


Chapter 2

Internet of Things Systems to Optimize Agricultural Processes in Developing Countries

Lilian C. Mutalemwa

 <https://orcid.org/0000-0003-4342-5562>
The Open University of Tanzania, Tanzania

ABSTRACT

Farmers use internet of things (IoT) devices to implement smart agriculture and optimize agricultural processes. This chapter identifies different types of IoT devices for smart agriculture. Then, advantages of using IoT-based smart agricultural systems are outlined. Subsequently, key issues to consider when deploying IoT for smart agriculture in developing countries are explored. Challenges such as limited number agricultural specialists, poor network infrastructure and internet connectivity, and farmers' inability to afford IoT devices are considered. Furthermore, techniques to use IoT systems to provide agricultural advisory services to smallholder farmers are discussed. Also, techniques to use IoT system for early detection of plant diseases are presented. Finally, based on the observations, recommendations are presented to promote the adoption of IoT solutions for agriculture in developing countries.

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INTRODUCTION

Internet of Things (IoT) systems provide mechanisms for data acquisition and communication infrastructure to connect smart devices to end-user applications through the Internet. The systems also provide mechanisms for cloud-based intelligent data analysis and process automation (Qureshi et al., 2022). These capabilities are useful in the field of agriculture. Farmers use IoT systems to implement smart agriculture, optimize agricultural processes, and increase production. Furthermore, IoT systems enable farmers to address various challenges that are related to crop health, soil nutrients, environmental conditions and climate change, plant diseases, control of agrochemicals, irrigation systems, etc. For example, farmers use IoT systems for soil monitoring to determine the nutrient status of soil so that measures can be taken accordingly when nutrient deficiencies are found. An IoT system that is enabled with Artificial Intelligence (AI) techniques can be used to implement an intelligent irrigation system that uses real-time data from the farm to prepare a watering plan and decide when to start or stop the sprinklers automatically. As a result, unnecessary use of water is prevented, and the irrigation process is optimized. To optimize the process of harvesting fruits, farmers use IoT systems to monitor fruit conditions such as color and size to predict an optimal harvest date. Table 1 presents examples of IoT systems that are used to address different challenges in agriculture.

The use of IoT systems requires reliable network infrastructure. However, many smallholder farmers in developing countries, especially in sub-Saharan Africa, have no access to reliable network infrastructure or Internet connectivity. Sub-Saharan Africa had the lowest percentage of population with Internet access in the year 2020 (Abdulai et al., 2023). Furthermore, many of the farmers are unable to afford IoT devices. This chapter presents a study on IoT solutions for agriculture in developing countries through a review of literature. The objectives of this chapter are summarized as follows:

- Exhibit the operational features of various IoT devices that are useful in agricultural processes.
- Outline the advantages of using IoT-based smart agricultural systems.
- Explore the key issues to consider when deploying IoT systems for agriculture in developing countries that experience the challenges of insufficient agricultural specialists, poor Internet connectivity, and farmers' inability to afford IoT devices.
- Discuss the use of mobile technologies for smallholder farmers to access agricultural advisory services in developing countries.
- Based on the observations from this study, present recommendations to promote the adoption of IoT solutions for agriculture in developing countries.

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