INTELLIGENT FARMING WITH ARTIFICIAL INTELLIGENCE

[1]Megha Raina, [2]Dr. Archana Sharma
[1]Assistant Professor, [2]Assistant Professor
[1]Department of Computer Science,[2]Department of Computer Science
[1]Maulana Azad Memorial College, Cluster University of Jammu, Jammu, India.,
[2]Maulana Azad Memorial College, Cluster University of Jammu, Jammu, India.

Abstract: Agriculture is a major activity in many countries around the world and with population growth, which according to UN figures will increase from 7.5 billion to 9.7 billion by 2050, there will be significant global pressure as there will be only extra 4% more land that will be used for cultivating in 2050[1]. This means that farmers will have to do more with less land. Food production will increase by 60% to feed two billion people. However, traditional methods are not enough to handle this need. This pushes farmers and agricultural companies to find new ways to increase productivity and reduce waste. As a result, Artificial Intelligence (AI) is slowly emerging as part of the technological revolution of the agricultural industry. The challenge is to increase global food production by 50% by 2050[2] to feed two billion people. Advancement in computer, artificial intelligence, and machine learning enables the expansion and placement of remote sensing technology to identify and treat plants, weeds, pests and diseases. It provides a rare opportunity to develop intelligent planting methods for accurate fertilization. Artificial intelligence solutions can enable farmers to not only reduce waste, but also improve quality and ensure faster market access of the product. In this paper we will discuss various AI technologies for improving crops and their production, problems that are faced by farmers while implementing AI, Startups of AI and future scope of AI in farming.

Index Terms - **Farming, Artificial Intelligence, Machine Learning, Startups.**

I. INTRODUCTION

The estimation of the global food production must be increased by 60–110% to feed 9-10 billion of the population by 2050 [3, 4]. Weather and climate change conditions are major challenges in the next years. So in order to improve the food production instead of traditional farming we have to adopt new technologies in farming like Artificial Intelligence and Machine Learning. Artificial intelligence (AI) is a branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence[5]. Artificial intelligence (AI) makes it possible for machines to learn from past experience, adjust to new inputs and have the ability to execute tasks naturally associated with human intelligence, like speech recognition, decision- making, visual perception and translating languages[5]. Artificial intelligence technology is supporting different sectors in agriculture to boost productivity and efficiency. AI solutions are assisting to overcome the traditional challenges in every field. Intervening of AI in agriculture is helping farmers to improve their farming efficiency and reduce environmental hostile impacts[6].Machine learning (ML) is one of the central themes of AI and helps people to work more creatively efficiently [7].

II. TRADITIONAL FARMING

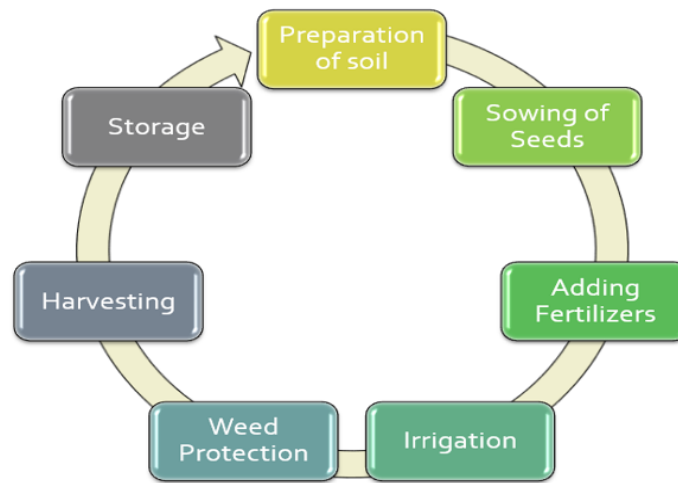Traditional farming is divided into different stages. These are shown in fig-1 below

fig-1[8]

A. **Preparation of soil:** In this initial stage of farming farmers arrange soil for sowing seeds. In this process farmers break large soil clusters and remove waste such as rocks, roots, sticks. They also, add fertilizers and organic matter rely on the sort of crop to create a perfect scenario for crops.

B. **Sowing of seeds:** This level requires looking after the gap among two seeds, depth for planting seeds. At this degree climatic conditions which includes temperature, humidity, and rainfall play a critical part.

C. **Fertilizers:** To preserve soil fertility is a critical component so farmer can keep growing nutritious crops and healthy plants. Farmers flip to fertilizers due to the fact these substances contain plant nutrients along with nitrogen, phosphorus, and potassium. Fertilizers are purely planted nutrients carried out to agricultural fields to supply the required elements present within the soil. Crop quality is determined in this stage.

D. **Irrigation:** This stage enables to preserve the soil wet and preserve humidity. Less or more watering of crops can decline the development of plants and if no longer taken care of it is able to result in broken vegetation.

E. **Weed protection:** Weeds are undesirable vegetation that develops near plants or at the boundary of farms. Weed safety is essential to issue as weed decreases yield, increases production value, interfere with harvesting, and decreases quality of crops.

F. **Harvesting:** It is the procedure of collecting ripe vegetation from the fields. It requires a number of people for this job as this is a hard work-extensive task. This level also deals with after harvest work which includes cleansing, sorting and packing.

G. **Storage:** This level takes place after harvesting phase in which the products are saved in this way so as to guarantee food security. Basically it is packing and transportation of plants in a safer way for future use.

III. PROBLEMS FACED BY FARMERS IN TRADITIONAL FARMING

A. Climatic factors which includes rainfall, temperature and humidity play a crucial function in farming lifecycle. Growing deforestation and pollutants result in climatic modifications, so it's tough for farmers to take decisions to prepare the soil, sow seeds, and harvest[8].

