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Artificial Intelligence in Agriculture: A literature Survey

*Abstract*—*This paper encompasses a detailed literature survey on the different AI methods used in the field of agriculture. Farmers practicing agriculture face many problems ranging from insufficient water supply, plant diseases, poor soil treatment, improper irrigation facilities and so on. All these issues affect agricultural productivity, quantity and quality. Artificial Intelligence with its self- learning abilities can play a huge role in addressing these problems. Agriculture contributes 17% to the GDP of the country. Hence it is of the utmost priority that we address these issues. The survey goes through many important breakthroughs experienced by artificial intelligence in its role to solve the problems faced by agriculture. It discusses applications and uses of artificial intelligence in different domains of agriculture that have been researched over the past 30 years.*

***Keywords*** *—****Agriculture; GDP; Artificial Intelligence;***

1. **INTRODUCTION**

Artificial intelligence is basically the intelligence shown by different kind of machines. Artificial intelligence forms an important part of research and study in computer science. AI, because of its tremendous applicability in issues concerning humans and the lack of solutions to these issues is becoming an important part of our lives. Around 31% of the population in the world is completely dependent on agriculture. Such an important field is not without its obvious issues. Computers were first used in agriculture in 1983[1]. Many different methods were studied to solve the evident issues concerning agriculture including database [2].

Study of these solutions suggested that those including artificial intelligence performed much better than others. Agriculture as a whole is an ever-changing field and hence it is nearly impossible to generalize its problems and solutions. This is where AI plays an important part as it is able to understand each specific detail of each problem and provide a solution for that particular issue. As progress has been made in the field of artificial intelligence, it has been able to solve more complex problems. Expert systems, fuzzy systems, artificial neural network all form a part of some of the most important techniques in artificial intelligence. Farmers can get data insights in things such as temperature, solar radiation, wind direction. Analysis of previously recorded data offers a chance to compare the different values in predicting the desired output. This paper studies problems in different domains of agriculture so as to also see the development of artificial intelligence in agriculture over the years.

# **RESEARCH**

1. GENERAL CROP MANAGEMENT

A crop management system basically presents a interface to manage crops and all their aspects. Problems faced due to improper irrigation systems and issues pertaining to soil management are very important. Improper soil management can affect productivity. Herbicides are weed killers that destroy unwanted plants. Herbicides though, have a direct effect on human health and the environment. AI methods and techniques can reduce the use of herbicides through effective weed management systems. Pest infestation heavily affects the produce and thus leading to major economic losses. Developing a system that can identify active pests can go a long way in addressing this issue. Storage, grading, and dying are important aspects of agriculture. AI can also be used in storage control and product monitoring. Artificial intelligence was first used in crop management in 1985 by Mckinion and Lemon when they published the paper “Expert systems for agriculture.” [3]. Expert systems would play the role of integrated crop management decision aids which would include irrigation, weed control, fertilization, nutritional problems and insect control. These systems can raise the performance of an average worker to the level of an expert.



1. PEST MANAGEMENT

Agricultural pests are of great concerns to the farmers. They lead to heavy economic losses. On an average the world loses one or two fifth of its crops to disease and damages. Over many years, researchers have tried to develop a computerized system to solve this problem. Data in agriculture is most of the times variable, imperfect and imprecise and hence normal expert system don’t work in these cases. To capture this uncertainty, many fuzzy logic-based expert systems were presented including Siraj and Arbaiy [4]. According to this paper, knowledge regarding all the aspects of crop-fest systems are foundations on which pest management systems are based upon. Fuzzy logic approach is put to use to find the pest activity level which in turn will help to find the damage caused by pest. As the data involved is imperfect, fuzzy logic is used to compensate for the uncertainty of information. Due to this uncertainty, it becomes a tedious job to measure the symptom occurrences completely. This expert system tough, will allow the farmers to answer these questions with rigid crisp values. Here the degree of damage helps in predicting the activity of pests. So, a forecasting method is needed to determine the level of damage. This will allow for early treatment before the situation worsens. Nowadays drones are also used to monitor the damages caused by pests. A specially programmed drone monitors the crops row by row. It locates pests, or any kind of diseases from a distance. It also helps to find whether the issue is plant based or the problem is deeper underground. It is almost impossible to completely automize the pest management system but technology certainly helps. Artificial intelligence makes this process safer, quicker and also helps in saving a lot of money.



