Chapter 47
Applications of ANN for Agriculture Using Remote Sensed Data

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ABSTRACT

Ever since the advent of modern geo information systems, tracking environmental changes due to natural and/or manmade causes with the aid of remote sensing applications has been an indispensable tool in numerous fields of geography, most of the earth science disciplines, defense, intelligence, commerce, economics, and administrative planning. Remote sensing is used in science and technology, and through it, an object can be identified, measured, and analyzed without physical presence for interpretation. In India remote sensing has been using since 1970s. One among these applications is the crop classification and yield estimation. Using remote sensing in agriculture for crop mapping, and yield estimation provides efficient information, which is mainly used in many government organizations and the private sector. The pivotal sector for ensuring food security is a major concern of interest in these days. In time, availability of information on agricultural crops is vital for making well-versed decisions on food security issues.

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INTRODUCTION

In India more than 60% of population is depending on agriculture. In agriculture, crop yield estimation before harvesting is a challenging task. Many models have been developed in Asia, USA, Europe and elsewhere in the country, but due to the complexity of agriculture ecosystem, yield prediction is still based on the traditional methods or the statistical methods. Artificial Neural Network (ANN) is one of the most powerful and self-adaptive model for crop yield estimation using remote sensing. This method employs a nonlinear response function that iterates many times in a special network structure in order to learn the complex functional relationship between input and output training data. Once trained, an ANN model can remember a functional relationship and be used for further calculation. For these reasons, the ANN concept has been widely used to develop models, especially in strongly nonlinear, complicated systems. Since Remote sensing provides the availability of large data in time with respect to the crop season would be combined with ANN to develop an efficient model for predicting the yield before harvesting. ANN and satellite remote sensing has got an unlimited scope in the sector of agriculture these days as it is being used for land resource mapping, weed detection, pesticide management, soil health mapping, crop yield estimation, and for assessment of natural calamities. In India the technology is being promoted by ministry of agriculture through MGNREGA scheme for rural area to assist farmers remotely.

The chapter is presented as follows. Section II covers overview of ANN, followed by detailed study of remote sensing in section III. Applications of ANN in agriculture using remote sensed data is briefed in section IV, followed by contribution to chapter, future scope for research and conclusions in the remaining sections.

Overview of ANN

Most of recent innovations and advances in statistical technology are conveyed through computational model artificial neural networks (ANN). ANN concept will be briefed in this section. The ANN model functions similar to nervous systems in human beings, where neurons are connected in complex patterns. It is not a new concept, but it has underwent gradual change because of which the current ANN does not certainly same as to that of its inception C. Stergiou (1996). As Howard Rheingold's explanation on ANN "The neural networks is these days technology is not an algorithm, it is a network that has weights on it, and you can adjust the weights so that it learns. You teach it through trails." ANN can be hardware or software that is carved of functioning to that of human brains. Few of researchers define ANN has a mathematical model of human neural network architecture with learning and generalization functions. The figure 1 gives comparison between actual neurons and synapses in human brain. The neurons are termed as perceptron in ANN during 1960 by McCulloch while presenting McCulloch –Pitt's neurons model V.S. Dave, K. Dutta (2014).

A typical ANN consist of large number of perceptrons, they operate parallel even though organized in the form of layers. As human brains receive information similarly in ANN first layer receives input, process and forward it to next layer, same sequencing happens until input reaches last layer T.J. Huang (2017). The working process is divided into three layers; input, hidden and output layers. ANN will consist of single and equal perceptron numbered input and output layer, and multiple hidden layers as in figure 2(a). Every perceptron in network will receive weighted input from its preceding perceptron known as synapses. The perceptron will process received inputs to generate output based on activation function of a perceptron. The single perceptron is shown in figure 2(b). The sum of weights and inputs