

# Chapter 14


## Building Smart Farms: Interoperability of Blockchain and IoT in Precision Agriculture

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### ABSTRACT

*The combination of Blockchain with IOT technologies brings opportunities to create revolutionary improvements in agricultural farming operations as well as operational efficiency and system transparency and sustainable agricultural practices. This section demonstrates how precise agricultural success requires systems and devices to effectively exchange data because interoperability represents a necessary condition for achieving full potential. The paper first reviews key technologies such as IoT sensors alongside drones and autonomous machinery or smart irrigation systems that blockchain strengthens by implementing its secure decentralized data management system. The paper presents the major obstacles to interoperability such as conflicting data formats and non-standardized API systems. The paper bases its conclusions on practical agricultural applications and modern industry patterns before presenting recommendations to promote adoption of digital solutions and expand innovation for creating a sustainable digital agricultural future.*

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## 1. INTRODUCTION

Digital technology changes now reshape the oldest and essential industry of farming. Data technology systems for farm management become essential for better production numbers and better outcome in farming activities (Abiri et al., 2023). Please connect the Internet of Items with IoT devices to gather information about soil moisture levels and farm conditions across the property.

The rise of Blockchain technology matches the growth of IoT by providing reliable secure data storage systems that no one can alter. Agricultural blockchain technology applies in different ways to make farm products traceable, automate buy/sell agreements, handle crop insurance payments and preserve genuine farm records (Patel & Shrimali, 2023). By uniting IoT and blockchain technologies agriculture becomes more reliable and efficient with lower risks of failure.

These technologies will reach their maximum benefits when different devices operate seamlessly with all systems and platforms (“Digital Twins for the Agriculture Sector,” 2025). The agriculture sector struggles because different IoT devices and blockchain networks do not easily talk to each other due to industry-wide technology problems.

Standards for communication must exist to bring different systems together. They make different devices and systems communicate seamlessly by allowing sensors to safely store and process data across blockchain networks despite varying product brands and information technology platforms (Sakib Sizan et al., 2025). It makes system links easier to build and improves data accuracy and security standards at the same time.

This paper explains how standard integration rules help combine blockchain technology with IoT devices for accurate farm management. We examine today's precision agriculture systems and their network problems before studying worldwide standards and suggesting ways to join them correctly. This paper shows the future potential of interoperability by reviewing actual projects and sharing ideas about next-level agriculture technology development.

## 2. UNDERSTANDING PRECISION AGRICULTURE TECHNOLOGIES

Farmers use smart farming systems to detect and react to changes in farm areas through digital tech systems that measure variations in their operation fields (Mandal et al., 2024). Precision farming separates land into small areas instead of using farm-wide standard methods. The system brings out more production from each resource while preserving natural systems.

The main principles of precision agriculture include using several connected technologies. By using IoT technology the Internet of Things IoT enable farms to consistently monitor soil conditions through sensors added to farming equipment and observe plant movement from the web (Shahab et al., 2025). The IoT sensors read how wet the soil is plus temperature and acidity levels to keep farmers updated about plant needs for water and food.

UAVs have become important devices to help farmers improve accuracy in their operations. These devices use drones for crop examination and NDVI assessment to show plant health status. Drones take high-quality images that show farmers where their crops need attention because they look different from normal through their camera system (Canicatti & Vallone, 2024). Detecting problems early leads to appropriate action that decreases investments while making more grain in less time.

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