

# Leveraging Machine Learning Technology in Agriculture to Accomplish Viksit Bharat Goal

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**Abstract**—Agriculture is a very important sector in Indian economy and contributes more towards India's GDP. Also, agricultural sector employs the largest workforce in India. Ministry of Statistics & Programme Implementation (MoSPI) has released the Second Advance Estimates of National Income which estimates the share of Gross value added (GVA) of agriculture and allied sectors in total economy as 20.3%, 19.0% and 18.3% for the years 2020-21, 2021-22 and 2022-23 respectively. Clearly agricultural sector is the means of livelihood for millions of Indians, especially the citizens in the rural part of the country. Indian government has taken many scientific measures to improve the agricultural sector. Government of India has recently launched the "Viksit Bharat" scheme which aims to make, India – a developed nation in the year 2047. To achieve the goals of "Viksit Bharat", India should harness the technological advancements in all fields. Machine Learning as a research field cuts through all the domains which help to predict future and take informed decisions. This paper proposes a new holistic machine learning approach in the agricultural sector that can be leveraged to realize India's Viksit Bharat goal in agriculture sector by 2047.

**Keywords**— agriculture, machine learning, Viksit Bharat, technology, economics, India, agricultural research

## Introduction

Agriculture is the back bone of Indian economy and mainly India's rural population is dependent on agriculture for income. Population of the India and the World countries are increasing and parallelly the demand for food is also increasing manyfold. A meta-analysis on projected global food demand and population [1] predicts the rise of food demand by +0% to +20% and +35% to +56% between 2010 and 2050. The rapid growth of world population requires drastic increase in agricultural production, which faces risks from many factors like weed infestation, pest, climate changes etc. It also faces many challenges and uncertainties due to changes in the market demand, loss in production. Though advancement in predicting climatic changes and disasters have advanced there is a need for more technological integration to make informed decisions. Traditional farming methods will not be able to produce crops that can meet the needs of future. Agricultural sector should undergo systematic changes and incorporate technology at all levels from seed selection to supply demand prediction to increase the productivity. Infusing the technology with agriculture and automating the process is the way forward to ensure food security in future. Machine Learning (ML) is an expanding field that can be applied to agriculture to solve the

challenges faced by the agriculture sector. Research is underway to harness the power of machine learning and data centric approach in agriculture to improve crop production, predict plant disease and market demand.

## WHAT IS MACHINE LEARNING ?

Machine Learning is a branch of Artificial Intelligence (AI) that uses data to predict trends, classify images, cluster data points and do data mining to exude new information. Underlying machine learning is some statistical techniques and algorithms that work directly on data to find patterns. The wide range of techniques available in machine learning makes it suitable to find optimal solution to many real-world problems. Machine learning algorithms take the (training) data as input and finds relationship among the data. It then uses the learnt mechanism to find patterns in the new (test) data.

As a recent development machine learning is even able to generate new content like images and videos. Generative Adversarial Networks (GAN) – a type of deep learning based neural networks create new images [2] which are very unique and have never been seen before, which opens a broad range of applications in the creative field such as design. Machine learning is applicable in almost all fields of study and various industries. Recommender system for instance is used to recommend products, movies, songs based on user behaviour. Computer vision is one of the main applications of machine learning which is used in automatic image recognition, navigation of driverless cars.

## APPLICATIONS OF MACHINE LEARNING

As more data is generated due to advancement in internet, computing and online transactions, data is readily available for training the machine models.

Hence Machine Learning is largely applied in many industries. Healthcare use cases of Machine Learning has seen a steady rise and even has given 100% accuracy in some disease prediction [3]. Some of the major applications of Machine Learning are enumerated below.

### A. Health Care

Machine Learning can be used in medical field to predict disease and patient care management [4]. Machine Learning models can not only predict disease it can suggest medical regimen based on medical history of the patients. Medical Image Processing is advancing with new research insights [5] and can automatically diagnose disease from MRI and CT images.

### B. Sentiment Analysis

Sentiment analysis is done using Natural Language Processing (NLP) which uses reading and understanding of spoken language with computer as the interface. NLP helps to read a text or recognize speech from the voice input and analyse the given content [6] to exude the sentiment of the language. ChatBots are the best example, which answers query given to it and will try to answer like a human.

### C. Spam Detection

Spam detection is the process of filtering the normal mail from spam messages. Now a days Email service providers develop applications with inbuilt spam filters using ML algorithm. ML powered techniques automatically send the spam messages to the spam folder [7].

### D. Pharmacology

ML algorithms are used in drug discovery, which saves a lot of time and cost as it reduces the clinical trial largely. Using ML [8] based drug discovery has proven to reduce the time and give better and accurate results.

## E. Genetics and Genomics

To determine the underlying effects of heredity on human health, machine learning in genomics [9] influences a number of fields, including genome sequencing, genetic research, and gene manipulation. Predictive testing for early disease diagnosis using ML is a newly developed application that aims to enhance the standard of patient care.

## F. Financial Services

Financial services can benefit greatly from machine learning. By tracking each user's behaviours and determining whether an attempted activity is characteristic of that user or not, machine learning algorithms show themselves to be quite good at identifying frauds. Another crucial security use case is financial surveillance for identifying money-laundering activity. With the use of ML algorithms that can concurrently examine thousands of data sources [10], it also aids in improving trading judgments.

## PROPOSED SYSTEM

A holistic machine learning based agricultural farming system is proposed to overcome the challenges faced by the farmers including all stakeholders. Fig 1 depicts the process flow of the proposed system. The new system starts from as early as soil condition and nutrient prediction, which will be the pre process before tilling of the land. Using machine learning, soil deficiency will be predicted. Next crop suggestion will be done based on climate, soil and demand in the market. This module can help resolve the ambiguity among farmers in choosing the right crop. Based on climate data, rainfall for the agricultural season (Kharif, Rabi and Zaid) will be predicted taking the geographical location in to account.