B. Each crop requires particular nutrients in the soil. There are three principal nutrients: Nitrogen(N), Phosphorous(P) and Potassium(k) necessary in soil. The deficiency of nutrition can cause bad variety of plants.

C. As we see from the farming lifecycle that weed protection performs a crucial part. If it is not restricted it could result in rise in production value and additionally it absorbs nutrients from the soil that can cause nutrient deficiency in the soil. [8]

IV. ROLE OF ARTIFICIAL INTELLIGENCE IN FARMING

A. **Monitoring of Soil and Crop:** With the help of AI/ML, we can monitor crop health for diagnosing pests/soil defects, nutrient deficiencies in soil.[1]

B. **Diagnosing of diseases:** Prior information and classification of plant diseases will help farmers to control the disease with proper strategy.[1]

C. **Prediction of yield and Price forecasting of crops:** With the help of AI farmers can identify the output yield of crops and forecast prices for the next few weeks so that the farmers can obtain maximum profit.[1]

D. **Intelligent spraying:** AI sensors can detect weed affected regions and may precisely spray herbicides inside the proper region lowering the usage of herbicides.[1]

E. **Predictive Insights:** AI can provide the insight on proper time to sow the seeds for optimum productiveness. Insights are created by the climate conditions.

F. **Robots:** We can use robots for crop harvesting for massive capacity of crops and with rapid speed.

V. AI STARTUPS IN FARMING

For the automation of farms around the world many start ups are being established with the help of AI and its technologies. Some of the start ups are discussed below:

1. **Prospera:** This startup has built a cloud-based solution that collects all data available to farmers, such as land/water sensors, air images, etc. It then connects to a device in the field that analyses the data and suggests desired results. Prospera can be used both in greenhouses and in the field; it works with a variety of sensors and technologies such as computer vision. The input from these sensors is used to determine the correlation between the various data labels and their predictions.[10]

2. **Blue River Technology:** It combines AI, computer vision and robotics to save costs and reduce the amount of pesticides. The computer vision defines each plant separately, machine learning determines how the characteristics of each should be observed and allows the robot to intelligently control the farm machinery and takes suitable actions.[10]

3. **Formbot:** It was founded in 2011 has taken precision research to the next level by reaching out to the community by using precision farming techniques for home farmers. It allows the farmers to perform a range of activities from planting seeds to weed detection, and testing of soil to watering plants through robots that work with an open source software system.[10]

4. **Harvest CROO Robotics:** It is a robotic strawberry harvesting system that allows the detection and identification of ripe berries for picking strawberries using machine vision and artificial intelligence. Strawberry growers face acute labour shortage, which increases crop costs and the risk of incomplete harvests. The development of mechanical harvesting methods and the use of other artificial intelligence will reduce the manufacturer's manual labour, lower harvesting costs and increase overall competitiveness.[10]

5. **G r a m o p h o n e (AgstackTechnologies):** They use image recognition skills to help farmers get the right information, methods and materials at the right time to get the best harvest possible. The company uses artificial intelligence and machine learning to predict pests and diseases, predict food prices to maximize productivity, and recommend products to farmers.[10]

6. **Jivabhumi:** It is creating a "Smart" Agriculture Marketplace for optimising the supply and demand for agricultural products, which is often inadequate. It is an innovative food aggregation solution that integrates agricultural products, e-marketplace services and innovation. It uses technologies such as blockchain to collect information about products at various stages of the supply chain[10].

VI. PROBLEMS FACED BY FARMERS WHILE ADOPTING AI[9]

There are many benefits for adopting AI in farming but while implementing these technologies farmers faces many problems. Some of the problems are:

A. **Process of adoption of lengthy technology:** Farmers need to understand that AI is only an advanced part of simpler technologies for processing, gathering, and monitoring field data. AI requires a proper technology infrastructure for it to work. That's why even those farms that already have some technology in place can find it difficult to move forward.[9]

B. **Less experience with new technologies:** The agricultural sector in developing countries is different from the agricultural sector in Western Europe and the US. Some regions could benefit from artificial intelligence agriculture, but it may be hard to sell such technology in areas where agricultural technology is not common. Farmers will most likely need help adopting it.[9]

C. **Security and Privacy issues:** Since there are no clear policies and regulations around the use of AI not just in agriculture but in general, precision agriculture and smart farming raises various legal issues that often remain unanswered. Privacy and security threats like cyber attacks and data leaks may cause farmers serious problems. Unfortunately, many farms are vulnerable to these threats.[9]

VII. FUTURE SCOPE

The future of AI in farming will need to focus more on universal access because many high- tech technologies are only used on large, well-connected farms. Increasing access and communication with even small farms in remote areas around the world will strengthen the future of mechanized agricultural products and data science in farming. In addition to that we can also create an application so that every farmer can use that application in their mobile phones as in today's world ever one has a smart phone. They can either type or give instructions verbally like we use Google assistant in our smart phones.

VIII. CONCLUSION

Traditional farming methods will not be able to meet the demands of future population. AI is the only way to overcome this challenge. With the help of AI farmers can produce more and with faster rate. Scope of AI in farming is very vast. Though the technology is developing rapidly but it is expensive and out of reach of many farmers. We have to overcome these challenges and have to make AI available to common farmers. With the help of AI we can overcome all the deficiencies that are present in Traditional farming. AI allows farmers to store crops, grow more crops, reduce wastage of water, suggest appropriate pesticides, plants to grow in every season, predict climate, rainfall.

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