

Chapter 25

Applications of Data Mining Techniques in Smart Farming for Sustainable Agriculture

Anandhavalli Muniyasamy

 <https://orcid.org/0000-0001-8940-3954>

King Khalid University, Saudi Arabia

ABSTRACT

Smart farming is a development that highlights the use of technologies such as the internet of things, cloud computing, machine learning, and artificial intelligence in the farm management cycle. For sustainable agriculture to adapt the ongoing change in climate and social structure is a major challenge for scientists and researchers. The approach needs information from various sources and its use in the relevant field, which lead to a growing interest in knowledge discovery from large data. Data mining techniques provide effective solutions for this problem as it supports the automation of extracting significant data to obtain knowledge and trends, the elimination of manual tasks, easier data extraction directly from electronic sources, and transfer to secure electronic system of documentation, which will increase the agriculture productions from same limited resources. In a nutshell, the aim of this chapter is to gain insight into the applications of data mining techniques in smart farming, which direction to employ sustainable agriculture and identify the challenges to be addressed.

INTRODUCTION

Smart farming (SF) involves farming management concept using modern technology and the integration of information and communication technologies (ICT) into machinery, equipment, and sensors for use in agricultural production systems to increase the extent and value of agricultural products. The smart farming system is an autonomous & sophisticated mechanism, which will aid in the growth of agriculture yield by applying hi-tech agriculture techniques without human intervention. Agricultural practices are expected to advance the leading notion of “smart farming” (Tyagi, 2016; Babinet, Gilles et al., 2015) as it is being supported by biotechnology (Rahman, et al., 2013) and emerging digital technologies such

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as cloud computing (Hashem, et al., 2015), artificial intelligence (AI) & robots, Internet of Things (IoT) (Weber & Weber, 2010), and remote sensing (Bastiaanssen, et al., 2000).

Traditional farming practices are resource intensive in terms of capital, land, water, and fossil fuel use. But it threatens future food production by reducing biodiversity and contributing to environmental degradation and climate change which lower yields. Modern agriculture focuses on the high degree of mechanization, large scale, use science and technology, high capital and equipment, and use biotechnology to produce organic pollution-free food.

Farmers in the twenty-first century have access to Global Positioning System (GPS), soil scanning, data management, and IoT technologies. Agricultural enterprises have started collecting large amounts of data that includes soil and crop properties, which enables higher operational efficiency also. So, growth in this data size requires an automated method to extract necessary data.

Data mining is the process of finding correlations or patterns among the features in large relational databases. The overall goal of the data mining process is to extract information from a data set to extract previously unknown, interesting patterns such as groups of data records (cluster analysis), unusual records (anomaly detection) and transform it into an understandable structure for further use, which is used for all data mapping & processing. The technology of data mining is narrowly connected to data storage and is intertwined with the database management system. By applying data mining techniques, it is possible to extract useful knowledge, find patterns and trends in huge data.

Smart farming system covers main issues of farming such as water required for the crop at a particular stage, fertilizer to be used according to the micro-nutrients as well as macronutrients present in the soil, and the pesticides to be used depend on various environmental factors such as humidity, pollution (air, soil and water) etc.

Smart farming technologies require more and more professional skills to analyze agricultural data; extracting useful information has become the question of great importance. The implications of these situations highlight the need to consider the applications of data mining techniques to overcome the various problems faced by farmers in agriculture to grow good yield with SF for sustainable agriculture.

Since the growth in agriculture data is huge (Miller, McCarthy & Zakzeski, 2009), information is often hidden, so data mining techniques are used for their detection. Data mining techniques can be useful for finding the schemes of marketing in data, which are valuable and interesting for crop management (Mucherino & Rub, 2011). Both data mining and smart farming are relatively trending concepts, so it is expected to have knowledge about these applications and their implications for research and development be not widely spread.

Agriculture practices have developed from the mule and plow into the high-tech business. Smart agriculture is abundant with diverse information, which conditions the necessity to use data mining. The basic idea is when the same data analyzed in different the context, there will a generation of new context-based information and knowledge which agricultural management uses for improving its decisions. Data mining techniques have made statistics enhanced by the quality of data from collection to evaluation. By ease of use and the possibility of presenting complex results in a simple fashion, data mining has shown to be fertile ground for future innovation in the field of agricultural statistics (Miller et al., 2009).

This chapter mainly focuses on how smart farming can be achieved with descriptive and predictive information as support to decision making with the help of data mining techniques; insights the concepts of smart system, smart farming, precision agriculture, sustainable agriculture, traditional agriculture practices with its pros and cons; describes the smart farming framework for data mining applications and the proposed conceptual framework of data mining applications towards smart farming; discussing the

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