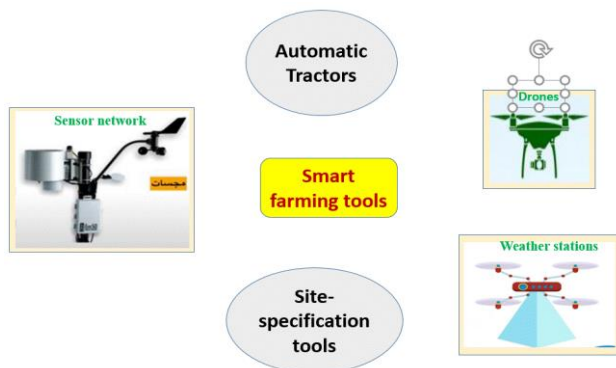


Figure 1: Some smart farming tools.

- Site-specification tools reduce inputs, improve yield quantity and quality, protect the environment, and increase farmers' profitability [10].
- Sensor network: Wired and wireless sensors are used to measure soil moisture, pH, pathogens infection, and adjust various agricultural practices such as nutrient availability in soil according to the requirements of crops [11,9].
- Weather stations: that monitor environmental conditions such as rainfall, temperature, solar radiation, and combine data about the climate and send it to the control unit, which helps farmers tailor their agriculture practice according to climate conditions [12].
- **Drones:** The use of drones in agriculture has shown enormous advancement in smart agriculture. Where it performs many tasks with high efficiency for human labor, such as determining the places of pest infestation and spraying against infections, planting seeds, surviving germination rates, and monitoring nutrient deficiency in certain places of the farm [13].

### Some Devices That Use in Smart Farming

- GPS units for automatic machinery
- GPS Tags as a guiding sensor for any error in the work of auto-machine.
- Light beam sensors that protect the perimeter of the farm
- Motion sensors and monitors to warn of external interference or theft.

### Benefits of Smart Farming

Smart agriculture engagements different tools like sensors, information systems, automatic equipment, and monitoring management, to sustain food production under fluctuations in climate conditions [7]. Commercially smart agriculture techniques used from the 1990s, there are various tools that provide support to farmers in various fields like crop farming, horticulture, and zootechnics.

Combination of different tools to monitor different variabilities in the farm, to use adequate inputs as per soil conditions and crop requirements.

### Crop Management

Various devices are placed in the whole farm to collect data that affect growing crops, including temperature, wind, rainfall, solar radiation, and everything that affects plant health [14]. These devices allow the farmer to access this information at any time and from anywhere to monitor the growth of crops efficiently and to intervene to address any infection or nutrient deficiency that affects crop growth and productivity.

### Optimization of Crop Productivity

Smart agriculture tools help farmers to optimize crop productivity [15], in different ways such as:

- Recommended accurate plan for harvesting.
- Activate preventive control measures to reduce infection with pathogens.
- Improving fruit quality.

### Sustain Soil Health

Smart sensors provide adequate data about soil conditions, which help in soil restoration, reduce soil pollution, and increase the availability of nutrients for plants, consequently, increasing farmers' profits [16].

### Conclusion

Smart farming engagements various devices to sustain natural resources, maximize crop production, and protect the environment. Through dealing with various crops according to Spatio-temporal of soil variability with the aim of minimizing inputs, maximizing profitability, improving production quality, and improving yield. These devices allow the farmer to access this information at any time and from anywhere to monitor the growth of crops efficiently and to intervene to address any infection or nutrient deficiency that affects crop growth and productivity.

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