The amount of irrigation required will be predicted in the next step, which can help the farmers decide on the water requirement. Based on the crop - fertilizer will be suggested and timely remainder will be given to maintain the crop health. Centralised weather alarming system based on government warning and disease breakout warning system will be done at the next level.

Computer-vision based disease prediction will be carried out at the next step. Pesticide and weedicide recommendation system will be implemented to control the pests and weeds. Crop yield and demand for the crop in the market will be predicted. In case of crop production failure, mitigation measures by government or insurance companies will be predicted at the next step. As the final step marketing and price prediction will be done. At each level of the process appropriate machine learning algorithms will be used to predict or recommend action. This proposed system can increase the crop yield, and help farmers and government to take informed decision.

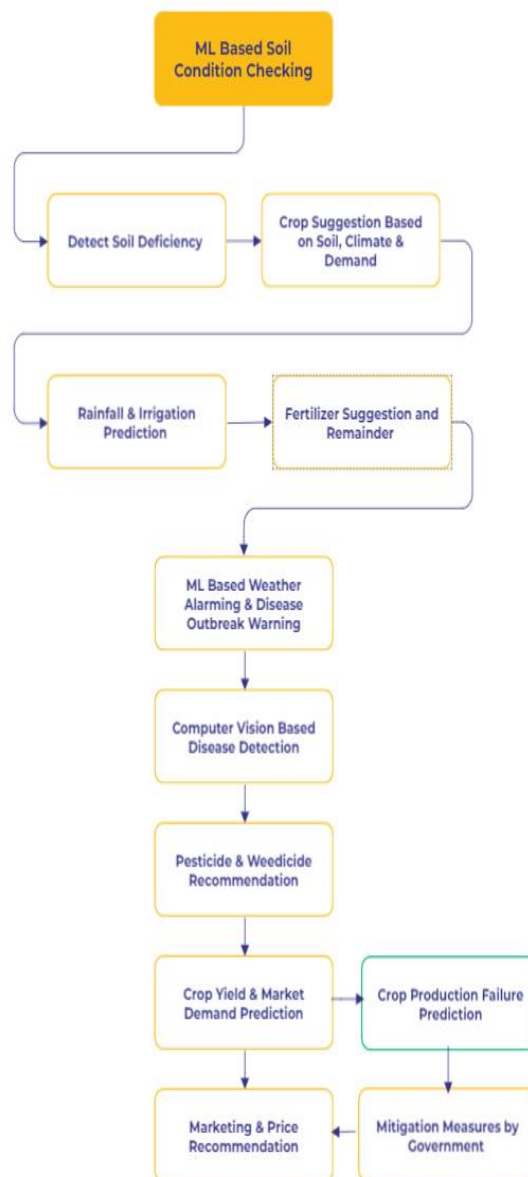


Fig 1. Proposed System Process

### BENEFITS OF PROPOSED SYSTEM

Farmers may better understand soil health by using machine learning to map out management plans and identify regions of degradation. Farmers can find alternate water sources and adjust irrigation schedules with the use of proposed system.

By determining the best growth conditions and creating early warning systems for extreme weather occurrences, proposed system can assist farmers in adapting to changing environmental circumstances.

Precision farming is one of the most important uses of the new proposed system in agriculture. Farmers can make accurate decisions about when to sow, fertilize, and harvest crops thanks to machine learning algorithms that examine a variety of data variables, including temperature, nutritional levels, and soil moisture. Farmers may increase productivity and reduce waste with precision agriculture, which improves the sustainability and efficiency of their businesses.

One of the biggest risks to agriculture that significantly reduces production quantity and quality is crop disease. Agronomists have historically used labour-intensive, error-prone manual field inspection methods to search for symptoms of crop diseases, such as

curled leaves or wilting. However, the proposed system can analyse images and evaluate the condition of the soil and individual crops, allowing pesticides to be applied only to diseased plants rather than the entire field.

Weeds are a known enemy to any farmer. They propagate quickly, invade agricultural areas, disperse a range of plant diseases, and lower productivity. The most popular weed-control strategy is the use of herbicides. Despite the fact that this strategy is effective, farmers usually cover entire fields with herbicides, which harms the ecosystem. Farmers can apply herbicides to particular areas of their fields rather than the entire one by using computer vision-powered equipment to identify unwanted plants. This can greatly reduce the harmful effects of herbicides.

Farmers with the use of proposed system can achieve more efficient crop health monitoring. Satellite imagery can be analysed by ML algorithms to find early indicators of crop stress and possible crop diseases. This makes it possible for farmers to safeguard their crops proactively by doing things like using pesticides or modifying watering schedules. Farmers can increase yields and lower crop losses by using machine learning to monitor crop health.

Forecasting yields is important for the economy, both locally and globally. Any farm needs to know when to harvest a crop and what crops to cultivate in order to meet market demands. Yield quantity can be affected by a wide range of elements, such as meteorological information, phenotypic data, and environmental conditions. All the elements can be analysed by proposed model to improve yield prediction accuracy.

## CONCLUSION

In this paper we discussed the applications of various machine learning algorithms and proposed a new model to increase the productivity of farmers. This holistic approach of incorporating Machine Learning Algorithms at each step can help farmers increase the crop yield and profit. This new model can benefit all the involved stakeholders in agriculture. The proposed holistic approach can help achieve the Viksit Bharat goal of India.

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