Chapter 20
Deep Learning Applications in Agriculture:
The Role of Deep Learning in Smart Agriculture

Hari Kishan Kondaveeti
https://orcid.org/0000-0002-3379-720X
VIT-AP University, Andhra Pradesh, India

Gonugunta Priyatham Brahma
VIT-AP University, Andhra Pradesh, India

Dandhibhotla Vijaya Sahithi
VIT-AP University, Andhra Pradesh, India

ABSTRACT

Deep learning (DL), a part of machine learning (ML), comprises a contemporary technique for processing the images and analyzing the big data with promising outcomes. Deep learning methods are successfully being used in various sectors to gain better results. Agriculture sector is one of the sectors that could be benefitted from the deep learning techniques since the current agriculture techniques cannot keep up with the rapid growth in population. In this chapter, the recent trends in the applications of deep learning techniques in the agricultural sector and the survey of the research efforts that employ deep learning techniques are going to be discussed. Also, the models that are implemented are going to be analyzed and compared with the other existing models.

DOI: 10.4018/978-1-7998-1722-2.ch020

INTRODUCTION

Agriculture does not only provide a livelihood to the people, but also contributes significantly towards the national income, and therefore, national development. Agricultural products when processed and exported, provide a very valuable source of foreign exchange. The money so generated helps a lot with the development of a country, ensures the stability of the country's currency, and gives the nation a veritable tool for importation. Agricultural products that are consumed have been the main sustenance of the human race since time immemorial. Since hardly anyone can stay without eating for several days, the role of agriculture in global civilization cannot be overemphasized. Yet the rapid, continuous increase in the human population will lead the world to face a severe catastrophe: food shortage and unprecedented hunger. According to some researchers, by the year 2050, it is assessed that the global population is going to exceed 9.5 billion (Alexandratos & Bruinsma, 2012). In such a case, food production has to be increased by two times to meet the growing demands of the population. In the meantime, the constraints like global warming and urbanization will make increasing the food production problematic. Global warming is drying up previously fertile ground, rendering them unproductive while making planning more difficult in the face of weather and seasons unpredictability. Urbanization has taken over agricultural lands, converting them into cities, and abysmally reducing available land for agriculture. This makes commercial agriculture difficult and reduces8 to a big extent total agricultural output.

Moreover, the collective effects of changes in climate, scarcity of energy and water requires a drastic change in the present agricultural systems. Industrial wastes, unburnt carbon, and oil spillage have combined to contaminate our waters and deny the world of aquatic agricultural products while also poisoning lands, killing crops and other plants. Thus, there's a need to not only confront all of these problems but to also produce enough products to meet up with the food needs of an astronomically rising population. This is where Machine Learning (ML) can play an essential role to double the production rate. Machine learning in agriculture will usher in and augment current efforts in building smart agriculture. (Smart Agriculture is a concept of agriculture management that uses the latest technologies such as Global Positioning System, soil scanning, IoT, data processing, and management to improve the quantity and quality of agricultural products, production efficiency, and agricultural resources optimization).

Smart agriculture is crucial to confront the challenges of crop production, such as crop diseases, sustainability, food security, and environmental impact. Nowadays, the new concepts of deep learning algorithms have been proven to be highly accurate. Deep learning algorithms make inference for future uses by analyzing images and pictures from phenomenons of interest. It goes into an in-depth study of such phenomenons, studying their characteristics deep into their genetic makeup. These deep learning algorithms empower smart agriculture. There are various applications of these deep learning algorithms in agriculture, such as leaf classification, plant disease identification, yield approximation, weed detection, weather prediction, and soil moisture prediction. These applications are going to be discussed in this chapter by comparing and analyzing the deep learning procedures with the present techniques that are being used.