1. DISEASE MANAGEMENT

Crop diseases cause huge problems for the farmers. Significant knowledge is required to detect a disease in plants and then take the necessary steps. Many computerized systems are used to detect diseases and they also suggest many control measures. Very early a rule-based system was developed by Byod and Sun [5]. They have developed an expert system wherein it identifies fungi in seed health analysis. It identifies close to 46 fungi that are there in seed species. To increase the accuracy levels, the expert system is also filled with a glossary of technical terms related to the input picture. Many artificial neural network models were also developed. Through the utilization of AI referred to as machine learning, we are ready to discover and diagnose crop diseases in real time right from the sector. The ability to spot and address diseases quickly can have an enormous impact on a farmer’s time, resources, and ultimately the productivity of their crops.  
The rise of digitalization and data has opened a wealth of latest opportunities for farmers. Artificial intelligence (AI) tools analyze this overwhelming amount of data at high speeds and they send it back it to the farmers in the form of useful solutions to the issues, helping them make important in-field decisions. For example, satellite and drone imagery, and sensors on the cameras can detect small parts of a field that are inflicted by disease, and a farmer acts thereon information and treats that tiny area with a targeted application. Just a couple of years ago, a farmer won't have detected the crop disease until a widely visible area of a field was inflicted and would have needed to spray the entire field vs. treating a tiny portion.

d.) SOIL AND IRRIGATION MANAGEMENT

Irrigation has been practiced as an art for about 3000 years now.Soil and irrigation management is an act of regulating irrigation water applications in such a way that it will meet the requirements of the crop without further wastage of water,soil,plant, nutrients or energy. It means applying that much water that can be held in the soil and at a particular rate that is consistent with the intake characteristics of the soil and the erosion hazard of the site. The irrigation space,like agriculture as a whole, is fertile ground for the application of AI to solve real-world problems. Yongsheng Si et al. [6] redesigned and tested the control system of laser leveling machine and land leveling accuracy was improved.Land leveling is an important method to improve water coverage in field, can improve the irrigation efficiency and uniformity. Arif et al. [7] using the Artificial Neural Networks (ANN) estimated the soil moisture in paddy fields which is required for irrigation scheduling and water resource allocation.They collected the information under different weather between the two cultivation periods.Training was carried using the data of first while validation on data of second period.

e.) WEED MANAGEMENT

Application of herbicides have a direct implication on human health and environment as well. Modern AI methods are being applied to minimize the herbicide application through proper and precise weed management. Pasqual [8] designed a rule based expert system for identifying and eliminating weed in crops like oats, barley, triticale and wheat. Burks et al. [9] used machine vision with a back propagation trained neural network to identify weeds of five distinct species. Burks et al. [10] compared three different neural network models mainly back propagation, counter propagation and radial basis function based model with the same set of inputs as the previous paper and found that back propagation network

f.) YIELD PREDICTION

The crop yield prediction is useful for marketing strategies and crop cost estimation. Also, in the age of precision agriculture analysis (To visualise The Crop Variation Within Your Fields by means of Satellite)of relevant factors that directly effects the yield can also be done through prediction models.

Liu et al. [11], used an artificial neural network model for back propagation learning algorithm. And then they predicted yield from the soil parameters. This paper presented an artificial neural network model for crop yield responding to many parameters including soil parameters. The data for experiment was obtained from a precision agriculture experiment. They took data from a demo farm from Beijing in 2000. The model was trained back propagation neural network. Their dataset had 58 samples for training and 14 samples for testing. Their Neural Network consisted of 6 input layer, 11 hidden layer and 1 output layer with step length as 0.05 and epoch as 20000. A small Neural Network yet very powerful. The conclusion they found out was correlation of soil parameter’s coefficient is 0.916 and average error value was 2.8×10-2.

1. **CONCLUSION**

In this survey, we studied different research articles which were published in this field. There is a lot of work being done. The paper has been made to make it as informative as possible covering different AI techniques.

During the earlier years rule based expert systems were extensively used. Nowadays artificial neural network models and fuzzy inference systems are prevalent. These are more accurate systems. Research is still being carried out to further development and help the farmers.

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